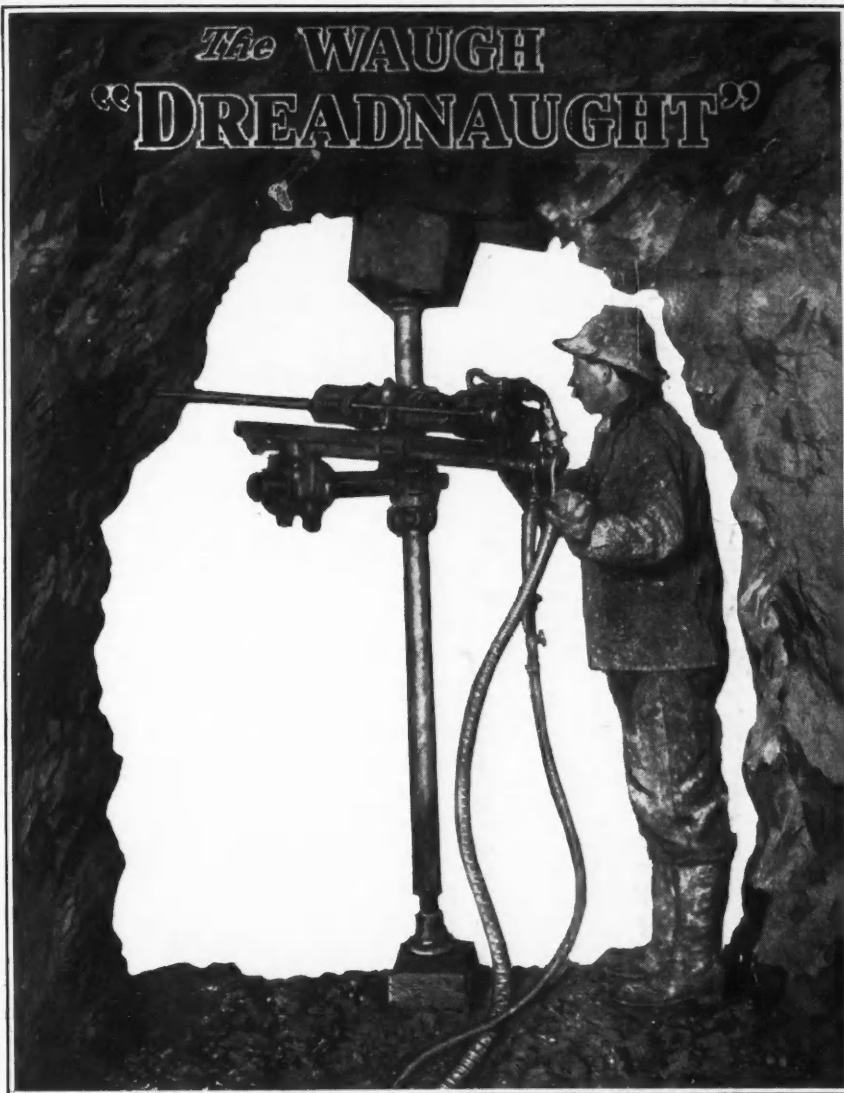


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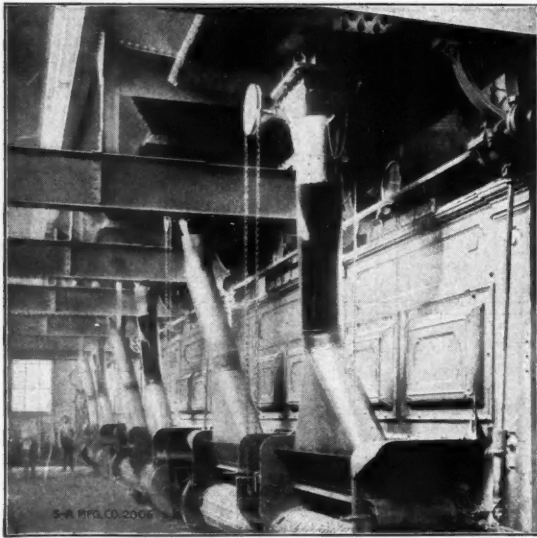
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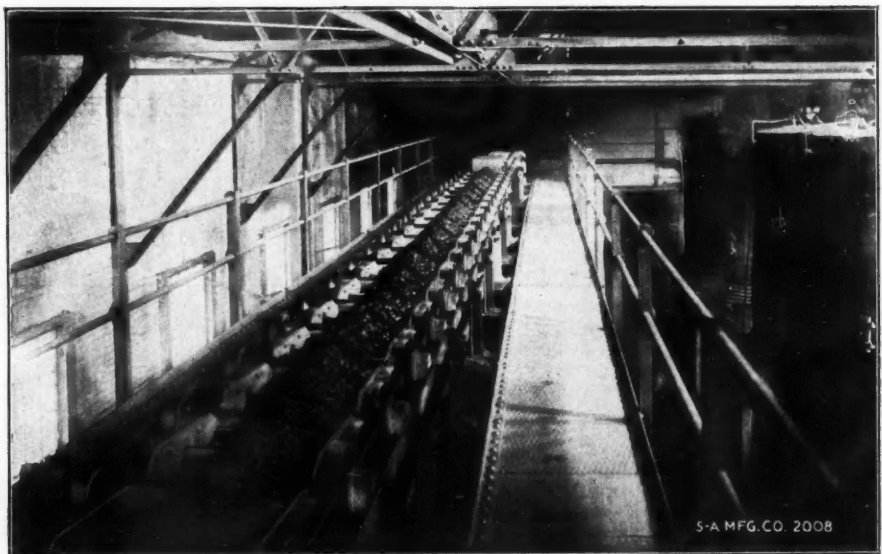
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HEAP-LEACHING OF COPPER ORE AT BISBEE, ARIZ.

Some Experiments in Heap-Leaching Copper Ores

BY GEORGE D. VAN ARSDALE

Chemist, Phelps Dodge Corporation, 99 John St., New York

In the United States no attempts have been made at commercial heap-leaching of copper ores, but the Phelps Dodge Corporation has conducted experiments on its Copper Queen and Burro Mountain ores, which warrant further research on a larger scale. Leaching of a heap of about 40,000

tons is now to be tried at Tyrone, N. M., following successful preliminary experiments there and at Douglas and Bisbee, Ariz. Rio Tinto's leaching process not applicable to the disseminated copper ores of the Southwest. Proper regeneration of iron salts and sufficient capillarity are essential.

IT IS usually unwise to publish reports of experimental work before final results are obtained, but when the operation is not patentable, is of general interest, and one phase has been finished, the publication of preliminary notes may be warranted, and, indeed, the information thus offered is often of value in preventing mistakes and misunderstandings in further experiments. Therefore it must be understood that the notes herewith presented represent such a preliminary phase of the heap-leaching investigations of the Phelps Dodge Corporation, and it is hoped that they will be of interest. It is not now possible to determine whether

or not they will be followed by other work or by commercial development, and they are therefore submitted only as an account of the results to date of experiments. In this country no account has been published of systematic large-scale investigation of the question of possible application of the so-called heap-leaching methods, in use at Rio Tinto, to low-grade ore such as the "porphyry" ores of the Southwest.

There is a limit to the copper content of such material as may be defined as commercial ore for each locality and set of conditions. The fact that in many places where such ores occur there are large amounts of material in

some cases only slightly lower in grade than the ore mined makes it evident that the developing of a successful method for treating lower-grade copper-bearing rock would have an extensive field of application. It is seldom safe to prophesy, but it at least seems probable that the grade of ore that can be profitably treated by present concentrating methods will not be lowered to any great degree unless some process, at present unforeseen, cheaper and more efficient than current practice, be developed. It is doubtless true that flotation may be developed so as to give, in some cases, better extractions than are now possible, but it seems probable, also, that this method may show distinct limitations as to the kinds of ore that will yield higher extractions. The scale of concentrating operations also determines the grade of ore that can be considered commercial, but is dependent on the size of the orebody being treated, limiting the possible investment for plant installation.

ORE MILLED IN SOUTHWEST IS ABOVE 1½ PER CENT.

It is probably safe to assume that for a large "porphyry" orebody, and consequent large daily concentrating-plant tonnage, under normal conditions, the low limit of copper content may be put at 1½%, though in many places it is much higher. The average grades of ore milled by some of the Southwestern companies during 1916 were approximately as shown in the accompanying table. There is evidently needed a method low both

TABLE I. GRADES OF COPPER ORE MILLED IN 1916

	Per Cent. of Copper
Utah Copper Co.	1.43
Ray Consolidated Copper Co.	1.61
Chino Copper Co.	1.83
Inspiration Consolidated Copper Co.	1.55
Phelps Dodge Corporation.	2.59

in treatment and installation cost which would be applicable on a large scale for ores containing 1.25% copper or less, part of which may be oxides. It seems at least possible that heap-leaching may be the solution of the problem in some cases.

In order to see the possibilities of the process, some figures, although of value only if the assumptions made prove finally to be correct, may be considered. Assume a daily supply of 2000 to 5000 tons of ore averaging, say, 1.25% copper; that mining can be done for 75c. per ton and that 75% extraction can be made by heap-leaching in three years. In Table II are shown the possible costs under such conditions.

TABLE II. POSSIBLE COST WITH HEAP-LEACHING

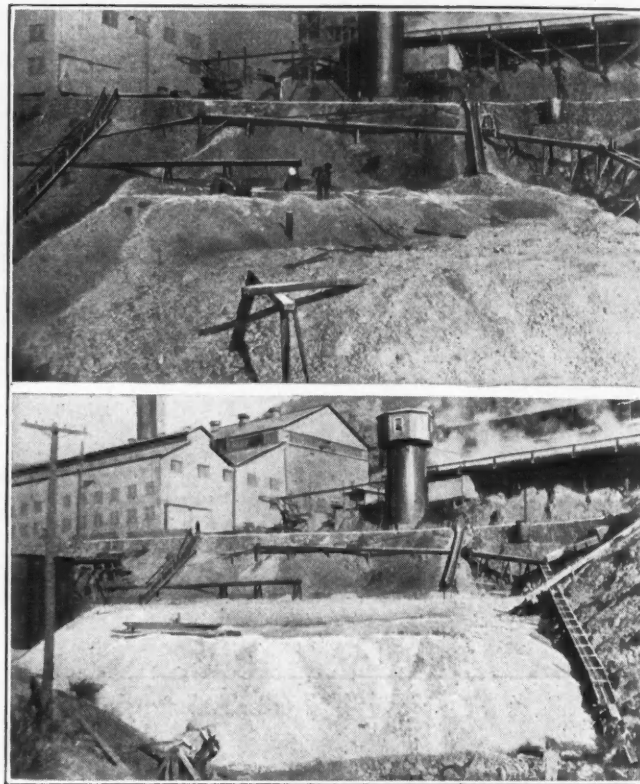
	Per Ton Ore
Mining	\$0.75
Transportation and piling .....	.10
Preparation and repair of site .....	.05
Interest .....	.12
Iron at 1½c. per lb. of Cu .....	.5625
Labor at 1c. per lb. of Cu .....	.375
Pumping and labor on pile .....	.05
Removal .....	.05
Total	\$2.0575
18.75 lb. cement copper cost \$2.0575 = 10.96c. per lb. (not including overhead etc., treatment and other charges on cement copper).	

From these figures, provided the assumptions are correct and if the method works out, there is an ample margin of profit on a 1.25% ore, and under favorable conditions a good profit could be made on a mixed sulphide and oxide ore of a copper content less than 25 lb. per ton. It is to be understood that the only object in any such crude and preliminary cost calculations as those set down is for the purpose of ascertaining whether a sufficient possible margin exists, under reasonable assumptions, to make it worth while to consider the mat-

ter. The next steps are to determine in a small way the probability of successful operation; to check, in a larger way than is possible through laboratory experiments, the conclusions thus made, and, finally, as far as possible, to determine the unknown factors and to outline and carry out a series of experiments on a scale as near as possible to actual working conditions.

EARLY LEACHING EXPERIMENTS OF DR. DOUGLAS

With the above introduction, the following preliminary notes are intended to describe the experimental work to date and to say something about that which will be done



HEAP-LEACHING OPERATIONS OF COPPER QUEEN CONSOLIDATED MINING CO. AT BISBEE, ARIZ.
Above—Feb. 1, 1917. Below—Feb. 10, 1917.

in the future by the Phelps Dodge Corporation in determining the applicability of heap-leaching to some of the company's ores. So far as I know the first proposal to apply heap-leaching methods to the ore of the Southwest was due to Dr. James Douglas, and in this, as in many other lines of copper metallurgy, he was the pioneer. As I remember, the experiments made at his direction were for the purpose of determining the applicability of heap-leaching methods to pyrite carrying small amounts of copper from the Copper Queen mine, the idea being also to utilize any excess acid produced by extracting therewith the copper from low-grade oxidized ores. Some tests were made, but they did not lead to sufficiently encouraging results at the time to make further work advisable.

Following these experiments, which were made at Bisbee under the direction of F. H. Probert more than 15 years ago, I made some investigations to determine the probable theory of the method and its possible application. It seemed certain that mere exposure to the air, even accompanied by wetting, would not suffice, so that to confirm this point experimentally seemed hardly worth while, since it had been established, for example,

that a pile of sand tailings from a mill, after exposure to air and rain for years, will finally have only a small amount of its copper rendered soluble. It seemed equally certain that the solvent action of ferric sulphate would be effectual if it could be produced and regenerated. Ferrous sulphate as a solvent has only a slow and imperfect action on oxides of copper, and I believe none at all on sulphides.

FERRIC REDUCED TO FERROUS IRON AT RIO TINTO TO LESSEN IRON CONSUMPTION

At Rio Tinto there is no lack of iron, either ferrous or ferric; in fact, so much of the latter is produced from the ore heaps that it is necessary to pass the liquors from the heaps through a filter bed of raw ore to reduce the ferric to ferrous iron and thereby lessen the consumption of iron. Further, it may or may not be necessary to return any part of the liquors, carrying sulphates of iron, from the precipitating launders back to the heap, but with the application of the method to a low-grade "porphyry" ore, it would undoubtedly be necessary to return to the heaps all liquors from the precipitating launders in order to maintain the proper amount of iron in the liquors.

Establishing this return of all liquors as the first probable condition, it was evident that some method of regenerating ferric iron would be necessary, since the liquors to be returned, if any reasonable economy of precipitation was to be had, would contain practically all of their iron as ferrous sulphate.

FERRIC IRON REGENERATED BY EVAPORATION

No practicable method of cheaply converting, for leaching purposes, ferrous to ferric iron has been worked out, and it seemed evident that the only method sufficiently cheap was the partial conversion to be obtained by evaporation. Further, if this evaporation were carried on in intimate contact with the ore being leached, probably a better and quicker extraction could be obtained. Accordingly the following steps were adopted as a method for preliminary tests: (1) Wetting ore with excess of solution containing ferrous sulphate and a small amount of ferric sulphate. (2) Allowing the ore to drain and air-dry thoroughly. (3) Precipitating copper from resulting liquor by iron, returning to ore and repeating. This procedure does not differ materially from Rio Tinto practice, but there are, as will be noted, some differences as well as the possibility of variation of a number of experimental conditions.

EXTENSIVE EXPERIMENTATION REQUIRED BEFORE DETERMINING A METHOD OF HEAP-LEACHING

It is also evident that while the conditions and chemistry of heap-leaching are well known as applied to Rio Tinto conditions, in the application of heap-leaching to an ore so radically different as Copper Queen low-grade siliceous and partly oxidized ores, which carry in many cases large amounts of soluble alumina and other bases, there exist conditions so different that Rio Tinto practice may not apply at all.

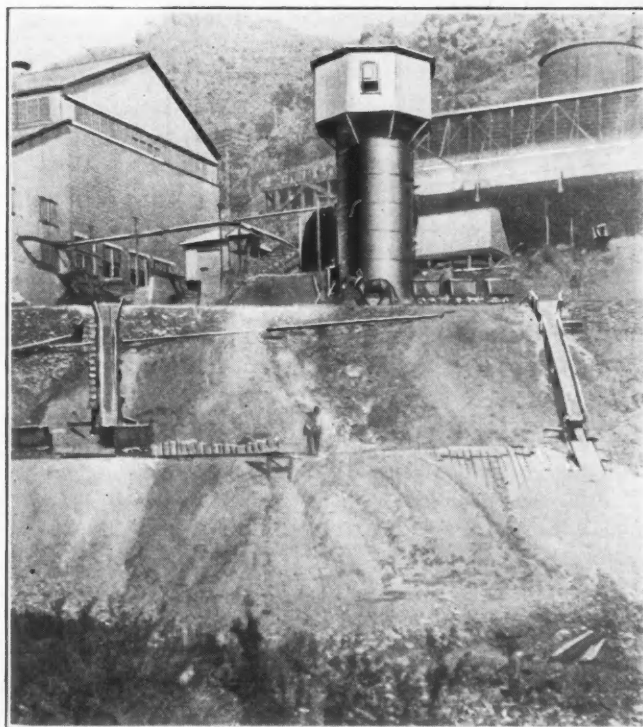
Broadly speaking, it is necessary, then, to determine first whether the Rio Tinto methods can be applied and, if not, to ascertain if any practicable modification of them is feasible. The first experiments were on a heavy sulphide ore from Arizona, and this ore gave up practi-

cally all of its copper to the leach solutions applied successively. Other ores, as well as tailings, gave similar results, and it therefore seemed probable that, if the conditions under which these laboratory tests were conducted could be duplicated in larger-scale work, further experiments should be made. The following description of a systematic laboratory test made subsequently on one ore will serve to show the conditions of the experiment and the results obtained.

NEUTRAL SOLUTION PRODUCED IRON PRECIPITATE

In the first series of experiments, in which a neutral solution of ferrous sulphate was used for leaching, it was found that after 8 or 10 leach cycles the solution of the copper practically ceased. The purpose of the second series was to determine the reason for this and if possible find a remedy. It was noticed in the first series of experiments that the ore disintegrated, became slimy, a yellowish precipitate of ferric hydroxide or basic sulphate was formed, and it seemed probable that the cessation of leaching might be due to the clogging of the ore by this slime.

In the second series a small amount of acid was added to the leach liquor to prevent the formation of precipitate. It is to be noted particularly that this acid is not primarily for the purpose of dissolving any copper, but merely as a sort of restraining agent to prevent oxidized iron from precipitating. Consequently, it may or may not be neutralized and used up. As long as any oxide copper or other acid-soluble bases are present, there



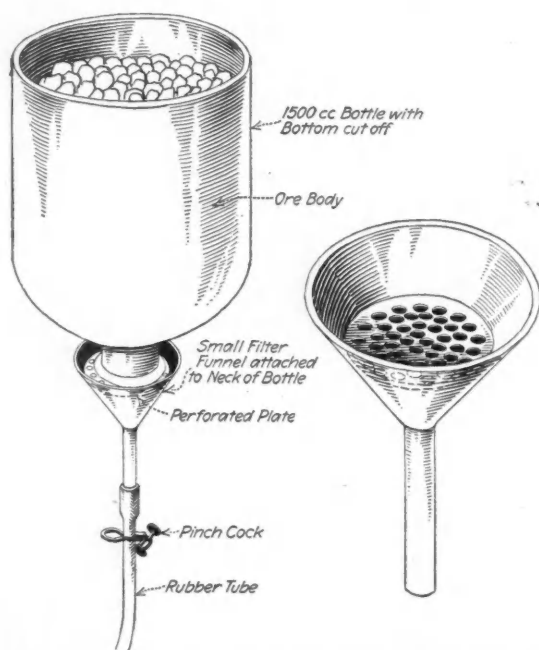
PLACING ORE ON BISBEE HEAP, OCT. 18, 1917

will undoubtedly be some consumption of acid, but this does not reach the point at which iron begins to precipitate it may possibly not mean a prohibitive amount of acid.

A preliminary test was made to determine the solubility of copper in strong $\text{Fe}_2(\text{SO}_4)_3$ solution. For this two batches of 25 grams each of ore (0.97% Cu) were

treated with 10% Fe₂(SO₄)₃ solution—one cold, the other warmed to 80-90° C. The liquor, after digesting two hours, was filtered off and the residue washed, dried and weighed. There was practically no loss of material, and the ores analyzed, after leaching, 0.50% and 0.09% Cu for the cold and warmed samples respectively. It seems, therefore, that half the copper is readily soluble, the remainder slowly so, in strong Fe₂(SO₄)₃ solution.

For the actual leach experiments 1000 grams of ore (0.97% Cu, 4-20 mesh) were placed in the apparatus shown in the accompanying sketch. It required 270 c.c. of solution to cover the ore. After standing two hours the pinch cock at the bottom was opened and the liquid allowed to filter off. This was then measured and a sample taken for analysis. The leach liquor consisted of a solution of ferrous sulphate made by dissolving 55



APPARATUS FOR MAKING LEACHING EXPERIMENTS

grams of the crystallized salt per liter of water. The analysis of the solution after adding 1 c.c. H₂SO₄ (1.83 sp.gr.) per liter was: Ferrous iron, 1.15%; ferric iron,

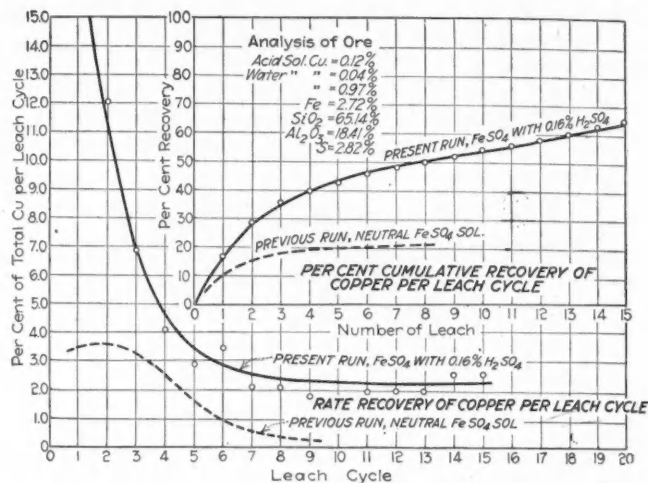
TABLE III. LEACH EXPERIMENTS ON COPPER ORE USING ACIDULATION SOLUTION
(Using 1,000-gram sample, 0.97% cu., 4-20 mesh; 270 c.c. leach solution, 1.2% ferrous, 0.1% ferric, 0.16% H₂SO₄)

No. of Leach	Solution in Leach Liquor, c.c.	Sample Analyzed, c.c.	Copper in Sample, Grams	Copper in Leach Liquor, Grams	Original Copper in Leach Liquor, %	Cumulative Recovery, %	Cu per Ton of Ore per Leach Cycle, Lb.	H ₂ SO ₄ per Lb. Cu, Lb.
1	225	10	0.0710	1.596	16.45	16.45	3.19	0.27
2	232	10	0.0505	1.171	12.07	28.52	2.34	0.37
3	255	10	0.0259	0.660	6.81	35.33	1.32	0.65
4	212	10	0.0188	0.398	4.10	39.43	0.80	1.06
5	215	10	0.0130	0.280	2.89	42.32	0.56	1.49
6	232	10	0.0145	0.336	3.47	45.79	0.67	1.29
7	230	10	0.0086	0.198	2.04	47.83	0.40	2.18
8	228	10	0.0086	0.196	2.02	49.85	0.39	2.20
9	243	10	0.0071	0.173	1.78	51.63	0.35	2.50
10	238	10	0.00966	0.230	2.37	54.00	0.46	1.82
11	251	10	0.00738	0.185	1.91	55.91	0.37	2.34
12	246	10	0.00763	0.188	1.94	57.85	0.38	2.30
13	236	10	0.00839	0.198	1.92	59.77	0.40	2.18
14	230	10	0.01068	0.245	2.53	62.30	0.49	1.77
15	241	10	0.01017	0.245	2.53	64.83	0.49	1.77

0.11%; H₂SO₄ (by calculation), 0.16%. Table III shows the results for the first 15 leaches.

The curves plotted from the data obtained show the values of cumulative recovery, rate recovery, and pounds of

copper obtained per ton of ore per leaching cycle for the second tests, and have been plotted alongside the results of the first tests, using neutral FeSO₄ solution. It will be noticed that the results are superior for the acid solution, as the recovery reaches a constant fixed rate of

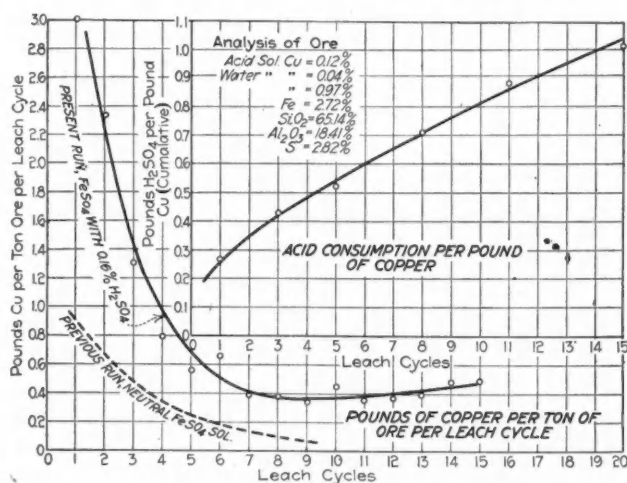


CURVE SHOWING RATE AND PERCENT CUMULATIVE RECOVERY OF COPPER IN LEACHING EXPERIMENTS

about 2% and does not decrease to zero, as with the neutral solution. The recovery consequently continues to increase at an approximately constant rate.

SUCCESSIVE LEACHES SHOW DECREASED COPPER RECOVERY

Assuming that all the acid is lost (new solution was used each time in these experiments), the acid consumption has been calculated per pound of copper in two ways. The first of these represents that for each individual leach and would average about 1.5 lb. H₂SO₄ per lb. of copper. The second, as shown in the plot, is the cumu-



CURVE SHOWING ACID CONSUMPTION AND COPPER RECOVERY IN LEACHING EXPERIMENTS

lative consumption, calculated in the following manner: Taking, as an example, leach No. 10, the recovery is 54% of 1000 × 0.97% = 5.24 grams of copper. For this there was used 270 × 0.0016 × 10 = 4.32 grams of

acid. Acid used per lb. Cu = $\frac{4.32}{5.24} = 0.825$. The reason this figure is lower than the average in the table is due to the large amount of copper in the first few original leaches that were made in the experiments.

Conclusions made as a result of these tests were: That the ore treated, under the conditions of the experiments, could be made to give up virtually all of its copper content under probably practicable conditions of length of time for drying, number of leaching cycles, etc.; that a neutral solution is not suitable for return to the ore, since by its use the ore breaks down, clogs up, and percolation and extraction cease; that by adding to the leach a small amount of acid and maintaining this acidity, this undesirable action could be prevented; that this amount of acid will probably not add too much to the cost of operation; and that the amount of conversion of ferrous to ferric iron, by evaporation of the original solution in contact with the ore, is sufficient for the solution of the sulphides of copper.

TEST ON 25 TONS OF SAND TAILINGS

The next step in the investigation of the method was at Douglas, Ariz., where, several years ago, the Phelps Dodge Corporation decided to make a large-scale test and a more or less complete investigation of leaching as applied to local conditions. I was in charge of the beginning and final steps of this investigation, and during the latter period, as a next step in heap-leaching investigation, I had placed a small heap containing about 25 tons of sand tailings from one of the company mills. These sand tailings contained about 0.52% Cu, of which 0.19% was acid- and water-soluble copper, and the remainder sulphide copper. The tailings were deslimed by passing through a small Dorr classifier, after which the coarse part was placed in a pile.

The apparatus used and method of operation were as follows: A board platform with raised edges was constructed and made as tight as possible. The platform tilted slightly so as to drain to one side, along which a series of holes was bored in the side so as to communicate with a launder leading to a sump measuring tank. On the top of the board platform a layer of crushed slag was placed to provide a porous bottom, through which drainage to the side could take place. Over this layer of slag the sand tailings were piled, the final height being about 6 to 8 ft., and the sides of the pile were sloped so that the top, which was flat, contained a small basin into which the liquor could be pumped. The remaining apparatus consisted of the sump measuring tank, a launder large enough to accommodate the liquor and iron used in the treatment, and a steam siphon for raising the liquor to the launder and to the top of the pile. It was recognized that the heating of the solution, due to the steam, introduced a doubtful factor that could not be duplicated in larger-scale work, but, except for this and the depth through which percolation was done, there were no impracticable conditions evident.

RESULTS OBTAINED WARRANT FURTHER TESTS

There was on hand from previous experiments a stock of liquor carrying small amounts of iron salts suitable for irrigation, and the method of procedure was to run this liquor over the heap until it was apparent from the effluent liquor that no more copper was being leached out, and then to let the heap dry. During this period of drying usually there soon appeared on the outside of the heap a crust or coating of nearly pure sulphate of copper, and it was evident that, probably from some capillary action, there was a migration of the copper to the surface after it was rendered soluble by the action

of the salts of iron remaining in the pile. After a suitable drying interval, determined by the weather and the appearance of the heap, it was again irrigated, and the copper at that time rendered soluble was washed out. The whole operation was then repeated until the conclusion of the experiment. On account of the completion of the other leaching work it did not seem worth while to go on with this small experiment, but the results obtained seemed sufficiently encouraging to warrant further experiments on a large scale, which was decided on and a good-sized heap arranged at Tyrone for the Burro Mountain branch of the Phelps Dodge Corporation.

The material used for this test, which is still in progress, was a part of an old ore dump that had been exposed to oxidizing influences for several years, and consequently contained a considerable quantity of the copper content in an oxidized condition. From the appearance and action of this ore as exposed to air and moisture, it seemed fairly safe to conclude that its sulphide-copper contents were of such a character as to oxidize with fair readiness, especially if properly and systematically treated for the purpose. An analysis of this ore as originally laid down indicated 2.71% copper. No crushing was done.

ORE LAID DOWN IN A SERIES OF TERRACES

The site selected for the experiments was a sloping piece of ground, fairly level transversely, near the head of a canyon. It was decided to lay down the ore in a series of terraces, and sufficient ground was prepared to accommodate the amount of ore, about 20,722 tons. It was thought probable that if the heap was put down without some attempt at waterproofing the ground surface, the loss of solution through seepage would be considerable, and therefore a layer of slime tailings, having practically the character of clay, was laid down first. A certain amount of fuel oil was also used for this purpose. After building the proper drains, made from large rock, laid dry, the ore was put in place, leveled and a series of basins made on the top of the terraces, arranged to intercommunicate when necessary. The drains under the heap led to main drains, which were at the sides and lower edge of the heap, and the liquor draining out into these was led to a sump tank, from which it was pumped up to the precipitating system at a higher level than the heaps.

SCRAP IRON AND TIN CANS USED TO PRECIPITATE COPPER

There are no points of special interest regarding the precipitating plant, the usual launder system being used. Scrap iron and tin cans are used to precipitate the copper, which is cleaned off and collected in the same way as at similar plants. From the precipitating plant the barren liquor flows by gravity to the heaps, and arrangement has been made so that its flow can be diverted to any of the basins, a record being kept to insure that each part of the heap receives its proper period of rest and leaching.

The small-scale work showed that apparently disintegration of the ore, which would otherwise have taken place, could be controlled and prevented to a certain extent by the presence of a small percentage of acid in the liquors. It is, of course, obvious, also, that the precipitation of hydrates of iron will be excessive from a neutral liquor. Beginning in September, a small amount

of acid was added to the solutions. Table IV shows the results obtained from the operation of this heap at Tyrone. The immediate supervision of this heap-leach-

TABLE IV. HEAP-LEACHING TESTS AT TYRONE

(Using tons of ore, 20,722; grade, 2.71% copper; pounds of copper, 1,124,286.)

1917	Copper Extracted Lb.	Copper Remaining Lb.	Copper Extracted Per Cent.	Copper Ex- tracted Lb. Per Ton
To Feb. 1	41,500	1,082,786	3.6	2.0
February	44,587	1,038,199	3.9	2.1
March	43,544	994,655	3.8	2.1
April	40,354	954,301	3.6	1.9
May	26,950	927,351	2.4	1.3
June	17,196	910,155	1.5	0.8
July	17,949	892,206	1.5	0.8
August	14,390	877,816	1.3	0.6
September	3,941	873,875	0.3	0.1
October	8,492	865,383	0.7	0.4
November	12,247	853,136	1.0	0.5
Totals	271,150		24.1	13.0

ing work at Tyrone, as well as the large-scale tests which have been authorized and will be referred to later, is now under the direction of A. W. Hudson.

CONDITIONS AT SACRAMENTO HILL, BISBEE

At Bisbee the drilling of Sacramento Mountain showed considerable amounts of siliceous ore of concentrating grade, some ore of shipping grade, and large amounts of low-grade ore. Most of the latter would have to be removed in any case, and, since the cost of preparing this for leaching would be little more than for any other method of disposal, and its extraction cost would properly be charged as stripping expense and a part of the cost of mining the main orebodies, it seemed advisable to make some experiments on this material also. In this case, in view of the above, while a complete extraction was to be desired, a lower percentage of extraction than that required by the conditions at Tyrone would still be sufficient. Furthermore, that part of the low-grade ore that would have to be removed by stripping could be leached and its copper recovered when market conditions permitted, and the operation suspended when its recovery became unprofitable.

Both the work at Tyrone and the small heap started at Bisbee cannot be considered as complete tests, but rather as rough preliminary experiments to determine the prospect of the amenability of the ores to the method. For this reason little attempt was made at either place to lay out the work in such a way that full and complete information on many necessary details needed for intelligent design of a plant for operation on a large scale could be secured.

PREPARING THE LEACHING HEAP AT BISBEE

Joseph Irving, who was in charge of the mine-water treating plant at Bisbee and had had considerable leaching experience both at Rio Tinto and at several places in this country, in addition to his connection with a part of the Douglas experimental work, was placed in local charge of the tests to be made at Bisbee, and work was started in September, 1916. A large part of the following description of the work done to date is taken from reports made from time to time by Mr. Irving, and the accompanying photographs, showing various stages of the operations, are also by Mr. Irving.

Preliminary operations included track repairs, construction of bins and chutes and preparation of the site. This site, lying as it does between the power plant and the Sacramento loading station, was selected as being the most convenient, though certainly not the most ideal. Owing to the nature of the ground, care had to be taken

in preparing the site, which on the sides is partly floored with old lumber and partly dressed off with slimes from the creek. These precautions were taken to prevent excessive losses through percolation of the copper liquors through the open soil. The creek bed was cribbed over and the cribbing covered with large pieces of ore and rock. This creek now constitutes the main drain from the heap, and other smaller drains (12 x 12 in.) were laid out which lead toward the main drain. The smaller drains were constructed from the large pieces of ore coming forward from the dump, while between the drains the whole floor was covered with large pieces of ore.

SAMPLING AND PLACING THE ORE ON THE HEAP

Actual moving of the ore from the air-shaft dump to the leaching site began on Sept. 30, but was erratic until Oct. 13, when the work was placed on a contract basis. The cars were of 19-cu.ft. capacity and averaged over 2086 lb. of ore per load, so that, allowing for moisture, delivery was just a little over one ton per car.

For a few days at the start each carload was weighed and tared; later on, however, 12% of each day's work was weighed and tared. A sample was taken from each car at the loading bins, and the whole sample sent to the laboratory and assayed for copper only. A composite sample was prepared at end of each month, and a general analysis made, of which the following is a fair average: Ag, 0.12 oz.; Cu, 1.30%; SiO₂, 60.7%; Fe, 10.5%; CaO, 1.2%; Al₂O₃, 12.1%; S, 9.9%. Daily moisture samples were taken separately.

The ore was delivered on the prepared floor at a point from which it was calculated that a heap laid out would not exceed a depth of 25 ft. over the main drain or creek. No attempt was made at screening; neither was crushing on a large scale contemplated. However, all large pieces, excepting those required for walls or drains, were broken up at the loading station. The reason for this was to keep the dump open and so permit of free percolation, and to save expense. In light of past experience and the nature of the ore to be treated, 20 to 25 ft. was considered sufficient depth for the heap in order to obtain proper saturation and at the same time avoid the evils of channeling or packing.

The work of transporting the ore from the air-shaft dump to the leaching site continued, with few interruptions, till Jan. 31, when there had been formed a heap of 9487 dry tons and a surface area of nearly 12,000 sq.ft. The heap was laid off in two benches, one 5 ft. lower than the other. The maximum depth above the creek is 25 ft., the minimum 5 ft. and the average close to 20 feet.

TABLE V. HEAP-LEACHING TESTS AT BISBEE

(Using tons of ore, 9,487; grade, 1.33% copper; pounds of copper, 252,354.)

1917	Copper Extracted Lb.	Copper Remaining Lb.	Copper Extracted Per Cent.	Copper Ex- tracted Lb. Per Ton
To June 1 (app. 2 mos.)	26,486	225,868	10.4	2.7
June	3,011	222,857	1.1	0.3
July	12,700	210,157	5.0	1.3
August	7,804	202,353	3.0	0.8
September	9,535	192,818	3.7	1.0
October	8,503	184,315	3.3	0.9
Totals	68,039		26.9	7.1

At present the surface of the heap is being arranged into convenient squares for irrigation purposes, and a concrete settling tank for liquors from the heap is being built. The water coming to the heap, whether from the spray or from the sump at the main plant, will be

measured and sampled. The copper liquors will be pumped from the settling tank to two precipitating tanks at the main plant, being automatically measured and sampled en route. Daily samples will also be taken of the copper liquor entering and leaving each tank. The total cost for all preliminary work not including mining was \$5734.43 for the 9487 tons of ore. In Table VI these costs are classified.

TABLE VI. DETAIL OF COSTS PRELIMINARY TO LEACHING

	Cents per Ton of Ore
Ore moving, distributing, etc.	32.28
Preparing site	3.31
Track repairs	2.94
Chutes and bins	3.23
Laundries	7.94
Drains	5.17
Measuring tanks	2.85
Sampler	0.32
Pump	2.40
Total per ton	60.44

The ore contained 1.33% copper, equivalent to 252,354 lb., and the costs recorded therefore are equivalent to about three cents per lb. on the 75% extraction, which, if obtained, will be equivalent to 189,265 lb. of copper. The stated costs do not include any outlay for a precipitating plant, since the capacity of the mine-water treating plant already in use is ample to take care of all liquors.

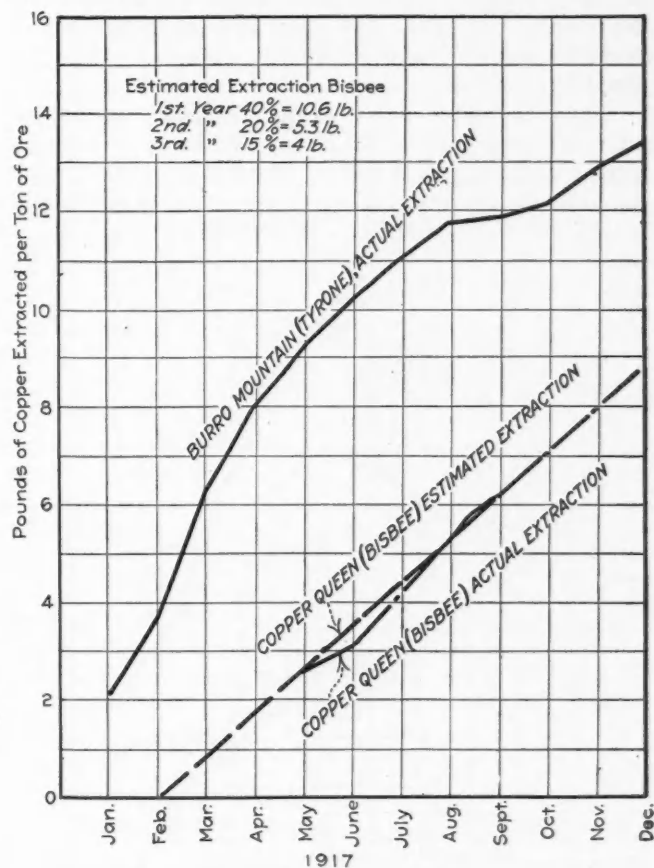
Table V shows the results at Bisbee. Extractions by months expressed in pounds copper per ton of ore are also shown by curves for both Burro Mountain and Bisbee. No comparison is possible between the two, since the character of the ore is different, and because the Burro Mountain ore originally carried 2.71% Cu, as compared with 1.33% for Bisbee. It is interesting to note, however, that so far the curve for extraction from the Bisbee ore follows almost exactly the original estimate based on the small-scale tests and other data. This estimate for an ore carrying about 25 lb. of copper per ton was 40% for the first year, 20% for the second year and 15% for the third year, which is equivalent, on this Bisbee ore, to 10.6, 5.3 and 4 lb. per year, respectively. This assumed extraction is shown by curve on the diagram and it is evident that the actual extraction obtained followed the assumed almost exactly.

EXTRACTION OF 40% PROBABLE ON BISBEE ORE DURING THE FIRST YEAR

This does not necessarily mean anything for the future, and it is not possible to extrapolate this curve, except possibly for a short distance, but I believe it is at least safe to assume an extraction of 40% of the copper from the Bisbee ore for the first year under the conditions of the experiments as made. It should also be noted that the figures obtained are necessarily conservative, since they are based on actual measurements and assays of the liquors from the heaps as taken to the precipitation laundries. There has been an unmeasured and indefinite amount of leakage and loss of liquor through seepage and other uncontrolled factors. This may not have actually represented a considerable percentage of the total, but there must have been some loss, and it is almost certain, assuming that the assays and measurements of liquor, as computed, are correct, that the actual extraction will not be less than that calculated.

Attention should also be called to an interesting practical result of the Bisbee experiments. This is that some time ago the heap paid all expenses connected with it

(except, of course, mining, which was done for other purposes and charged elsewhere), including all preparation, moving, installation and operating costs, and is now being operated at a profit. This is, I think, rather unusual in experimental work of an entirely new character, and the point of emphasizing this and the preceding extraction figures is to show that under favorable conditions, when, for example, a large amount of ore must be removed for stripping and other purposes, profitable operation of the method is reasonably cer-



CURVES SHOWING COPPER EXTRACTION BY HEAP LEACHING AT BISBEE AND TYRONE

tain. This does not mean that anything approaching a complete extraction has yet been demonstrated, but only that, under conditions where cost of mining and moving may properly be charged to other operations, it is probable that the treatment of ore (provided the selling price is high enough) will be profitable even at a comparatively low percentage of extraction.

It is obvious that as yet little is known about the conditions for large-scale operation. Following exactly the conditions of the work thus far done for the same time will naturally be expected to give the same results for an identical period, and if these conditions have been properly selected, treatment for a further time will also be successful. The reverse may be true and, if it should be demonstrated that a longer treatment will not yield the results expected, a series of more complete and systematic tests should be instituted to ascertain what the reason for such failure was or whether it could be obviated by changing the conditions under control of the operator.

This is the object of the work to be done at Tyrone, and, broadly speaking, the results obtained may be ex-

pected to apply elsewhere except for ores of different character. It is planned to mine, for the purpose of the test at Tyrone, from 30,000 to 40,000 tons of ore, which of course must be so selected as to be representative, as nearly as possible, of the ore eventually to be treated if the method is successful.

FACTORS TO BE CONSIDERED IN DETERMINING SUCCESSFUL TREATMENT METHODS

The following list of questions represents in a preliminary way the information needed as indicated by the results achieved, and tests are being planned to furnish, as far as possible, definite answers to these and other questions:

Assuming more or less exact knowledge of the tonnage of ore available, its grade, analysis, uniformity, mining cost, etc., what will be the total investment costs, the probable operating cost and the profit, experimentally and on a large scale? What will be the scale of

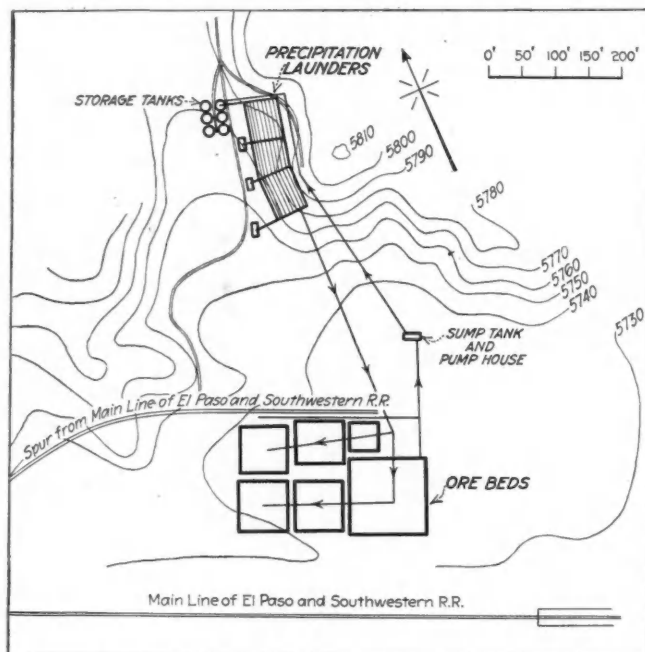


DIAGRAM OF PROPOSED EXPERIMENTAL LEACHING PLANT AT TYRONE, N. M.

eventual operation, and the minimum daily tonnage that will pay at a normal copper price? What will be the investment needed for transportation of ore to pile, and the distance and cost of this operation?

As to breaking before piling, can run of mine be used, and, if not, what is the best size? What amount of screening or other separation of sizes will be needed, and what will be the cost for breaking or screening if needed? Regarding preparation for the pile, what is the best kind, construction, etc., of the foundation? Will waterproofing of the site be needed, and, if so, what kind will be practicable? What is the best method of piling and what is the best height of pile? What amount of fines will be needed for the top to insure proper distribution of the liquors? What will be the cost of the above factors?

Regarding the leaching operation itself, what will be the total volume of solution to be pumped and the corresponding pumping cost per ton of ore? What will be the probable total extraction and the rate for any period, and the time required for such extraction? What

is the most favorable composition of leaching liquor with respect to ferrous iron, ferric iron, free acid and other constituents? What is the balance of the cycle for iron and other constituents? What disintegration of the ore under treatment will take place in connection with the other variables?

What is the best manner of solution application, the time interval for drying, etc.? Assuming that better results can be had with increased ferric iron in solution, can this be increased by any practicable method? Will acidity of solutions be needed and, if so, what will be the amount of acid required per ton of ore? As to precipitation, what will be the best form of apparatus? To what extent can present labor costs for precipitation be reduced? What will be the best form and the cost of iron for precipitation and its consumption per lb. of copper? Assuming that reducing beds for the control of ferric iron before precipitation will be needed, what will be the best material available for them, their extent, efficiency, durability, etc.? What will be the best method of collecting the precipitate?

CONDITIONS GOVERNING REMOVAL OF ORE AFTER LEACHING

For these and other calculations it is assumed that, for any scale finally decided on as the daily production, in starting operations this amount will be piled daily and treatment started as soon as possible. At the end of three years, or whatever time extraction is finished, the daily addition of the same amount will be continued, and in addition removal of the leached ore will begin. The question of the relative advisability of removal of the ore or its remaining after leaching will depend on the available space and the relative cost of removal, compared with the preparation of a new site.

It will, accordingly, be necessary if large-scale work is done to provide sufficient space to accommodate the daily tonnage for, say, three years, the estimated extraction period. In addition there will be needed either storage space thereafter for the amount of daily tonnage coming forward, or a new site. The former will probably be preferred. What will be the best form of machinery for the storage and eventual removal of the amount of ore per day to be treated?

LEACHING SITES SHOULD BE NEARLY FLAT

Regarding the selection of site and other matters in connection with it, it is assumed that the best site will be nearly flat and much longer than broad. Questions to be answered include: What is the best and the greatest allowable slope of the ground? What are the best horizontal and other pile dimensions? What will be the dimensions, slope, etc., of the main launders along the heap and of the transverse collecting launders under the heap, and the distance apart, etc., of the latter? What is the best method and material for constructing transverse and other drains? Will "ventilating chimneys," as at Rio Tinto, be needed, and, if so, what is the proper distance apart for these, their construction, etc.?

In order intelligently to answer the above and, probably, other questions that will arise, it seems likely that not less than the stated 30,000 to 40,000 tons of ore will be needed.

An accompanying sketch shows the arrangement of the various features of a proposed experimental plant, which embodies the following features: A spur from the

main line of the railroad for transportation to plant of ore, iron and other supplies, and shipment of cement copper produced; piles of ore, the arrangement of which will consist of six piles, divided as shown for the purpose of conducting simultaneously a number of the experiments called for by the questions propounded. These piles will be arranged to have measuring and sampling devices attached to the launders from each, and the launders connect with and discharge into the main collecting launder to the main sump as shown. From this the liquors will be pumped up to storage tanks, placed as shown at the top level of the plant, and from these storage tanks the liquors will flow by gravity to precipitation launders arranged as shown. These will communicate with transverse collecting launders through which the cement copper will flow by gravity to collecting tanks, to be washed and prepared for shipment. From the precipitating launders the solution, free from copper, will flow back by gravity to the heaps through the return launder system, and will be distributed to the piles as required. A short length of narrow-gage track, with an incline at the end parallel to the precipitating system and extending to the top level of the latter for the purpose of bringing scrap or other iron to the plant and removing the cement copper, is also provided.

The system of distribution to the beds is not shown, but this is comparatively unimportant, since methods suitable for larger-scale work would be too expensive for a small installation. There will be needed, in addition, suitable smaller-scale arrangements for carrying on simultaneously a number of small-scale tests, together with proper laboratory facilities for analyses.

BISBEE AND BURRO MOUNTAIN ORES RESPOND DIFFERENTLY TO SIMILAR TREATMENT

Regarding the probable chemistry of the operation, much could be said from analogy with other work, especially at Rio Tinto. I personally feel, however, that while one may be reasonably sure of some of the main reactions, it will be wiser to omit any extended discussion until more is known. It is rather a curious fact, aside from the expected favorable action of slight acidity in preventing iron precipitation and promoting extraction, which is shown in the curves already alluded to, that, as stated, it was found that slight acidity has a restraining influence on disintegration of the rock. This is desirable and is also distinctly shown by the fact that at Bisbee, where the liquor used from the beginning has been slightly acid, percolation has remained good, while the Tyrone pile, up to the time acid was systematically added (in September), has shown more or less increasing resistance to percolation.

Table VII shows a tabulation of analyses, made at intervals, of the water to and from the first Tyrone heaps.

TABLE VII. ANALYSES OF WATER FROM BURRO MOUNTAIN LEACHING PLANT

	July		August		September		October	
	Heads	Tails	Heads	Tails	Heads	Tails	Heads	Tails
Fe.....	316	513	615	880	444	651	1,580	1,737
Al ₂ O ₃			262	203	200	119	276	218
K ₂ O.....	172	147	150	155	145	145	149	149
Cu.....	394	24	351	9	585	27	249	37
Zn.....	136	86	170	150	123	104	125	114
H ₂ SO ₄			318	112	85	75	85	55

It will be noted that determinations of potash have been made, and there is some indication of a possible building up of this element in the liquors, coming from the disintegration of the feldspathic constituents in the ore.

Many Southwestern ores carry potash in small amounts, and it is possible that a concentration of this element might take place to a considerable degree in liquors thus used over and over for considerable periods. This may or may not be of importance practically, but if such concentration occurred to a sufficient degree the recovery of potash from such liquors would not be impossible, and its byproduct value could be applied against the cost of copper.

CAPILLARITY OF ORE HEAPS ESSENTIAL

The migration of the copper salts, due probable to capillary action already noted in the description of the Douglas tests on sand tailings, may also be of practical importance. If this action occurs, as it did under the conditions of a closely packed pile of fine sand, there is some probability of its taking place so as to produce more or less migration of the oxidized soluble salts of copper from the interior of a lump of some size to the outside of the same without any appreciable disintegration of the lump taking place. This really is the gist of the whole matter. For the process to be successful it must be necessary for not only small pieces but also for lumps of ore as large as 6 in. to have in them sufficient capillary channels to permit the entrance and exit of the leaching solutions, and if such action is accompanied by too much breaking down of the rock success will be doubtful because of the incidental packing and clogging.

There is no doubt of the solubility of the copper under the action of the solutions employed in the tests described, and it has been proved that under certain conditions the rock can be completely disintegrated, but it remains to be seen if these two factors can be so adjusted as to be successful metallurgically and commercially.

Land Office Adjudications

BY A. L. H. STREET*

There is a fundamental legal principle that where a particular fact affecting a property right is once finally determined by a tribunal in a regular manner, the adjudication is conclusive against the parties to the particular controversy and other persons claiming title under them. The reason of the rule exists in the policy of the law to avoid relitigation of settled points.

Applying this principle in the case of Cameron vs. Bass, 168 *Pacific Reporter*, 645, the Arizona supreme court recently decided that a decision of the Department of the Interior, on application for a patent under a mining claim, denying a patent on the ground that the ground was nonmineral in character, the decision standing unreversed in any direct proceeding for review thereof, is conclusive and binding on the world, annulling all rights under the claimant's location, in the absence of fraud, accident, imposition or mistake inducing the decision.

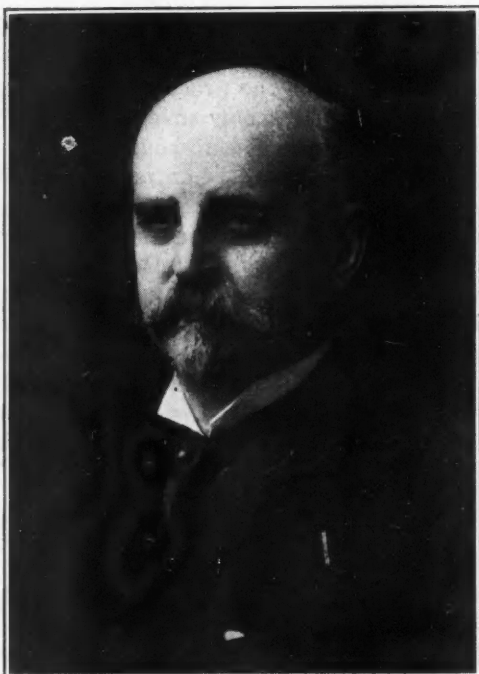
In this case defendant was sued by plaintiff to avoid the latter's occupation of certain ground claimed by plaintiff under a mining-claim location; defendant relying on a permit from the Government authorities controlling the forest reserve in which the land lay. Defendant successfully asserted that a decision of the Land Office finding the land to be nonmineral in character foreclosed plaintiff's rights.

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Col. Thomas L. Livermore

Col. Thomas L. Livermore, for more than 20 years vice president of the Calumet & Hecla Mining Co., died of pneumonia at his home in Boston, on Jan. 9, at the age of 74 years. He was born in Galena, Ill., in 1844, and spent his boyhood in Milford, N. H., to which place his parents moved soon after his birth. At the outbreak of the Civil War, Colonel Livermore, then a 17-year old student in Lombard University, at Galesburg, Ill., returned home and enlisted as a private in the 1st New Hampshire Regiment. Later he joined the 5th New Hampshire Volunteers, rising in rank in this regiment until, at the end of 1863, he was made colonel. He served on the staff of General Hancock at Gettysburg and Petersburg.

After the war, Colonel Livermore studied law in Milford, and, on admittance to the bar, went to Boston,



COL. THOMAS L. LIVERMORE

where he practiced for 11 years. He was then appointed resident manager of the Amoskeag Corporation at Manchester, N. H., which position he held for six years, resigning to become counsel for the Calumet & Hecla company. He was associated with the latter company until 1910, when he retired from active service, having risen to be vice president. At this time Colonel Livermore stated that he had an agreement with the late Alexander Agassiz to stay with him as long as Mr. Agassiz remained with the company. He deferred his retirement long enough to aid Quincy A. Shaw, who was elected president to succeed Mr. Agassiz. Colonel Livermore was succeeded as vice president by Rodolphe L. Agassiz, who later became president.

In 1911 Colonel Livermore was instrumental in forming the Lewis Mine Co., which undertook the development of a lead-zinc-copper property in southwestern Colorado; in this enterprise he was associated with his son, Harris Livermore, a Boston lawyer, and Thomas E. Sherwin, son of the former president of the New England Telephone and Telegraph Co. He had also been an officer of various other companies, including the follow-

ing: Ashburton Mining Co., as its vice president; Contention Mining Co., vice president and director; Marysville Dredging Co., director; New England Exploration Co., president and director; Old Colony Trust Co., director, and Smuggler Union Mining Co., director. He was exceedingly well informed on copper and occupied a position of prominence in the copper industry.

Colonel Livermore was also a member of the corporation and executive committee of the Massachusetts Institute of Technology, and a member of the Union and St. Botolph clubs and of the Massachusetts Military Historical Society. He was an officer of several civic organizations of Boston and evinced in many ways his interest in the city's municipal government. For several years he served on the Park Commission and later was a member of the Board of Metropolitan Park Commissioners. He was vice-chairman of the executive committee of the Citizens' Municipal League and vice president of the Public School Association, lecturing frequently on civic subjects and on his experiences in the Civil War. Colonel Livermore, who had been a widower for more than 35 years, is survived by three sons, Thomas L. Livermore, Jr., now of Florida; Robert Livermore and Harris Livermore, both of Boston, and a daughter, Mrs. Bulkeley Wells.

Field in China for American Zinc

There is an excellent opportunity for American manufacturers of spelter and zinc products to capture trade in China, according to Consul General Thomas Scammons at Shanghai. In 1914, the net imports of spelter into China were 1,145,600 lb., with an approximate value of \$150,000. Of that amount more than 57% came from Germany and Austria-Hungary and more than 40% from Great Britain and Hongkong. In 1915 only 36,800 lb., valued at \$15,176, were imported, of which nearly 98% came from Hongkong. In 1916, 87,200 lb. were imported, at an approximate value of \$43,185, and more than 89% of this came from Japan.

Zinc sheets and plates which were imported into China amounted to 1,299,067 lb., valued at \$200,000, in 1914. Thirty-three per cent. came from Belgium, 28% from Great Britain and Hongkong, and more than 17% from Germany. There were 137,067 lb., valued at \$49,800, imported in 1915, of which more than 42% came from Great Britain and Hongkong, and more than 26% from the United States. In 1916, 835,467 lb., valued at \$372,200, were imported, of which more than 65% came from the United States and more than 16% each from Great Britain and Japan. Of all other kinds of zinc manufactures, 774,400 lb. were imported, at an approximate cost of \$107,300, in 1914, of which more than 63% came from Germany and Austria-Hungary, and almost 26% from Belgium; 24,933 lb., at a cost of \$8800, in 1915, of which more than 78% came from Japan and 16% from the Philippine Islands; and 122,800 lb., valued at \$90,925, in 1916, of which almost 54% came from France and more than 40% from Japan.

Lucero, a Copper-Nickel Alloy, developed by the Electric Alloy Co., of 135 Broadway, New York, is claimed to be a satisfactory substitute for German silver and can withstand higher temperatures. It is noncorrosive, does not contain any zinc and is useful for rheostats, car heaters and similar devices demanding the distinctive qualities mentioned.

The New Russia*

BY WILLIAM B. THOMPSON

I HAVE returned to this country with some very strong ideas regarding Russia, and the duty of the United States and the Allies to that stirring, and, I am afraid you will think, somewhat erratic young democracy.

I come from a people now generally known as the Bolsheviki, who just now are extremely unpopular in the American press. They are held up to execration as assistant Germans and are being denounced for having deserted the Allies and throwing their influence on the side of the Kaiser. I am afraid the American people are slow to realize one of the greatest facts in the war at this time. The Bolsheviki at the present moment are a tremendous factor in bringing the Central Powers of Europe around to a basis of a reasonable and a lasting peace. The newspapers that are denouncing the Bolsheviki just now are printing columns about a revolution in Austria-Hungary, a revolution based upon immediate peace with no annexations and no indemnities. This Austro-Hungarian revolution was inspired by the Russian Bolsheviki. The importance of this revolution should not be ignored. The example and efforts of the Russian democracy are setting the Central Powers on fire. The most damaging enemy Germany has is the Russian democracy alongside of it, preaching to the German common people and to the German soldiers the same doctrine of democratic peace. Stranger things have happened than that a lasting peace, without the realization of any of Germany's despotic war aims, may be, at this very time, in the making.

When I arrived in Russia last July I found the country almost prostrate through demoralization caused by unopposed German propaganda. German propaganda had brought about a strike through all Russia three days before the declaration of war in 1914. German intrigue and propaganda had so surrounded the Czar that a separate peace was almost impending last March. Food had been cut off deliberately from Petrograd and other cities in order to cause bread riots and strikes, with the cold intention on the part of the German and Russian autocracies of using these measures as an excuse for a separate peace. The Russian soldiers refused to fire on the hungry people, and the long-sought-for Russian revolution was realized with the abdication of the Czar.

At the time I reached Petrograd, that noble Russian patriot, Alexander Kerensky—and I am deliberate in calling him a noble man—was attempting a coalition government—a government representing the rich and the poor. The rich, however, were not satisfied to work with the poor. German propaganda was busy tearing down, Allied haggling was unconsciously aiding, and this resulted in an attempt to place over Russia a man on horseback, Korniloff. To me it seems that a madder scheme was never conceived in the brain of man. It aroused to frenzy the great mass of Russians, who interpreted it as a return of the old order. Just at this time, a Russian general, Gurko, who had been deprived of the command of the army for writing letters to the Czar, saying that he hoped to see him return

to power, escaped to England and was received in audience by King George. When you who have not been to Russia are puzzling your brains over the Bolsheviki, and wondering why they should be so extreme and so opposed to the property-owning classes, it would be useful for you to remember these things, which will explain why the workingmen and peasants are in absolute control in Russia, and passionately devoted to making their freedom secure. The terrorism under which the limited property-owning class is living in Russia is slight compared with the terrorism in which the workingman and the peasant lives in contemplating a return of the power of the Old Régime.

We talk about patriots in this country, but we do not know what patriotism is until we see in Russia examples of what I should call the patriotism of mankind. While in Russia I met some real patriots. There I met men and women who, for the benefit of their fellows, had spent three-quarters of their lives in prisons and chain-gangs. There I met the heads of the revolutionary groups who, for 50 years and more, had been risking their all for Russian freedom—Mme. Breshkovsky, Mr. Tchaikovsky (Shaykovsky), and Mr. Lazaroff. Think of Breshkovsky, the "Grandmother of the Revolution," 74 years old, a prisoner and an exile for 34 years, still working night and day, with might and main, for the benefit of her fellow Russians! This group surrounded Kerensky, who believed in working out the social problem by the Russian labor classes in conjunction with the property-owning classes. Then again, I saw the workings of another group, equally patriotic, who believed that ultimate freedom, and the possession of the land, could only be worked out by the workingmen and the peasants. I can easily see how Marie Spiridovna, now a leading figure in Russian life, believes that freedom is only to be realized by a government of workingmen alone. The Russian revolution, only a few months ago, released this young woman, now only in the thirties, from 15 years' solitary confinement in a Siberian prison.

I will say right here, that if at any time during my travels I was a witness of deeds of wanton destruction and violence, it was not in Russia. If at any time I was subjected to any discourtesy or incivility, it was not in Russia. If at any time I was in any danger, it was not in Russia.

Yet Russia is a good deal disorganized these days, and needs our help. There have been revolution and attempted revolution, one coming on the heels of another. There has been considerable civil strife in one section of the country or another, but the reports always appear much more dreadful than the facts really are. Russia is happy in her trials, because Russia has found something which her sons, and their fathers and grandfathers and great-grandfathers, have been striving for. Russia has found freedom. Russia is a democracy. It is a democracy which comes as near being representative of the soil as it would be possible to find anywhere. It has mud on its boots, hair on its face, and the love of freedom in its heart. Russia is a government of the workingmen and the soldiers, of the peasants and the mechanics. It is a democracy which is striving for

*A speech at the dinner of the Rocky Mountain Club, Jan. 23, 1918.

the uplift of the great masses. The one great desire of perhaps 94% of Russia's 180,000,000 people is to have peace; to have land which they can control and call their own; to have a part in the industrial life of the country, and feel that they own a part of it; to live lives of order, unrestrained by any Czar or dictator; to acquire education, and to improve their condition. This is the impulse which has stirred the Russian people long before and ever since they overthrew the Czar.

When I say that they want peace, I do not say that they want a separate peace. Democratic Russia, in my opinion, will never make a separate peace with autocratic Germany. The present government has not ordered the soldiers away from the trenches. On the contrary, it is filling the places of deserters with new soldiers recruited from the Red Guard. The Russian democracy wants peace, as we in America want peace, as they want peace in France and England and Italy. They want a peace with a democratic Germany and not with an autocratic Germany.

I have been deeply impressed with the effect of the new-found liberty upon the great masses of the Russian people. It did not turn them into a vengeful horde, bent on wholesale massacre and bloodshed, the newspaper reports in most part to the contrary notwithstanding. As a matter of fact, it did not change them very much, except that from a sad, brave, protesting people they became a glad, amiable but rather bewildered people. They attained liberty, and naturally it is taking some time for them to work out the system of government under which they will live. They are a kindly people, and as a nation they have very high ideals.

It was the Russian democracy which gave to the world the cry that there should be no annexations and no indemnities. That is a cry which should have been appreciated earlier in America, and should have resulted in the unswerving sympathy of America being extended to the Russian democracy. It was the democracy of Russia which injected into this war the cry "No secret treaties!" It was the democracy of Russia which gave to the world the principle of self-determination by small nationalities, which President Wilson has crystallized in his message, and which will form the basis for the freedom of the world. In the face of declarations like these from the Russian democracy, there has been a torrent of abuse from some of the Russian upper classes and from the American press, which, I am sorry to say, apparently does not comprehend some of the most important and fundamental elements of the Russian situation. Attempts have been made to stop all supplies going to Russia from the United States. Advice was given for all Allied representatives to withdraw. If this advice had been followed, it would have tended to put Russia into the arms of Germany. Do you realize what this would have meant? The German General Staff in time would dominate Russia, socially, commercially and politically. All Asia would be Germanized, and Germany would realize her ambitions on the Pacific similar to those which she entertained on the Atlantic. We are sending our youngest and our best blood to the trenches, and we owe them the best diplomatic advice and service that we can possibly obtain.

I urge strongly that we do not relax our efforts to help the Russians. We should not grow impatient because of their attempts to put into practice what we might regard as wild theories. We should always remember our own shortcomings whilst our government was in the making. Some of the things which we have introduced into our government and which have worked out satisfactorily would have been regarded as wild populism 30 years ago. The Russians are groping for light. The revolution and the experiments in government are the natural outbursts of untrained men organizing freedom on their own lines. Many of the laws of the old autocracy must be changed in Russia. They were made for the vested interests in which the common people had no part. In the legislative cataclysm many things will be attempted to be later discarded.

It must be remembered that prior to the revolution over 160,000,000 human beings were in a condition not much better than serfdom. Our negro slaves before the Civil War were better cared for, as most of them had good masters who lived on the soil. On the other hand, in Russia most of the masters lived away from the land, oftentimes at Berlin, Paris, and Monte Carlo. What I saw in Russia has impressed my mind with the necessity for cooperation between employer and employee. First, Russia had an Extreme Right under the Czar, exploiting labor as it was never exploited outside of the Congo. Then we had Kerensky, endeavoring to unite labor and capital in a government. Capital was arrogant, and did not want to let labor have a voice. Kerensky fell. Now the government is all labor.

Great forces are moving in every country. I would like to urge my friends to ponder seriously the problems which we shall have to meet at the conclusion of the war; indeed, perhaps before the war is ended. If we are wise, we will prepare for the time which should soon come, when genuine capital and genuine labor, if both are wise, will be sitting around the office table and in the halls of Congress, settling great questions at issue between them.

We must stop to consider whether we have not delegated the lawmaking power, so far as it relates to capital and labor, too much to paid attorneys. No one will accuse me of underrating the usefulness of lawyers. They can be used too much, however, and if there has grown up a system of legislation by proxy in this country, then it can and should be ended. With lawyers representing labor and capital in Congress and in our legislatures, both labor and capital get what might be termed "the absent treatment," and that is not a good thing for either.

Many of my friends who are in this room tonight were pioneers of the Far West when civilization was being carved out of the wilderness. They had no government except as they made it. We know that miners' law, sometimes reinforced by the Vigilance Committee, was good law. This law was made by the workingmen. Our problems then were partly those that Russia has today, only hers are a thousand-fold greater. The men in the Western country were the makers of their country, and it is a country of which the Rocky Mountain Club may well be proud. Those men would not have hesitated very long about extending recognition and giving the fullest help and sympathy to the workingmen's government of Russia, because in '49 and the years following

we had out there Bolshevik governments made out of the raw material, and mighty good governments too. What happened in Montana, Colorado, Wyoming, Idaho, and California is now in progress in Russia. Remember that a republic probably much greater than ours is in the making on the other side of the world, my friends, and it is such a republic as the German autocracy cannot have very long next door and survive. Democratic Russia means democratic Germany, and democratic Germany means peace, lasting and complete, for the world. That is why at this moment the example of Russian democracy finds expression in revolution in Austria-Hungary, and continuous agitation in Germany against the aims of the German General Staff.

Do not be alarmed as to the future of Russia. Some of my newspaper friends are taking frantic alarm that the Russian national debt may be repudiated. Well, it has not been repudiated yet, and I very much doubt whether the Russia that is emerging from this turmoil will ever repudiate any obligation, even though it may have been incurred in trying to hold the Czar on his throne. All we need is a great patience, and a great fairness, and a great sympathy. Russia will soon learn that capital and labor must go hand in hand. Russia's vast resources must be developed for the benefit of the Russian people. That will be realized by the Russians quite as rapidly as we are realizing that the employers of labor must cooperate with labor to bring about the best possible results.

The freedom of Russia was as inevitable as the natural laws governing the rotation of the earth. The uniting of all forces in Russia in a democratic social system is just as inevitable. They say, "The Russian Democracy is red!" Yes, full of good, red blood—but you will find it is not yellow!

Mark my words, if the present program of the Bolsheviks, the common people of Russia, is not successful in aiding the common people of Austria and Germany to break down their autocracies, the Russian soldiers will be fighting again.

Benedict Crowell Cuts Red Tape*

BY ALBERT WHITING FOX

There is one phase of present work at the War Department which is being distinctly felt by those on the inside, but which has not yet become known to the public. It is a new driving force which is supplying oil to the clogged mechanism of the system of operations or tearing out such parts of the works as are useless or entangled in needless red tape. It is directed and given punch by Benedict Crowell, Assistant Secretary of War, who was selected for the job because of a capacity for work and a record for getting results by common sense, straight from the shoulder methods.

You don't need to ask now who is Assistant Secretary of War or what kind of a man he is if you have business at the War Department. You are stopped perhaps in the Navy Department corridor by one of Franklin Roosevelt's assistants, who says, "Say, that man Crowell's a live wire; he's making the wheels go around."

This means that some particular business has come up to bring Army and Navy matters in contact, and Mr.

Crowell has been appealed to to straighten things. Red-tape methods in matters of this kind involve the writing of letters, their approval via various branches, where they are held up and initialed, even if not read. At the end of a week, or two weeks, or three, the matter is ready to be passed upon and the decision is reached. This is the accepted formal way. Hoping perhaps to speed up results, the matter is taken to Mr. Crowell by an official who wants to direct special attention to it and who asks what time he can have a few minutes to talk it over in the morning.

"What time can I have a few minutes to go over this in the morning?" is the question asked of the Assistant Secretary who has been interrupted in his work after hours.

"I'm tied up with board meetings until 1 o'clock to-morrow and then I have so and so to see and—"

"How about day after to-morrow?"

"I could squeeze the time in all right but, by the way, what's the matter with finishing it up now? Here's a chair. Sit down and let's get it done."

Five minutes later the matter is settled. The red-tape letters may have to go through their regular form



BENEDICT CROWELL

to keep to legal requirements, but the work involved will have been disposed of long before the endless chain of initialed letters finishes its tedious route.

Mr. Crowell is not only a driving force, but he impresses one at once of his calibre in this line. There is a faint suggestion of "Bob" Fitzsimmons—but built along normal lines—in the athletic makeup of the Assistant Secretary when in motion. Tall, clean-cut and with an ease and grace of action, Mr. Crowell gives an idea of being able to handle the gloves pretty well himself. Your guess would be that he could stand roughing it with the factory workers. As a matter of fact, Mr. Crowell has seen some pretty strenuous life and got his start because he was able to stand it.

Born in Cleveland in 1869, he started as a chemist with the Otis Steel Co., of Cleveland. He worked through their plant as testing engineer and was put in

*Condensed from an article in the "Sun," Jan. 20, 1918. Republished with permission of the "Sun."

charge of the night shift with openhearth furnaces to handle. It required a "he-man" for this job, but there was a better and more difficult one that loomed as a possible promotion. That was to be put in charge of the "day shift." When this fell to his lot, it seemed to him as if the ambition of a lifetime had been realized.

It was driving power in the real sense of the word that brought promotion. But the knack of getting results soon brought about another step upward and Mr. Crowell was given work at the mills which provided him a chance to work toward the top. It was not long before he was placed in charge of a mill. Next he was placed in charge of two mills. Then he opened offices as consulting engineer.

Mr. Crowell, now, in his capacity as Assistant Secretary of War, has virtually been given the munitions problem to handle. There is enough work attached to this to keep any one busy, but he supervises the regularly prescribed work of his office as well, and is a member of the War Council and is actively engaged in general reorganization work at the department.

Several of the new ideas put into effect recently originated with Mr. Crowell. They appear as departures by the War Department in the matter of increasing efficiency, but they are known to have started in the Assistant Secretary's office and then gone to Mr. Baker, who has approved and adopted them.

Certain features of the munitions business at the department were in a hopeless mess when Mr. Crowell took hold. The best example that can be given concerns "hand grenades." The Government wanted 30,000,000 hand grenades, and the question arose as to the speediest means of getting them. The first move was to take the matter up with the so-called "design branch." How about designs for grenades? Which should be adopted?

HOW RED TAPE RETARDED PRODUCTION

Under proper organization, it would only have been necessary to take down various designs held in readiness and choose. But the bureau of ordnance did not do business that way. In response to a request for designs, the answer came back that work would be begun in getting a design ready, a simple matter, say of six months. The design of a hand grenade includes metal parts, fuses, the primer or percussion element, the loading design, the assembling, etc.

There began the endless work along each of these particular branches. The question of how the grenade should be loaded had to be discussed and debated. There were divergent views. These were to be wrestled with and quarrelled over.

When finally the design in its various parts was ready the question came of really starting to work. The matter went to the War Industries Board and then to the purchase branch, which was to take up the question of letting contracts. There were to be contracts for every element, and faithful to red-tape methods there was to be secrecy as to which contractors got the work. It seemed as if particular effort was made to prevent cooperation.

But the real comedy—or tragedy—of red tape began when the purchase department got into action. Every individual letter had to go to the production department, the War Industries Board, the contract section, the legal department, the recording department,

etc. A record-breaking letter might come through the mill and be nicely initialed in three weeks.

Then the confusion connected with getting the specifications out to contractors began. The Government wanted a list of producers for certain needed parts and asked for it. "All right," came back the answer, "we'll see about having a list of producers drawn up." One might think it would have saved time had the list been ready in advance. But business was not done that way.

This gives an inkling of the kind of reforms which Mr. Crowell will institute, or has already instituted. "Short-cut" methods on vital matters will be the slogan from now on.

One munitions manufacturer told me a long story the other day of hopeless delay on a matter of prime importance. He thought the public should be advised of conditions, and he had copious figures and materials. The next day he called up and said to disregard all he had said. "It's all changed now," he added.

He had seen Crowell.

Gross Blundering*

It hardly needed a blow on the head to make the country believe that the Government at Washington was not the best of possible governments. But the startling order of the Federal Fuel Administrator is like a surgical operation to force that conviction into all brains. It uncovers a long series of Governmental blunders. The order dates from yesterday, but the mischief dates from months back. Men of experience in the coal trade gave repeated warnings to the Administration, we are informed, as long ago as last June and July, that there was danger of such a crisis as has been precipitated upon the country. But they were smilingly disregarded. The talk now is of the blizzard having deranged all plans. But the real blizzard struck the Administration last summer, and buried it under drifts of ignorance, complacency, and short-sightedness. Unusual cold weather is now offered as the excuse. But the official mind of Washington was frozen up first of all. Think of the bare facts! Ten million tons more anthracite were mined in 1917 than the year before. The 1917 production of bituminous coal was forty-two million tons above that of 1916. Of this vast amount, this adequate supply, we had an all-wise Fuel Administrator to regulate the distribution, but now he makes open and abject confession of flat failure.

To remedy his own long accumulating blunders, the Fuel Administrator has made one still huger. We do not mean that some form of restricting the consumption of fuel had not become necessary. But if the thing was to be done, it should have been done decently and in order. What we have had is hysteria piled on hugger-mugger. We have had action at once inexcusably precipitate and confused. There was no wide consultation with the interests involved—or threatened with deep and perhaps needless injury. Millions of protests are heard after the fact; before it, a mere trickle of advice was sought or had.

Into the official optimism at Washington the outcry from the country should penetrate and convey a double lesson. One part of it is that special competence must be sought for special tasks. Because the President

*From the "Evening Post" of Jan. 17, 1918

knows and likes and admires a given man, it does not necessarily follow that he is the man for a particular job. General ability and good will and industry cannot take the place of peculiar knowledge of the work to be done. That Mr. Garfield has made a mess of coal distribution one does not need to go beyond his own official utterances to show. All last October and November he was assuring the country that there would be coal enough for all. His infallible "priority" orders would make certain of that. He was headed straight for a breakdown and a smash, but did not know it. You can hardly say anything of an administrator worse than that. He may allege that the system under which he had to work was at fault, but this is the very point of the second lesson which the Government is being roughly taught. This is that state socialism is no panacea, and will not work automatically any better than any other theory or plan of government. To grasp all power and centralize all functions at Washington will be of no avail unless Washington is built to endure the strain. Immense fussiness, in place of reasoned activity; solutions without end on paper while the real problems are scarcely touched with the tips of the fingers; the appointment of countless agents and committees; consultations with no action resulting; the everlasting heaping up of words and advice and good wishes—this is not efficient government. It is the feeblest kind of doctrinairism. If this is the state socialism which is to bring millennial happiness after the war, hard-headed Americans will look twice at it before they desire another dose. They will not be so anxious to run with all their troubles to the Little Father at Washington when they see that his head easily gets into a whirl and often he is as one that beateth the air. Congestion of freight is bad; but congestion of intelligence is worse.

A tremendous loss hangs over the nation, but the nation is rich enough and great-hearted enough to submit to it if it be necessary as a war measure. The United States always has floundered out of its difficulties, and we believe that it will out of this one. But it will not and should not lightly forgive responsible officials who have ignorantly and blindly run our heads into a noose which foresight and resolution and energy could have enabled us to avoid.

Papers To Be Presented at Meeting of A. I. M. E. in New York

Many papers are to be presented at the New York meeting of the American Institute of Mining Engineers, which is to be in session from Feb. 18 to 21 inclusive. The list is as follows:

MINING

- Incline Top-Slicing Method, by W. G. Scott.
- Otis Passenger Elevator at Inspiration Shaft, by C. E. Arnold.
- Canvas Tubing for Mine Ventilation, by L. D. Frink.
- Branch Raise System at the Ruth Mine, Nevada, by Walter S. Larsh.
- Measures for Controlling Fires at the Copper Queen Mine, by Gerald Sherman.

MILLING

- Recent Tests of Ball-Mill Crushing, by Charles T. Van Winkle.
- Notes on Theory and Practice of Ball-Milling, Particularly Peripheral Discharge Mills, by Pierre R. Hines.

- A New Method of Separating Materials of Different Specific Gravities, by Thomas M. Chance.
- Some Practical Hints in Bucket-Elevator Operation, by A. M. Nicholus.

The United Eastern Mining and Milling Plant, by Otto Wartenweiler.

PETROLEUM AND GAS

- Extraction of Gasoline from Natural Gas, by F. P. Peterson.
- Age of the Oil in Southern Oklahoma Fields, by Sidney Powers.
- Methods of Valuing Oil Lands, by M. L. Requa.
- Water Surfaces in the Oil Fields, by M. R. Daly.
- Principles and Problems of Oil Prospecting in the Gulf Coast Country, by W. G. Matteson.
- The Possibilities of Oil and Gas Fields in the Cretaceous Beds of Alabama, by Dorsey Hager.
- Some New Methods for Estimating the Future Production of Oil Wells, by Carl H. Beal and J. O. Lewis.

GEOLOGY AND ORE DEPOSITS

- The Chilean Nitrate Industry, by Allen H. Rogers and Hugh R. Van Wagenen.
- Phosphate in Egypt, by E. Cortese.
- Pyrite and Pyrrhotite Resources of Ducktown, Tenn., by Joseph H. Taylor.
- Relation of Sphalerite to Other Sulphides in Ores, by L. P. Teas.
- Ore Deposits of the Yellow Pine Mining District, by Fred A. Hale, Jr.
- Genesis of the Sudbury Nickel-Copper Ores as Indicated by Recent Exploration, by Hugh M. Roberts.

ZINC

- Zinc Refining, by L. E. Wemple.
- The Wisconsin Zinc District, by H. C. George.
- Fine-Grinding and Porous-Briquetting of the Zinc Charge, by W. McA. Johnson.

STEEL

- The Erosion of Guns, by H. M. Howe.
- Transverse Fissures in Steel Rails, by J. E. Howard.
- The Effect of the Presence of a Small Amount of Copper in Medium-Carbon Steel, by Carle R. Hayward and Archibald B. Johnston.
- Temperature-Viscosity Relations in the Ternary System CaO-Al₂O₃-SiO₂, by A. L. Field and P. H. Royster.
- Slag Viscosity Tables for Blast-Furnace Work, by A. L. Field and P. H. Royster.
- Grain Size Inheritance in Iron and Carbon Steel, by Zay Jeffries.
- The Time Effect in Tempering Steel, by A. E. Bellis.
- Some Structures in Steel Fusion Welds, by S. W. Miller.

COAL

- Review of the Coal Situation of the World, by George S. Rice.
- The Briquetting of Anthracite Coal, by W. P. Frey.
- Drifton Breaker, by Effingham B. Humphrey.
- Heating of Coal in Piles, by C. M. Young.
- The Economy of Electricity Over Steam for Power Purposes in and About the Mines, by R. E. Hobart.
- Penshihu Coal and Iron Company, Ltd., South Manchuria, China, by C. F. Wang.

EMPLOYMENT PROBLEMS

- Industrial Accidents as a Labor Problem, by H. M. Wilson.
- Illness in Industry: Its Cost and Prevention, by Thomas Darlington.
- The Employment Manager and Labor Turn-Over Reduction, by Thomas T. Read.
- Training Workmen for Positions of Higher Responsibility, by F. C. Stanford.
- Social and Religious Organizations as Factors in the Labor Problem, by E. E. Bach.

MISCELLANEOUS

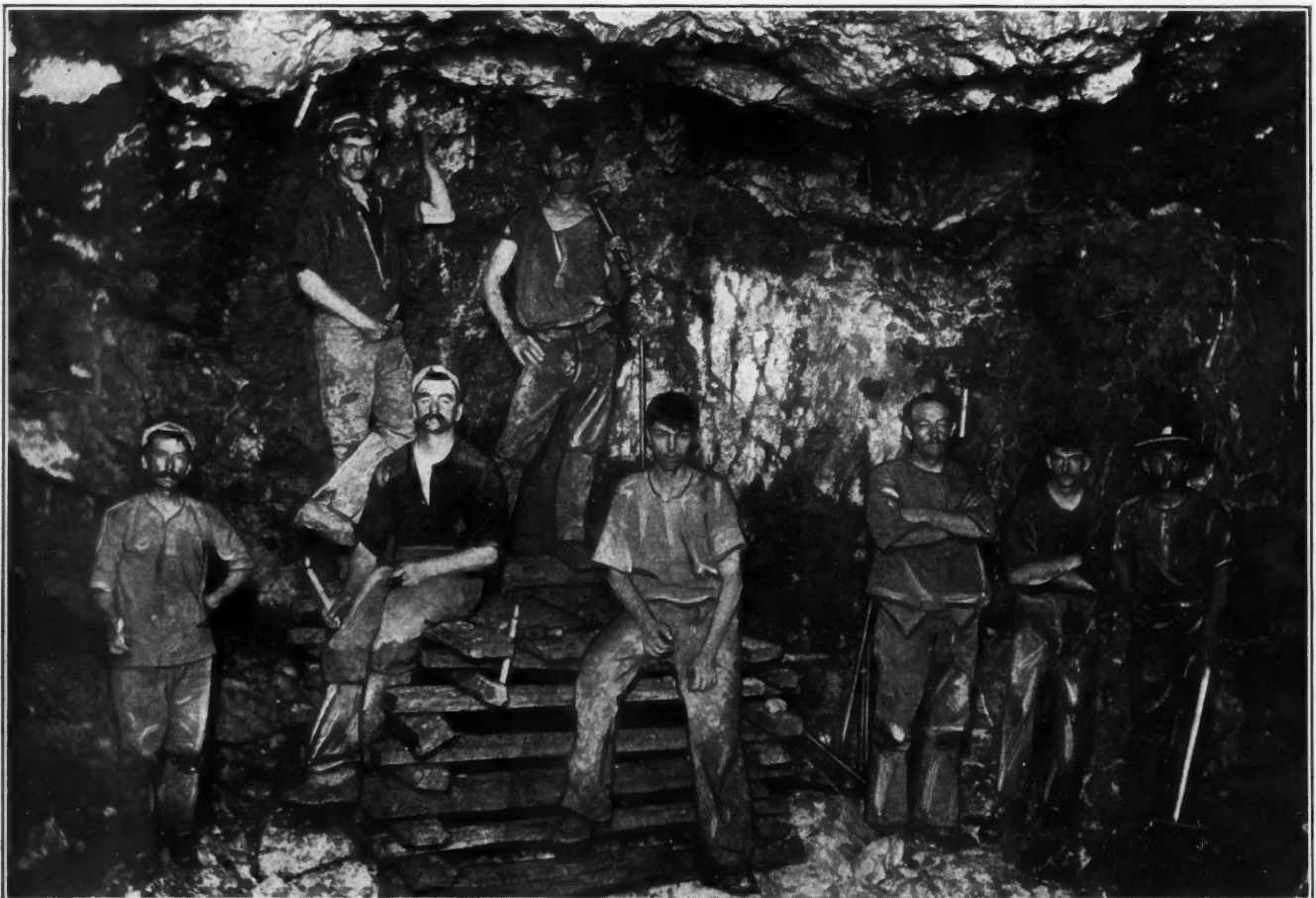
- Notes on the Disadvantages of Chrome Brick in Copper Reverberatory Furnaces, by F. R. Pyne.
- An Automatic Filter at Depue, by G. S. Brooks and L. G. Duncan.
- Bone-Ash Cupels, by F. P. Dewey.
- High-Temperature Resistance Furnaces with Ductile Molybdenum or Tungsten Resistors, by W. E. Ruder.

Additional papers are in the hands of the Institute's committee on publications and will be announced later.

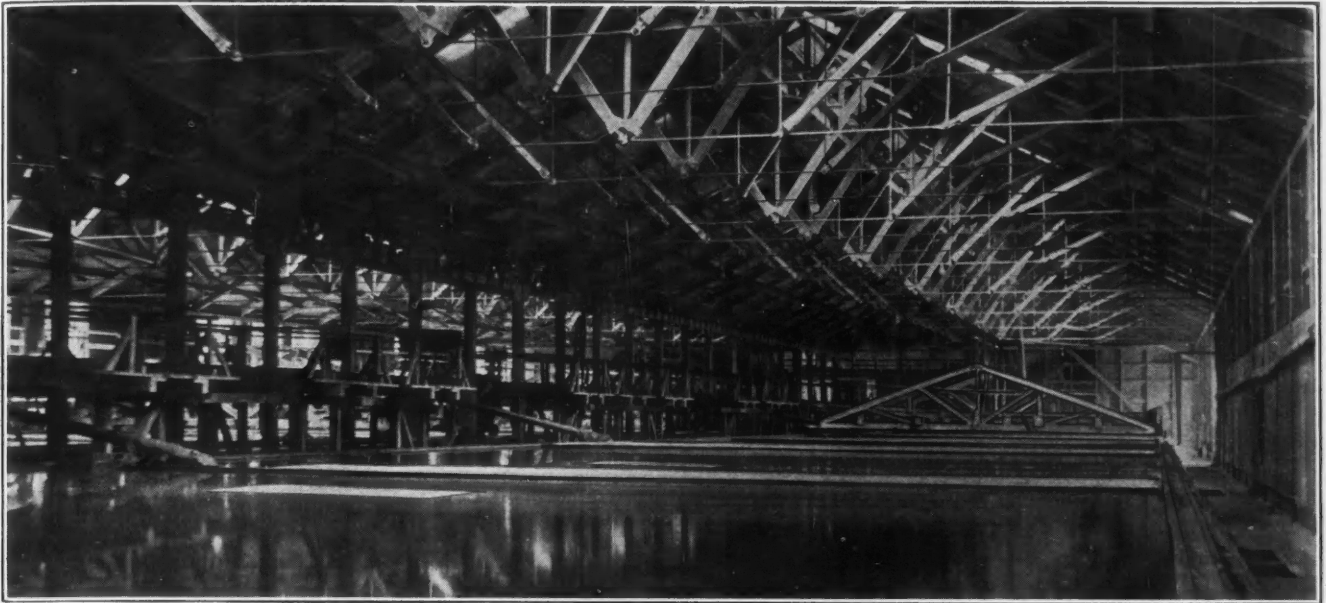
Waihi Gold Mine in New Zealand



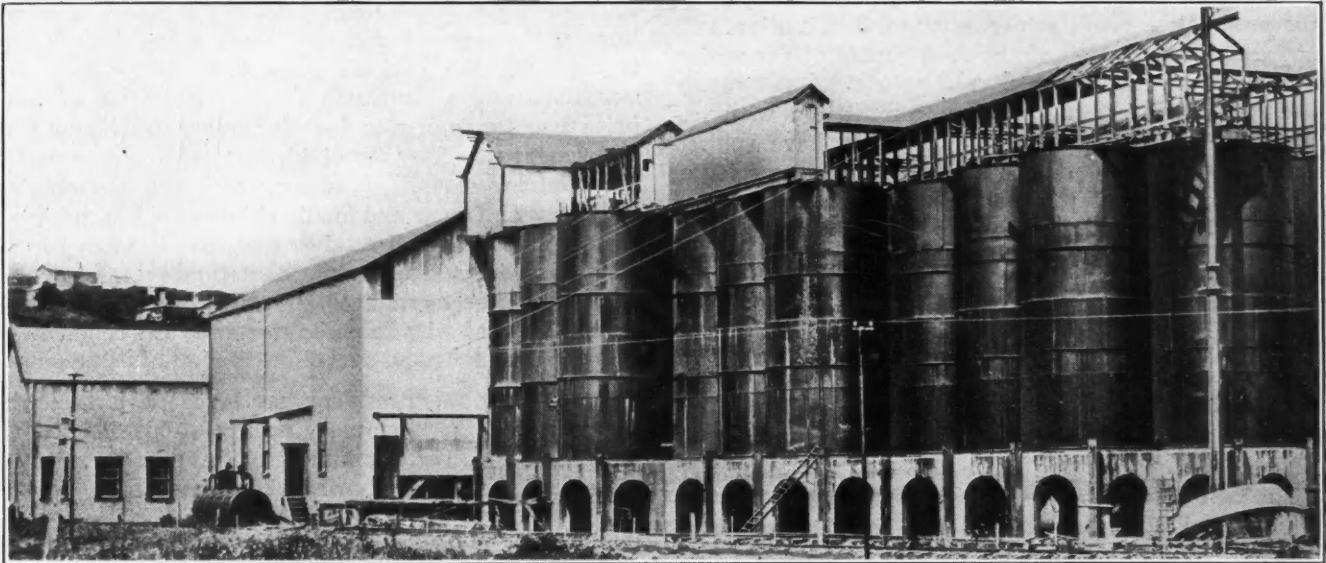
THE TOWN OF WAIHI, WHERE THE WAIHI GOLD MINING CO. HOLDS 518 ACRES OF MINING LAND



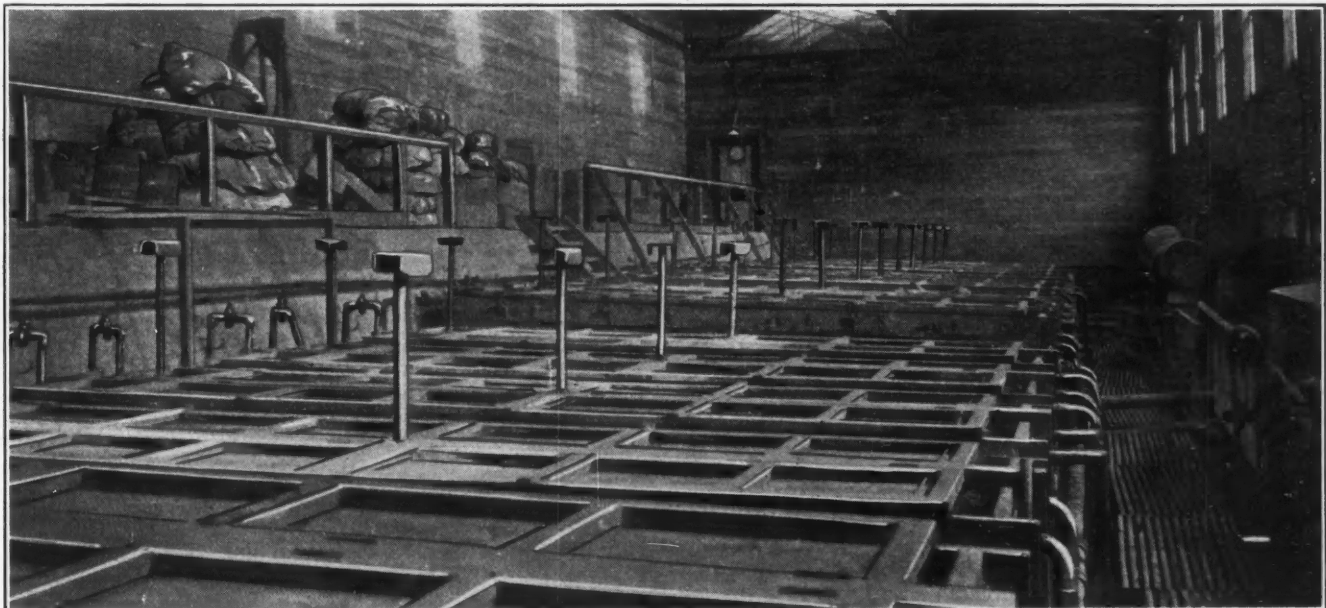
STOPE IN WAIHI MINE OF THE WAIHI GOLD MINING CO., WAIHI, NEW ZEALAND



LEACHING TANKS OF WAIHI GOLD MINING COMPANY



BROWN AGITATORS AT CYANIDE PLANT OF WAIHI GOLD MINING CO., NEW ZEALAND



ZINC BOXES IN EXTRACTION HOUSE OF THE WAIHI GOLD MINING CO.'S 200-STAMP MILL

What One Man Has Taken on Himself To Do*

HERE is a short catalogue of some of the major powers and responsibilities, never exercised or borne by any of his predecessors, which Mr. Wilson, as war President, has taken or proposes to take upon his shoulders; with a courage which seems dauntless, a patience that seems inexhaustible, and an apparently boundless confidence in his ability to bear the load:

I.

He has undertaken to be not only the executive administrator of the laws enacted by Congress with his approval, but also the fountainhead of legislative policy, the dictator of his political party's creed without restraint by precedent or previous platform deliverances, the inspirer and leader of public opinion for the whole country.

II.

Under the general war powers conferred by the National Security and Defense act of Aug. 10, 1917, he has undertaken to supersede in his own person the *Laissez Faire* of the old political economy with regard to the production, manufacture, storage, distribution, sale and even consumption of the food supply of the nation of a hundred million people. The natural laws of supply and demand, operating through competition with enlightened selfishness as the mainspring, have sufficed during 60 centuries or so of recorded human experience. In the days when it was the fashion to deride the idea of any arbitrary substitute for the established economic system, a favorite illustration was to picture the certain breakdown of Government paternalism in a Quixotic attempt to provide the single city of New York with the single article of milk for only one day. Yet that is what President Wilson, with calm confidence, is taking on himself to do for the entire food supply of the United States for an indefinite period.

III.

He has undertaken to regulate the production and distribution of foodstuffs not merely with reference to domestic consumption but beyond that to meet the food needs of foreign peoples, our Allies in the war or the objects of our national sympathy as sufferers by the acts of the common enemy. It need not be said that this is an amplification of executive function which no other American President ever dreamed of as possible.

IV.

He has taken on himself, through his Fuel Administrator, the enormous task of doing for the cook stoves and heating apparatuses and factory furnaces and lighting and power plants and locomotive and steamship boilers of the entire nation the same thing which he is attempting to do, through his Food Administrator, for the stomachs of our people. Not only the comfort, health and lives of the men, women and children of the country, but also the life of American industry in its myriad forms, is made to depend directly upon the wisdom, foresight, technical knowledge and personal integrity of the agents he chooses.

The President is responsible for it all; and while our patriotic people are resolving to obey and suffer, mistake or no mistake at headquarters, the suspicion is becoming widespread among them that there might have

been less suffering, less loss on the whole, if *Laissez Faire* and not Dr. Garfield had been on the job. Whether this impression is just or unjust to the Fuel Administration and to Mr. Wilson behind it, there has been no announcement yet from the Committee on Public Information that the President himself has wavered or staggered, or that a hair of his head or even an eyelash has whitened in consequence. The power is concentrated in him, both as to the American supply and as to that which can be spared for foreign needs. The next step with regard to fuel would make the President, for the period of the war, the miner of coal both hard and soft, the pumper of oil from the subterranean reservoirs, the dispenser of natural gas, the chopper down of forests for firewood. These further functions are implied in the law which concentrates in him the power of control by Federal license; in order to exercise them he has but to proclaim his intention so to do.

V.

To an extent which turns topsy-turvy all previous notions of the scope of executive power, President Wilson is becoming the nation's price fixer; price fixer for munitions and a multitude of the necessities of war; price fixer for fuel; rate fixer for transportation on land and water; rate fixer for dividends; price fixer even for the wretched pound of sugar which the housekeeper pursues with frenzy and finally obtains for less, perhaps, than it cost the small retailer who sells it when he can get it. The practical results of a further enlargement of this swiftly expanding executive responsibility can only be awaited with intense interest by the community.

VI.

Incidentally the President has taken on himself the regulation of the sumptuary affairs of his fellow citizens. Not directly, but indirectly through the exercise of the new powers concentrated in him, he has become the dictator of the people's pleasures, the censor of their luxuries, the overseer of their habits and manner of life.

VII.

He has taken on himself, with the general acquiescence of the representatives of the properties concerned, the management of the entire transportation system of the United States and the responsibility for the just and efficient use of a power such as has been possessed by no other man since Stephenson's "Rocket" first hit the rails. Through the Director-General of Railroads, his own appointee responsible solely to him, he has undertaken to carry on for the public benefit and for war purposes a business which in immensity and complexity and financial importance has no counterpart. He has undertaken to do in block, in the name of Government, that which has been done before this in detail by a body of the most highly specialized professional talent on earth. He can send all these skilled organizations a-marching and put his own men in charge. He can order any change in physical equipment. He can build up one system and relegate another to innocuous desuetude. He can alter schedules, lower or raise ticket money and freight tariff, make new combinations of service, put box cars where Pullmans have been running, depopulate suburban regions by his supreme authority over the

*From the New York "Sun," Jan. 19, 1918.

time table, shift real-estate values by ordering freight this way and passenger traffic that way, take the flesh off the commuters' bones, take the dollars off the stockholders' bank account; all this and much more is within the power now concentrated in President Wilson. That he will exercise it to the best of his judgment and with a single view to war efficiency and the public interest who may doubt? The power and the burden are with him all the same.

The President has already knocked railroad competition into the shape to which he once expressed a fervent desire to reduce Mr. Bryan. There can be no competition under this régime, except so far as it might be forced upon a recalcitrant or unfavored line by thrusting that line beyond the pale of Government operation and thus leaving it in dismal independence with a single competitor, namely, the Government of the United States!

VIII.

He has taken upon himself to do with and for American shipping just about the same thing as in the case of the railroads. He has also undertaken, under the compulsion of manifest necessity, to create a merchant marine with which to do that thing. He is already establishing in different quarters of the globe agencies to facilitate the operation, under Government control, of the new merchant marine now being or to be created under Government supervision. Thus the future of our flag on the seas rests with President Wilson.

IX.

He has undertaken, with the cordial assistance of a Congress uncommonly ready for any patriotic sacrifice in the way of self-effacement, both to arrange the method and the impact of Federal taxation and to prescribe the extent and distribution of the expenditure to be voted.

X.

He has taken upon himself, after conference with the Allies, to finance to a very considerable extent the military and naval operations of the governments abroad with which we are acting in concert. And the American people, with confidence in his judgment in the exercise of this novel function of concentrated power, are buying the bonds and paying the taxes for this purpose also.

XI.

In order to keep the way clear for the Government's necessary borrowings from the people, the President is getting ready to undertake the regulation of the issue of new securities by every private concern in the market for money; to say what proposed loans to corporations shall be permitted and what investments prohibited for the general good.

XII.

The very day upon which the Congress awoke to a half-dazed realization of what the powers it had already granted signified in the matter of coal alone, the President was reported as proposing to the Capitol further war legislation, one of the specified new grants being "Government control of *all* necessities and their production and price."

XIII.

In addition to all the enumerated undertakings and in addition to many more of almost equal or minor im-

portance, Mr. Wilson, without a symptom of faltering in the gigantic task, has taken on himself the duty of formulating the ethical principles and political considerations that should determine the hereafter of the international structure, for the protection of weak peoples abroad, the insurance of relief to the oppressed of every continent, the safeguarding of democracy throughout the world. He is concerning himself with the geography of the Balkans, with the fate of the African colonies, with the righting of old wrongs effected by conquest, with the rectification of European frontiers and the reorganization of European nationalities on the basis of racial affinity and the justice of voluntary choice. And so general is the recognition of the vast new powers now concentrated in his representative office that his words on these extraconstitutional subjects command most respectful attention wherever Civilization has ears to hear.

Such is the burden on one mortal's shoulders. We are not now examining the necessity of these successive steps in the concentration of power or criticising the President's way of employing the powers thus concentrated. We are not now attempting to measure them for any purpose except the exhibition in bulk of the tremendous total.

For assistance in the administration of Brobdingnag the President has gathered about him a group of personally devoted or politically subservient men, some of ability, some conspicuous for incapacity to the verge of grotesqueness, but all dominated by his will and more or less merged in his individuality. Never for a moment can there be doubts as to the exact location of the centre of concentrated power.

Nenana Coal Lands Almost Ready for Leasing

A tract of approximately 19,000 acres of coal land in the Nenana coal field of Alaska is soon to be offered for lease under the provisions of the Alaska coal-land leasing act of Oct. 20, 1914. Secretary Lane of the Interior Department announced on Jan. 19 that the work of surveying and dividing into leasing units the more accessible part of the Nenana field has been completed. The land to be offered has been divided into 23 blocks, from 160 to 1664 acres in size, and in such form as is believed to permit the most economical mining. Under the law, a lease cannot exceed 2560 acres and may include one or more contiguous blocks.

The 23 blocks, constituting the more accessible part of the field, lie in the valley of Lignite Creek, a tributary of the Nenana River. The coal is a fair grade of lignite, occurring in frequent beds, of thickness varying up to 30 to 35 ft. There are said to be at least 12 beds of workable thickness, of which probably six are 20 ft. thick. The strata are gently folded and are not cut by intrusives so far as known. The coal is not suitable for export, but will furnish much-needed fuel in parts of interior Alaska. It will probably be used on the Government railroad; also as domestic fuel and for power and thawing at mines in the Tanana Valley, and as fuel on Tanana River boats and possibly on some of the Yukon steamers.

Correspondence and Discussion

The Ferrochrome Situation

Considerable nervousness has of late manifested itself in many quarters of the country relative to the supply of chrome, and much concern is expressed as to the ability of those industries to which the metal is essential to secure a sufficient supply for the needs of America's fighting force on land and sea. This is not without reason. For war purposes it is not a luxury, but a necessity, and the importance of finding enough of the crude ore in the mountains of the United States to dispense with importation from foreign countries has become obvious, for various reasons. The general formula of a defensible national policy may here be applied; namely, that the money paid to foreign countries in return for imports is lost while money spent at home still remains a part of the country's total wealth. Moreover, that money sent abroad goes to build up or strengthen competing industries, while money expended among the people of the United States is a fortification against attacks, industrial or otherwise, from abroad.

But, what is of greater importance, more than 100,000 tons of chromite consumed annually in America's industries is not only imported but is ocean borne, which means that to supply the reduction works of the country with foreign ore no inconsiderable amount of shipping must be withdrawn from the Franco-American route where it is now so urgently needed to sustain the fighting forces of the Allies.

The uncertainty of the foreign market is an additional reason why a strenuous effort should be made to become self-supporting in this field of industry. At no time should the industries of America be placed in a position of dependence upon a possible enemy country for supply of anything, least of all for material needed for the nation's defense.

What can be done to stimulate the mining of chrome in America? History and experience during the last four years point out with unerring certainty the course that will attain the desired end. Surely no industry has shown itself so responsive to the seductive influence of higher prices as has that of chrome mining. Observe: In 1913 the price of chromite was \$11.19 and the output 255 tons; in 1914 the price was \$14.75 and the output 591 tons; in 1915 the price was \$14.85 and the output 3281 tons; in 1916 the price was approximately \$35 and the output rose to 47,035 tons; in 1917 the estimated price of \$40 has produced about 48,000 tons.

This mineral is widely distributed but it occurs in small erratic bodies. The largest single deposit known on the Pacific Coast yielded only 15,000 tons. The development of chromitic orebodies consists in removing them. As a rule the ore in sight is the ore on the dump. It cannot be mined without some capital, but prospects are usually not such as to incite the avarice of the heavy investor. But to small capital the industry

can be made attractive. What is needed is not only good prices, but certainty of the market. So far no chromite of consequence is touched unless it is on top of the ground, so to speak, and conveniently situated for transportation. The places where the indications of the existence of valuable orebodies are decidedly encouraging are numerous, but to justify a person in spending his money in prospecting a deposit or in building trams, trails, or trollies to get the ore to the railroad or the dock, there must be a reasonable certainty that the price will not fall below a fixed minimum until the enterprise has been afforded an opportunity to pay for itself. This observation may, of course, be applied to any business, but it is prompted here by a knowledge of the fact that the unwillingness of the buyer of this ore to quote prices for the future has been the main discouragement to any investment in chrome mining which did not promise immediate return. It is possible to ascertain approximately what silver, copper, iron, lead or tin will be worth next year, war or no war, but who can say what chrome ore will bring?

Surrounding the price of chrome there is an air of mystery which is almost uncanny. Seldom does the technical press refer to the price, but on the fourth of last August the *Journal* quoted business as being done in chrome ore at \$1 per unit f.o.b. California for ore containing minimum 46% chromium oxide. Later, however, I was advised by the accredited representative of an Eastern consumer that this quotation was a mistake; that he had considerable correspondence with the editor concerning this matter, and as a result the editor had omitted all quotations on chrome ore.

On Sept. 22, 1917, the *Journal* reported: "There appear to be wide ranges in the prices offered for chrome ore according to district and according to buyers; and contracts are closed at widely varying prices, according to the foregoing conditions and the knowledge or ignorance of sellers as to market conditions." The less elegantly expressed opinion of a prospector is in harmony with this view. "The price obtained," said he, "varies inversely with the size of the sucker." But this is not a condition conducive to the healthy growth.

In this connection there are two controlling factors to be borne in mind: The first is that the price of chrome ore means everything to the mining end of the industry, and the second is that this price has nothing to do with the cost of ferrochrome to the consumer.

Even if the price of ferrochrome were dependent upon the price of chrome ore, this would mean next to nothing to the ultimate consumer. Armor plate contains only 3½% chromium. A hundred dollars more or less per ton for this mineral would not affect perceptibly the price of armor plate. The total cost of the entire amount consumed by the nation is, in proportion to the general business, so small as scarcely to be observed, while the absence of this mineral might be almost destructive in its effect.

On the other hand, when it is remembered that prior to the war ferrochrome brought about \$200 per ton and chromite ore \$11.19, while at the present date the reduction works charge some \$400 per ton for the ferrochrome after a payment of only about \$50 per ton for the chromite, but little reflection is needed to arrive at the conclusion that the cost of the ore is in no way responsible for the cost of ferrochrome. Surely, no Sherlock Holmes is needed to discover the cause of the high price of one and the low price of the other.

But enough on that subject for the present. The question is: What must be done to make the United States self-supporting so far as chromite is concerned? A good, fixed minimum price for the ore is needed. That and nothing more—or less. Obviously either the chrome refiners must find some way of squaring their business with patriotism, and see that the producer of the crude ore gets a fair share of the price of the finished product, or else the reduction of the ore must be made a Governmental enterprise. W. P. LASS.

Juneau, Alaska, Dec. 24, 1917.

[The author is not correct in his comments and inferences respecting quotations for chrome ore last summer. Our quotation of \$1 per unit for 46% ore in our issue of Aug. 4 was correct. Transactions were made at that price. Somebody in California later telegraphed us that he had bought ore but had been unable to sell at the price quoted. We found a buyer for him, but he was unable to deliver the ore. We did not subsequently omit quotations of chrome ore on the strength of representations of the California representative of an Eastern consumer. There was considerable controversy about the market at this time and much conflicting information from several quarters—buying, selling and intermediate—which caused us to believe that quotations might be misleading unless they were summarized in the light of thorough knowledge of conditions, which we did not have.—Editor.]

Tube Milling in Rhodesia

I have read A. W. Allen's remarks in the *Journal* of Sept. 1, 1917, with much interest. The distinctive features of Komata liners, as compared with the El Oro and other types, is the small reduction made in the working area (cross-sectional) of the mill, their long life, and the ease with which worn parts can be replaced. The actual work performed by the two types is similar, although Mr. Allen's tests on a coarse feed are in favor of the El Oro type.

In Mr. Allen's article in the *Journal* of Mar. 17, 1917, he states that the Komata liners were run at the reduced speed¹ as advocated by the makers, and it may be here that some further light can be thrown on this particular test. I do not know just what speed was used, as Komata liner catalogs or bulletins are published in

¹Mr. Allen's statement on p. 453 of the "Journal" of Mar. 17, 1917, is: "A Komata lining was installed in one of the mills and the speed reduced to satisfy the requirements of this particular type. It was found, however, that the reduction in speed resulted in a serious diminution in duty. Further investigations showed that the grade of product being handled (about six holes per sq.in.) was too coarse to be effectively slimed in a mill of this type at the reduced speed. By returning to a speed based on

Davison's formula $s = \frac{200}{d}$, where d = diameter in inches and s = the r.p.m.) the Komata still showed a lower efficiency than other types.—Editor.]

several countries and the speed given in the early catalogs has, from time to time, been altered to suit the altered conditions of grinding. In 1906, when these liners were introduced, tube mills were used to grind fine material finer, and the feed seldom exceeded about 20 mesh, and was usually very wet, as the Dorr classifier had not come into use. It was found that for such a feed the Komata liner gave too much throw or splash at the normal speed for tube mills and that a reduced speed did better work. Later on, as it became more and more the custom to feed coarse material and to reduce the moisture by good classification, it was found advantageous to increase the speeds, and later bulletins gave a formula different from those first issued. It is easy to see that a coarse thick feed will stand more throw of the pebbles than fine thin material. If Mr. Allen used the speed given in an old catalog for grinding material of two to three mesh, which was probably well dewatered, I think the mills were running too slow.

It is difficult to get parallel tests in tube milling, as only a few plants have the opportunity for making these, but some figures relating to grinding coarse material may be of interest in this discussion. These figures are obtained from working conditions extending over several years. A very hard, dense, quartz ore was crushed by stamps through woven-wire screens having $4\frac{1}{2}$ holes per linear inch, the wire being 20 gage. Coming from the stamps, the pulp gave the following screen test: On 40 mesh 38.7%, on 60 mesh 12.0%, on 90 mesh 16.5%, on 200 mesh 14.8%, through 200 mesh 18%. One hundred tons of this feed per 24-hour day went to two tube mills, each 4 x 16 ft., run at a speed of approximately 28.5 r.p.m.; the power consumption was 25 hp. per mill; wear of liners 0.48 lb., and of pebbles 2.2 lb. based on the 100 tons of feed per day. The screen test of the classified product from the tube mill was: On 40 mesh nil, on 60 mesh 1%, on 90 mesh 22%, on 200 mesh 25.9%, through 200 mesh 51.1 per cent.

Tests were made with these mills to ascertain the maximum coarseness of feed permissible for good grinding efficiency, and it was found that the mills would handle four mesh, but that three mesh was too coarse. Experiments at another plant showed that three-mesh feed could safely be put into mills of 5-ft. diameter. The rounded coarse particles in the underflow from the classifiers which Mr. Allen calls attention to in his article not only occur with Komata liners but with silex liners also. I have made no observation in this connection with El Oro liners.

From my experience, one of the main factors in efficient tube-mill grinding is to pass a large tonnage of coarse, well dewatered feed through the mills, using a good system of classification to return the oversize. I have also found that roughly 0.75 ton per cu.ft. of mill volume per 24 hours can safely be fed to a mill, this of course including the returns. In other words, as much as 150 tons per 24 hours, including "returns," can be fed to a 4 x 16-ft. tube mill which has a volume of about 200 cu.ft. A small quantity of feed of fine sloppy pulp results in low mechanical efficiency and heavy wear of liners and pebbles. Sliming 200-mesh concentrates in a 4 ft. 8 in. x 18-ft. tube mill gave a consumption of pebbles of 15 lb. per ton of concentrates and a very heavy wear of liners. FREDERICK C. BROWN.

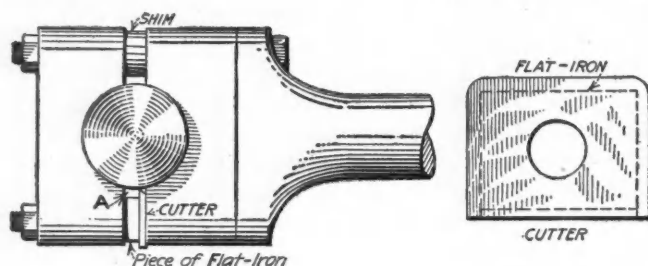
Silver City, Idaho, Sept. 24, 1917.

Details of Practical Mining

Truing Up a Crankpin by Hand

BY CHARLES LABBE*

The crankshaft of a semi-high speed compressor knocked considerably when carrying a full load, and the connecting-rod brasses became hot when they were tightened. The compressor had been in service for some time and when the brasses were taken off and the crank was calipered it was found to be out of true and flattened by wear. A piece of steel, cut from an old wood saw, was ground to the exact shape of the crank journal, sharpened, tempered and inserted in place of the shims



METHOD OF TRUING CRANKPIN WITHOUT A LATHE

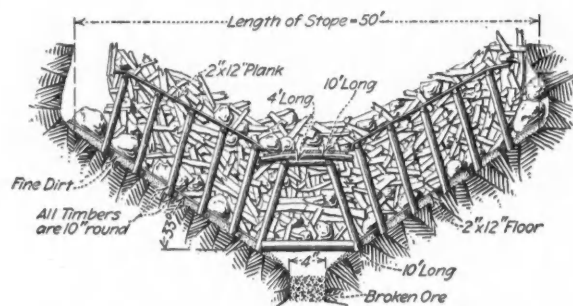
on one side of the brasses, with a piece of flat iron taking up the remaining space of the shim on that side, as shown in the sketch. A space was left at A for shavings, an excess of lard oil was supplied to the crankpin and the flywheel turned two full revolutions by hand. The shavings were then removed from the space A by compressed air, the cutter was driven in about two- or three-thousandths of an inch and the operation was repeated until the crankpin was trued up. Then the brasses were taken off, cleaned scrupulously of shavings and the crank journal was polished with fine emery cloth. The brasses were then scraped to fit, and when reassembled the crankshaft trouble was over. The entire job took four hours and did away with the necessity of sending the parts to an outside machine shop, as no lathe of sufficient size was provided at the plant.

Details of Timbering in Stopping by the Incline Top-Slice Method

Details of the method of catching up the timber mat over the shrinkage and slicing portions of the inclined top-slicing system of stopes as described by W. G. Scott in a paper to be presented at the February meeting of the American Institute of Mining Engineers are shown in the illustration. The "Coronado Incline Top-Slicing Method" was described in the *Journal*, Apr. 7, 1917. After a slice has been completed, the posts blasted out and the overlying mat settled to the planked floor, a new slice is started at the shrinkage portion of the stope 11 ft. below. The 4-ft. wide shrinkage stope is first

*Mechanical engineer, Johnnie, Nevada.

drawn down about 12 ft. below the mat. At this section of the slice the mat is prevented from settling with the broken ore by a series of 10-in. round stulls 10 ft. long previously set at 12-in. intervals across the opening to act as a grizzly, and constitutes a bulkhead for the mat at each slice. When the broken ore has been drawn down sufficiently, the open part of the shrinkage stope is widened out to 10 ft. and a new grizzly similarly laid. This work is started at one end of the stope and the overlying mat is caught up by battered sets progressively for the length of the next slice. These sets consist of 10-in. round stulls. The posts are 10 ft. long and have a 10-ft. spread at the bottom resting in hiches or footboards. The caps are also 10-in. round stulls 10 ft. long and are placed under the overlying grizzly and mat lengthwise to the shrinkage stope; that is, across the grizzly stulls. The two posts are battered at 17° to the vertical and catch up the double row of caps which are held apart at each set by a 4-ft. 10-in.-round spreader. From this timbered opening the incline slices are started in each direction at 33° to the horizontal. Flooring consists of 2 x 12-in. plank 12 ft. long and is spiked to 10-in. round sills 10 ft. long set about 5 ft. apart parallel to the shrinkage stope. These sills become the caps of the next slice below. The upper ends of the posts are roughly indented with an ax to conform to the roundness of the caps, the large



TIMBERING DETAILS OF INCLINED TOP SLICES

end of each post being used for this purpose on account of its greater bearing surface.

The flooring in the incline portions of the slice rests across the sills at right angles to the shrinkage stope, but over the grizzly the planks are laid lengthwise, or, across the grizzly stulls. As the slice advances, the caps being already in place gives an opportunity for catching up an exposed sill with a stull before it is entirely undermined, thus avoiding having to expose a large section of mat at one time, as would be the case if it were necessary to blast out enough ground to accommodate a full set at once. The practice is, whenever the end of a cap is exposed enough for a post, stand it up. This keeps it in place until the other end is exposed enough for a post, and so on until the panel is completed. Broken mats are rare, and if the proper care has been

taken in timbering over the shrinkage portion little trouble will be experienced. The ore rolls down to the shrinkage portion from the force of the blast at the face and but little has to be coaxied by shoveling. When this is necessary a shovel bent over in the shape of a hoe is used.

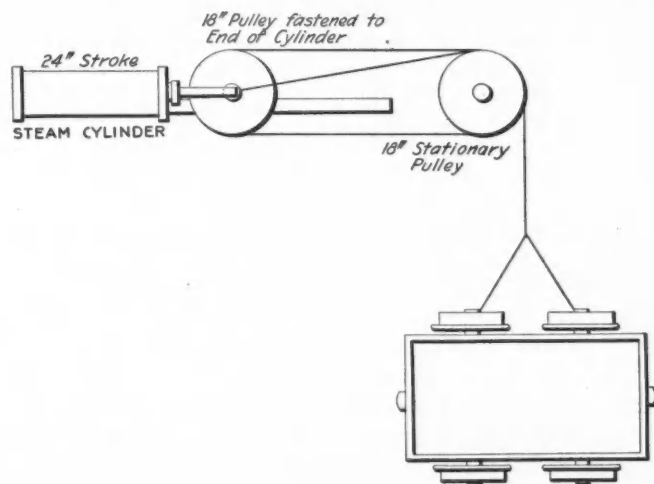
Crowning a Large Pulley

A method used in crowning a job lot of split wood pulleys in a country shop, where the largest lathe was 16-in. swing, and the pulleys in question were about 30 in. in diameter, is described by W. W. Rickard in *American Machinist*.

"I chucked a piece of pipe in the lathe a little longer than the bed, put the steadyrest as near the tail end of the lathe as possible, clamped the pulley on the end of the pipe, built a rest out of 2 x 4 scantling, made a turning tool out of an old file, and I was ready for the job, which was done satisfactorily and in good time. This is probably not a new stunt to most old-timers."

Car Lifter for Mine Car Shop

In the car shop of one of the large anthracite coal mines near Wilkes-Barre, Penn., is a car lifter, or turner, that can be made in any mine blacksmith shop. This car lifter, according to *Coal Age*, Dec. 15, 1917, is made from an old steam cylinder 10 in. in diameter, having a stroke of 24 in. To the end of the piston rod is connected a double-groove sheave 18 in. in diameter. This sheave moves forward and backward with the stroke of the piston. About 4 ft. in front of the sheave is another double-groove sheave of the same diameter, with



HOW THE CAR IS LIFTED

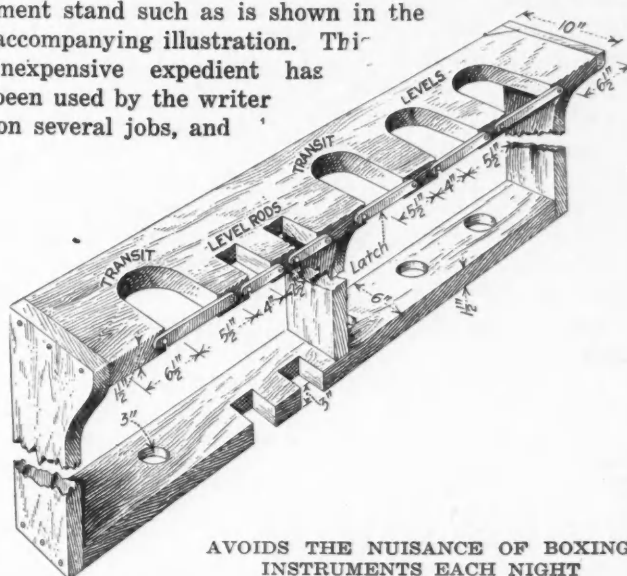
stationary bearings. A 1/2-in. wire rope passes around both the sheaves, being made fast to the rear one. The car lifter is placed on a platform built about 10 ft. above the floor. To the loose end of the rope is attached a chain that can be hooked to the axles or the wheels of one side of a car.

There are two steam pipes from the main steam line, one to each inlet valve of the cylinder. In each of these steam pipes is a throttle valve. This is so arranged that when it opens the exhaust outlet on the opposite end of the cylinder is automatically opened. Valves are placed about 5 ft. above the floor. To turn

the car over on its side it is only necessary to hook the chain to the wheels or the axles and open the proper throttle valve. This forces the piston to the rear of the steam cylinder, lengthening the distance between the sheave wheels and thus raising the car. To lower the car the operation is reversed.

Stand Eliminates Necessity of Boxing Instruments Every Night*

All the trouble and waste of time in removing surveying instruments from their tripods and placing them in their boxes at the end of the day's work can be avoided if an office is provided with an instrument stand such as is shown in the accompanying illustration. This inexpensive expedient has been used by the writer on several jobs, and



AVOIDS THE NUISANCE OF BOXING INSTRUMENTS EACH NIGHT

has been found satisfactory in every case. The construction is very simple. Slots cut into a 1 1/2 x 10-in. plank provide recesses into which the tripods and levels may be set. The tripods are then held in the slots by metal latches hinged at one side and fitting over a nail at the other. The feet of tripods and the lower ends of level rods fit into holes cut in another plank set lower.

Making Drawings on Tracing Paper

Preliminary pencil drawings or shop sketches that must be hurriedly produced for immediate use are often made on tracing paper, but this reproduces poor blueprints, on account of its opaque nature. The use of a sheet of black carbon paper, with the impression side next to the tracing paper, while the drawing is being made, will darken the lines on the under side so that a clear print will result. In making the drawing, a harder pencil than that ordinarily used will assure heavy lines from the impression paper. Care must be taken, however, that the carbon lines on the back of the drawing are not blurred by rough or careless handling during blueprinting.

A 20% Solution of calcium chloride in water jackets of automobile gasoline engines is effective and much less expensive than alcohol and other liquids used to prevent freezing, at any temperature higher than -9° F. (-23° Centigrade).

*By George W. McAlpin in "Engineering News-Record," Nov. 22, 1917.

The Assayer and Chemist

Chemical Glassware Compared

The U. S. Bureau of Standards has compared five brands of American-made chemical glassware with the two best-known European brands. The mode of procedure in making the tests and the results obtained are described by P. H. Walker and F. W. Smither in *Journ. Ind. and Eng. Chem.*, Dec. 1917, in a paper published with the permission of the bureau.

The tests included chemical analysis, determination of coefficient of expansion, refractive index, condition of strain, resistance to repeated evaporation, to heat and to mechanical shock, and resistance to chemical reagents. In all cases beakers and flasks approximating in size the 400-c.c. Jena beaker and flask were used. All the ware tested bore permanent trade-marks. From 45 to 50 beakers and flasks of each ware were secured for this series of tests.

Table I gives the composition of the different wares tested.

TABLE I. ANALYSES OF CHEMICAL GLASSWARE

	Kavalier Beaker	M. E. G. Co. Beaker	Pyrex Beaker	Jena Beaker	Jena Flask	Nonsol Beaker	Fry Beaker	Libbey Beaker
Al ₂ O ₃	0.14	1.0	2.0	4.2	4.2	2.5	2.7	2.1
Fe ₂ O ₃	0.08	0.35	0.25	0.25	0.27	0.23	0.22	0.44
ZnO.....		5.6		10.9	10.9	7.8	3.6	
PbO.....								1.0
MnO.....	0.02	0.02	0.01	0.01	0.01	0.01	0.03	0.03
CaO.....	8.7	0.66	0.29	0.63	0.56	0.79	2.6	0.42
MgO.....	0.17	4.3	0.06	0.21	0.25	3.4	2.6	0.08
Na ₂ O.....	7.1	10.8	4.4	7.5	7.8	10.9	9.8	8.2
K ₂ O.....	7.9	0.30	0.20	0.37	0.31	0.30	1.5	0.67
SiO ₂	75.9	73.0	80.5	64.7	64.7	67.3	68.6	75.9
B ₂ O ₃		3.6	11.8	10.9	10.6	6.2	8.1	10.8
P ₂ O ₅	0.08							
SO ₂	0.20	0.02						
As ₂ O ₃	Trace	0.02	0.70	0.14	0.19	Trace	0.18	0.36
Sb ₂ O ₃		0.60				0.62		
Totals.....	100.29	100.27	100.21	99.81	99.79	100.05	99.93	100.00

Selenium and fluorine were not found, but lithium was detected spectroscopically by Paul W. Merrill in all the samples.

The evaporation test, which was made only on beakers, consisted in repeated evaporation to dryness of sodium-chloride solution with examination for cracks after each evaporation. None of the wares developed cracks after 12 evaporations. One of the heat-shock tests consisted in filling the beakers with cold water, which was then rapidly heated to boiling. Other tests included the plunging into ice water of vessels containing boiling water, paraffin at 150° C., and paraffin at 200° C., and the dropping of beakers bottom down upon a thick board from heights increased by intervals of five inches.

The solubility tests were made by determining the loss in weight of pieces of the wares upon treatment with water and various solutions commonly used in the laboratory. With water on beakers the action was continued about 72 hr., the water being heated about 24 hr.; on flasks, the action was continued about 17 hr., keeping the water boiling during five hours; with mineral acids, solutions containing sodium chloride and sodium nitrate were mixed with a large excess of sulphuric acid, boiled and heated for an hour after fumes of SO₂ appeared. With sodium and potassium carbonates and hydroxides and sodium phosphate, half-normal solutions were boiled for 20 min. in the vessels, and in the case of

beakers fresh half-normal solutions were subsequently evaporated in the same beakers. With ammonia, strong ammonia was allowed to stand 24 hr. in the vessel, then diluted and boiled for 30 min. With ammonium sulphide and chloride, mixtures of twice normal salts were allowed to stand in the vessels 24 hr., then boiled for 30 minutes.

Table II gives a general summary of the resistance to the various solutions and to mechanical and heat shock of the wares tested. In this table the italic letters indicate the minor differences in resistance, letter *a* being the most resistant and *d* the least so. The absence of such a letter indicates that the differences in resistances are too small to justify any differentiation between the wares graded in the same group.

TABLE II. GENERAL SUMMARY OF TESTS

Ware	Resistance to						
	Water	Mineral Acids	Car- bonated Alkalies	Caustic Alkalies	NH ₄ OH and NH ₃ Salts	Heat Shock	Mechanical Shock
Kavalier M. E. G.	Poor	Good	Poor	Good (b)	Good (b)	Poor	Poor
Co.....	Good (c)	Good	Good (a)	Good (a)	Good	Poor	Poor
Pyrex.....	Good (b)	Good	Good (c)	Fair	Good	Good (a)	Good (c)
Jena.....	Good (d)	Good	Good (b)	Fair	Good	Good (c)	Fair
Nonsol.....	Good (c)	Good	Good (a)	Fair	Good	Good (b)	Fair
Fry.....	Good (d)	Good	Good (b)	Fair	Good	Poor	Good
Libbey.....	Good (a)	Good	Good (c)	Fair	Good	Good (b)	Good

(c) Far superior to any of the other wares.

In the rating of resistance to caustic alkalies the boiling tests only have been considered. These results indicate that all the American-made wares tested are superior to Kavalier and equal or superior to Jena ware for general chemical laboratory use.

Determination of Manganese and Chromium

In the estimation of manganese as permanganate by oxidation with ammonium persulphate in presence of silver nitrate, the solution should not be boiled after addition of the reagents, according to Travers in *Comptes rend.* (abstr., *Journ. Soc. Chem. Ind.*), otherwise low results will be obtained, possibly by the reduction of permanganate by hydrogen peroxide formed from the persulphate. The permanganate is titrated with sodium arsenite solution, the latter being added to the former, except when small volumes are used, as is the case in back titrations.

Details of analysis are as follows: 0.2 gram of carbon steel is dissolved in 20 cc. of nitric acid (sp.gr. 1.1) and 30 cc. of cold water is added so as to bring the temperature to 40°—50° C.; 5 cc. of N/10 silver nitrate and 1 to 1.5 cc. of saturated solution of ammonium persulphate are added and the mixture is shaken. Three minutes after the appearance of the violet color, the mixture is poured into 100 c.c. of cold water and titrated at once with sodium arsenite until the color is discharged. If the Mn content is greater than 0.5% a greenish-yellow color is produced. The arsenite solution should contain 0.650 gram of As₂O₃ per liter, when

1 cc. = 0.0002 gram Mn or 0.1% Mn on the sample. Titrating at a temperature below 30° C., no appreciable re-oxidation of manganese occurs.

With suitable modifications the method can be applied to chrome, tungsten, vanadium, and molybdenum steels, also to cast iron, iron and manganese ores, slags, brasses, and bronzes. In chrome steels, the chromium can be determined by titration, with the same sodium arsenite solution, of the sample dissolved in nitric acid of sufficient concentration (20 cc. of nitric acid of 36° B. per 100 cc. of solution). Unlike ferrous solutions and titanous chloride, sodium arsenite is stable and does not reduce vanadium, which often accompanies chromium in steels.

Recovery of Ammonium Molybdate in Phosphoric-Acid Analysis

The recovery of ammonium molybdate from the filtrates obtained in the estimation of phosphoric acid is described as follows by H. Kinder in *Stahl und Eisen*, 1916 (translated, *Journ. Soc. Chem. Ind.*):

The molybdic acid is precipitated by adding sodium phosphate to the solution and the yellow precipitate is washed by decantation with 0.1% sodium-sulphate solution until free from soluble phosphate and iron salts. The precipitate is then dried; each 325 grams is dissolved in 1100 c.c. of ammonia (sp.gr. 0.96), and the solution is treated with a mixture of 30 grams of magnesium chloride and 30 grams of ammonium chloride dissolved in water to make 100 c.c., the precipitate is separated by filtration, and each 420 c.c. of filtrate is mixed with 1200 c.c. of nitric acid (sp.gr. 1.2). The blue molybdic-acid residues obtained in the gravimetric estimation of phosphoric acid may be treated in a similar way, after being dissolved in ammonia and acidified with nitric acid.

Detection of Germanium

Germanium has recently been shown to exist in certain Wisconsin and Missouri blends, and to be greatly concentrated in their distillation residues. This has led to renewed interest in this metal, and to the publication of the following method for its detection by the *Journal of Industrial and Engineering Chemistry*, July, 1917. The essential details of the method are due to A. A. Noyes.

Weigh a 100-gram sample of the oxide of zinc into a liter distilling flask connected with a water-cooled condenser, and add 200 cc. concentrated hydrochloric acid. Pass chlorine into the mixture until the gas appears in the receiver of the condenser, and then heat the mixture to boiling and distill to about half volume, continuing the passage of a slow current of chlorine. Dilute the distillate with an equal volume of water and pass hydrogen sulphide into it for at least 30 min. If no precipitate is formed (other than the usual opalescence due to sulphur) germanium is absent. If a precipitate is formed, filter it off on a small paper and wash it with a little cold water.

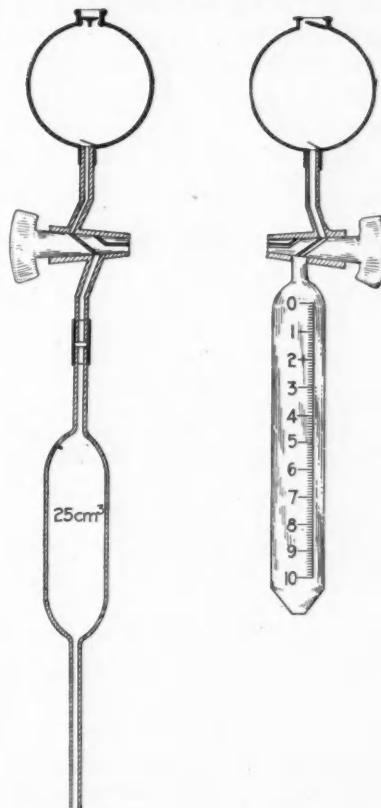
Place the paper containing the precipitate in a flask with about 150 cc. water, boil for 15 min., and filter. To the filtrate add 50 cc. concentrated hydrochloric acid, cool and treat with hydrogen sulphide as before. A

white, flocculent precipitate indicates the possible presence of germanium. Filter on a small paper and wash once with a little cold water. Pour ammonia through the filter, receiving the solution and washings in a platinum dish. Evaporate to dryness. Moisten the residue with concentrated nitric acid and evaporate to dryness again. When dry, ignite for a few minutes.

To the residue add a little water and a few drops of hydrofluoric acid, saturate with solid potassium chloride and allow to stand in the cold for 15 min. If germanium is present, a grayish, gelatinous precipitate is formed, soluble on heating or diluting the solution. The presence of germanium is not reported unless this last confirmation test is obtained.

New Form of Safety Pipette

A way to avoid drawing poisonous or unpleasant solutions into the mouth when using the pipette is described by A. S. Behrman (*Journ. Ind. Eng. Chem.*, November, 1917) as follows: A three-way cock is interposed, as shown in Fig. 1, between a stiff atomizer bulb and an ordinary pipette, junction being made by means of rub-



TWO FORMS OF SAFETY PIPETTES

ber tubing. To operate, the cock is turned so as to connect the pipette with the bulb. The pipette is then filled a little above the mark by pressing and releasing the bulb one or more times, the bulb valves acting to prevent back flow of the liquid. With a stiff bulb, pipettes of even 25 to 50 cc. capacity can usually be filled with one compression and release of the bulb. The stopcock is then turned so as to admit the outside air to the bulb, by which means the liquid may be let down to the mark and subsequently delivered. Fig. 2 shows the three-way cock made integral with a graduated pipette of Mohr's type.

Report of the Granby Consolidated

The annual report of the Granby Consolidated Mining, Smelting and Power Co. for the fiscal year ended June 30, 1917, shows a net profit of \$4,196,529.41 after deducting \$1,580,346.34 for amortization and depreciation. Four 9% dividends were declared, amounting to \$1,349,961.80, and the undivided profits of the year bring the total surplus credit to \$9,434,038.22. During the period a total of 1,558,345 tons from company and

TABLE I. PRODUCTION STATEMENT OF GRANBY CONSOLIDATED

Mine	Ore, Dry Tons Smelted	Lb. Copper Recovered Per Ton Ore	Metals Produced		
			Copper, Lb.	Silver, Oz.	Gold, Oz.
Hidden Creek.....	760,791	33.62	25,580,630	269,231	4,320
Phoenix.....	673,742	13.52	9,108,762	119,212	18,409
Mamie.....	21,697	22.20	481,693	3,058	306
Midas.....	20,556	72.80	1,496,491	8,177	1,214
It.....	14,018	71.96	1,008,792	6,624	874
Total Consolidated					
Ores.....	1,490,804		37,676,368	406,302	25,123
Purchased ores.....	67,541		4,202,200	193,047	4,698
Total production....	1,558,345		41,878,568	599,349	29,821

custom ores was treated, and produced 41,878,568 lb. of copper, 599,349 oz. of silver, and 29,821 oz. of gold, and the average prices received at New York were 27.4c. per lb. for copper and 71c. per oz. for silver.

At the company's Phoenix smeltery 761,590 tons of ore and furnace products were smelted and refined at

TABLE II. ESTIMATED ORE RESERVES

Mine	High Grade			Low Grade		
	Tonnage	Per Cent. Copper	Per Cent. Silver	Tonnage	Per Cent. Copper	Per Cent. Silver
Phoenix.....	3,274,996	1.00	\$0.75	300,000	0.65	\$0.60
Hidden Creek.....	9,882,183	2.31	.30	8,257,500	0.64	.15
Bonanza.....	414,775	2.66	.30	22,066,030	0.70	.15
Mamie.....	93,080	1.39	.35	2,550,392	0.81	.20
It.....	7,500	3.3	1.36	495,000		
Midas.....	44,487	4.0	1.53	3,558,960		
Totals.....	13,717,021			550,727,156		
				9,476,560		
						123,461,860
				Tonnage		Lb. Copper
Total high and low grade.....				23,193,581		674,189,016

a cost of \$1.661 per ton. This department produced 17,549,453 lb. of copper at an average cost of 20.8c. per lb., New York. The ore shipped from the company's Phoenix mines amounted to 677,292 tons, yielding a recovery of 13.52 lb. of copper, 0.177 oz. of silver and 0.027 oz. of gold at a mining and development cost placed on board

TABLE III. TOTAL COSTS AT ANYOX, B. C.

	1914	1915	1916	1917
Mining.....	1.7952	1.062	1.001	1.235
Ore haulage.....	0.0798	0.049	0.053	0.057
Smelting and converting.....	2.4684	1.877	1.804	2.155
General.....	0.0341	0.250	0.275	0.356
Marketing.....	0.5200	0.532	0.515	0.572
Totals.....	4.8985	3.770	3.648	4.375

the cars of \$1.75 per ton. Underground development work amounted to 8900 ft., of an average cost of \$12.20 per ft., or 16c. per ton shipped. During the year 6502 ft. of diamond drill hole was made.

The production from the company's various mines at Hidden Creek and Phoenix, B. C., and the Mamie, Midas, and It, Alaska, is shown in Table I

Total mining and development costs at Hidden Creek were \$1.23; at the Mamie, \$3.73; at the Midas, \$5.77, and at the It, \$5.54 per ton. Smelting and converting at Anyox cost \$2.155 per ton of ore treated, and produced copper at a cost of \$0.115 per lb. delivered in New York. Ore reserves developed during the year, less the tonnage extracted during the same period, are shown in Table II. A comparison of the total cost at Anyox, B. C., for last four years is shown in Table III.

Kerr Lake Annual Report

The annual report of the Kerr Lake Mining Co., Cobalt district, Ontario, Can., for the year ended Aug. 31, 1917, shows a production of 2,551,346 oz. of silver at a cost per ounce as follows: Mining and development, 11.65c.; shipment and treatment charges, 14.52c.; administration and general, 0.58c.; total, 26.75c. This production was derived from the shipment of 740 tons of sacked ore, yielding 1,729,889 oz. of silver and 89,454 lbs. of cobalt, and 27,201 tons of mill ore, yielding 821,-

KERR LAKE OPERATING COSTS (Figures Based on 55,376 Hoisted Tons)

Production and Development:	Cost per Ton
Stoping.....	\$0.40
Development.....	.72
Power, light and heat.....	.38
Ore sorting and jigging.....	.24
Tramming.....	.47
Hoisting.....	.09
Timbering.....	.37
Pumping.....	.05
Drills and steel.....	.17
Mine expense.....	.20
Repairs to plant and buildings.....	.06
Stable expense.....	.07
Office expense.....	.10
Surface maintenance.....	.14
General expense.....	.03
Taxes.....	1.82
Boarding house.....	.06
Total.....	\$5.37
Shipment, Treatment and Other Charges:	
Shipment expense.....	\$0.02
Milling.....	.13
Freight.....	.09
Ore treatment expense.....	2.55
Assaying and sampling.....	.20
Insurance.....	.09
Total.....	\$3.08
Administrative and General Expense:	
Mine management expense.....	\$0.17
Directors' fees.....	.01
Traveling expense.....	.01
General expense.....	.08
Total.....	\$0.27
Depreciation on buildings, plant and equipment.....	.15
Amount written off property acquired in connection with lake drainage and exploration of outside properties, etc.....	1.35
Grand total.....	\$10.22

457 oz. of silver. The total ore as hoisted was 55,376 tons, and this figure is used as the basis for the costs given in the table. During the year 3105 ft. of development work was done, and the reserves as of Sept. 1, 1917, are estimated at 52,400 tons of milling ore, containing 898,900 oz. of silver, and high grade ore containing 2,221,500 oz. silver, making a total silver reserve of 3,120,400 ounces.

Semi-Annual Report of the Broken Hill South Silver Mining Co.

The semi-annual report of the Broken Hill South Silver Mining Co., no liability, at Broken Hill, New South Wales, Australia, for the fiscal year ended June 30, 1917, shows a debit balance of £283,490. During the period two dividends were paid, amounting to £120,000, after setting aside £27,500 for taxation and royalty, and £15,733 for depreciation of plant. The directors have found it difficult to calculate what the company's position under the War Times Profits Bill will be, and until this measure is passed by Parliament the board purposes keeping considerable sum of money at short call, and in the serious financial and industrial outlook it is considered inadvisable to increase the dividends for the present. Shortage of men has made it advisable to operate at a reduced capacity during the period. The ore treated by the concentrator during the

year amounted to 279,700 tons, containing 38,695 tons of lead, 1,880,792 oz. of silver, and 38,004 tons of zinc. Of this amount during the second half 122,240 tons were treated as a grade averaging 13.7% Pb, 6.6 oz. Ag, 13.3% Zn. From this tonnage 92.6% was derived from the stopes on contract, 0.1% by day's pay, and 3.7% from development sources. During the period 3008 ft. of shafts, drifts, crosscuts, raises and winzes were driven and 2933 ft. of diamond-drill hole made. Filling in depleted stopes amounted to 32,563 cu.yd., at a cost of 5s. 1.8d. per cu.yd., or 1s. 4.2d. per ton of ore extracted. The average number of men employed underground was 788 and at the surface 457. Production was derived from nine working levels to a depth of 1270 ft. for the period covered by the report.

CONCENTRATES AVERAGED 66.3 PB, 23.2 OZ. AG AND 7.2% ZINC

During the period the concentrator produced 18,180 tons of concentrates of a grade averaging 66.3% Pb, 23.2 oz. Ag and 7.2% Zn. The zinc tailings, amounting to 57.8% of the total tonnage, contained 3.6% Pb, 3.4 oz. Ag, and 16.7 Zn. Quartz tailings, amounting to 12.3% of the tonnage, assayed 1.4% Pb, 1.5 oz. Ag, and 5.8% Zn, and slimes to the amount of 15.1% of the tonnage assayed 10.4% Pb, 7.8 oz. Ag, and 12.6% Zn. Three new cells, a third 25-ft. diameter Dorr thickener and additional elevators have been added to the lead section of the selective-flotation plant. This plant treated 18,387 tons of slime and produced 2482 tons of lead concentrate, assaying 61.9% Pb, 49.4 oz. Ag, and 7.8% Zn, and a residue of 15,905 tons, assaying 2.4% Pb, 1.2 oz. Ag and 13.4% Zn. The zinc section has made satisfactory progress in overcoming the commercial and metallurgical difficulties met in connection with the recovery of zinc concentrate from the delead residues, and when the outlet for zinc concentrate improves it will be in a position to start production.

"CASCADE" FLOTATION NOT SUCCESSFUL

Total recovery for the period was lead, 81.4%, silver, 65.8% and zinc 9.3%. An experimental "cascade" flotation plant has been erected, but has not proved a success on selective lead flotation of current mill slime, and arrangements are in hand to test it on coarser products. A comparative statement of the working costs for the last year is printed herewith:

COMPARATIVE SEMI-ANNUAL STATEMENT OF BROKEN HILL SOUTH SILVER MINING COMPANY

	Half Year to Dec. 31, 1916	Half Year to June 30, 1917
Production	Tons	Tons
Crude ore treated	157,460	122,240
Cost per Ton		
Mining	\$4.03	\$4.35
Filling depleted stopes	.28	.33
Development	.65	.91
Concentrating	1.06	1.32
Totals	\$6.02	\$6.91

Total mine costs (excluding selective flotation) per ton of concentrate produced, were:

	Tons	Tons
Production (concentrates)	27,650	18,180
Cost per ton	\$49.33	\$46.56

The Amalgamated Zinc (De Bavay's) Ltd. has taken delivery of all the company's current production of zinky tailings, and from the old dumps 24,867 tons, assaying 7.2 Pb, 4.1 Ag and 18.0% Zn have been delivered to the Zinc Corporation, Ltd.

Annual Report of the Tomboy Gold Mines Co., Ltd.

The annual report of the Tomboy Gold Mines Co., Ltd., for the fiscal year ended June 30, 1917, shows a working profit from operations of \$357,265. The ore treated at the 60-stamp mill, amalgamator, concentrator, and cyanide plant for the period was 148,939 tons, yielding bullion carried at \$314,823, concentrates, \$675,674, and cyanide bullion, \$160,114. The estimated reserves in the Argentine group is 150,000 tons of ore, of which

PRODUCTION COSTS PER TON OF TOM-BOY GOLD MINE

Mining and developing	\$2.73
Milling	.59
Concentrating (including transportation to railway)	.58
Water supply	.09
Assay office	.04
Cyaniding	.86
General expense	.25
Taxes and insurance	.31
Total	\$5.45

120,000 tons is broken in the stopes. In the Montana group 5122 ft. of drifts and raises was driven, mainly to the north on the 1000-ft. and the 1750-ft. levels, including work on the Sidney vein. The ore reserve in the Montana group amounts to 390,000 tons, of which 240,000 is broken in the stopes. The costs per ton are given in the table.

Annual Report of Jumbo Extension

The annual report of the Jumbo Extension Mining Company, of Goldfield, Nev., for the fiscal year ended June 30, 1917, shows a production of 8143 tons of ore of an average value of \$26.946 per ton, and 807.5 tons of dump ore sold at a value of \$1 per ton. During the period 4930 ft. of development work was performed in drift, crosscuts, raises and winzes, together with 293 ft. of core drill hole, in the search for new orebodies. Numerous new properties have been examined by the company, and a lease and bond was taken on a promising property at Copper Mountain, Nevada, upon which \$22,726 was expended in development work. Operations for the year show a loss of \$1270. Disbursements from the cash balance for the year include \$10,000 invested in Liberty bonds. The smelting and mining costs are given as follows:

PRODUCTION AND EXPENSES OF JUMBO EXTENSION MINING COMPANY

For the Year Ended June 30, 1917

	Production	Total Value	Average per Ton
8143.66 tons (dry) shipped		\$219,441.14	\$26.946
Smelting losses		26,727.00	3.281
Smelting recovery		\$192,714.14	\$23.66
807.53 tons dump (mill) ore		\$807.53	1.000
Expenses:			
Mining		\$32,008.97	\$3.931
Development		58,366.00	7.167
Freight, treatment and sampling on ore produced		82,502.95	10.131
General:			
Mine office		18.00	0.002
Miscellaneous		1,110.92	0.136
Administrative		14,122.27	1.734
Marketing ore		757.55	0.093
Taxes		3,973.84	0.488
Total operating expense		\$192,860.50	\$23.682
New equipment		1,931.78	0.237
Net operating costs, including freight, treatment and sampling on ore shipped		\$194,792.28	\$23.919
Net loss from operations		1,270.61	0.152

Manganese Ore Imports in November, 1917, were 44,141 tons ore, as compared with 31,225 tons in November, 1916. The imports for the 11 months of 1917 were 599,423 tons, comparing with 526,525 tons in the same period of 1916.

Report of Copper Production for 1917

This table is compiled from reports received from the respective companies (except in the cases noted by asterisk as estimated), together with the reports of the United States Department of Commerce as to imported material, and in the main represents the crude-copper content of blister copper, in pounds.

MONTHLY CRUDE COPPER PRODUCTION, 1917

	Sept.	Oct.	Nov.	Dec.
Alaska shipments.....	8,501,806	10,763,500	6,671,687	8,858,827
Arizona:				
Arizona Copper.....	nil	1,568,000	2,100,000	2,040,000
Cons. Ariz. Smelting.....	1,450,000	1,930,000	1,800,000	2,080,000
Inspiration.....	2,250,000	2,400,000	2,500,000	5,600,000
Miami.....	1,900,000	2,673,775	3,361,426	4,931,450
New Cornelia.....	1,460,936	2,278,000	2,106,000	2,260,000
Old Dominion.....	1,225,000	2,623,000	2,844,000	3,368,000
Ray.....	7,413,881	7,700,000	7,600,000	7,442,000
Shannon.....	nil	nil	148,000	658,000
Other Arizona.....	24,085,753	25,223,854	28,625,157	33,262,317
California:				
Mammoth.....	1,280,000	1,590,000	1,500,000	1,640,000
Michigan:				
Calumet & Hecla.....	11,556,438	12,265,380	12,224,589	*13,000,000
Other Lake Superior *.....	7,000,000	7,000,000	7,000,000	7,000,000
Montana:				
Anaconda.....	2,800,000	22,336,460	21,660,000	22,600,000
East Butte.....	2,203,300	1,691,008	2,033,000	2,506,260
Nevada:				
Mason Valley.....	1,267,532	1,469,631	1,308,528	1,260,000
Nevada Cons.....	6,524,352	7,000,000	6,900,000	6,500,000
New Mexico:				
Chino.....	7,719,496	6,333,000	6,313,272	8,094,122
Utah:				
Utah Copper.....	17,839,378	18,100,000	16,300,000	16,250,000
Eastern smelters *.....	2,000,000	2,000,000	2,000,000	1,750,000
Total reported.....	108,477,872	136,945,608	133,995,659	151,100,976
Others, estimated.....	10,000,000	9,000,000	8,000,000	7,000,000
Total United States.....	118,477,872	145,945,608	141,995,659	158,100,976
Imports, ore and concentrates, etc.....	16,892,867	14,206,272	16,062,344	.....
Imports in blister, etc.....	22,030,450	18,747,533	20,643,329	.....
Grand total.....	157,401,189	178,899,413	178,701,332	.....
British Columbia:				
Canada Copper Corpn.....	537,229	724,961	491,111	.....
Granby Cons.....	3,321,754	3,259,974	2,886,489	4,468,388
Mexico:				
Boleo.....	1,454,880	.....	1,764,000	.....
Cananea.....	nil	nil	nil	1,650,000
Other Foreign:				
Braden.....	5,348,000	5,414,000	5,756,000	5,836,000
Cerro de Pasco.....	7,041,000	7,325,032	6,440,000	6,308,000
Chile.....	3,294,000	9,050,000	8,872,000	7,912,000
Cape Copper.....	nil	246,400	360,000	.....
Kyshtim.....	582,400	725,760	.....	.....
Katanga.....	4,960,350	5,092,625	4,475,340	5,335,132

* Estimated.

The total production of the United States for the year 1917 was as follows:

January.....	174,658,602
February.....	180,726,627
March.....	190,211,648
April.....	185,930,898
May.....	185,750,810
June.....	171,341,047
July.....	117,810,739
August.....	117,445,458
September.....	118,477,872
October.....	145,945,608
November.....	141,995,659
December.....	158,100,976
Total.....	1,888,395,945

In giving our monthly figures, we are obliged to estimate the product of custom smelters. Comparison with the statistics for the year, as reported in our issue of Jan. 12, shows that the aggregate of our monthly figures, as previously reported, would be about 62,000,000 lb. too high, this reflecting an over-estimate of the product of custom smelters. We have therefore readjusted those estimates and the corresponding totals. This will explain the difference in the figures now presented from those previously published.

The grand total, which in the case of September was 157,401,189 lb., includes, under "Imports in ore and blister copper," the production of such companies as

Canada Copper, Granby, Cananea, Braden, Cerro de Pasco and Chile. As a matter of record, however, the individual figures are given after the total. We also report the production of the Boleo, Cape Copper, Kyshtim and Katanga companies, whose copper does not come to the United States.

The item "Alaska shipments" gives the official figure of the United States Department of Commerce. Kennecott production September to December was 7,100,000, 7,116,000, 7,142,000 and 7,086,000 lb., respectively.

Co-operative Rescue and First-Aid Training Work

To extend the usefulness of the work of the U. S. Bureau of Mines in training miners in rescue and first-aid work a plan for coöperating with privately or state-owned rescue stations has been evolved. According to its "Yearbook" for 1916, the Bureau announced that it would list such stations as coöperative provided their equipment and facilities were found to meet the purpose of training. When a station asks to be placed on the list of coöperating stations, a representative of the Bureau is assigned to investigate the station and to report on its status. His recommendation is considered before the station is designated as coöperative.

Every coöperative station is allowed to train men so as to qualify them to receive Bureau of Mines certificates for mine-rescue and first-aid work if it conducts training according to a schedule similar to that used by the bureau. At the conclusion of the training a formal application is made for an examination and further test of the fitness of the applicants to receive certificates.

When a class is ready for examination the Bureau sends to the station one of its engineers or foreman miners, who conducts the examination and directs practical demonstrations in first-aid and mine-rescue work. If the records of the examination and work are satisfactory to the Bureau, certificates are issued. This co-operation, which is conducted with the least possible cost to the Bureau, affords a greater number of miners an opportunity to receive training.

Under this plan coöperative training stations have been listed as follows: Arizona Copper Co., Morenci, Ariz.; Colorado Fuel and Iron Co., Jansen, Colo.; Copper Queen Consolidated Mining Co., Bisbee, Ariz.; Colorado School of Mines, Golden, Colo.; Detroit Copper Mining Co., Morenci, Ariz.; Ellsworth Collieries Co., Ellsworth, Penn.; Knox Mining Co., Jellico, Tenn.; Knox Mining Co., Rockwood, Tenn.; Missouri School of Mines and Metallurgy, Rolla, Mo.; Oliver Iron Mining Co., Ely, Minn.; Oliver Iron Mining Co., Eveleth, Minn.; Oliver Iron Mining Co., Hibbing, Minn.; Oliver Iron Mining Co., Iron Mountain, Mich.; Oliver Iron Mining Co., Ironwood, Mich.; Oliver Iron Mining Co., Ishpeming, Mich.; Pennsylvania State College, State College, Penn.; Ray Consolidated Copper Co., Ray, Ariz.; Republic Iron and Steel Co., Republic, Penn.; Superior Coal Co., Superior, Wyo.; Union Pacific Coal Co., Cumberland, Wyo.; Union Pacific Coal Co., Hanna, Wyo.; Union Pacific Coal Co., Rock Springs, Wyo.; United States Fuel Co., Salt Lake City, Utah.; United Verde Copper Co., Jerome, Ariz.; Victor American Fuel Co., Gibson, N. M.; West Virginia University, Morgantown, W. Va.

Events and Economics of the War

Attention during the week was centered upon the struggle in Washington between the Administration and those who would force upon the President a "war cabinet" and a director of munitions, as provided in Senator Chamberlain's bills. Great inefficiency in the War Department was charged by the Oregon Senator and others. Secretary Baker's appointment on Jan. 25 of Edward R. Stettinius, of J. P. Morgan & Co., as "Surveyor General of all Army purchases," was at first interpreted as a victory for those who desire to see a munitions director created; Stettinius, however, is merely to act as an adviser to the head of the new Army procurement division. Prompt passage of the railway bill was urged by Secretary McAdoo. The latter, as Director General of Railroads, put under embargo all new shipments of freight, excepting fuel, food and war necessities, on certain Eastern roads.

Little action was reported on European fronts; Austrian troops gave up positions on Monte Tomba, in the Italian hills. Von Hertling, the German Chancellor, defiantly rejected President Wilson's peace terms; a more favorable attitude was taken by Count Czernin, Foreign Minister of Austria-Hungary. The Russian situation is apparently little changed.

Garfield's Drastic Fuel Order

The account of the order of Fuel Administrator Garfield to shut down business in the East was accidentally omitted from the last issue of the *Journal*. The order, which has precipitated much discussion of the Administration's policy, was issued late on Jan. 16 and provided that throughout the United States east of the Mississippi River and including all Louisiana and Minnesota, no manufacturing plant, with certain exceptions, should burn any fuel or use power derived from fuel on Jan. 18 to 22 inclusive, and also on the Mondays beginning Jan. 28 and ending Mar. 25. The exceptions, in brief form, are as follows:

(a) Plants that must run continuously to avoid injury; (b) manufacturers of perishable foods; (c) manufacturers of foods not perishable, if authorized by the Fuel Administration; (d) printers or publishers of daily papers, except that on the 10 Mondays specified no more fuel may be burned than is customarily burned on holidays; papers not issuing editions on holidays are limited to one edition on specified Mondays; (e) printing establishments were permitted to burn fuel on Jan. 18, 19, 20, 21 and 22 necessary to issue current numbers of magazines or periodicals.

The order further provided that on the 10 specified Mondays no fuel should be burned to heat (except to prevent injury by freezing) the following places:

(a) Business or professional offices except those used by the Federal, state and municipal government, by transportation companies, banks, trust companies, physicians and dentists; (b) wholesale or retail stores, etc., except that such stores may maintain heat until noon for selling food, or throughout day and evening for selling drugs and medical supplies; (c) places of amusement; (d) rooms or buildings where liquor is sold on specified Mondays.

No fuel is to be burned on the specified Mondays for moving city or suburban transportation cars to more

than the extent customary on Sundays. The following instruction to fuel dealers is also included in the order:

Until further order of the U. S. Fuel Administrator, all persons selling fuel in whatever capacity, shall, in filling their contracts or orders now on hand, give preference to necessary current requirements of railroads, domestic consumers, hospitals, charitable institutions, army and navy cantonments, public utilities, byproduct coke plants supplying gas for household use, telephone and telegraph plants, shipping for bunker purposes, the United States for strictly Governmental purposes (not including factories or plants working on contracts for the United States), manufacturers of perishable food or of food for necessary immediate consumption and municipal, county or state governments for necessary public uses. Any tonnage remaining after the foregoing preferred shipments have been made may be applied in filling any other contracts or orders.

The order was issued without warning, and became effective before opposition could be organized.

War Cabinet Bill Introduced in Senate

The recent drastic order of U. S. Fuel Administrator Garfield, which was forced upon the country without opportunity being given for discussion or preparation, together with the practically universal dissatisfaction with the conduct of the war, resulted in the drafting of a bill by the Senate Committee on Military Affairs, providing for a war cabinet of three members. These members, the bill reads, must be "distinguished citizens of demonstrated ability, to be appointed by the President, by and with the advice and consent of the Senate, through which War Cabinet the President may exercise . . . the powers conferred on him . . ."

The bill provides that the War Cabinet shall have jurisdiction and authority to devise plans for the effectual conduct of the war and to procure the execution of the same; to direct and control the activities of all executive departments, officials and agencies of the Government, so far as it may be advisable for the vigorous prosecution of the war, and to require information from and utilize the services of the executive departments, officers or agents of the United States and of the several states and territories as may help it in performing its duties. The War Cabinet is to make rules governing its own procedure. It may requisition from the Secretaries of War and the Navy such commissioned officers as it may desire and may employ clerks and other help that it may need. The salary of each of the three members is fixed in the bill at \$12,000 a year, and the act provides that the War Cabinet is to cease to exist six months after the end of the war.

Embargo Laid on Eastern Freight

Director General McAdoo on Jan. 23 ordered an embargo upon all new shipments of freight on the Pennsylvania lines east of Pittsburgh, the Baltimore & Ohio lines east of the Ohio River, and on the Philadelphia & Reading system. Fuel, food and certain war necessities were the only exceptions made. The order was issued

by Mr. McAdoo, it is said, only after he had been convinced that it was absolutely necessary. It has been stated that had a general embargo been laid on freight shipments in the first place, Dr. Garfield would never have issued his now famous order closing down Eastern industries. The only advantage gained from the five-day shut-down that is thus far apparent, was that several ships held in port for lack of fuel were coaled and permitted to sail. At the expiration of the five-day period, freight congestion was still acute, the coal famine still existed, and the embargo order issued was the inevitable result.

In addition to the embargo, it is the purpose of the Fuel Administration to work out a zone or districting system for the distribution of coal, to stop cross-hauling, as far as possible, and to continue supplying preferred industries first. The former plan is that recently proposed by Francis S. Peabody, chairman of the coal committee of the Council of National Defense, and along the lines of the system worked out in Great Britain. The plan of supplying coal to preferred industries first is already in effect, being prescribed in the first section of Dr. Garfield's order.

Must Hurry Passage of Railway Bill

Ten billion dollars must be raised by the Government before next June. Such was the reminder given by William G. McAdoo, this time in his rôle of Secretary of the Treasury, when he urged upon the Interstate and Foreign Commerce Committee of the House that the immediate passage of the Administration's railway bill was necessary to the success of the war plans.

"Over and above the deficit and other measures now before Congress," said the Secretary, "the Government faces the necessity of raising \$10,000,000,000 between now and June. With our financial situation as it is now—uncertainty largely prevailing—we can do nothing. Our savings banks, investment concerns and other fiduciary institutions hold \$4,000,000,000 of railroad securities. So long as these institutions are uncertain as to the status of the securities they hold, what income they will get, and what the future holds for their interest and dividends, they are in no position to buy the bonds which we must offer."

The opposition of the Administration to placing any time limit on the return of the railroads to their owners after the war was emphasized by Mr. McAdoo upon this occasion. He also resisted the suggestion that the President's power to fix rates, delegated to himself as Director General, be curtailed. With several of the "short lines" suddenly cut out of the Government's plan of operating a great system of railroads during the war, Mr. McAdoo expressed the opinion that Government operation of roads would show a profit eventually.

Naval Ordnance Matters Well Handled

The ordnance situation in the Navy Department was found to be excellent at the inquiry conducted by the special committee. Although the expenditures of the Navy's ordnance bureau have increased since the war began from \$3,000,000 a year to more than \$560,000,000, the business has been conducted with dispatch. This was stated by Representative Oliver, chairman of the

committee. More than 1100 vessels have been furnished and equipped with guns, ammunition, spare parts and the like since the *Campana*, the first ship to be so equipped, received these protections on Mar. 14 last, Mr. Oliver said. In addition to this, the bureau furnished quantities of guns and ammunition ranging from the smallest to the largest calibers to England, France and Italy for their naval vessels and merchantmen as well, which supply is still continuing.

While the ordnance bureau of the War Department refused to approve the Lewis gun, the Navy's ordnance bureau conducted a test in April, 1917, and as a result ordered several thousand of these guns. The second detachment of marines which left for Europe was entirely outfitted with the Lewis gun, and recent reports from the war zone indicate that this gun is giving entire satisfaction. In spite of the enormous pressure of business on the bureau, Mr. Oliver said the committee found that in addition to the greatly increased demand for ordnance material of standard types the bureau had found time to develop such new material as large depth charges, new submarine bombs, non-ricochet shells, guns for throwing depth charges, smoke screen apparatus, heavier ordnance on aircraft and many other important designs which cannot be disclosed.

Where there were shortages in the market of various materials, the bureau took steps immediately to develop new sources of supply. "It placed contracts rapidly," Mr. Oliver declared, "and the committee is confident that the Navy's needs for ordnance during this war are fully covered by existing contracts and with the capacity now under its control."

Soldiers Must Pass Mental Tests

Following the experiments in psychological examination made at Camps Lee and Devens, Major General Gorgas, the Surgeon General of the Army, has announced that the War Department will require all enlisted men and newly appointed officers to take the mental tests. He states that the total estimated personnel for conducting the examinations in the 31 divisional training camps and for a special staff in the Surgeon General's office is 27 majors, 51 captains and 54 first lieutenants of the sanitary corps of the National Army, and 62 sergeants, 62 corporals and 620 enlisted men. Special buildings and equipment, to cost \$10,000 to \$12,000 per camp, have been authorized for the work. A school of military psychology will be established at the Medical Officer's Training Camp at Fort Oglethorpe, Georgia.

According to Major Robert M. Yerkes, in charge of the section of psychology in the Surgeon General's office, results of the experiments made so far indicate in brief: (1) That about 2% of the drafted men as they appear in camp are so seriously defective in mental development that they are either menaces or nuisances in military organizations; (2) that the intelligence ratings of their men supplied to company commanders greatly assist the latter in properly placing and effectively using the men in their commands; (3) that the examining officers will assist greatly in selection for assignment, promotion or retirement. It is thought that the tests proposed will substantially increase the efficiency of the military organization.

General Construction Regiment Being Formed

There is now forming at Camp Devens, Ayer, Mass., under the command of Col. Mark Brooke, a regiment of engineers for general construction work in France. In it are offered opportunities for all classes of labor, skilled and unskilled, who are qualified for this kind of work. Bridge, house and form carpenters are needed, also structural-steel men, reinforcing-steel setters, engineers, firemen, mechanics, machinists, steam fitters, blacksmiths, riggers and derrick men, pile-driver operators, concrete laborers, construction superintendents and foremen, civil and mechanical engineers, clerks, stenographers, timekeepers, paymasters, storekeepers and supply men; in fact, every kind and class of worker on a building or construction job.

Men of draft age may join by applying by mail to Headquarters, 33rd Engineers, Camp Devens, Ayer, Mass. Age, address, occupation, draft status and number, and number of local board, should be stated and a desire expressed to volunteer for immediate service in this regiment. Men not in the draft, between 31 and 41 years of age, may enlist at the nearest Army recruiting station, specifying that they are enlisting for service with the 33rd Engineers.

Chemical Service Section Created in National Army

The importance of chemistry in the conduct of the war has received a gratifying endorsement from the War Department in the establishment of a new division attached to the General Staff and designated the Chemical Service Section of the National Army. The two immediate purposes to be accomplished by the formation of this division are, according to *Journ. Ind. and Eng. Chem.*, (a) the unification and more comprehensive development of the various research activities now being conducted for the War Department, and (b) the creation of a chemical organization, complete in personnel and equipment, for service with the American expeditionary forces in France.

General Pershing has urgently requested that a chemical unit be organized and sent to France at the earliest possible moment. This unit will serve as adviser to General Pershing on all chemical matters pertaining to the war, and will be attached to his staff through Col. A. A. Fries, head of the Gas Warfare Division. It will also act as the chemical eyes of the unit in this country, transmitting information relative to chemical problems of the war to the men at work here. Able scientists throughout the country have responded eagerly to this call to national service. The following have been recommended for commissions:

Lieutenant Colonel, Raymond F. Bacon; majors: Gilbert N. Lewis, William A. Hamor; captains: H. H. Hanson, B. H. Nicolet, J. H. Hildebrand and F. G. Keyes; first lieutenants: A. R. Norton, L. V. Walker, J. K. Senior, L. H. Cretcher, P. R. Parmelee, W. L. Argo and T. D. Stewart; second lieutenants: P. G. Woodward, A. H. Hooker, Jr., H. W. Nichols, Jr., L. H. Ashe, G. S. Skinner, D. H. McMurtrie, J. J. Hast, J. W. MacNaugher, E. B. Peck, N. F. Hall, R. B. Hall, Allen Abrams, C. B. Spofford, Jr., and A. R. Olsen.

About 25 enlisted men, including some of the best of the younger chemists of the country, make up the re-

maining personnel as at present organized. As the work develops, more men will be added so that the laboratory will be in position to solve quickly the many problems which the constant changes in the methods and munitions of the war introduce.

French Mining Politics

The ministry of armaments and war materials, which includes in its field the various mining industries of France, has established a Consulting Committee for Mines, according to an editorial by Edouard Payen, in *L'economiste Français*. This committee is charged with the "immediate investigation and examination of ideas and plans for the rapid realization of the great mineral riches of France." It is composed of representatives of parliament, mine owners, mine workers, the administration, and the state department. It is the direct result of a secret debate in the Chamber of Deputies on Oct. 29, 1917, during which a number of grave and ominous revelations were made concerning the mining of essential minerals and coal in France.

The French mining laws date chiefly from 1810, and have hardly been changed since. As a necessary result they are hopelessly antiquated, comprising a conglomeration of red tape that has resulted in more than 400 applications for mining permits being pending before the authorities at the present time—some of them dating back as far as 1907! Others have been pigeonholed for periods varying from two to nine years, without official action.

French mineral resources have hardly been touched because of the old laws and the difficulties of "concessions" from the proper authorities. The state owns all mining rights under the surface, and permission to work the mineral deposits can be obtained for only a comparatively short period, during which the share paid to the state each year grows progressively. Capital naturally fights shy of investments under such conditions, and what mining there is is carried on with the idea of "cleaning up" as much profit as possible, in as short a time as possible, with the lowest possible investment. Where the mining property is below a farm or private surface property, the state pays the owner of this land a certain percentage of the money collected from the mine operator.

The modern objection of the French is that the state has no business to collect a goodly share of the profits of a successful mine without assuming also a share in the losses of unsuccessful mines. The new Committee of Mines is working on a number of reforms proposed by M. Loucheur, minister of armaments, which are designed to encourage the opening of new mining properties.

Nitrate Board Formed

A board to control the purchase and distribution of Chilean nitrate has been formed by representatives of the Allies. Sir Edmund Wyldbore-Smith, who has been Director of the International Commission for the purchase of supplies for the Allies, is chairman of the committee, and Robert P. Skinner, American Consul General, is vice chairman.

Industrial News from Washington

BY PAUL WOOTON, SPECIAL CORRESPONDENT

Bureau of Mines to Co-ordinate Work in Metal-Mining Sections

Extension of U. S. Bureau of Mines activities into the metalliferous mining sections of the country has been accomplished in piecemeal fashion, owing to difficulties in securing appropriations from Congress. Efforts now are being made to coördinate the work more systematically than has been possible heretofore. Plans to this end are being worked out by H. M. Wolfkin, representative of the Bureau in San Francisco; Dr. A. J. Lanza, of the Public Health Service, but who is assigned to the Bureau of Mines; D. Harrington, and R. R. Sayers, Butte, Mont.; J. J. Forbes and J. F. Warley, Reno, Nev.; and C. A. Herbert and R. C. Williams, Raton, N. M.

Iron-Ore Production in 1917

Iron-ore production in the United States during 1917 was practically the same as in 1916, when a little over 75,000,000 tons was mined, according to E. F. Burchard of the U. S. Geological Survey. The average value of the ore in 1917 was \$3.12, compared with \$2.34 in 1916. Stocks on hand at the end of 1917 were slightly less than at the end of 1916. Eighty-five per cent. of the ore mined came from the Lake Superior district. Owing to less favorable weather conditions, there was a decrease of about 2,000,000 tons in the amount of ore handled by the Lake fleet, as compared with 1916. The ore mined in the South in 1917 was 8,112,000 tons.

Chrome Ore Problem Confronts War Industries Board

Exactly the same problem, but on a smaller scale, has arisen with chromium as with manganese and iron pyrites. The scarcity of tonnage has caused inquiry to be made of the War Industries Board as to what chance there is of reducing the number of ships engaged in bringing chromium from New Caledonia. Half of the chromium consumed in this country is imported. The U. S. Bureau of Mines is studying the problem of making greater use of low-grade material in the country.

Association of Carbonate of Zinc with Lead-Silver Ores

It is the opinion of Adolph Knopf, of the U. S. Geological Survey, that valuable deposits of zinc carbonate will be discovered in limestone in association with galena orebodies that were formerly worked in California for lead and silver. This conclusion of Mr. Knopf follows his study of the geology of the Inyo Range of California.

"The discovery of zinc carbonate ore at the Cerro Gordo mine, which has yielded more silver-bearing lead ore than has any other mine or district in California," says Mr. Knopf, "is another striking illustration of

what has been happening in recent years at many of the other silver-lead mining camps in the Western states. Oxidized zinc ores formerly were unsought or were thrown over the dumps unrecognized. At Leadville, Colo., the zinc-carbonate ores were long unrecognized. The same is true for the Kelly or Magdalena district in New Mexico and for the Yellow Pine district in Nevada. As shown by the occurrence at Cerro Gordo, the primary orebodies need not have contained a large proportion of sphalerite to have given rise to commercially important deposits of zinc carbonate."

Delay in Developing Western Phosphate

After an extended geologic reconnaissance of phosphate areas in the West, Alfred R. Schultz, of the U. S. Geological Survey, expresses the following opinion:

"The delay in development of the Western phosphate deposits may be attributed in part to the fact that some of the properties first located have been involved in litigation; also to the high cost of transportation from the deposits to places where phosphate is needed for depleted soils and to the fact that the agricultural public does not fully appreciate the increased production which the use of phosphate fertilizer will make possible.

"A high-grade fertilizer that will be able to stand a high transportation charge is the product that is desired. As soon as such a fertilizer is placed on the market at a price which justifies its use in the densely settled agricultural communities, the development of the Western phosphate fields will be assured. Henceforth, there will probably be a more rapidly growing market for fertilizer products in both the Middle and the Far West, and it is to this territory that the Western phosphate producer must look for markets."

Concentrating on Manganese Problems at Lake Superior Station

Members of the staff of the School of Mines of the University of Minnesota have been instructed by the board of regents of the University to cooperate to the greatest possible extent with those working at the Lake Superior station of the U. S. Bureau of Mines. This concentration of effort is due to the important bearing on national welfare of the problems attendant upon the use of low-grade and siliceous manganese ores.

Potash Recovery Retarded

Efforts of the U. S. Bureau of Mines to induce cement plants to undertake the recovery of potash are being hindered by the curtailment of building operations and by transportation difficulties, which are causing many companies to shut down or to reduce their scale of operations. On the other hand, the increased activity of blast furnaces has made possible greater experimentation looking to the recovery of potash from the dust.

Editorials

The Price for Copper

ON TUESDAY, Jan. 22, the War Industries Board announced, with the sanction of the President, that the agreement with the copper producers entered into on Sept. 21 and expiring on Jan. 21 would be continued until June 1, 1918, all provisions, including price 23½c., remaining unaltered. The copper producers had previously made strong representation in favor of an increased price, which representation was based on the increased cost of production, estimated to have risen from 1 to 3c. per lb. since September last. Evidently the War Industries Board listened politely to the representations, and made up its mind that no increase of price was justified.

Of course the decision of the War Industries Board may be viewed from different angles. If its governing motive is the obtaining of just enough copper for Governmental requirements, and obtaining it from the largest and cheapest producers at the lowest possible price, there is something to be said in favor of its policy. It might even trim things more, making it a question of how closely it can shave the producers making a certain desired production, and still let them live so as to make that production. Without entering upon a discussion of a policy that makes a distinction between the producers of copper and of cotton, we may point out the grave danger that is courted by the Government itself. If it has figured that it needs 180,000,000 lb. of refined copper per month, and having adjusted the price so as to get that production, and no more, it should suddenly develop that somebody had underestimated, and the actual requirements for copper proved to be 200,000,000 lb. per month, the additional quantity would not be forthcoming.

If, on the other hand, the policy of the War Industries Board is to obtain the maximum production of copper, the steps that it is taking are unqualifiedly wrong. The statistics of production do not look well.

The mines of the United States in 1917 produced about 1,888,000,000 lb. of copper. This was a little less than in 1916, but in order to examine the records intelligently we must turn to statistics of monthly or quarterly production. Fortunately such statistics are available from our own monthly reports, corrected in minor details so as to agree with the year's total.

In the first quarter of 1917 the production of American mines attained the unparalleled total of 545,600,000 lb., a production of 190,200,000 lb. (high water mark) being recorded in March. The production in the second quarter was about 543,000,000 lb. This quarter would have broken all previous records without any doubt had it not been for the curtailment owing to the strikes, which showed in the June production. In the third quarter many of the most important mines were severely crippled by the strikes, and the production was only about 354,000,000 lb., the monthly production in July, August,

and September being in the neighborhood of 118,000,000 lb. in each case. The fourth quarter showed a production of about 446,000,000 lb. The strikes having been mainly settled by the end of September, the October production jumped to about 146,000,000 lb., and in December there was an output of about 158,000,000 pounds.

These figures show how copper mining in the United States has been hurt. The smaller producers, especially those who ship to custom smelters, are being crowded out. With respect to the matter of total supply, however, we must defer consideration until we have fuller figures for the importation of raw material from foreign countries.

Overproduction or Underproduction

IN THE national mortification and hysteria over the collapse in our coal supply, a variety of explanations has been offered. One authority has asserted positively that the trouble is at the mines; another has said that it is ascribable to congestion at the seaports and other terminals, while a third is sure that the only reason is an insufficiency of locomotives. Other persons who are less entitled to be classed as authorities have averred that the country is paying the penalty of overproduction, that there is no use in manufacturing more things than the railways can possibly carry, to see those things pile up on the docks, in the warehouses and in the factories. Let us examine the last assertion in the light of some specific although fragmentary information. The status of the mineral industry is something whereof we claim to have a fair degree of knowledge.

The mineral industry is one of the basic industries, and its relative importance is gaged by the fact that something more than 60% of the freight carried by the railways of the United States consists of mineral products. We think that everyone will agree with us that unless mineral products increase there will be no increase in the quantity of manufacture, for there can be no manufacturing unless there be raw material.

We already possess statistics of the production of the most important minerals and metals in 1917. None of these show any very large increases. The production of bituminous coal increased about 8%. In anthracite there was an increase of about 13%. In coke there was a small decrease. Among the metals, iron ore, which constituted the greatest tonnage, was just about the same as in 1916. The outputs of pig iron and copper were less in 1917 than in 1916. In lead and zinc there were increases of a few thousand tons. In the production of petroleum and cement there were small increases. We know nothing as yet respecting the production of bulky materials like brick, building stone, sand, etc., but the check to building operations implies diminished output of those things. This would be quite in line with the experience in Great Britain, and,

moreover, is distinctly indicated by the record of the portland cement industry in the United States in 1917, wherein there was a diminution of about 4,000,000 bbl. in shipments, although production increased about 1,500,000 bbl., stocks accumulating at the mills.

Moreover, it may be remarked that in the cases of several industries whereof we possess monthly statistics the production was smaller in the second half of 1917 than in the first half. Thus, although lead and zinc exhibited small increases for the year, their production in the last quarter was at a greatly diminished rate. Iron and copper productions decreased in the annual figures, but in their cases also production was less in the second half of 1917 than in the first half.

This evidence, admittedly fragmentary, although representative of some very important industries, including those of the biggest tonnages, does not indicate that increased quantity of manufacture imposed any unusual burden upon the railways. We may add to this that the cotton crop and the wheat crop of 1917 were smaller than in 1916.

Moreover, we were told by the Railway Administration, only a few weeks before the collapse in December, that the efficiency of the railways had been remarkably increased, by virtue of better car-loading and improved arrangements in general. Some astonishingly favorable figures were presented, and the railways were warmly congratulated upon their performance.

Our mind is not clear respecting what really happened to the railways to produce the congestion which has tied up traffic so seriously. We are inclined to think that it was not increased volume of freight, and that there is no reason whatever why manufacturers should cease from manufacturing. On the contrary, they should push work as hard as they can. We conjecture that the trouble has been not so much due to the quantity of freight as it is to readjustments of the distribution, especially the concentration of unusual tonnages in the channels leading to the seaports.

The Direction of the War

THE ministerial crisis, if we may use that analogy, has been the chief thing of interest this week in Washington and all over the country. Senator Chamberlain introduced a bill for a supreme cabinet of three members and a director of munitions. The President announced his opposition to that plan, alleging that it would deprive him of authority in the things for which he is responsible. He said, furthermore, that Secretary Baker is the best public official that he has ever known, and that internal reorganization then going on in the War Department would correct whatever defects in administration there had been previously. Senator Chamberlain was obliged then to defend the critical remarks that he had made in New York on Jan. 19, and did so in a powerful, dramatic speech in the Senate on Jan. 24.

We do not understand the President's opposition to the proposed "war cabinet." The text of the bill introduced in the Senate shows that no invasion of the President's constitutional powers is contemplated, notwithstanding which the President bases his objection on that ground. According to the terms of the bill the President, himself, would appoint "three distinguished citizens of demonstrated ability," and they would be re-

sponsible to him, just as are members of the present Cabinet. Evidently the President sees in the bill a reflection upon his administration of the war heretofore. We cannot see that any such thing was intended. Rather does it appear that a thoughtful element in Congress (the bill was introduced by a leader of the President's own party) is aiming to give him improved means for the administration of affairs that are beyond the capacity of one man to do. The President might well have been eager to accept this opportunity to insure the success of the colossal task to which he has put his hand.

In the discussion of the conduct of the war hitherto, with Senator Chamberlain as the leading critic, and Secretary Baker (supported by the President) as the main defender, neither party has dwelled upon the main issue, and we doubt if either party understands it. Secretary Baker asserts that great work has been done in getting a well-equipped army to France, in larger numbers than nine months ago was believed would be possible by this time. He admits that there have been mistakes, but claims that if the whole story could be revealed (which for reasons of state may not be) the good work performed would be found by far to outweigh the bungling. Senator Chamberlain in his great speech of Jan. 24 dwelt upon the delay in providing machine guns and rifles, and the suffering of recruits in the cantonments owing to insufficient supply of blankets and warm clothing. Senator Chamberlain introduced some pathetic stories that will doubtless have great effect in the popular mind, as he intended, although they have only minor bearing upon the main point.

The main point is that in the administration of affairs there has been a reprehensible absence of forethought, a deplorable lack of coördination, and a general working at cross purposes. Although the President and Secretary Baker complacently entertain the opinion that things have been done efficiently, that in the main the work of the bureaus is praiseworthy, and dismiss all criticisms as being manifestations of political attacks, the engineers of the country, the captains of industry, the officers in the bureaus themselves know that the administration of affairs in Washington in many respects has bordered upon plain stupidity.

We are aware that great purchasing departments are unprovided, 10 months after the beginning of the war, with any estimates of the quantity of important materials that are required.

We are aware that bureaus of the Army Department are making plans for explosives requiring substances that cannot be supplied in sufficient quantity.

One department is building more motor trucks than can ever be transported to France, while another department overlooks the shortage in the locomotive equipment of the United States. One department issues an order of powerful influence upon industry, even checking production, while other departments may suffer serious consequences, such things being done without any previous consultation among them.

We state but a few illustrations; to proceed with them would be mortifying. But even these few will be sufficient to indicate the need for the formulation of a general plan, one in which all of the several departments may work in unison. In other words, what we need is coördination and team work. That is manifestly the

idea in proposing the supreme war cabinet, an executive committee, so to speak, and we think that the President is woefully ill-advised in his rejection of that plan.

The creation of a separate director of munitions is less important. Yet, while rejecting that idea, the Administration adopts it, but instead of having a "director general," it appoints a "surveyor general." In naming Mr. Stettinius for that post, there was an ideal appointment. Indeed, one of the faults that we have found with the Administration has been its unwillingness to take advantage of the great munitions supply department organized by Mr. Stettinius within the firm of J. P. Morgan & Co., which furnished the Allies with billions of dollars' worth of material, economically and to their great satisfaction in all respects. With that organization right at hand, and not to make immediate use of it, was a terrible exhibition of blindness, even if it were dictated by political considerations.

We hope that Mr. Stettinius, as surveyor general of munitions within the Army Department, will not become enmeshed in red tape, and will have real authority. In the creation of his office the Administration recognizes that its present critics are right. Would that it would consult the unprejudiced engineers and business administrators of the country and find out that there is really needed such a supreme coördinating council as Senator Chamberlain proposes.

As the *New York Times* remarks, it is, indeed, one of the defects among the great qualities of the President that he does not turn an inviting ear to criticism of officers or policies of his Administration when his mind is already made up. And we may add that he tries to direct details in number and of character that are beyond the capacity of any man.

The address on "The New Russia," by Col. William B. Thompson, at the banquet of the Rocky Mountain Club in his honor, in New York, on Jan. 23, which is published in full elsewhere in this issue, gives a new and surprising view of conditions in Russia by one who was unusually qualified to observe the inside of things. Colonel Thompson went to Russia as head of the American Red Cross in that country and performed great service in the fulfilment of his mission. He affords another brilliant example of how mining men do things. His friends who greeted him at the Rocky Mountain Club dinner had good reason to be enthusiastic.

BY THE WAY

Diamond-drill bits are frequently lost and seldom, if ever, recovered. But recently, at the Maas mine of the Cleveland Cliffs Iron Co., near Negaunee, Mich., a diamond-drill bit, containing six black diamonds valued at \$2700, and 200 ft. of drill rods were recovered by miners working underground. The bit, which was lost in 1901, had reached a depth of 1285 ft., according to measurement of the rods, but actual vertical distance was less, as the drill hole, originally vertical, had flattened out almost 45 deg. This change in the course undoubtedly caused a torsion and sheared off the rods. The spring core lifter, the bit and the rods were in excellent condition and showed no signs of rust.

Rocky Mountain Club Honors Col. W. B. Thompson

The Rocky Mountain Club expressed its appreciation of Col. William B. Thompson's services as head of the American Red Cross in Russia, from which country Col. Thompson has just returned, by giving a dinner in his honor in New York on Jan. 23. John Hays Hammond, president of the club, was unable to be present, on account of ill health, but sent the following message to the toastmaster, John C. Montgomery:

Dear Sir:

Will you please extend, on behalf of the Rocky Mountain Club and its president, a most cordial welcome home to our esteemed fellow member, Col. William B. Thompson, and express to him our appreciation of the honor he has conferred upon our club by the distinguished service he has rendered the nation in the discharge of his high mission as the head of the American Red Cross in Russia. Tell him, please, that we are ever grateful to him for his part in the formation of our club. Tell him, also, that we recognize him as the prime mover and the most generous patron of the Rocky Mountain Club Fund for Belgian Relief, and wish him many years of useful service, prosperity and happiness.

JOHN HAYS HAMMOND,
President Rocky Mountain Club.

Washington, D. C., Jan. 23, 1918.

No rule of the Food Administration was broken at the dinner. Delmonico's menu was characterized by a strict observance of the law as laid down in the Code Hooverian. In fact, the great Administrator was moved to send the following letter to the chairman of the menu committee:

My Dear Sir:

I thoroughly approve the menu you have prepared for the dinner to be given my old friend William B. Thompson and am very glad to say to the Rocky Mountain Club, and through that unique organization to all my Western friends, that they can get up just as good dinners as they ever served and still keep within the lines of food conservation which the exigency of war makes necessary to lay down.

I congratulate the Rocky Mountain Club upon its hearty coöperation in setting a good example, and ask for the work of the Food Administration the same splendid support that has been so characteristic of engineers and Westerners throughout this war.

Faithfully yours,
HERBERT HOOVER.

Washington, D. C., Jan. 17, 1918.

The most striking speech of the evening was that by Col. Thompson, himself. Talking of conditions in Russia, he said that the ideals of the Bolsheviki were healthy and that "the most damaging enemy Germany has is the Russian democracy alongside of it."

Officers Assigned to 27th Engineers

News of the 27th Engineers is becoming more frequent as the regiment, now at Camp Meade, in Maryland, takes increasingly definite shape. In the latest Army orders, we note that Maj. O. B. Perry, who has been directing the forming of the Twenty-Seventh, has been appointed to the grade of Lieutenant Colonel of Engineers, in the National Army. First Lieut. C. J. Mampel has been ordered from duty in the office of the Chief of Engineers, in Washington, to Camp Meade to join the mining regiment. Similar orders have been issued to First Lieut. A. F. Victor, of the 513th Service Battalion, and to First Lieuts. J. M. Jenkins and H. D. Kinney, who had been stationed at Camp Lee, Virginia. Capt. Edward S. Berry has also been ordered to duty in the regiment.

The Comfort Fund for the regiment has taken another jump upward, due to the liberal donation of the Utah Copper, Nevada Consolidated, Chino and Ray Consolidated companies. The list of givers to date stands as follows:

"Engineering and Mining Journal".....	\$1000.00
New York Engineering Co.....	1000.00
A Friend, Nov. 23.....	5.00
H. H.....	5.00
D. E. Charlton.....	5.00
H. W. Hardinge.....	1000.00
Frank N. Spencer.....	5.00
W. L. Coursen.....	5.00
J. H. Polhemus.....	5.00
J. H. Janeway.....	10.00
Albert D. Beers.....	10.00
J. E. Hayes.....	10.00
J. A. Van Mater.....	25.00
L. Vogelstein & Co.....	100.00
"Cuprite".....	10.00
R. H. Bassett (Hanna Ore Mining Co.).....	10.00
A Friend, Dec. 10.....	10.00
P. A. Mosman.....	10.00
American Zinc, Lead and Smelting Co.....	100.00
J. G. H.....	5.00
Daniel Guggenheim.....	100.00
A. H. H.....	5.00
Willard S. Morse.....	25.00
August Heckscher.....	100.00
Anaconda Copper Mining Co.....	1000.00
F. W. Bradley.....	100.00
Charles Le Vasseur.....	5.00
A Friend, Dec. 13.....	50.00
Freeland Jewett.....	10.00
Herman A. Wagner.....	5.00
Francis P. Sinn.....	10.00
R. C. Gosrow.....	5.00
D. C. Jackling.....	10.00
"V".....	5.00
J. H. Brickenstein.....	5.00
E. E. Northrup.....	50.00
Rogers, Mayer & Ball.....	30.00
Denver Technical Staff, American Metal Co., Ltd.....	100.00
A Friend, Jan. 9.....	10.00
E. B. Coolidge.....	200.00
J. V. N. Dorr.....	50.00
Pope Yeatman.....	50.00
W. H. Aldridge.....	5.00
C. E. Hart.....	5.00
Robert I. Kerr.....	5.00
Engineers of Washoe Smeltery, Anaconda Copper Mining Company.....	205.00
Harry C. Graham.....	25.00
Utah Copper, Nevada Consolidated, Ray Consolidated and Chino copper companies.....	1000.00
A Friend, Jan. 23.....	5.00
John Gillie.....	25.00
Total.....	\$6625.00

One large contributor said recently that he liked especially to give to such a fund because he could follow the ways in which the money was doing good, and thereby derive much enjoyment. Everything connected with the Comfort Fund will be given the fullest publicity. We have requested Mr. B. B. Thayer, vice president of the Anaconda Copper Mining Co.; Mr. Clinton H. Crane, president of the St. Joseph Lead Co.; and Mr. A. C. Ludlum, president of the New York Engineering Co., to assist us, as an advisory committee, in applying the fund for the purpose intended.

It has been suggested that the women folk in the mining camps, who, like all other women, are knitting sweaters, wristlets, socks, etc., should knit especially for the mining regiment. This is a good idea. Let the better-half of the management at every mine organize a knitting club among the wives, daughters, sisters and nieces of the staff. We will make arrangements for the handling of the products and delivery of them to the regiment, which will be announced later.

Those who have not yet contributed to the Fund for the 27th Engineers should fall in line without delay. The cause is a good one. The amount raised to date, though large in itself, represents but a trifle per capita for the entire regiment. The goal of \$100,000 that we set for ourselves is entirely reasonable. The regiment is large and will be in the service for the duration of the war. Send in your checks payable to the *Engineering and Mining Journal*.

January Mining Dividends

Mining dividends paid in January, 1918, by 32 United States mining and metallurgical companies amounted to \$7,443,402, as compared with \$13,345,466 paid by 42 concerns in January, 1917. One item contributing to this large decrease was the payment of \$3,500,000 in January, 1917, by the New Jersey Zinc Co., which made no similar disbursement this year. The balance is due to the decreases and discontinuances resulting from adverse conditions. Vindicator, Iron Blossom and United Verde are among the companies which passed their dividends in January. Homestake, Isle

United States Mining and Metallurgical Companies	Situation	Per Share	Total
Ahmeek, c.....	Mich.	\$2.00	\$400,000
Allouez, c.....	Mich.	1.50	150,000
Am. Smelters, pfd., A.....		1.50	243,846
Am. Smelters, pfd., B.....		1.25	375,000
Arizona Commercial, c.....	Ariz.	.50	132,500
Caledonia, ls.....	Utah	.50	75,000
Bingham Mines, c.....	Utah	.50	78,150
Caledonia, ls.....	Ida.	.03	110,501
Camp Bird, pfd., g.....	Ida.	.18	50,000
Cerro Gordo, lz.....	Calif.	.05	640,000
Champion, c.....	Mich.	6.40	232,495
Cons. Interstate-Callahan, z.....	Ida.	.50	11,000
Continental Zinc.....	Mo.	.50	122,000
Cresson, g.s.....	Colo.	.10	15,000
Daly, ls.....	Utah	.10	6,403
Douglas.....	Ida.	.001	18,750
Dragon Cons.....	Utah	.01	50,000
Empire Copper.....	Ida.	.05	45,000
Golden Cycle, g.....	Colo.	.03	50,000
Hecla, ls.....	Ida.	.05	125,580
Homestake, g.....	S. D.	.50	2,363,934
Inspiration, c.....	Ariz.	2.00	72,405
Iron Cap, c.....	Ariz.	.50	75,000
Isle Royale, c.....	Mich.	.50	107,500
North Butte, c.....	Mont.	.25	192,300
Osecola, c.....	Mich.	2.00	58,520
Plymouth Cons., g.....	Calif.	.24	90,000
Portland, g.....	Colo.	.03	175,000
Shattuck Arizona, c.....	Ariz.	.50	182,415
Silver King Coalition, s.l.z.....	Utah	.15	187,504
Tonopah Belmont, g.s.....	Nev.	.121	75,000
Tonopah Min., s.....	Nev.	.071	68,150
United Eastern, g.....	Ariz.	.05	438,894
U. S. Smelting, com.....	U. S.-Mex.	1.25	425,555
U. S. Smelting, pfd.....	U. S.-Mex.	.871	
Canadian and Central American Mines	Situation.	Per Share	Total
Cons. Min. & Sm. Co., c.z.....	B. C.	.621	261,936
LaRose, s.....	Ont.	.05	74,931
McKinley-Darragh-Savage, s.....	Ont.	.03	67,531
N. Y. & Hond. Rosario.....	C. A.	.50	100,000
Nipissing, s.....	Ont.	.50	600,000
Temiskaming, s.....	Ont.	.03	75,000

Royale, Shattuck Arizona, and Tonopah reduced. Canadian and Central American companies paid \$1,179,298 in January this year, against \$1,574,968 in 1917.

The only holding company which paid in January was St. Mary's Mineral Land Co., which distributed \$2 a share (\$320,000).

Red Cross Wants Old Tracing Cloth

Discarded tracing cloth, as well as old linen and cotton articles, is wanted by the American Red Cross for making surgical dressings. Many companies have stored away accumulations of old tracings that are practically valueless. The Red Cross has announced that such concerns will find the large laundries in their city, or in the nearest city, only too willing to send for such cloth as they may care to give to the society. It is possible to remove all of the gelatinous dressing and most of the ink from the tracing cloth, the remaining linen fabric being excellent for bandages.

Military and Naval Insurance must be applied for on or before Feb. 12, 1918, by enlisted men and officers who were in the service before Oct. 15, 1917. Those who joined after Oct. 15, 1917, have 120 days from the date of enlistment in which to apply. For his own benefit and for the benefit of his family, every enlisted man and officer in the Army and Navy should take the full \$10,000 of insurance allowed. Insurance of almost \$400,000,000 has already been applied for. The cost is extremely low.

Personals

Have you joined the Comfort Club for the 27th Engineers?

Capt. George Blow, E. O. R. C., has been promoted to be a major.

Donald M. Liddell is serving as chief engineer to the War Credits Board, Washington, D. C.

Lieut. Adam T. Shurick, E. O. R. C., formerly of the editorial staff of "Coal Age," has been promoted to be a captain.

L. D. Davenport, chief engineer of the Oliver Iron Mining Co. in the Hibbing district, Minnesota, was in New York last week.

A. E. Anderson has been appointed superintendent of the Northern Pacific ore docks at Superior, Minn., succeeding J. Howard Cooke, who recently resigned.

First Lieut. C. J. Mampel has been ordered from duty in the office of the Chief of Engineers, in Washington, to the 27th Engineers, Camp Meade, Maryland.

Dennis M. Hines has resigned his position as mine foreman with the Cinco Minas Co., Jalisco, Mex., and has joined Co. A, 27th Engineers, Camp Meade, Maryland.

Maj. O. B. Perry, who has been in charge of the work of forming the 27th Engineers, has been appointed to the grade of lieutenant-colonel of engineers in the National Army.

Fred S. Norcross, Jr., superintendent of mines for the Canada Copper Corporation, has been commissioned a captain in the U. S. Reserve Engineers and is at the Camp Lee training camp.

S. H. Brockunier desires it stated that he resigned as superintendent of the Hermine Operating Co., of Westville, Calif., and Pittsburgh, Penn., in 1916 and has had no connection with them since.

Arthur Houle, of Shattuck, Ariz., is in charge of the development of claims at Big Clearwater Lake, Rice Lake District, Manitoba, which are owned by a St. Paul-Minneapolis syndicate, headed by E. E. Kain.

Valerius, McNutt & Hughes, petroleum and mining geologists of Tulsa, Okla., and Lexington, Ky., are now prepared to make complete analyses, examinations and physical tests of natural gas for gasoline content and black carbon content.

P. S. Coudrey, formerly superintendent of mines at Cerro de Pasco, Peru, is reported to have joined the Royal Engineers in Kent, England, where he was attached to the inland waters and docks division. He left Peru in April, 1917, for Canada.

Minerals Separation North American Corporation, Edward H. Nutter chief engineer, announces the removal of its San Francisco office and testing laboratory from the Merchants Exchange Bldg., to 220 Battery St., where it has established an ore-testing works.

A. G. McGregor, who erected the International, Calumet & Arizona, Verde Extension and other reduction works in the Southwest, has returned to Arizona from New York and is expected to sail at an early date for Chile and Peru with representatives of copper interests.

Harry Sherman, superintendent of the Genoa mine at Gilbert, Minn., of the Oliver Iron Mining Co., is taking the place of H. W. Overpeck, superintendent of the company's mines at Buhl, Minn., during the latter's absence. Mr. Overpeck is spending the winter in California for his health.

James Taylor Kemp, son of Prof. James Furman Kemp, of New York, was married on Jan. 26 to Miss Molly Graham Lord, daughter of Prof. Herbert Gardiner Lord, of Columbia University. After a wedding trip, Mr. Kemp and his bride will take up their residence at Port Colborne, Ontario.

O. E. Jager, formerly superintendent of the Cerro de Pasco smelting plant at La Fundicion, Peru, who left Peru for England in May, 1917, to offer his services to the government, is now on the staff of one of the government-controlled plants in London, working on matters pertaining to production of lead.

Capt. Edward S. Berry has been ordered to the 27th Engineers, Camp Meade, Maryland. Other officers ordered to report for duty with the mining regiment, the 27th Engineers, are as follows: 1st Lieut. A. F. Victor, from the 513th Service Battalion; 1st Lieut. J. M. Jenkins and 1st Lieut. H. D. Kinney from duty at Camp Lee, Virginia.

Forest Rutherford announces that he has established office headquarters at 120 Broadway, New York. As consulting metal-

urgical engineer, he is prepared to undertake work on the construction and operation of mills and smelters for the treatment of ores, more especially those of copper, and to give particular attention to ore smelting contracts.

Obituary

Oscar A. Turner, formerly connected with various mine promotion schemes, died recently in Baltimore.

Edward Callister, captain at the mines of the Republic Iron and Steel Co. at Gilbert, Minn., died suddenly on Jan. 17 at Gilbert.

William Mayger, president and manager of the St. Louis Mining and Milling Co., of Marysville, Mont., died recently at Helena, Mont., at the age of 76 years. He was born in Missouri and went to Montana in 1864, settling soon after in Marysville.

Major Kenneth B. Carruthers, for 10 years in the employ of the Consolidated Mining and Smelting Co. of Canada, was killed in France late in 1917, while serving in the Canadian Expeditionary Forces. He was a graduate of McGill University and was 36 years old.

Lieut. Gordon D. Cooke, formerly with the McGraw-Hill Publishing Co., Inc., in its "field service" department, died at the base hospital at Fort Bliss on Jan. 10 from pneumonia. He was 24 years old. He was commissioned a second lieutenant in the Engineer Corps on Sept. 1, 1917, and was temporarily stationed 75 miles from a railroad in New Mexico, doing military mapping for the U. S. Geological Survey.

Societies

Coming Meetings

American Concrete Institute Boston Feb. 7-9
American Institute of Mining Engineers New York . . Feb. 18-21

Engineers' Club of Dayton, Ohio, will dedicate its new home today, Feb. 2. The building is the gift of Col. Edward A. Deeds and Charles F. Kettering and is situated at Monument Ave. and Jefferson St., Dayton.

Engineers' Club of Northern Minnesota will hold its annual banquet at the Oliver Club, at Hibbing, on Feb. 16. This is expected to be the largest gathering of the year of mining men on the Mesabi Range. A military engineer from Washington will be the principal speaker. The committees in charge of the meeting include B. St. Vincent, H. S. Ranken, E. J. Hawley, K. Duncan, W. E. Bates, R. Downing, H. Angst, O. Sundness, F. R. Mott, F. A. Pollack and F. A. Wildes.

United Engineering Society—The following officers were elected for the ensuing year at the annual meeting of the board of trustees in New York on Jan. 24: President, Charles F. Rand, member of American Institute of Mining Engineers; first vice president, Calvert Townley, member of American Institute Electrical Engineers; second vice president, Robert M. Dixon, member of American Society of Mechanical Engineers; treasurer, Dr. Joseph Struthers, member of American Institute of Mining Engineers; secretary, Alfred D. Flinn, member of American Society of Civil Engineers; chairman finance committee, J. Vipond Davies, member of American Society of Civil Engineers.

Industrial News

Driver, Harris Co., Harrison, N. J., announces the death of F. A. Driver on Feb. 21 at the age of 82 years. Mr. Driver was a director of the company for many years and was identified with it from its start.

Newton Manufacturing Co., Lowell, Mass., announces that F. C. Newton has resigned as general manager of the Newton Mfg. Co. and is now assistant to the general manager of the U. S. Cartridge Co., at Lowell, Massachusetts.

Westinghouse Electric and Manufacturing Co. announces that Guy E. Tripp, of New York, chairman of the company, has been appointed chief of the newly created production division of the War Department by Secretary Baker and has been commissioned a colonel. He has been granted a leave of absence for the duration of the war by the board of directors.

New Patents

Alumina—Art of Producing Alumina. Maurice Barnett and Louis Burgess, New York, N. Y. (U. S. No. 1,252,384; Jan. 8, 1918.)

Drill—Drilling Apparatus. George H. Gilman, Claremont, N. H., assignor, by mesne assignments, to Sullivan Machinery Co., Boston, Mass. (U. S. No. 1,252,375; Jan. 1, 1918.)

Drill—Drilling-Machine. George H. Gilman, Claremont, N. H., assignor, by mesne assignments, to Sullivan Machinery Co., Boston, Mass. (U. S. No. 1,252,374; Jan. 1, 1918.)

Drilling—Apparatus Employed in the Formation of Wells. Edward R. Gnade, Oil City, Penn., assignor to Oil Well Supply Co., Pittsburgh, Penn. (U. S. No. 1,252,426; Jan. 8, 1918.)

Drilling—Device for Extracting Cores From Wells. Redus D. Dodds, Humble, Tex. (U. S. No. 1,252,555; Jan. 8, 1918.)

Drilling—Drilling-Tool Joint. William R. Childers, Oilfields, Calif. (U. S. No. 1,253,149; Jan. 8, 1918.)

Electrodeposition of Metals. Anson G. Betts, Asheville, N. C. (U. S. No. 1,252,654; Jan. 8, 1918.)

Electric Precipitation—Art of Electrical Precipitation of Particles from Fluid Streams. Charles W. Girvin, Philadelphia, Penn., assignor of one-tenth to Valentine G. Scott, Philadelphia, Penn., and one-tenth to Horace G. Seitz, New York, N. Y. (U. S. No. 1,252,104; Jan. 1, 1918.)

Electrolysis—Diaphragm for Electrolytical and Electro-Osmotic Purposes. Botho Schwerin, Frankfurt-on-the-Main, Germany, assignor to Gesellschaft für Elektro-Osmose M. B. H., Frankfurt-on-the-Main, Germany. (U. S. No. 1,252,185; Jan. 1, 1918.)

Excavating Machine. Charles Frank Rayburn, Moscow, Ida. (U. S. No. 1,252,175; Jan. 1, 1918.)

Furnace—Electric Ore Furnace. John A. Ward, Spokane, Wash., assignor of one-fourth to E. S. Campbell, one-fourth to W. A. Ridgeway, and one-fourth to Henry Sorensen, Spokane, Wash. (U. S. No. 1,252,635; Jan. 8, 1918.)

Hoisting-Engine. Thomas Spencer Miller, South Orange, N. J., and Louis G. Ruggles, New York, N. Y., assignors of one-half to Lidgerwood Manufacturing Co. (U. S. No. 1,252,473; Jan. 8, 1918.)

Hot-Metal Car. John D. Pugh, Harrisburg, Penn. (U. S. No. 1,251,282; Dec. 25, 1917.)

Iron—Alloy of Iron. Oliver B. McMillin, Pittsburgh, Penn., assignor, by mesne assignments, to Pittsburgh Rolls Corp., Pittsburgh, Penn. (U. S. No. 1,252,596; Jan. 8, 1918.)

Iron or Steel—Method of Treating. Napoleon G. Petinot, New York, N. Y., assignor to United States Alloys Corporation, New York, N. Y. (U. S. No. 1,252,023; Jan. 1, 1918.)

Lamp—Portable Electric Lamp. John J. Brownrigg, Harry Henderson, and Arthur E. Case, Marion, Ind., assignors to Delta Electric Co., Marion, Ind. (U. S. No. 1,250,960; Dec. 25, 1917.)

Ore Washing Plant. James P. Dovel, Birmingham, Ala. (U. S. No. 1,252,414; Jan. 8, 1918.)

Peat, Treatment of. Thomas Rigby, Dumfries, Scotland, assignor to Wetcarbonizing Limited, London, England. (U. S. No. 1,251,285; Dec. 25, 1917.)

Phosphate—Process of Making Acid Calcium Phosphates. Henry Blumenberg, Jr., Los Angeles, Calif., assignor, by direct and mesne assignments, to Carroll Allen, Los Angeles, Calif. (U. S. No. 1,252,318; Jan. 1, 1918.)

Potash—Recovery of Alkali. John S. Beckett, Cranford, N. J., assignor of one-half to Percival R. Moses, New York, N. Y. (U. S. No. 1,247,619; Nov. 27, 1917.)

Roasting—Blast Ore Roaster. George H. Dern, Salt Lake City, and Theodore P. Holt, Silver City, Utah, assignors to Holt-Christensen Process Co., Provo, Utah. (U. S. No. 1,251,189; Dec. 25, 1917.)

Smelting Furnace. Ramon Bonastre Llopert, St. Louis, Mo., assignor to Mineral Refining and Chemical Corp., St. Louis, Mo. (U. S. No. 1,253,064; Jan. 8, 1918.)

Smelting—Process of Making Metals in Electric Furnaces. Ernest Humbert, Welland, Ontario, Canada. (U. S. No. 1,252,443; Jan. 8, 1918.)

Editorial Correspondence

SAN FRANCISCO—Jan. 16

Charles H. Moyer Spoke to Mother Lode miners recently during a visit. It is reported that Mr. Moyer talked chiefly on the duty of the workingman during the war and strongly decried hasty and ill-advised strikes.

The Yellow Aster Mine at Randsburg starts 1918 with a fine prospect of mining the low-grade ores at a reduced cost. During November and December, 1917, the 100-stamp mill was closed down, according to the "Golden State Miner," owing to the fact that it could not handle with a satisfactory margin of profit the low-grade ore available for open-cut mining. Unfortunately during 1916 overburden stripping was practically abandoned, so that in 1917 little or no mining could be carried on at the east face of the gloryhole. This accounts for the shortage of better grade ore which forced a cessation of operations in spite of every effort being made to rush stripping. The new crushing plant, which will eliminate hand sorting, will handle nearly twice the daily tonnage of the old plant. It has been proved by experiment that the coarser material can be rejected as waste by screening; the fine product from the screens carrying practically all the gold, will make a mill feed of such character that the capacity of the stamp mill will be materially increased. It was expected that this plant would be ready for operation by Jan. 1, but delay in machinery delivery prevented. Favorable weather conditions have permitted active work on the south face of the big cut, which has resulted in the recovery of a working bench buried under the great slide in the winter of 1914. With this ore, which was better than the average from the gloryhole, available for milling, it is proposed to start the old plant again and keep it in operation until the new machinery is installed and in operation. Ore for the new plant will be handled by a system of mill holes into chutes from which trains will be loaded direct. Such ore as cannot be mined into mill holes above the tramming level will be shoveled by hand on a contract basis. Plans of the Yellow Aster Co. involve power shovels, or a cableway excavator system which is expected to greatly decrease mining costs. It also is probable that stamps will be replaced by ball mills.

SALT LAKE CITY—Jan. 20

Governmental Control of the Metal Mining Industry is against the sentiment of Utah mining men, and protest is being made through the American Mining Congress at what is proposed by the Foster bill. At a meeting of the Utah Chapter of this body, held Jan. 12, the following resolution was unanimously adopted: "Utah metal mining conditions are such that we are producing to full reduction capacity and therefore no immediate improvement can be secured by Governmental supervision. There is no shortage of metals produced here, and thus the only object to be attained by such supervision is absent so far as Utah is concerned. Many of our mines are small and situated in remote parts, and it would involve a needless expense to them and the authorities to impose supervision. We also fear that labor conditions would be greatly disturbed and the properties would suffer. Operation conditions are so widely varied in the metal mining industry that such supervision as proposed would be a distinct loss and possibly a disaster to hundreds of companies." A later meeting endorsed this resolution, and in discussion the feeling against Government supervision was found to be even stronger. It was decided to send delegates to a conference to be held Jan. 21 at Denver at the time of the annual meeting of the Colorado Metal Mining Association and the Colorado Chapter of the American Mining Congress. Delegates chosen were Walter Fitch of the Chief Mining Co. and John M. Hayes of the Utah Copper Co. J. Mullen of the Utah Copper Co. and N. W. Haire of the Michigan-Utah were named as alternates. It was hoped that Secretary Lane would be present at the conference, but as he will be unable to be present, he will be represented by Dr. David T. Day of the U. S. Geological Survey and Dorsey A. Lyon of the Bureau of Mines.

Oil Shale in Uintah Basin in the vicinity of Watson is experiencing something in the nature of an oil boom. During the last three weeks of December more than 160 claims were filed with the county recorder. The ground comprised shale deposits near Watson, saturated sands near White rocks and ground for drilling purposes near Vernal. The shale occurs in flat seams of alternating rich and poor shales and occasional sandstone. In some places the deposits appear to be of such a nature as to suggest possible steam-shovel operation, with a return, it is stated, of about 30 gal. of oil per ton. With a little sorting or selection of particular beds in a vertical section, some of the shales would yield 50 gal. per ton. The Crane Oil Co. has an option on shale land near Watson, and owning a process known as the Crane process, is stated to be planning the erection of a reduction plant. Other companies stated to be contemplating the erection, in the same section, of plants to treat oil shales are the Utah Shale and Oil Refining Co., the Ute Oil Co., and interests connected with the Midwest Oil Co. Various processes of treatment have been worked out and considerable experimenting is being done. The Ute Oil Shale Co., with offices in St. Louis, has recently sent a shipment for further test in the experimental retort at the University of Utah. The point of departure for the different processes has been the method of reduction for many years in successful operation in Scotland. The Scotch deposits have yielded excellent profits throughout their period of operation, although they are neither so rich nor so great in thickness as the shales in Utah and other western states. Also the shales here are frequently exposed above the surrounding country so as to present the possibility of cheap exploitation on a large scale by steam shovels.

BUTE, MONT.—Jan. 21

The Anaconda Copper Company is hoisting more ore at present than at any period since June. There are now 23 of the properties in full operation, which leaves only the Belmont among the leading producers idle. This mine is having the shaft repaired and relined with wire lathing and concrete, as in the Tramway, and it is not expected to be ready for operations in less than two months. When the Belmont resumes operations again the shaft will be fire proof.

With the starting up of the High and St. Lawrence mines 900 more miners were added to the payroll of the company and an average of 1600 tons more ore is being brought to the surface. For January the Anaconda company will probably come close to the May production of 28,400,000 lb. copper.

Government Decision on Copper Price to remain at 23¢. per lb. has created dissatisfaction among small mine owners. It is asserted that the price is all right for the large producers with their big byproduct of gold and silver, but the small operator cannot do any better than make both ends meet at the price. Some of the small owners contend that assurances of an unofficial character had been given that the price would be boosted to 25¢. and the announcement that the price was to remain as at present, while actually not official, is generally regarded as having been given out by some person or persons who have inside knowledge. One mine owner said that he could produce figures to show that the production of copper at the present time was costing him 20¢. per lb. and he could not see how he could further reduce costs.

SPOKANE, WASH.—Jan. 20

Resumption of Operations at the Trail Smeltery, Trail, B. C., has partly cleared away the feeling of depression prevalent among mining men here during the last two months. The unsatisfactory condition of the metal markets and the uncertainty of the income and excess profits tax law are still most disturbing factors but there is relief over the changed situation in British Columbia, where operations have been crippled for several weeks by the strike. The strikers lost out on virtually all points at issue when the International Mine, Mill & Smeltermen's Union declared the plant "fair" and censured the local organization for violating an agreement entered into for

period of the war. The wage scale is based upon the price of lead, according to agreement, and, as a result, the men are now working for less pay than they received before calling the strike. Mining men are closely watching for action by the Government on the price of silver and many predictions are made that unless the figure is put up to \$1 per ounce there will be a suspension of operations in several mines. The constantly increasing cost of materials, added to the higher scale of wages generally prevalent, has cut earnings down so much that action by the Government on the price of silver seems the only hope. There is little expectation of Government action on the price of lead and spelter.

Northwest Mining Association, through Secretary F. C. Bailey, is receiving assurance of a large attendance at the annual convention to be held in Spokane, Feb. 11-17. British Columbia will be well represented and an organized effort has been made by leading mining men of that section to provide an exhibit that will be as nearly complete as conditions permit. It will include specimens from districts represented heretofore in only a limited extent. A strong effort will be made to obtain part of the exhibit assembled by Arthur Johnson, gold commissioner at Revelstoke.

JOPLIN, MO.—Jan. 19

Site for a Zinc Rolling Mill in Joplin or Webb City has been decided against by the special committee appointed to look into this matter by the Webb City operators' association several weeks ago. It is considered too far from the zinc smelteries. The committee is continuing its inquiry into the possibility of increasing the uses of zinc, with promise of some success.

Associated Zinc Ore Producers' Association announced today that there was 30,000 tons of zinc and lead ore in bins in this district on Jan. 1. Figures compiled by their representative showed a total of 29,000 tons, and some mines did not report. About one-third of this tonnage had been sold, but not shipped on account of the car shortage. It is believed this tonnage has been decidedly reduced since, as the last two weeks have served to increase curtailment on account of bad weather, while the car situation has been slightly better. Report is considered by producers, however, as being good argument for continued curtailment of output, which is now greater than at any time in many months.

TORONTO—Jan. 18

As a Result of Conferences at Ottawa between the War Committee of the Canadian government and representatives of the leading steel manufacturing companies, during which the government emphasized the urgent need of more steel to supply the demands of the railways, the manufacturers have promised to increase the steel output of last year by 20%, provided that the raw materials are available. The question of labor shortage for both agricultural and industrial purposes is now engaging the attention of the government, who have this week been conferring with representatives of the labor unions. A government investigation into the labor situation, in connection with the coal and steel industries of Sydney, N. S., is in progress.

Program for Government Shipbuilding on large scale in the present Canadian shipyards, involving an expenditure of between \$50,000,000 and \$60,000,000 annually, has led to negotiations that are in progress with the Dominion Steel Corporation, Nova Scotia Steel Co., and Algona Steel Co. looking to the establishment of rolling mills in connection with their plants in order to secure the requisite supply of steel plates and shapes. The companies are considering the commercial feasibility of the proposal, which will involve an expenditure of approximately \$3,000,000 in each case. If this plan is not regarded favorably, the government may establish its own rolling mills. The question of how the government's ocean-going ships will be operated is not yet decided. It may either be done directly by the government, or on the plan adopted by the British government, under which the vessels are handed over to private firms who are paid operation fees out of earnings and the balance paid into the treasury.

The Mining News

ALASKA

SHIPMENTS FOR DECEMBER of copper ore and matte to the United States were 20,219 tons with a copper content of 8,858,827 lb. evaluated at \$2,055,693.

ARIZONA

Cochise County

CALUMET AND ARIZONA (Douglas)—Smeltery production for December from company ores, 5,816,000 lb.; from custom ores, 3,320,000 lb. fine copper.

Greenlee County

SHATTUCK ARIZONA (Bisbee)—Production: For December, 626,612 lb. copper, 47,556 lb. lead, 5817 oz. silver, and 85.97 oz. gold; for 1917, 11,935,317 lb. copper, 2,010,145 lb. lead, 154,344 oz. silver, and 1542.39 oz. gold.

Pima County

NEW CORNELIA (Ajo)—December production of copper from cathodes, 2,260,000 lb., from shipping ores, 500,000 lb., and from cement copper, 1,090,000 lb. Total, 3,850,000 pounds.

ARKANSAS

Izard County

BROOKS HILL (Cushman)—Walter Dennison, operating this manganese property, has installed new steam shovel for use in mining.

Marion County

CONTINENTAL MINING CO. (Dodd City)—Operating the Bear Hill, Buelah and K and M zinc mines. Purchased large truck to use in hauling their output 45 miles from the Bear Hill mine to Yellville for shipment. If trucks are successful will put them on all hauls.

MONKEY HILL (Flippin)—Negotiations completed between N. Stanfield and associates of Oklahoma City, and the owners of the Monkey Hill mine, whereby the former will immediately take over the property. Mill will be overhauled and new equipment added.

DRY BONE (Buffalo)—Fox Den Mining Co. have taken over the Dry Bone mine near the Fox Den. Equipping with engine and compressor. Dirt from Dry Bone will be milled at Fox Den mill, where capacity is now being increased.

CALIFORNIA

Amador County

OLD EUREKA (Sutter Creek)—Shaft deepening started. New mill and restraining dams for tailings storage to be built on Frakes and Goodman ranches, now owned by company.

Eldorado County

CINCINNATI (Placerville)—The new Ellis Ball Chili mill installed and now operating. Mine developed and worked through 300-ft. drift on vein. Ore being stoped above breast of drift in friable porphyry containing gold-bearing quartz. Total cost of mining and milling stated to be \$1 per ton. Mill driven by 7-hp. gasoline engine and handles 36 tons in 24 hr. Can be increased to 50 tons. Property situated 11 miles from Placerville. N. H. Burger is manager.

Inyo County

NEW TUNGSTEN DEPOSITS on Mt. Morgan at an elevation of 11,000 ft. may be developed soon. Property controlled by Vaughn, Beauregard and Sproule, negotiating with Cooper Shapley to undertake the opening of the deposits.

Mono County

PITTSBURG-LIBERTY (Masonic)—Reported closed down on Dec. 24 and that representatives of the Guggenheim interests have been making examinations. Stall Brothers are owners. It is reported in this connection that the Guggenheim interests have optioned the Serita property, also owned by the Stalls.

Shasta County

BIG DYKE (Igo)—Reported optioned to southern California interests represented by J. A. Hassell. Property owned by W. H. Dyke, of Dunsmuir, Charles Reichter, of Redding, and John Reichter, of Igo. Mine developed by shaft, drifts and raises. Contemplate installation of new electric hoist.

COLORADO

Boulder County

JAMESTOWN MINES are making fluor-spar shipments. Rise in price has stimulated production. Mines now shipping are: Emmett, Invincible, Rattler, Harlow and Terry group.

MANN MILL (Boulder)—Experiments in fluor-spar concentration conducted in this plant for two months. Both jigs and tables tried. The jigs were a failure, but the tables a success. A new Deister-Overstrom table has just been installed. Wilfley tables in successful operation. Plant capacity is 30 tons per day. Custom ores to be treated. The mill has been remodeled and is being operated by George Chesebro and A. K. Langridge.

Clear Creek County

BIRMINGHAM MINING CO. (Idaho Springs)—Has acquired the Big 40 properties, and will commence active development in the near future.

ALICE (Alice)—Property being carefully prospected by Crown Reserve Mining Co., Ltd. Numerous holes to be churn drilled to bed rock. First hole reached bed rock at a depth of 40 ft. Hydraulic mining under consideration. J. B. Ballantine and A. L. Carnahan are in charge.

ARGO REDUCTION AND ORE PURCHASING CO. (Idaho Springs)—Milling operations show a substantial gain in 1917 over 1916. Three shifts were in steady operation. The gross value of ore purchased was \$475,433.52, ore milled was 24,561 dry tons and concentrate shipped was 6327 tons.

PRIMOS (Urad)—Company now employing 143 men on development and construction. More men will be put on as fast as can be obtained. New boarding and bunk-houses have been built, and the machinery for the first unit of the new 200-ton mill has arrived at Empire station and is being hauled to the mine.

WYOMING VALLEY (Idaho Springs)—Tunnel being driven from Gibson gulch in direction of Black Hawk. Now in 500 ft. Further driving to cut two intermediate veins within 100 ft., and French Flag and Silver Age, two large producers of past years, to be cut in 300 ft. more, at depth considerably below present workings.

Gilpin County

LITTLE MELVIN (Rollinsville)—Leased by Rare Metals Co. Large shoot tungsten ore opened; shipping to company's plant.

Gunnison County

MORNING GLORY (Pitkin)—Reported 3-ft. vein of molybdenum ore cut at depth of 150 ft. by tunnel. Further development will be done before commencing shipments. Copper ore also opened on property.

San Juan County

COPPER KING (Silverton)—Bond and lease taken. Work to begin at once. Expected property will be on shipping basis by spring.

COMING WONDER (Silverton)—Anvil Mountain mine taken over by leasing company recently will be extensively worked. Property a regular shipper of silver-lead ore during last year.

San Miguel County

LEWIS (Telluride)—Unwatering of mine completed, and alteration of mill, with installation of flotation, completed. Both mine and mill in operation.

Summit County

GOLD LEDGE (Frisco)—This property on Ten Mile Creek being developed preparatory to spring shipments.

FOREMOST (Frisco)—Shipments good-grade lead-gold-silver ore made. Development work in progress.

AMERICAN METAL CO. (Buffer)—Milling plant for treating molybdenum ore, and tramways nearing completion. Ore will be conveyed from mine to crusher by two-bucket, counterbalance tramway, 500 ft. long, then to mill by 5000-ft. aerial tramway. At mill, ore will be crushed, ground in ball mill, concentrated in Janney and

Callow flotation machines, concentrate de-watered on Portland filter. Capacity of plant to start, estimated 250 tons daily.

MUTUAL COOPERATIVE MINING CO. (Kokomo)—Regular shipments being made from Golden Queen mine. Last seven cars returned average of \$300 each.

MINERALS PRODUCTS COMPANY (Frawley)—Milling plant under cover. When finished will have capacity of 200 tons per day. Ore assays 2% molybdenum in form of molybdenite.

Teller County

PORTLAND (Cripple Creek)—Sixth unit of Independence mill at Victor completed; capacity of unit 250 to 300 tons per day.

CRIPPLE CREEK GOLD MINING CO. (Cripple Creek)—Electric driven 6-drill compressor installed. Lateral development work to be done from 1000 level of shaft.

EXCELSIOR (Cripple Creek)—Operating Longfellow mine of Stratton estate, building ore house and washer of 200 tons capacity. Production to begin soon.

PATTERSON & BRADLEY LEASING CO. (Cripple Creek)—Operating Specimen and Sacramento mines of Stratton estate, purchased considerable quantity of mining supplies, including track and cars for use at Specimen shaft.

IDAHO

Bonner County

ARMSTEAD MINES, INC. (Talache)—Development under D. G. McLachlan, supt. Driving 3400-ft. adit at present rate of 17-ft. per 24 hours.

Shoshone County

IDAHO-NEVADA (Wallace)—Has been developing a property known as the Castle Rock, on Placer Creek. Suspended operations on account of failure to obtain extension of bond.

COPPER KING (Mullan)—Strike made which promises great importance. Extensive development for many years has disclosed more or less lead and copper ore, but nothing approaching the amount now shown.

SHERMAN (Burke)—Shipments to be made from shoot of lead ore 150 ft. long and in places 14 ft. wide, stopes now being opened. Joins Tamarack & Custer on east. Vein from which ore will be shipped is Tamarack. Contract let to drive 600 ft. on Custer vein, in which considerable ore has been found in tunnel 500 ft. above. Company well financed. James F. Callahan, of Interstate-Callahan fame, is now president and will direct operations.

MICHIGAN

Copper

HANCOCK (Hancock)—December production 284,000 lb. Falling off due to trouble with machinery.

COPPER RANGE (Painesdale)—On its optioned tracts south of Globe, which is next south of Champion, is diamond drilling 10th and 11th holes. So far no ore found.

FRANKLIN (Demmon)—Intensive mining by massing of 8 drills at end of drifts. Stopping back and letting poor hanging-wall cave. Mechanical haulage has raised tonnage from 1000 to 1200 daily.

CALUMET & HECLA (Calumet)—Daily production, 10,667 tons. Building short connection with No. 5 Tamarack and thence with No. 3. Carrying over own road rock formerly carried by Mineral Range.

SENECA (Calumet)—Much delayed by 6½ ft. of snow and zero weather nearly every day, but will start sinking shaft between Mohawk and Ahmeek 2100 ft. vertically, turning to Kearsarge lode in about a week.

COPPER RANGE (Painesdale)—Manager Schacht has undertaken to interest all employees in the thrift-stamp plan of the Government. Every employee gets a start with a thrift stamp in his pay envelope this week.

BEAR LAKE POOL (Calumet)—Just starting first of five diamond drill holes

500 ft. south of No. 4, which was above the mineralized formations; probably ore at shallow depth; two out of four holes have found good copper.

WHITE PINE (White Pine)—December production 16,000 to 18,000 tons; January expectation 19,000 tons. Transferring Erie engine from Calumet & Hecla to run everything but Hardinge mills and lights, in order to increase power for flotation plant, which will be installed after engine shaft arrives.

MINNESOTA

Mesabi Range

CLEVELAND-CLIFF IRON CO. (Nashwauk)—Have taken lease on Helmer mine from Swallow & Hopkins Lumber Co., of Minneapolis, who will start operations.

OLIVER IRON MINING CO. (Duluth)—Small gravity screening plant being erected in the Hull Rust mine to be used in separating waste and ore. Expected to be ready about first of March.

SACHEM IRON CO. (Eleventh)—Developed Burns mine sufficient to begin shipments next season; will also work Morrow mine adjoining. Pickands-Mather interests will market ore.

HELMER MINE (Buhl)—Cleveland Cliffs Iron Co. has taken over this lease and will carry on operations. The Helmer was formerly operated by Swallow & Hopkins, lumber, of Minneapolis. This is the third mine to be operated by the Cleveland Cliffs Co. on the Mesabi Range.

MONTANA

Jefferson County

MOUNTAIN STATES (Warm Springs)—Unwatering 150-ft. shaft with Denver capital.

Lewis and Clark County

ROCK ROSE (Helena)—One carload of ore at smelter and other shipments ready.

LEE MOUNTAIN (Rimini)—Sinking two shafts in lower tunnel below water level.

BARNES-KING (Marysville)—Sinking to 650 level from 500. Work nearly done. Gold ore.

BALD BUTTE (Bald Butte)—Mill treating gold ore from old mine and new openings.

PRODUCER (Helena)—Bonded to Spokane people who are preparing to build mill for saving the gold.

CRUSE CON. (Helena)—Last carload to smelter of 42 tons netted \$1032. Air compressor installed for deepening shaft to 1000 ft. New officers elected.

SHANNON (Marysville)—Barnes-King company sinking additional 150 ft., which will make shaft 650 ft. deep when completed. High grades in gold at 500 level.

GOLD SYNDICATE (Marysville)—Duluth operators ceased operations on Marysville Gold Syndicate after expending \$150,000. Adverse report by Louis Huntoon the cause, together with report of W. Vanwinter. Five reports by other engineers all favorable.

Silver Bow County

ANACONDA (Butte)—High-Ore and St. Lawrence mines resumed operations Jan. 14. Former has been out of commission since Modoc fire last April. St. Lawrence has been down since Oct. 1. This leaves only Belmont shaft idle. It is being fire-proofed with concrete and will take about two months more to complete. The two mines named will add between 500 and 800 men to the payroll and bring output nearly up to normal again.

CRYSTALS GOLDSMITH CO. (Butte)—Optioned property of Crystals Copper Co., located near the Moulton and Alice silver mines. The Ellingwood shaft is at a depth of 200 ft. and the Tong shaft at 400 ft. Property has been a good producer of gold and silver ore from above the 400 level. New 75-hp. electric hoist and a 1000-cu-ft. electric-driven compressor is being installed. Surface improvements in course of construction at the Tong shaft are a new headframe, carpenter-shop and other plant buildings. Upon completion of improvements, shaft sinking will be resumed to a depth of 800 feet.

NEVADA

Nye County

WHITE CAPS (Manhattan)—Changes being made in mill progressing rapidly. Large new tube mill is over foundation. The motor for tube mill is coupled and the tube mill can start at any time. About only change not completed is changing the level of receiving tanks from the tube mill.

MANHATTAN CONSOLIDATED (Manhattan)—Raise between the fourth and third levels in the east orebody has been completed and connection was made to the third level Jan. 16. Raise shows 150 ft. between levels. The hanging wall of the

orebody was followed in the raise and the grade as disclosed between the levels shows an average of from \$40 to \$50 per ton. It is intended to start an intermediate crosscut from a point midway in the raise and demonstrate the width of the ore at this point between hanging and footwall. Installing large station pump on fourth level. Pump is 5 x 8 direct-drive Gould triplex with rated capacity of 100 gal. per min. at a 500-ft. head. Three shifts of shaft miners to be employed as soon as the sinking commences.

Storey County

ANDES (Virginia)—Saved 50 cars from 350 level, averaging \$8.50 per ton.

OPHIR (Virginia)—Extracted and sent to Mexican mill 75 cars of ore, sampling \$19.03 per ton.

JACKET (Gold Hill)—Put 539 tons of mine ore in mill bins. West side Kinkead mills, tables and old cyanidation plant operated. Working on new equipment.

UNION CON. (Virginia)—Mill returns for week totaled 10,400. Ore from vein in the 2400 level sent to Mexican mill. Assays comparatively low: 37 tons sampled \$28.57 per ton. Total of 346 tons averaged \$25.33, and 193 tons of wedge ore averaged \$8.98. Preparations for prospecting the vein in northeast drift of the 2500 level of Sierra Nevada proceeded. Compressed-air lines and water lines are to be laid.

NEW MEXICO

Grant County

JIM CROW (Steeplerock)—On 300 level an 8-ft. vein cut assaying \$75 per ton. Geo. H. Utter now working property.

PROGRESS MINE (Steeplerock)—Station being cut on 400 level and development continued. Chas. Hanson is manager.

SOUTH CHINO (Lordsburg)—Boston interests here week of Jan. 21 looking over Atwood mine. Only small work now being done.

BONNEY (Lordsburg)—Lawrence Mining Co. has water under control. Mining ore from rich pocket found in development. Small shipments.

85 MINING CO. (Lordsburg)—Annual meeting held Jan. 21. Sinking new shaft for development on Heroes group. Work on mill construction continues. Steel framing under way.

RIVAL MINING CO. (Steeplerock)—Temporarily closed to install steam equipment to handle water in development. Financed by Arizona capitalists of Bisbee and Douglas. Good showing in development so far.

Luna County

GAGE MINING COMPANY (Gage)—Operations ceased owing to death of Chas. Qualey in El Paso, who was main financial support of company. About one hundred men employed. Company was operating the old Victoria mines.

UTAH

Juab County

MAMMOTH (Mammoth)—Building of tram line one mile in length to Denver and Rio Grande track, in belief that saving in freight during period of 12 months will pay for work. Present charge 15c. a ton over branch line to Denver and Rio Grande. Shipments during 1917 amounted to over 40,000 tons, and equal or greater tonnage expected for 1918.

Salt Lake County

LITTLE COTTONWOOD TRANSPORTATION (Alta)—Expected to begin operation over eight-mile narrow-gauge road between Wasatch and Alta early in spring. Forty 6-ton cars just received and additional Shay engine, making second engine owned by company. Engines capable of hauling 12 to 15 cars in train.

Summit County

PARK CITY SHIPMENTS for week ended Jan. 12 amounted to 4,839,270 pounds.

THREE KINGS (Park City)—Shaft down almost 700 ft. and water coming in taken care of by 25-gal. pump. Larger plant adequate for all possibilities to be installed. Three shifts working.

SILVER KING CONSOLIDATED (Park City)—Purchase of California-Comstock for \$300,000 and payment completed, confirmed by statement to stockholders, called to meeting Jan. 31, for purpose of increasing capitalization from 700,000 to 1,000,000 shares. Reason for increase desire to expedite opening of new ground. In Thaynes Canyon section Spiro tunnel present length, 5000 ft. Company owns Ferry ranch, Silver Bell, Oldham group, Russian Bear, and

U. S. Consolidated. In purchase of latter group indebtedness incurred to be met during 1918.

Utah County

BELLEROPHON (American Fork)—Statement of work between July 26 and Dec. 5, when work discontinued for winter, shows 50 ft. of work done in winze; 30 ft. of timbering in main drift, and opening and retimbering of caved raise to surface, 72 ft. Shipped 18½ tons of ore from surface cut, bringing net returns of \$538, and ore estimated at 11,000 tons (milling) developed. Power-line survey made and new cabin built. Plans for new 50-ton mill made and some of machinery on hand.

CANADA

Manitoba

KAIN CLAIMS (Big Clearwater Lake-Rice Lake district)—Development work is being commenced on eight claims owned by a St. Paul-Minneapolis syndicate headed by E. E. Kain. Samples from a vein are stated to show high assays. Equipment will be sent in as soon as a winter road is available. Arthur Houle of Shattuck, Ariz., is in charge of operations. It is stated that the company the name of which has not yet been determined will be a close corporation and will put no shares on the market.

Ontario

SILVER-ORE SHIPMENTS FOR DECEMBER over the T. & N. O. Railway were: Aladdin, 43.50 tons (2000 lb.); Buffalo, 164.98; Coniagas, 165.14; Dominion Reduction Co., 327.75; Kerr Lake, 60.2; La Rose, 83.68; McKinley-Darragh, 169.1; National, 33.59; Nipissing, 87.54; Penn-Canadian, 27.88, and Trethewey, 20.76; total, 1184.1 tons.

HOLLINGER (Timmins)—One unit of 20 stamps of the new equipment tried out and found satisfactory.

HONER (Kirkland Lake)—Temiskaming, which holds an option on this property, has commenced development work.

MINING CORPORATIONS (Cobalt)—Production for 1917 is expected to have amounted to 5,100,000 ounces.

GIFFORD (Cobalt)—Vein 10-in. wide found in crosscutting at 350 level. Two calcite stringers heavily mineralized also cut.

NIPISSING (Cobalt)—December output will be the greatest on record of the mine. Production for 1917 will run over 4,000,000 ounces.

HUDSON BAY (Cobalt)—As the result of extensive sampling a large tonnage of low-grade ore has been indicated, which it is believed can be profitably treated.

PREMIER LANGMUIR (Porcupine)—Almost completed mill for treating 30 tons of barite per day. This will be the first barite to be milled in Ontario.

CROWN RESERVE (Cobalt)—Annual meeting to be held Jan. 23. It is expected that an announcement will be made that the option on the New Ray in Porcupine will be dropped.

KIRKLAND-PORPHYRY (Kirkland Lake)—Orebody when tapped by crosscutting at the 170 level shows 11 ft. of ore, stated to be over 30 ft. wide, of high grade. Shaft is being put down to 300 ft. depth.

DOVE (Porcupine)—Said to have cut 138 ft. of ore that runs \$22 a ton on the 800 level. There is a good deal of criticism of the controlling interest and plans are under way to get more representation on the board.

ALEXO (Porquis Junction)—During December 14 cars containing 1,010,800 lb. of nickel ore were shipped to the smelter of the Mond Nickel Co. at Coniston. The total shipments for the last eight months of 1917 were 8,016,500 pounds.

TOUGH OAKES (Kirkland Lake)—Main shaft has a depth of 400 ft. and a winze is down to the 500 level and lateral work has been carried from the 100 level downward. An intrusion of diabase all the way from the surface to the lower levels has shortened a number of the oreshoots.

COSTA RICA

COSTA RICA MANGANESE AND MINING CO. (Playareal)—First of company's motor schooners has been given a cargo and in last of December two more, the "Tempeste," of 1000 tons, and the "Guana-caste," of 2500 tons, were expected. A nine-mile automobile road from Playareal to their "Curio" mine has just been completed by the company, and two special 10-ton Mack trucks were to have been put in commission on the first of January.

CHOSEN

SEOULE MINING CO. (Hol-Kol, Hwang-Hai)—Operating Suan concession in Whang Hal Province, reports total recovery for December valued at \$207,050.

The Market Report

SILVER AND STERLING EXCHANGE

Jan.	Sterling Ex-change	Silver		Jan.	Sterling Ex-change	Silver	
		New York, Cents	London, Pence			New York, Cents	London, Pence
24	4.7515	87½	43½	28	4.7525	87½	43½
25	4.7515	87½	43½	29	4.7525	87½	43½
26	4.7525	87½	43½	30	4.7525	86½	43½

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London quotations are in pence per troy ounce of sterling silver, 925 fine.

DAILY PRICES OF METALS IN NEW YORK

Jan.	Copper		Tin		Lead		Zinc
	Electro-lytic	Spot.	N. Y.	St. L.	N. Y.	St. L.	St. L.
24	*23½	†	6½	6½	6½	6½	7
25	*23½	†	6½	6½	6½	6½	7
26	*23½	†	6½	6½	6½	6½	7
28	*23½	†	†	†	6.70	6.70	7
29	*23½	†	6½	6½	6.80	6.80	7
30	*23½	†	6½	6½	6.80	6.80	7

† No market.

* Price fixed by agreement between American copper producers and the U. S. Government, according to official statement for publication on Friday, September 21, 1917.

The above quotations (except as to copper, the price for which has been fixed by agreement between American copper producers and the U. S. Government, wherein there is no free market) are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for the deliveries constituting the major markets, reduced to basis of New York, cash, except where St. Louis is the normal basing point.

The quotations for electrolytic copper are for cakes, ingots and wirebars.

We quote electrolytic cathodes at 0.05 to 0.10c. below the price of wirebars, cakes and ingots.

Quotations for spelter are for ordinary Prime Western brands. We quote New York price at 17.5c. per 100 lb. above St. Louis.

Some current freight rates on metals per 100 lb. are: St. Louis-New York 17c.; St. Louis-Chicago, 6.3c.; St. Louis-Pittsburgh, 13.1 cents.

LONDON

Jan.	Copper		Electro-lytic	Tin		Lead	Zinc
	Standard	3 Mos.		Spot	3 Mos.			Spot	Spot
24	110	110	125	300	297	29½	54
25	110	110	125	299	296½	29½	54
26	110	110	125	298½	295	29½	54
28	110	110	125	297½	294½	29½	54
29	110	110	125	299	297	29½	54
30	110	110	125	299	297	29½	54

The above table gives the closing quotations on London Metal Exchange. All prices are in pounds sterling per ton of 2,240 lb. For convenience in comparison of London prices, in pounds sterling per 2,240 lb., with American prices in cents per pound the following approximate ratios are given, reckoning exchange at \$4.7515. £29½ = 6.2576c.; £54 = 11.4545c.; £110 = 23.3333c.; £125 = 26.5151c.; £260 = 55.1513c.; £280 = 59.3937c.; £300 = 63.6362c. Variations, £1 = 0.2121205c.

Metal Markets

NEW YORK—Jan. 30, 1918.

None of the markets exhibited any features of especial interest this week.

Copper—Refineries continued to experience operating difficulties and delays in receiving raw material. The production in December was a little less than that of November.

Copper Sheets are quoted at 31½c. per lb., f.o.b. mill, for hot rolled, and 1c. higher for cold rolled. Copper wire is quoted at 26@27c. f.o.b. mill, carload lots.

Tin—The market continues bare of supplies of Straits tin, and consequently no business is done. There were arrivals this week of 500 to 600 tons of Banka tin, some of which was offered at 85c.

Ricard & Freiwald report tin statistics as of Dec. 31, 1917, as follows: Stocks, landing and afloat, Europe and America: Stocks in London, 1847 tons; other United Kingdom ports, 773; landing and in transit, 1875; afloat from Australia, 54; spot and landing in United States, 497 tons. Monthly supplies: Standard arrivals in United Kingdom and America, 650 tons. Monthly deliveries: United Kingdom, 1696 tons; America, exclusive of Pacific ports, 2800 tons. Deliveries of tin into the United Kingdom for 1917 were 17,244 tons.

Lead—In its main features the market was unchanged from last week. However, some producers were free sellers and consequently the market exhibited an easier tone, incipient excitement among buyers having been allayed.

Zinc—Business was very dull at prices substantially unchanged. One or two sales for export were reported.

The most interesting feature of the week was the agreement on Jan. 24 with the War Industries Board of a price of 12c. for high-grade spelter, this to apply to the U. S. Government, to the Allies and to the public, and to prevail until June 1.

Zinc Sheets—Price of zinc sheets has not been changed. Demand is strong and the market continues at \$19 per 100 lb. f.o.b. Peru, Ill., less 8% discount.

Other Metals

Aluminum—This market is inactive at 36@38c. per lb. for No. 1 ingots at New York, but more active inquiry is reported.

Antimony—Dull and slightly easier. We quote spot at 14@14½c., and futures at 13c., c.i.f., in bond.

An important antimony house communicates the following interesting notes respecting the stocks of antimony and the reports of Government buying:

"Last week several hundred tons of antimony changed hands, but probably not half of what was sold went to consumers. Rumors of heavy Government buying were the cause of a flurry. There were some sales made to the Government, but not enough to have any influence on the market. Government statistics show that on Oct. 31, 1917, the stock of antimony in this country in bond was 4350 short tons. We may reasonably suppose that on the same date the duty-paid stock was half as much again as the bonded stock, or, say, roughly, a total of 6500 tons; in other words, more than the entire imports for the year 1913. The reason for the present disproportionate accumulation of stock is not hard to find. The spectacular conduct of antimony early in the war drew a great number of speculators into it, and these speculators seem to be persuaded that sooner or later the Government must become a buyer of large quantities. Hence the very large arrivals from the Orient during the last seven or eight months. In October alone the imports of metal were 1750 short tons. There is no indication of a change of policy. Large quantities are still coming, and if the war should cease the country would probably find itself with sufficient on hand for a year or more. The supply in China is practically unlimited and costs apparently have not increased as much as has been generally believed. The cessation of buying by Russia may also have diverted some tonnage to this market. Imports of metal in 1915 were 6900 short tons, 9100 in 1916 and 15,200 short tons in 1917. There is good reason to believe that the consumption of antimony in 1917 was not so large as in 1916. In 1916 the country had a good many foreign contracts for shrapnel balls. In 1917 it had few such contracts."

Bismuth—Unchanged at \$3.50 per lb. for the pure metal.

Cadmium—This metal is quoted at \$1.50 @ 2.00 per lb., depending on the quantity.

Nickel—Steady at 50c. per lb., premium of 5c. per lb. for electrolytic.

Quicksilver—Spot continues in small supply, but liberal quantities are reported to be moving eastward. The market is unchanged at \$130@135 for spot, and \$125 for shipments to arrive. San Francisco reports, by telegraph, \$117.50, strong.

Gold, Silver and Platinum

Silver—The market has shown a slight downward tendency. Fresh business from San Francisco to the East seems inactive at present. The London market continues to absorb a moderate amount of silver. There seems to be nothing new in regard to the Government taking over the product of our mines at a fixed price.

Mexican dollars at New York: Jan. 24, 69c.; 25, 69c.; 26, 68½c.; 28, 68½c.; 29, 68½c.; 30, 68½c.

Indian currency returns of Dec. 31, 1917, according to Pixley & Abell, show the holding of rupees to have been 1905 lacs, comparing with 1736 lacs at the end of the previous year. In Bombay, there were stocks of 3700 bars, and at Shanghai 22,500,000 taels of sycee and 13,200,000 Mexican dollars.

Platinum—Unchanged at \$106@108. Demand continues good.

Palladium—Unchanged at \$135, strong.

Zinc and Lead Ore Markets

Joplin, Mo., Jan. 26—Blende, per ton, high, \$70.25; basis 60% Zn, premium, \$67.50; medium to low, \$60@50; calamine, per ton, 40% Zn, \$33@30; average selling price, all grades of zinc, \$52.41 per ton.

Lead, high, \$86.50; basis 80% Pb, \$86@85; average selling price, all grades of lead, \$77.67 per ton.

Shipments the week: Blende, 7114 tons; calamine, 252 tons; lead, 1172 tons. Value, all ores the week, \$477,480.

Advance purchases have continued to be made, even though shipping was exceedingly slow, until the smelters now own practically all reserve ore in the district; approximately 100 cars of ore are standing on tracks all the time, waiting orders for removal. The embargo east of St. Louis has been lifted to the Indiana line, but this still interferes with shipments to Eastern smelters. Severe cold has reduced production to a point below the demand.

Platteville, Wis., Jan. 26 (By telegraph)—Blende, basis 60% Zn, \$62 base for premium grade down to \$52 base for second grade. Lead ore, basis 80% Pb, unchanged at \$80 per ton. Shipments reported for the week are: 2685 tons of zinc ore, 43 tons of lead ore and 669 tons of sulphur ore. Shipped during the week to separating plants, 2380 tons of zinc ore. Shipments still curtailed by snow blockade and embargo.

Lead ore produced in the Wisconsin district in 1917 was 6054 tons. In the Platteville letter of Dec. 29, 1917, published in the "Journal" of Jan. 5, 1918, it was incorrectly stated that the total lead ore produced in the district in 1917 was 7154 tons. The real increase in production over 1916 was 1464 instead of 2544 tons.

Other Ores

Manganese Ore—Metallurgical ore unchanged at \$1.20 per unit.

Molybdenum Ore—Quoted at \$2.15@2.20 per lb. of molybdenum sulphide for the 90% grade. Several sales of lower grade ore, 65% molybdenum sulphide, were made at \$1.80 per lb.

Pyrites—Spanish lump is quoted at 15½c. per unit, on basis of 10s. ocean freight, buyer to pay excess freight and war risk, except that, depending on conditions, concession of 2% of war risk may be allowed. Ocean rates remain at 35s. for Northern, 40s. for Southern and 42s. 6d. for Gulf ports, but recent charters have exceeded these rates in several instances.

Tungsten Ore—Scheelite, \$26 per unit. Wolframite quotations ranged from \$26 down to \$20, according to grade.

Iron Trade Review

PITTSBURGH—Jan. 29

While the steel trade has hopes that the drastic means being employed to improve the railroad situation will bring results, it finds no improvement thus far, but rather a further trend in the wrong direction. The steel industry was suffering chiefly from two things, an insufficient movement of coke from the Connellsville region, whereby blast-furnace operations have been down to between 60 and 70% of capacity, on an average, and an inability to ship all the finished steel that could be made. In neither of these respects have conditions improved up to date. For weeks past the shipments of finished steel have been less than production, even though production was greatly curtailed, and in the last week there has been additional accumulation of finished steel in mill warehouses and yards, resulting in the closing of some additional departments because it was physically impossible to store more product.

The hopes of the steel industry center chiefly upon the weather moderating, or rather staying moderate, as yesterday and today have shown practically seasonable temperatures. It is believed that the railroads can recover from their blockaded condition of the weather permits. The embargoes ordered last Wednesday by those in control at Washington, on the Pennsylvania lines east of Pittsburgh and the Baltimore & Ohio east of the Mississippi River, simply supplement a group of embargoes already in effect, but reduce to practically nothing the number of permits granted to pass through the embargoes. Very little steel has been shipped east from the Pittsburgh and valley districts for some time, but there are a few outlets west. The most interesting item in this direction is that the American Sheet and Tin Plate Co. is making up a shipment of 100 carloads of tin plate for the Pacific Coast salmon industry, and this shipment is expected to get through in good time. The tin-plate mills were exempted from the plant-closing order and have been operating to the extent that the steel supply permitted. Many plants are on the verge of closing, however, on account of filled warehouses.

Pig Iron—The merchant furnaces in the valleys and western Pennsylvania generally are getting out about 70% of their normal output, representing a somewhat lighter rate of operating than obtained a few weeks ago. The output is below contract requirements and is going out to points not embargoed to the extent of nearly the full production. There is nothing being done in the market, except that occasional sales of foundry iron are being made for the second half of the year, with a clause to adjust the price to any new Government price that may be made before time of shipment of each lot. Set prices remain: Bessemer, \$36.30; basic and No. 2 foundry, \$33; malleable, \$33.50; gray forge, \$32, f.o.b. furnace, freight to Pittsburgh in the case of the valleys being 95 cents.

Steel—The market is very quiet. There is some demand for soft steel billets and sheet bars, but no material available. There are fairly free offerings of shell-discard steel, rolled to various billet sizes, but only a limited demand for this steel, prices being a few dollars a ton below the set prices for soft steel, which remain as follows: Billets, \$47; sheet bars and small billets, \$51; slabs, \$50; wire rods, \$57.

Ferroalloys

Ferromanganese—While inquiry is limited, offerings are still more limited, and the market is strong at \$250 for prompt or forward.

Coke

Connellsville—Production has been greatly restricted in the last three weeks, being about 60% of the rate obtaining in 1916, but car supplies began to show a slight improvement late last week, and this week is expected to make a decidedly better showing, provided the weather remains moderate. There are considerable stocks of coke in the region, but no hope of moving them at present. The cross movements so much complained of are now being rapidly eliminated and nearly all the coke shipped is going to nearest point of consumption measured on the rails, irrespective of who bought or sold it originally. The objection to these interchanges on the part of shippers suddenly disappeared early in January. There are no open-market transactions, the limited production being fully absorbed by contracts. Set prices remain at \$6 for furnace, \$7 for 72-hour selected foundry and \$7.30 for crushed, over 1 inch.

STOCK QUOTATIONS

Table with columns: N. Y. EXCH.† Jan. 29, BOSTON EXCH.* Jan. 29. Lists various stocks like Alaska Gold M., Alameda Juneau, Am. Sm. & Ref., etc.

N. Y. CURB† Jan. 29

Table listing various commodities like Big Ledge, Butte & N. Y., Butte & C. Z., etc.

BOSTON CURB* Jan. 29

Table listing various commodities like Alaska Mines Corp., Bingham Mines, Boston Ely, etc.

SALT LAKE* Jan. 23

Table listing various commodities like Bannack, Cardiff, Colorado Mining, etc.

TORONTO* Jan. 26

Table listing various commodities like Adanac, Balley, Beaver Co., etc.

STOCK QUOTATIONS—Continued

Table with columns: COLO. SPRINGS Jan. 28, LONDON Jan. 11. Lists stocks like Cresson Con., Doctor Jack Pot., Elton Con., etc.

* Bid prices. † Closing prices. ‡ Last Quotations.

MONTHLY AVERAGE PRICES OF METALS

Table showing monthly average prices for Silver and Copper from 1915 to 1917, with columns for New York and London.

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

New York and London

Table showing monthly average prices for Tin from 1916 to 1917, with columns for New York and London.

Lead

Table showing monthly average prices for Lead from 1916 to 1917, with columns for New York and London.

Spelter

Table showing monthly average prices for Spelter from 1916 to 1917, with columns for New York and London.

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

Pig Iron, Pgh.

Table showing monthly average prices for Pig Iron, Bessemer, Basic, and No. 2 Foundry from 1916 to 1917.

‡ As reported by W. P. Snyder & Co.

The Mining Index

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