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Stripping with Drag-Line Excavators

By L. E. Ives*

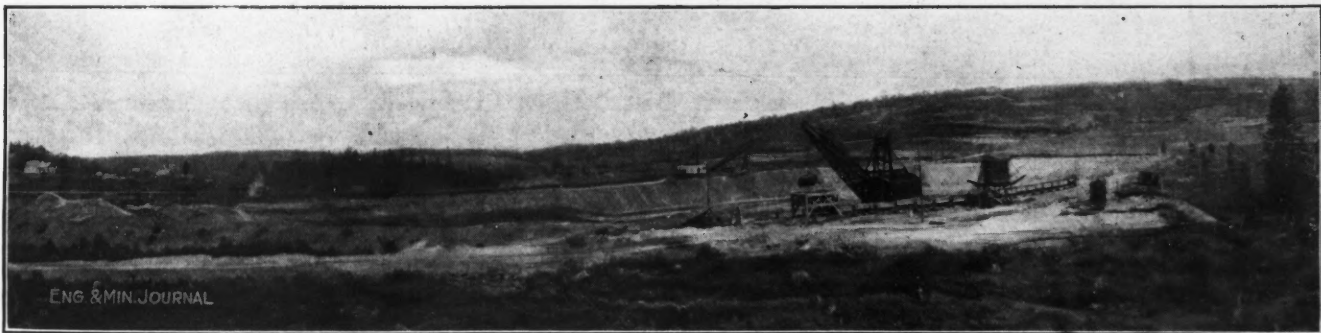
SYNOPSIS—At the Balkan mine in the Menominee region of Michigan, sand and water led to the use of drag-line machines instead of steam shovels for removing the overburden. Innovation was successful. One Bucyrus and one Marion machine used. Detailed mechanical description of each.

The Balkan mine of Pickands-Mather is being opened on the famous Mastodon find of the E. J. Longyear Co., at Alpha, Mich., near Crystal Falls. At this mine, for the first time on any of the Lake Superior iron ranges, drag-line excavators have replaced the familiar steam shovels for stripping the overburden and the results are eminently satisfactory.

REASONS FOR CHOOSING DRAG-LINE MACHINES

The principal factors leading to the selection of drag-line machines were the nature of the material, largely sand, and the fact that a good deal of water was expected. It was contended that the combination of sand and water offered a bottom which would not support a steam shovel, and furthermore the steam shovel is not an elastic machine; it must keep close to its work and must be on the same elevation as the cut, an important consideration in this case. The drag-line machine, on the other hand, remains on the surface and takes a first cut below its own elevation, the depth and slope of the cut depending on the size of the machine.

Under the contract the Balkan Mining Co. handles the water in the pit and the contractor the dirt. It was



THE BALKAN PIT, MICHIGAN, IN PROCESS OF STRIPPING

When it was decided to strip the overburden and mine the ore in an openpit, the Winston Bros. Co., which has done a great deal of stripping on the Mesabi, was asked to bid on the work. The job was a large one, calling for the removal of 1,200,000 cu.yd. before July, 1915, and bids were not called for until March, 1914. The Winston company made a preliminary examination and was convinced that the only way the work could be handled successfully would be through the use of drag-line machines, and that these would have to be larger than those it had used before on railroad work. Therefore when it got the contract it immediately ordered one Marion and one Bucyrus drag-line bucket excavator. The mechanical descriptions and features of these machines will follow later.

reasoned that with the drag-line machines a first cut could be taken all around the pit with the machines on the surface and that this would give the mining company a chance to drain the water from the ground to an extent sufficient to provide a suitable bottom from which the machines could take their second cut, for it is a well known fact that quicksand drained to a depth of 3 or 4 ft. constitutes an excellent bottom for supporting heavy loads. With the first cut nearly completed at the time of visiting in August, it was evident that the contractor had judged correctly, for it was evident that no steam shovel could have been kept upright long enough to dig, on the bottom presented by the quicksand after the first cut had been taken in it. It was literally soup.

Another advantage of the drag-line is that it requires no blasting. And finally it has a greater range of ver-

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tical lift and therefore necessitates less climbing on the part of the train and locomotive.

The Balkan pit itself is oval in shape, with axial dimensions 1100 ft. and 700 ft. The general trackage arrangement and operation of trains are patterned after the Mahoning pit on the Mesabi. The first bench will spiral down with sides sloping 2:1 and a track grade of 26%. The depth of the overburden varies from 60 to 100 ft. At some place lower than the first bench, hardpan is expected, but the contractor believes the Page buckets which are being used, built by the Page Engineering Co., of Chicago, will handle the hardpan without difficulty, and judging from their weight, 11,800 lb. empty, this does not seem unreasonable.

METHODS AND PERFORMANCE

Before the pit was opened plans for working it were drawn up and operations were started according to these plans. It was intended to work on two or three benches with cuts of about 30 ft. each. It was found, however, that the slopes would not stand and the continuous spiral

An interesting feature of the excavating is the manner in which the machines propel themselves when a change of site is necessary. The underframe is supported on rollers which rest on planking on the ground. When it is desired to move, the bucket is simply thrown out, dropped, and used as an anchor. The line to it is used as a dead line, and by pulling against this, the shovel propels itself toward the bucket.

NECESSITY FOR A LOADING HOPPER

The capacity of the Page buckets is larger than that of the contractor's cars. Therefore, when loading directly into the cars, it was found that much dirt was spilled on the ground and track, blocking the cars and sometimes derailing them. The hopper shown in one of the illustrations was therefore built and put into use; it permits the trains to pass beneath it and each car in turn is centered under its mouth. In this way the dirt is guided into the cars more satisfactorily. The hopper sides are lined with hard maple, which is asserted to be superior to sheet iron for the purpose, since it wears smooth and



THE BUCYRUS

Dumping the load into the loading hopper.

plan was finally decided upon. It has been found necessary to use 35° curves in the track arrangement and this forced the use of contractor's equipment rather than of the standard railroad type, as would have been preferred. The larger equipment would have permitted an increased output, but even with the smaller equipment some excellent records have been made. During July the two machines together moved 206,000 yd., 103,000 yd. apiece; good steam shovel performance on the Mesabi range is from 70,000 to 80,000 yd. in 26 working days, with an occasional production under unusually favorable conditions of 100,000 yd. It is only fair to say, though, that the material being handled at the Balkan is ideal for a drag-line machine, consisting as it does largely of sand, gravel and clay. At the time of visiting one machine was loading 400, the other 600, four-yard cars per 10-hr. shift. The discrepancy was due entirely to the position of the slower excavator which was temporarily so situated that only a limited number of cars could be served to it. Before closing down for the winter, Winston Bros. expected to move a total of 900,000 yd., leaving 300,000 to be handled during next spring and in the early summer, with ample leeway for additional new material that may have to be moved. On the entire work there are employed 170 men divided into two 10-hr. shifts.



THE MARION

Taking up a 4½-cu.yd. load.

shiny and offers a better sliding surface. The trains are made up of 10 cars and a dinkey locomotive, three trains serving each shovel.

THE BUCYRUS MACHINE

The Bucyrus machine is a Class 24 drag-line excavator, having a turntable diameter of 24 ft. The standard machine of this class has a 100-ft. boom and a 3½-cu.yd. bucket. This machine, however, has an 85-ft. boom and a 4½-cu.yd. bucket, the variation from the standard being determined probably by local conditions. The engines are self-contained on one-piece bases and are the same as those used on the larger Bucyrus shovels. The drums, engines, etc., are mounted on a structural-steel base, a strong and flexible arrangement designed to obviate cracked side-frames. The gears are steel castings with machine-cut teeth and the shafting is extra large. The hoisting and drag-line frictions are of the outside-band type with large friction surface. The sheaves are steel castings with turned grooves and bronze-bushed hubs; their diameter as well as that of the drums is large, to reduce wear on the cables.

The fair-lead consists of two horizontal sheaves mounted on a casting riveted to the front sill of the machine. The two vertical sheaves are carried in a swing-

ing frame pivoting on the first casting, which allows them to turn in the direction of the drag line and give it a straight lead in a vertical direction. The rope as it enters the machine thus travels over sheaves which are in line with the strains so that little slipping occurs and wear is reduced. The digging rope is $1\frac{3}{8}$ in. The main engines are double, $10\frac{1}{2}\times 12$ in.; the swinging engines are double, 8×8 in. The locomotive-type boiler is 58 in. in diameter and 15 ft. long with a working pressure of 125 lb. The boom suspension is operated by a drum geared to the main engine. The shipping weight of this machine without counterweight is 112 tons.

THE MARION MACHINE

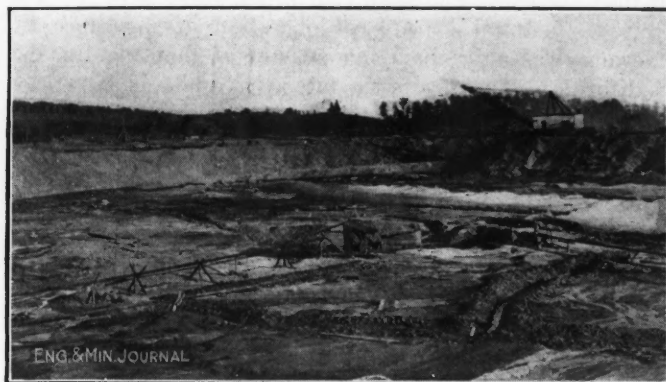
The Marion excavator also has an 85-ft. boom, a $4\frac{1}{2}$ -cu.yd. bucket and a 24-ft. turntable. The lower frame is 24 ft. square, built up of structural-steel shapes and plates. The turntable itself is of the roller-bearing type. The upper or rotating frame is constructed entirely of structural steel. The fair-lead for the drag rope is mounted in the bracket at the front of the frame and consists of two vertical and two horizontal sheaves of large diameter, fitted with the necessary guides and so arranged that the cable can pass over them without fouling, for any position of the bucket.

drag rope is direct-connected to the drag chains on the bucket, while the hoisting rope passes over a sheave in the bail and is anchored to the point of the boom. The boom-hoist cable is reeved between sheaves in the frame and the support bail on the boom and leads to the boom-hoist drum.

With the boom at a 30° angle, the maximum height of dump above the bottom of the rollers is 15 ft.; the maximum depth of cut below the bottom of the rollers, 45 ft.; the maximum reach from pivotal center, 84 ft.; the radius of cut, 84 to 102 ft. The size of the hoisting cable is 1 in.; of the drag cable, $1\frac{1}{4}$ in.; of the boom-hoist cable, 1 in. The approximate shipping weight less ballast is 252,000 lb.; the approximate working weight, 315,000 pounds.

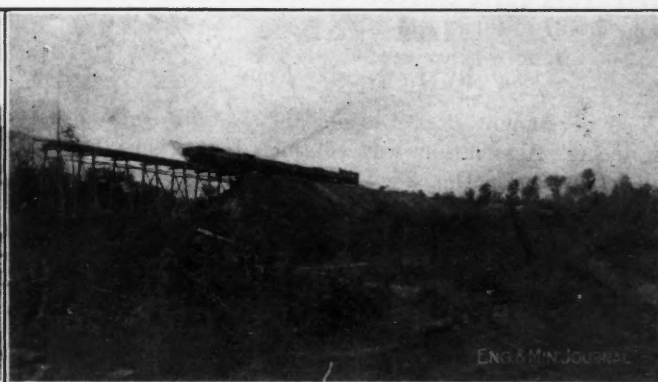
ADVANTAGES OF DRAG-LINE MACHINES

For many classes of work the drag-line machine is supplanting hand and team labor, the steam shovel and the dredge. In mining operations, it has already found a field of usefulness in the stripping of coal and phosphate properties, and now in iron mining. There are a number of reasons for this, but the most prominent advantages seem to be: (1) The wide radius of action, requiring less moving and making it possible to deposit material far



BOTTOM AFTER FIRST CUT

Showing drainage trenches, pump station and spiral-riveted discharge pipe.



STRIPPING DUMP

Note favorable start out from hill.

The main engines are double, horizontal, side-crank type, with 12-in. bore and 14-in. stroke. The machinery frame, in addition to supporting the engines, also carries the intermediate or clutch shaft and the drag-drum shaft. The hoist and drag drums have grooved barrels and are provided with two housings of large diameter and wide face, one for the friction band and one for the lowering or check band. The drums are actuated by steam-set frictions of the outside-band type. The boom-hoist drum is mounted at the rear of the machinery frame between the engine cylinders, and is driven from the intermediate shaft through bevel gears. The rotating engines are double, horizontal, center-crank type with 9-in. bore and 9-in. stroke, reversed and controlled by a central valve, requiring but one operating lever. The locomotive boiler is 60 in. in diameter and 17 ft. long; the maximum allowable steam pressure varying from 135 to 150 lb., although the pressure used is 125 lb. The operating levers are banked in quadrants at the forward end of the rotating frame on the left-hand side and are arranged to give the operator a clear view of the work. The boom is fitted at its point with a sheave for the hoisting cable in addition to the bail and sheaves for the boom-hoist cable. The

enough from the cut to keep the weight off the banks and prevent caving; (2) the possibility of digging a much better slope than can a dipper dredge or steam shovel; (3) a reduction in the amount of rehandling of material and the necessary equipment therefor; (4) the ability to dig wet material below the level on which the machine stands, where a steam shovel would be drowned out; (5) the fact that a skilled operator can throw the bucket from 10 to 30 ft. beyond the end of the boom, depending upon the size of the machine and the conditions under which it is working, thus still further increasing the radius of work.

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Mine Lessee's Liability for Royalties and Damages

By A. L. H. STREET*

In a recent suit (Northern Light Mining Co. vs. Blue Goose Mining Co., 143 *Pacific Reporter* 540) to recover royalties due under a placer-mining lease, and damages for claimed breach thereof by the lessee, the California

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District Court of Appeals decided that where such a lease calls for payment of an annual royalty, without fixing a time of payment, the amount falls due at the end of the year; that where the place for payment is not specified, tender should be made on the premises, and payment should not be withheld for omission of the lessor to fix a place, in the absence of notice to him requiring him to do so; and that suit for royalties may be brought after they are due, although no demand for payment has been made, if it appears that a demand would have been useless.

On the question of damages for the lessee's failure to continue operations required by his contract, it is held that proof as to the number of cubic yards of gold-bearing gravel that he could have mined by using reasonable diligence to perform his contract, and the best obtainable royalties obtainable elsewhere at the time of the breach, for working the claim, affords sufficient basis for computing the damages recoverable. The court declared that the lessor is not bound to work the claim himself or obtain someone else to do so as a condition precedent to recovering damages.

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California Mine Owners Discuss Insurance

BY LEWIS H. EDDY

The permanent organization of the California Metal Producers' Association was completed at a meeting in San Francisco on Oct. 28. The meeting was attended by 30 mine owners or managers, representing some of the largest operations in the state. The following named were elected officers and executive committee: A. Burch, representative Bewick, Moreing & Co., president; George W. Metcalfe, manager Mammoth Copper Co., vice-president; E. C. Hutchinson, president Kennedy Mining & Milling Co., San Francisco, vice-president; George W. Starr, manager Empire mine, Grass Valley, Nevada County; C. G. Knox, manager Black Oak Development Co., Berkeley; S. W. Mudd, manager Tumco Mine Co., Los Angeles; Newton Cleaveland, manager Yuba Construction Co., San Francisco. On Nov. 4 the organization selected John Mocine, of Nevada, for the position of secretary-treasurer. Mr. Mocine has had experience with a similar organization in Nevada and will become a resident of San Francisco when he undertakes the duties of the position. At the meeting on Nov. 4 the president of the association appointed a committee on workmen's compensation and insurance, naming E. C. Hutchinson, George W. Starr, and Newton Cleaveland. The executive committee will meet again on Nov. 17, and the association will meet again on Nov. 25.

On Nov. 5 the California Industrial Accident Commission held a public meeting, having invited a large number of metal producers and mine managers to participate in a conference regarding the insurance rates charged by the insurance department of the commission. The mining industry was represented at this meeting by members of the California Metal Producers' Association. The meeting was presided over by Mr. Pillsbury of the commission and was attended on the part of the commission by Col. Weinstock and Mr. French, members of the commission, Mr. Fellows, manager of the insurance de-

partment, Mr. Leslie of the same department and Mr. Wolfkin of the safety department. The principal subject discussed was the high rate of mine insurance charged by the state and the fact that the insurance department of the commission has not undertaken to write unlimited insurance on mining risks, declining anything further than the sum of \$10,000 on a single risk.

Mr. Burch, who is conducting mining operations in Nevada and California, recited briefly the history of the working of compensation and insurance in Nevada and showed that the insurance department of that state started without legislative appropriation and has written \$250,000 of insurance, and has operated at a cost of 10% of premiums collected, plus about $\frac{3}{5}$ of 1%, which it found necessary, and for which an appropriation will be asked of the legislature.

The California insurance rates carry a load of 40% for expenses and the insurance department of the commission shows that about one-third of the amount paid out in risks is expended in medical assistance for injured men. The Nevada showing is much less than this. But it must be remembered that the insurance department in Nevada pays nothing for medical assistance, which is provided for by a monthly assessment upon the workmen. The Nevada compensation is only 50% of the wages earned, as against 65% in California. As stated by Mr. Burch, the total expense of operation of insurance in Nevada was only about one-quarter of that required in California. The insurance rate in Nevada is less than 3% of the payroll, while the rate in California is nearly 8%. But the situation in Nevada referred to by Mr. Burch covered mine accidents, while California does not give its mines unlimited insurances, but has written \$500,000 insurance on other industries.

The mine owners and managers, so far as represented at this meeting, are apparently in favor of state insurance provided the state will write such insurance and write it at a reasonable rate. It was made plain that there was little disposition on the part of the mining men to encourage mutual-insurance plans, which would require the loaning to the state of sufficient funds by the mine owners, to carry out insurance.

It was held by the representatives of the commission that the high rate charged was for the purpose of taking care of extra hazardous risks such as great disasters in which a large number of men may be killed at one time. But in the history of California mining there have been, so far, no great disasters of this character. There have been some close chances taken in some deep mines provided with only one exit, and in some instances there are inflammable structures near intake airways and danger from underground fires in timbered mines. But these dangers should be very largely reduced by carrying out the careful plans in process by the commission in cooperation with the Bureau of Mines.

It is fortunate the metal producers had completed their permanent organization prior to the meeting of the mining men with the commission. When the representatives of the mining industry spoke at the meeting with the accident commission, they spoke not only as individuals representing their own particular operations, but they spoke as a representative body of strong and influential mine owners and managers; and what they said or may say must have weight not only with the commission but with legislators.

The Law of Crushing--II

By H. STADLER*

SYNOPSIS—Having shown the known laws of physics to favor Kick's law, the previous discussion on the subject is reviewed and shown to indicate the same thing. Practical examples in many cases support Kick's formula. The energy-unit comparison for crushing machinery is based on Kick's law, and the methods of utilizing it in practice are shown.

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Readers of the JOURNAL have been so well kept *au fait* with the argument that it may be opportune to make through this medium a few remarks on other contributions of recent times, as far as they have come to my knowledge.

DEL MAR'S COMPARISONS

Algernon Del Mar,⁶ in a praiseworthy effort to get at the truth, works out some comparisons of efficiency calculations by using the surface method (Rittinger's law) and the volume method (Kick's law), but he was unfortunate in selecting his examples. First he compares the efficiency of the same stamps crushing through a 12- and a 4-mesh battery screen, and finds by an elaborate calculation by the surface method, an efficiency ratio of 8:11 in favor of the 4-mesh screen. However, as the gradings given are, within a limit of 5% allowed by him for accuracy of screening, practically identical for both screens, he would have saved time by simply taking the proportion of the duties of 6 tons and 8.46 tons, respectively (all other factors being equal), which, reduced to above, works out at 8:11.28. In a second example, he compares the efficiencies of a Nissen stamp with a 5-stamp unit and found a ratio of 1:0.59 in favor of the Nissen stamp by the surface method, and of 1:0.56 by the volume method. Here again the gradings are practically identical and the efficiency ratio is therefore at once given by the ratio of the only different factor; of the quotient of duty into power consumption, which works out at 1:0.55. With identical gradings the application of all laws of crushing are bound to give identical results. In passing, I may remark that difficulties experienced in obtaining reliable tonnage and power measurements are evidently responsible for an experimental error. The figure of a 50% higher efficiency for the Nissen stamp is obviously unreasonable and not borne out by other tests.

The example of the two tube mills, shown in the table, dealing with feeds of different coarseness under similar other conditions, is best adapted for analysis:

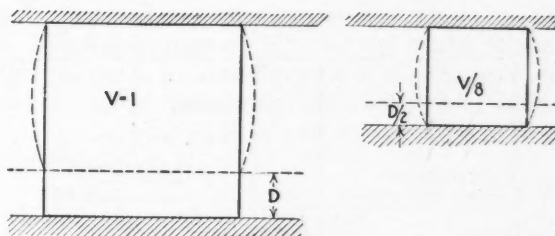
COMPARISON OF TUBE MILL WORK

	Tube Mill I		Tube Mill II	
	Duty per Day, Tons	Power Consumption	Duty per Day, Tons	Power Consumption
	75	30 hp.	25	25 hp.
	} 2.5 tons per hp.		} 3 tons per hp.	
Mesh	Intake	Discharge	Intake	Discharge
120	39.2%	63.6%	20.7%	30.5%
Comparative mechanical efficiency:				
Surface method.....	12,750 energy units per hp.	11,771 energy units per hp.		
	Increase 8.7%.			
Volume method.....	447 energy units per hp.	531 energy units per hp.		
	Increase 19%.			

*Care Royal School of Mines, So. Kensington, London, S. W., Eng.

⁶"Eng. and Min. Journal," Dec. 14, 1912.

The surface method having been proved to be based on error, the onus of proof that the greater efficiency shown by this method in favor of tube mill 1 lies on the other side. A most important fact must, however, be kept in mind. The factors, or multipliers, representing the average size of the grade passing the finest mesh employed can only be determined by approximation, but Mr. Del Mar says, "Any reasonable average will be fair alike for both machines." In this generalization the statement is not correct because the average size of the comparatively small percentage on the —120 grade of the second tube mill is naturally coarser than the average size of the considerably larger percentages on the same grade of the first tube mill. By applying in both cases the same factors, no credit is given to the first tube mill for the work performed in reducing a larger percentage of the —120 grade to overdone slime. From the metallurgical point of view we may purposely use for the totals of the finest grade a conventional standard independent of the true value of the actual average sizes, but then the efficiency values determined refer not really to the mechanical efficiency but they include a concession to the economical efficiency.



KICK'S LAW
 Example of Proportions
 Area on face A: $A/4$
 Average resisting force per sq. in. $F: F/4$
 Deformation $D: D/2$
 Energy $FAD: F(A/4) \times (D/2) = FAD/8$
 = $1:1/8$ or as volume

FIG. 9. KICK'S LAW

In order to make a rough correction, we may take, for the sake of argument, instead of the multiplier of 253, brought by Mr. Del Mar into account for the —120 grade, the higher value of 400 (applied by him in another example for the —200 grade) for the surface method, and of 26 against 24, respectively, for the volume method. The increase of the mechanical efficiency then works out in both cases in favor of the first tube mill; by the surface method, 94%; by the volume method, 7.5%.

In consequence of the rapid progression with which the surface factor increases with the fineness of the grades, an absurdly high efficiency is shown by the surface method for the first tube mill. The volume method, on the other hand, leads to a possible figure which is in logical agreement with the reasoning that the mechanical efficiency cannot differ much if all the work done in over-grinding the —120 grade is duly brought into account. As the mechanical losses by vibration, production of heat, sound, etc., are in this case very likely the same for both machines, a relatively greater loss shown for one

machine must be accounted for by the production of a larger amount of ultra-fine slime.

A. O. GATES' ARGUMENT FAVORING RITTINGER

Arthur O. Gates,⁷ in an elaborate article, breaks a lance in favor of Rittinger's law, which he believes to be more applicable to the study of crushing efficiency than that of Kick. Based on deduction drawn from Fig. 9, he admits that in this particular instance the energy absorbed is proportional to the volume. The first error creeps in when he limits the operation of this law to deformation within the limits of elasticity during which the molecular bond is only temporarily strained but not interrupted. Perfectly elastic materials do not exist, and we know (Bauschinger, Bach and others) that the application of any force, feeble though it may be, has always a permanent set as result. This permanent deformation may be so small that it is not measurable, but that it exists is proved by the fatigue to which finally any spring must succumb when the alternate exertion and release of the stresses is repeated millions of times.

With reference to Fig. 10, Mr. Gates claims to explain how Rittinger's law applies. Supposing, he says, that forces were applied on the two offset faces until the deformation shown by the dotted lines was obtained, it will be seen that only the molecules along the vertical center line are stressed and deformed, "the mass of the cube away from this surface receiving practically no pressure or deformation." The only excuse for venturing

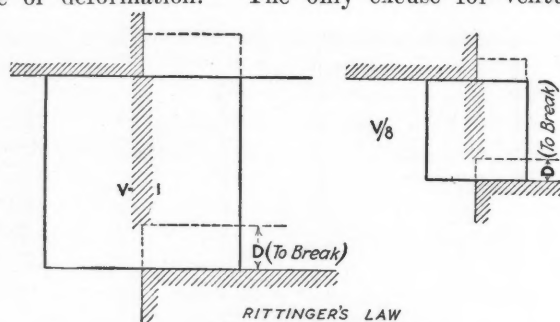


FIG. 10. RITTINGER'S LAW

such a bold statement is the quite arbitrary assumption that the material on which the external force acts be perfectly rigid and inelastic. In this fictitious and impossible case the force would act in the fracture plane itself, but then the distance which the external force has to overcome to do mechanical work would also have vanished. Not the work, but the force alone is in this ultimate hypothetical case proportional to the area of fracture. Both cases are exactly alike, as also in Fig. 9 the force would act in the fracture planes themselves if also here the material is assumed to be perfectly rigid and incompressible. Such a state is actually reached at the moment immediately preceding the rupture, when at the end of the performance of work the opposing stresses yield to the pressure. The breaking loads ascertained by testing machines measure, therefore, the stresses, and not the work spent upon producing them.

The most interesting remaining portion of the article in which Mr. Gates reduces the work done in crushing

to graphic form would have been much more appreciated if the examples selected had not been based on a wrong law.

CONFORMITY OF OPINION BY J. W. BELL

The metallurgical staff of the McGill University was the first to give early appreciation to my suggested system of applying grading analyses in connection with Kick's law to the computation of crushing efficiency. In 1911, on the occasion of H. S. Ball's experiments on tube-mill efficiency, it was, after careful consideration, unanimously decided that my method would in future be applied to all crushing tests carried out in the mining laboratory. The McGill University report of the same year states that the results of a large series of experiments directed to settle the truth of the laws of crushing agreed with Kick's law to within the reasonable limits of error of experiment on so variable a material as broken rock. In a later article,⁸ Mr. Bell worked out a most interesting extension of the practical applicability of my method. By using the data given by Messrs. Cætani and Burt, of tests carried out by them at the El Oro mill in Mexico,⁹ he studied the possible relations between the volume grades and the corresponding gold and silver extractions. It was at once apparent that the curves of the plotted results were straight lines, showing that extraction and volume vary very closely in the same proportion. Another important conclusion arrived at was that the extraction does not seem to be proportional to the increase of surface exposed, since the surface exposed increases at a rapid progression from one grade to another while the increase in extraction appears to be constant for a great interval. By prolonging the curve until it intercepts the parallel to the abscissa at 100% extraction, the fineness of the ore can be read off at which total extraction would be obtained. The value thus found for the limit of fine grinding at which the highest metallurgical efficiency is obtained is a valuable guide for the estimation of the critical size of the economical efficiency which, of course, is reached before the end limit of the estimated total extraction.

ARTHUR F. TAGGART'S ARGUMENT FOR KICK'S LAW

After a careful analysis of the proofs adduced for and against the various crushing laws, Arthur F. Taggart¹⁰ arrives at the conclusion that Kick's law is unquestionably correct for all substances where the changes of configuration are within the elastic limit. Mr. Taggart, like Mr. Gates, appears to take exception to the applicability of the law during the stage of permanent deformation taking place between the so called limit of elasticity and the point of final rupture. He adds, however, that these points so closely approximate one another that this permanent deformation can for all practical purposes be neglected. It has already been shown that the term "limit of elasticity" in the sense applied by him is misleading and would be better called "limit of plastic deformation" because the curve for compression of materials such as are generally subject to crushing show in strain-stress diagrams no bow, and it is, with the exception of a slight swell at the start, an uninterrupted straight line until the upset point is reached. The law holds good, therefore, right up to this point and does not need a con-

⁸"Eng. and Min. Journ.," May 24, 1913.

⁹"Trans.," A. I. M. E., Vol. 37.

¹⁰"Trans.," A. I. M. E., February, 1914.

⁷"Eng. and Min. Journ.," May 24, 1913.

cession of elbow room for accuracy. In tensile tests of ductile materials the different kinds of deformation are clearly discernible in the strain-stress diagram. The curve is here composite but as the law applies to each individual stage of "analogous deformation," it holds good also for the full range, and the curves will therefore be similar for different sizes of similar testbars. In plotting the strain-stress curves of two similar testbars of different volumes in the proportion of 1:8 (homologous dimensions 1:2) the deformation of bar II (on the abscissa) will be twice that of bar I and the stresses (on the ordinate) four times that of bar I, and as the area representing the work is consequently eight times that of bar I it is graphically proved once more that the work varies as the volume.

DR. CALDECOTT'S BREAKING TESTS

At the time of my connection with the late Mines Trials Committee, exhaustive breaking tests extending over a year (about 1910) were carried out under the auspices of Dr. Caldecott at the Government mechanical laboratory by the Mines Department. The report has never been made public. All that was heard about it was the following short remark in the annual report of the Mines

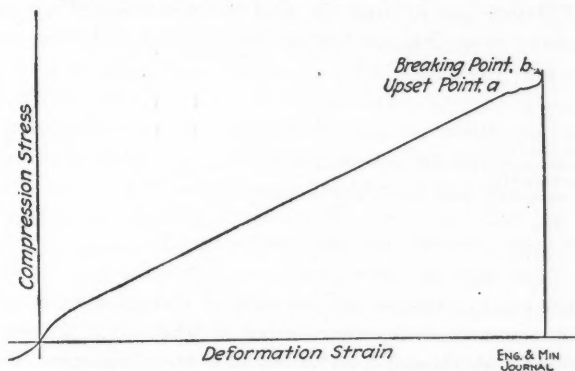


FIG. 11. TYPICAL COMPRESSION STRAIN STRESS CURVE FOR GRANITE

Department for 1912: "The result of the tests made with falling weights showed that under impact the strength of the specimens to resist crushing varied in a way nearly dependent on the square of the diameter. This result corresponds with the well known crushing law of Rittinger." The conclusion of the second sentence is, of course, incorrect, being in contradiction to the first in which it is said that the resistance to crushing, i.e., the stresses, vary as the square of the diameter, while Rittinger's law refers to the energy spent in producing these stresses.

All through the experimental work carried out by the writer over several years on behalf of the late Mines Trials Committee it could be ascertained that my method of efficiency calculation, derived from Kick's law, is for fine as well as for coarse crushing correct and reliable and in perfect accordance with the results of practical experience.

Scientifically and experimentally, the correctness of my method of efficiency computation can no longer be questioned and, thanks to the outside support received, I now have the satisfaction of seeing the following statement, made four years ago, fully confirmed:

"With this method we are now in a position to determine with a comparatively high degree of accuracy the

relative merits of different crushing appliances, or the efficiency of one and the same machine working under varying conditions."

PROCEDURE FOR COMPUTING CRUSHING EFFICIENCY

The application of the suggested method in practice is much simpler and easier than would appear from the many theoretical considerations required in devising it. The arithmetical mean of the ordinal numbers of the two screens determining a grade represents, in accordance with Kick's law, the work spent upon reducing the unit of volume, or weight, to the respective grade. These ordinal numbers, or energy units (E. U.), are the indicators, or multipliers, by which the percentages of the respective grades are to be multiplied for obtaining the energy value of that grade. The total of these products is the ordinal number, or energy value, of the complex samples. The difference between these values taken at the intake and discharge of the crushing appliances represents the comparative work done by the machines per unit, and the comparative mechanical efficiency per horsepower is then obtained by dividing the product of the work done by the machines per unit and the total tonnage by the unit of power consumption. In J. W. Bell's opinion, "there would be substantial reason for introducing the Stadler series of grades into the regular milling practice" on the ground of the simplification realized by being able to describe a grade, or a complex screen analysis, by a single number.

In order to bring about more uniformity in the records of grading analyses all over the world, it would be highly desirable for metallurgists to use the set of screens shown in the accompanying table, selected in such a way

STANDARD GRADES FOR SCREEN ANALYSES

Ord. No. Mech. Val.	Mathematically Correct Scale Reduction Ratio 1 : 4		Nearest I.M.M. Standard Laboratory Screens			
	Mesh Aperture In.	m/m	Mesh p. Lin. In.	Mesh Aperture In. m/m		
0	1.0	25.4	Com- mer- cial hand- screens	1 in.	—	
2	0.630	16.0		2 in.	—	
4	0.3969	10.080		3 in.	—	
6	0.250	6.35		4 in.	—	
8	0.1575	4.0003		5 in.	—	
10	0.09922	2.52		6 in.	0.10	2.540
12	0.06250	1.5874		8	0.062	1.574
14	0.03937	1.0		12	0.0416	1.056
16	0.0248	0.630		20	0.025	0.635
18	0.01562	0.3968		30	0.0166	0.421
20	0.00984	0.250	(60) 50	0.01	0.254	
22	0.00620	0.1575	(90) 80	0.0062	0.157	
24	0.00391	0.0992	120	0.0042	0.107	
26	0.00246	0.0625	200	0.0025	0.063	
28	0.00155	0.0394	—	—	—	
30	0.00098	0.0248	—	—	—	

$$R = \frac{1}{\sqrt[4]{4}} = 1.5874$$

Diameter of wire very close, equal to mesh aperture. Area of discharge fairly constant, 25 per cent.

from the complete set of I. M. M. standards that a regular reduction by one-quarter from one grade to the next is obtained. For any odd screen used or interpolated, the ordinal number, which is to be determined once and for all, is calculated by the formula:

$$\text{Ord. number} = -10 \times \log. \text{ of clear mesh aperture}$$

APPLICABILITY OF THE METHOD

The necessity for fine grinding is limited for each ore to a certain size at which it yields its metal contents at the highest economical efficiency. Still further grinding means waste of energy, since a possible gain in extraction by chemical treatment is nullified by additional costs incurred for finer grinding, and the greater losses of gold sustained in the slimes-treatment plant by dissolved

gold going to waste with the greater percentage of moisture retained in very fine slimes. Beyond this critical size, which for Rand ore is reached before the finest available screen, the mechanical efficiency, being no longer representative of the metallurgical efficiency, ceases to be of interest, and it is therefore, for practical purposes, advantageous and expedient to replace the multiplier expressing the mechanical efficiency by that of the economical efficiency, which is exactly that belonging to the grade of the critical size. The useless work done by over-grinding is then considered as waste, the same as losses of mechanical energy by friction, production of vibration, heat, sound, etc.

In addition to the required similarity of shape and technological state of the materials subject to deformation, it is as self evident and tacitly understood that the conditions under which the forces are applied must also be analogous within reasonable limits. For instance, the effect produced on a particle caught between two rollers is affected by the diameters and by the speeds. It has also been ascertained that similar deformations are produced by slow compression with less work than by the exertion of a blow, and further, that one single heavy blow is more efficient than a successive repetition of weaker blows representing in their total the same work.

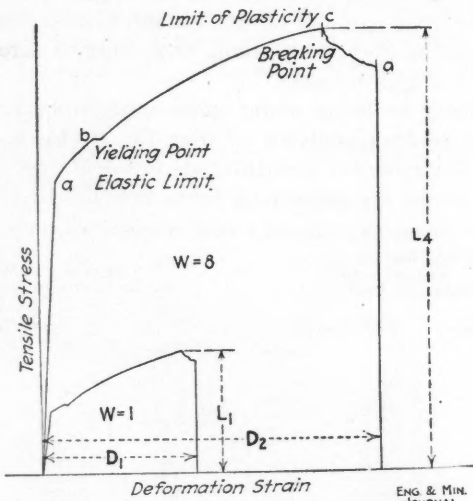


FIG. 12. TYPICAL TENSILE STRAIN STRESS CURVE FOR MILD STEEL

The effect of the velocity is, however, negligible for those varying within the range covered by all crushing appliances in use at the present time.

It might appear that all these reservations and limitations, which are common to all crushing laws, would impair the practical usefulness of efficiency computations. Such fears are groundless because the fulfillment of these conditions is of importance only to the experimentalist who, in investigating the laws of crushing, must carefully eliminate all sources of error. From the moment the correctness of the law is definitely proved we are no longer concerned with how far the reliability of the results may be affected by the influences of the physical peculiarities of the material, or of the different working conditions, etc. On the contrary, it is precisely the extent of the effect of these factors on crushing efficiency that we propose to measure by comparison of actual results with a theoretically unobjectionable ideal standard.

The industry of grinding has become so specialized that

the practical value of the method is not seriously diminished by the limitation of giving only relative values for given materials. It is doubtful whether attempts to arrive at a direct determination of the absolute values would be of any use, but in this direction the different breaking heights for the various materials may perhaps prove to be a valuable indication of the amenability to crushing of various materials.

La Rose Consolidated

The report of the La Rose Consolidated Mines Co., Cobalt, Ont., for 1913, shows a profit of \$955,130 from operations by the operating company, the La Rose Mines; after deducting losses and expenses on outside properties, a net profit of \$952,816. Dividends declared during the year amounted to \$931,000. Deducting the expenses of the holding company, the net profit for 1913 would be \$918,638. The mine produced 2,636,696 oz. of silver at a cost of 22.8c. per oz., and the net selling price was 59.32c. per oz. The property has produced 20,420,064 oz. of silver to date. Ore reserves are estimated to contain 94,082 tons of ore containing 2,071,098 oz. of silver, having a net value of \$622,521. Of the ore in reserve 93,459 tons are milling ore and the remainder high-grade shipping ore. The cost of production for 1913 was made up as follows:

	Per ounce silver
Mine operations	\$0.1474
Concentration	0.0388
Marketing, including deductions	0.0616
Depreciation	0.0045
Corporation and traveling expenses	0.0008
Total	\$0.2531
Less rents, interest and discounts	0.0251
Total cost of production	\$0.2280

Marketing expense was 10.42% of the gross value of the silver contained in shipments; of this, 4.48% was for smelter deductions, 2.63% for treatment charges, 2.33% for freights; and 0.98% for assaying, sampling, smelter representatives and ore insurance. The mine shipped 3274 tons of ore, of which 916 tons were concentrates. A record of concentrate production for the year follows:

CONCENTRATION	
Ore milled	37,556 dry tons
Silver contents of heads	508,288 oz.
Average assay of heads	13.53 oz. per ton
Concentrates produced	950.142 tons
Silver contents of concentrates	437,439 oz.
Average assay of concentrates	460 oz. per ton
Net value of concentrates	\$217,924
Cost of concentration	\$102,447
Cost per ton of ore milled	\$2.73
Average tonnage for 313 days	120 tons per day
Ratio of concentration	39.5 to 1

The development work consisted of 542 ft. of shafts, 8939 ft. of drifts and crosscuts, and 853 ft. of raises. Stopping resulted in the breaking of 11,186 cu.yd. of material.

Rutile Production in 1913

Virginia produced all the American rutile in 1913, according to the U. S. Geological Survey, the deposits being located at Roseland, Nelson County. The output was 305 tons. A large part was used in the manufacture of titanium-carbide electrodes for arc lamps. A part of the ilmenite found in the deposits and separated by means of a magnetic separator has been sold for use in making electrodes for electric lights, and the experiments with the electric furnace point to the possible use of ilmenite in the direct production of tool steel.

Butte & Superior Copper Co.

During the third quarter of 1914, the Butte & Superior Copper Co. milled 100,600 dry tons of ore, containing 18.582% zinc and 8.6359 oz. silver per ton. Concentrates amounting to 60,974,968 lb. were produced, containing 54.32% zinc and 24.15 oz. silver per ton. The zinc recovery in concentrates amounted to 89.14% of the total ore content. Milling cost was \$2.049 per ton, and mining cost, \$3.201 per ton.

Total value of product for the quarter was \$1,027,576, and costs were \$528,440, leaving profit of \$499,136. At the close of the quarter, and after payment of dividend, the total cash on hand was \$808,760, and the net current and working assets, including the value of products in transit, amounted to \$1,327,152. Profits for the quarter were calculated on an average price of 5.11c. per lb. for spelter.

During the past few months it has become apparent that it would be necessary to suspend operations for a time to make repairs to a section of the main shaft between the 300- and 700-ft. levels. This portion of the shaft was sunk many years ago and has not since been timbered. When originally constructed it was not as strongly timbered as it should have been, considering the heavy ground through which it was driven. It was hoped that operations might be continued until near the end of the year, but the condition of the shaft deteriorated more rapidly than was expected, with the result that near the middle of October, just previous to the writing of this report, some of the weakened timbering and guides gave way, causing damage that would have required several days for repair. Temporary repairs would have been difficult and expensive and would have left the shaft in about the same condition. It was decided, therefore, to suspend operations for sufficient time to make permanent repairs, which should be completed about the end of the year. Until that time operations will be confined to a necessary amount of work in development and maintenance, as many as possible of the regular employees being used in this work and in some minor betterments and improvements to the mill and the surface equipment at the mine. In the meantime, the earnings for the short operating period for October, together with accumulated surplus from excess of value of products in transit, over and above the estimated values, will go a long way to offset the decrease in operating earnings for the fourth quarter. In fact, the incomes referred to and creditable to the fourth quarter will probably cover fully all of the expenditures for repairs and betterments incurred during the period of suspension. Such being the case, the cash received during the quarter for products in transit will more than cover the quarter's dividends and leave the company's cash position at the end of the year and after dividend payments for the year fully as strong as it was at the end of the third quarter.

Imports of Copper Matte

The Court of Customs Appeals has rendered a decision sustaining the Board of General Appraisers in its ruling on copper regulus, ore and matte imported. There were several cases arising, the appeal of the American Smelting & Refining Co. being taken as a test case. The question was the status of certain material, which the importers

claimed to be copper regulus or matte, and free, while the government representative claimed it was lead ore and liable to duty on the lead contents. The evidence showed that it was an impure, unfinished product of the smelting of sulphide ore, the chief value being in the copper contents. That is, it was, commercially, copper matte, and not an ore. The Board of General Appraisers decided in favor of the importers, holding it to be copper matte or regulus, free of duty. The Customs Court sustains this decision. It affects a considerable number of entries, and there is a large amount of money paid under protest which will have to be refunded.

Zinc Mining in Wisconsin

The Wisconsin orebodies have their greatest extent horizontally rather than vertically. They vary in dimensions as follows: Length, from about 100 ft. to about 5000 ft.; width, from about 10 ft. to about 1500 ft.; thickness, from about 4 ft. to about 80 ft. The bottom varies in different mines, according to the locality, from a few feet to about 250 ft. below the surface.

The chief metallic constituents—sphalerite, iron sulphide, and galena—occur disseminated and in veins in Trenton and Galena limestone and dolomite, and at times constitute by weight as much as 15 to 20% of the total. The mixed ore and rock as broken in the mine and hoisted into the mill is known as "dirt."

The general practice is to cull out of the dirt as broken whatever barren or dead pieces may be conveniently thrown out. This is done either underground where the waste is piled up or "gobbed," or just before the dirt enters the mill, when it is thrown from a grizzly into the boulder pile. The amount of broken rock discarded runs up to 60 or 70% in the former case, and up to about 20% in the latter.

Two products result from the milling practices, a galena concentrate, which usually averages between 70 and 80% lead, and a sphalerite-iron-sulphide concentrate running between 20 and 60% zinc. The average grade of zinc concentrates for Wisconsin is now between 35 and 38%.

A planimeter computation made from several mine maps showed that approximately 10% of the volume of crude ore (ore and country rock in place) in a deposit is left in the mine as pillars and not recovered. Figures for mill recovery as far as they are at present available, show that of the metallic zinc that enters the mill in the "mill dirt" about 70 to 75% is saved in the concentrates. Of the metallic iron that goes through the mill, the saving varies from about 30 to 50%.

EXPLORATORY PRACTICE

The most efficient companies do just sufficient drilling to assure themselves that the orebody is large and rich enough to justify the necessary expenditure for development and equipment. Even this practice is far from general. Churn drills alone are used, and when ore is first struck, average samples of the cuttings are taken about every 2 ft. These samples are either assayed indi-

Note—This article is taken from a treatise entitled "A Study of Methods of Mine Valuation and Assessment, with Especial Reference to the Zinc Mines of Southwestern Wisconsin," by W. L. Uglow, which is to be published as Bulletin No. 41, Economic Series 18, of the Wisconsin Geological and Natural History Survey. It has been communicated to us in advance of publication by the courtesy of W. O. Hotchkiss, State Geologist of Wisconsin.

vidually for zinc, iron and lead, or a composite sample of every 2 ft. of cutting from the time ore is first struck until it is lost, is made for each hole. Considerable inaccuracies occur in the estimation of ore reserves from these assays, due in large part to: (a) Natural breaks or openings in the rocks which carry away a part of the cuttings; (b) the degree of fineness of the disseminated pyrites; (c) and whether or not the drill cuts perpendicularly or obliquely across a vein. Many of the smaller companies, of which there are a large number, do practically no exploratory drilling and have little or no reserve blocked out in advance of working breasts.

It is interesting to note that during each of the last five years the ratio of lead to zinc concentrates for the whole district has remained remarkably uniform, varying from 1.83% to 2.02%, the average for the five years being 1.91%.

Through the kindness of the Vinegar Hill Zinc Co., the Mineral Point Zinc Co., the Wisconsin Zinc Co., the Cleveland Mining Co., and the Field Mining & Milling Co., complete cost and production details of the following properties were made available for the purpose of constructing therefrom an average life history of one of the large zinc mines. Other companies also kindly volunteered their data, but owing to the lack of a few important details, it was considered inadvisable to include their mines in the composite. The following mines have been included: Vinegar Hill Mine (Day's Siding, Ill.); Ellsworth-Rundell Mine (Livingston, Wis.); Kennedy Mine (Hazel Green, Wis.); Fox Mine (Strawbridge, Wis.); East End Mine (Platteville, Wis.); Winskell Mine (New Diggings, Wis.); Cleveland Mine (Hazel Green, Wis.); Crawhall Mine (New Diggings, Wis.).

From the data thus available, the figures appearing in Column I, Table I, have been obtained. The figures for annual tonnage of dirt hoisted, grades or dirt and con-

TABLE I. WISCONSIN ZINC-MINING PRACTICE

Item	I 4 Years Weighted Average	II 1st Year Average Figures	III 2nd Year Average Figures	IV 3d Year Average Figures	V 4th Year Average Figures
Tons dirt hoisted (total)	300,000				
Tons dirt hoisted (per year)	75,000	60,000	70,000	80,000	90,000
Grade of dirt, %	8.62	10.25	8.50	8.20	8.00
Percentage ratio, Pbs to total concentrates	1.96	1.96	1.96	1.96	1.96
Tons ZnS concentrates	25,352.4	6,030	5,833	6,431.4	7,059
Tons Pbs concentrates	506.6	120	117	128.6	141
Grade ZnS concentrates	38.7	42.5	44.0	38.4	31.3
Price of spelter		5.70	5.40	5.00	5.50
Sale price of ZnS concentrates		\$24.27	\$24.10	\$17.90	\$15.50
Sale price of Pbs concentrates		\$56.00	\$51.00	\$46.25	\$51.80
Operating cost* per ton of dirt	\$1.266	\$1.350	\$1.300	\$1.260	\$1.190
Operating cost per ton of concentrates	\$14.70				
Cost of preliminary exploration, sinking, development and equipment	\$30,000				
Salvage value	\$1,500				

*Operating cost signifies the actual mining, milling and other expense essential to getting the ore ready for the market. No charges are included for interest, royalty or amortization.
The data in Table I have been recast into a series of annual totals for receipts, costs, and profits, as given in Table II.

TABLE II

Year	I Gross Receipts	II Royalty (10%)	III Cost, Including Amortization of Capital (\$28,500)	IV Net Profits* Col. I - Col. III	V Cost, No Amortization Charge Included	VI Operating Profits** Col. I - Col. V
1	\$153,200	\$15,320	\$87,710	\$65,490	\$81,000	\$72,200
2	146,570	14,657	97,710	48,860	91,000	55,570
3	121,050	12,105	107,510	13,540	100,800	20,250
4	116,570	11,657	113,810	2,760	107,100	9,470

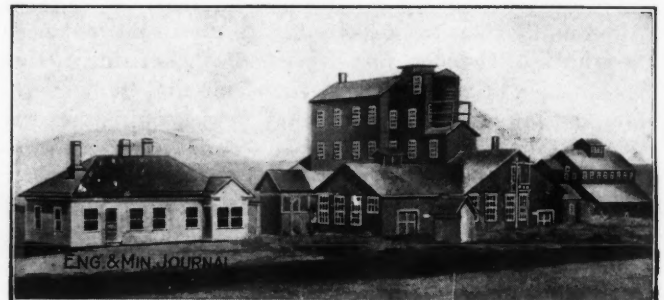
* See Part II, Chapter III, page 67, for method of determination.
** Operating profits are the difference between receipts and operating cost, as the latter is defined in the foot note, page 20.

centrates, and costs per ton of dirt and per ton of concentrates, represent the weighted averages for all the eight mines taken together. In Columns II to V, this set of figures is split up over a period of four years in such a way that the weighted averages for the four years are equivalent to the figures of Column I. The average annual spelter prices are assumed, and on them and on information obtained in the district, the prices of the various grades of zinc ore are based.

Park City Mills

SPECIAL CORRESPONDENCE

The new custom mill at Park City, Utah, began operation Oct. 1, treating ore from the American Flag mine. A company was recently incorporated by Salt Lake men as the Park City Mills, to treat siliceous silver-gold-lead-copper ores. The process to be used includes a chloridizing roast and leaching, similar to that used at the Knight mill at Silver City and also to that employed by the Mines Operating Co. at Park City. The precious metals are converted into chlorides, which are soluble in the chlorides of the base metals and in brine. The process consists of four steps: Crushing and grinding, chloridizing roasting, leaching the roasted ore with concentrated brine solution, and precipitating the dissolved metals.



PARK CITY MILLS, FORMERLY GRASSELLI CHEMICAL Co.'s ZINC MILL

The Grasselli zinc plant was taken over early in the year, and the work of remodeling started Apr. 15. The crushing machinery was received in June and was installed by the middle of July. The Knight-Christensen roaster was received in August, but was not completely installed until the latter part of September.

The mill has been designed to treat 50 tons daily, but can treat more without additional roasting capacity. The ore passes over a 1-in. grizzly to the crusher. Ninety per cent. of the American Flag ore passes through the grizzly. The crusher is a swinging-jaw Blake type, 7x10 in., and crushes to about 2 in. Traylor 30x14-in. rolls reduce the ore to about 1/4 in. Tests show that this size gives as good an extraction as if ground finer.

The ore is mixed with 9% of salt, 2% of pyrite and 1% of coal dust before being fed to the Knight-Christensen roaster. About 10% moisture is left in the mixture.

The Knight-Christensen roaster is 17 ft. in diameter (as compared to 36 ft. in diameter at Silver City) and consists of a circular revolving hearth, or grate, which is about 2 ft. wide. This grate is made up of 32 plates with fine slots approximately 1 1/2 x 1/4 in. The roasting width, or slotted part of the grate is 2 ft., and the whole grate 3 ft. wide. The furnace makes one revo-

lution in 45 min., the ore remaining under the firebox for 1½ min. Crude oil is burned, and a suction or down draft used. The charge keeps on burning all the way around, and goes into the concrete bins red hot. In roasting, some of the fines passes through the grate, and this is shoveled out every few days. The grate is revolved once for a complete roast, and the ore taken off by a worm. The bed of ore, or charge, has been tested from 2 in. to 8 in. deep, but as far as determined, about 6 in. has been found to give the best results.

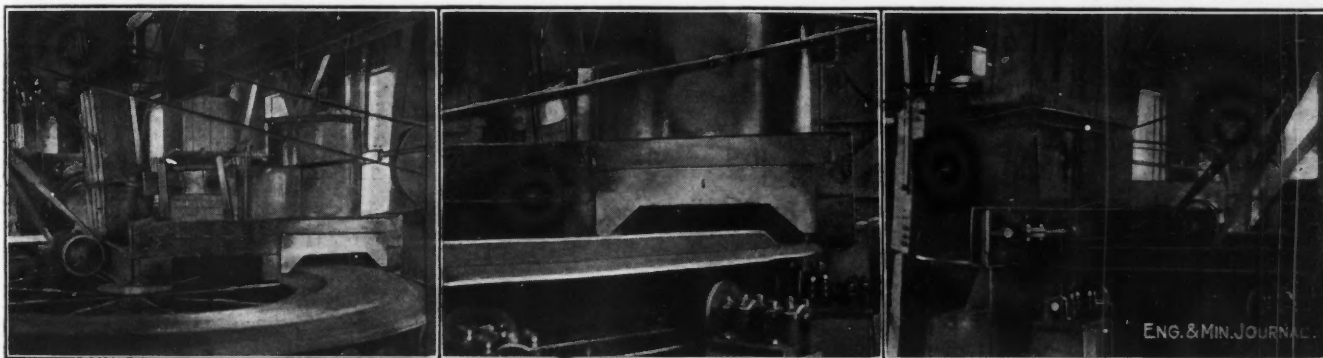
The roasted ore in the concrete bins is dumped into cars and transferred hot to the leaching tanks. There are three 60-ton ore tanks and three solution tanks. The ore remains in the tanks 24 hr. and is leached with a salt solution, containing chlorides of the base metals, which dissolves the silver and gold. The solution is run over scrap iron to precipitate the copper, silver, gold and lead. Later, copper will first be used to precipitate the gold and silver. The tailings from the ore tanks are discharged on a traveling belt and are stacked.

A saving of 92% of the silver, 90% of the gold, 90% of the lead, and 75% of the copper has been indicated by laboratory tests. It is expected that in practice a saving of at least 90% will be reached.

Silicidized Carbon--Silfrax*

When solid carbon is acted upon by vapors of silica or silicon there is formed a silicon-carbide product of the same shape as the original carbon but differing from carborundum in essential characteristics. To distinguish this form of silicidized carbon commercially, it has been given the name "silfrax." The properties and characteristics of the product vary with the temperature of formation. If the carbon article is heated in the amorphous zone of a carborundum furnace, the temperature range of this zone being 1550 to 1820°, the product is amorphous in appearance, showing no crystals except under high magnification. It has a yellow color and a lusterless fracture. If the carbon is heated in the crystalline zone of the furnace, the temperature of this zone ranging from 1820 to 2220°, the material is of great density and plainly crystalline. Upon fracture it shows a steel-black color and a metallic luster.

The commercial applications of silfrax are as refractory materials, electric-heating elements and chemical ware. It has all the chemical and heat-resisting properties of carborundum and in addition great density and toughness. Heretofore the articles produced have been of small size. Pyrometer tubes are now made 24 in. in



THE KNIGHT-CHRISTENSEN ROASTER

General view

Firebox and ore bed

Discharge end, showing feed box

The estimated operating costs on a basis of 50 tons daily are: Roasting, \$0.35; supplies, \$1.15; labor, \$1; interest, depreciation, insurance and administration, \$1; or total, \$3.50. These are outside figures, and will probably be reduced. Tests made by the Mines Operating Co. on American Flag ore showed an extraction of over 90%. It was estimated by the Mines Operating Co. that the costs would amount to about \$2.50 a ton in a modern 50-ton plant. This is exclusive of the cost of marketing, which would be about 5% of the gross value of the product if sold to the local smelteries.

The Park City Mills has made arrangements to treat American Flag ores, which are sufficient in quantity to keep the mill busy for some time. Other custom ores at Park City will probably be treated. The company is capitalized at 150,000 shares of a par value \$1, of which 50,000 shares remain in the treasury. The metallurgical work has been under the direction of George H. Scibird, general manager. F. V. Bodfish is president of the company.

Production of Selenium in 1913 in the United States is reported by the Geological Survey as 29,097 lb., valued at \$46,900. It is produced by most of the electrolytic copper refineries from anode slimes. The demand, however, is much less than the possible output of electrolytic refineries. A small quantity of tellurium was produced at the Raritan Copper Works of the Anaconda Copper Mining Co. and shipped to Europe.

length, and by special furnace construction it will be possible to make much larger articles for refractory vessels and chemical apparatus. It has not yet been determined whether the material can be produced of sufficient density to be used as acid-evaporating vessels, for which its very low coefficient of expansion and high thermal conductivity specially adapt it.

Nitride of Iron

Iron nitride (Fe_2N), obtained by heating finely divided iron in a rapid current of ammonia at 650° to 700° C., is completely decomposed when heated in nitrogen above 600° C., even at pressures as high as 18 atmospheres, according to Charpy and Bonnerot (*Comptes rendus*, 1914, p. 994). Below 600° C. only about half the nitrogen is expelled, which suggests the existence of a more stable nitride, Fe_4N . Iron does not combine directly with nitrogen even at pressures of 18 atmospheres. Having regard to its properties, iron nitride probably does not exist in metallurgical products; the nitrogen often found in iron may either be occluded or combined with some other element than iron.

*Excerpts from a paper by F. J. Tone read at the Niagara Falls meeting of the American Electrochemical Society.

Underhand Square Setting for Finishing Stopes*

SYNOPSIS—Overhand stopes at Broken Hill South mine, New South Wales, are stopped 30 ft. below old filled stopes and the top section taken out by underhand stoping with square sets. A winze enlarged for starting. Ore removed in transverse slices. Timber sets and bottom of fill caught up by spiles and booms. Certain sequence in taking out sets and slices. Precautions necessary. Filling keeps pace with extraction. Pillars may be left. Former careless mining makes difficulty.

It is customary practice at the Broken Hill South mine in New South Wales to mine by overhand methods, using either the open-stope system or the square-set system with subsequent filling. When such a stope approaches an old filled stope, it is stopped about 30 ft. below, and this 30-ft. section is removed by underhand stoping methods and square setting. This operation is called "picking up bottoms." It consists of taking out a series of vertical slices, whereas the overhand stoping involves a removal of the ore in horizontal slices. The relation of the two methods is exhibited diagrammatically in Figs. 1 and 2. The object of this vertical slicing is to have exposed only a small section of back under the old filled stope; while the extent of the back is limited, however, the fact that the slice is 30 ft. deep results in capacity and reasonable economy.

FINISHING THE UNDERHAND STOPE

The last horizontal slice taken off on the overhand principle is somewhat thin and designed to allow room for standing a floor of square sets which are then completely filled. An open gangway is left, however, from a chute and ladder-road connecting to the level below to a winze from the level above. The square-set floor gives a feeling of security to the miners, serves as an excellent foundation for the square-set timbers of the subsequent underhand-stoping operations, and closes the stope with a level back so that the section left has a uniform thickness, and its lower floor is available for tramping purposes.

The thickness of the remaining section is measured, and the number and dimensions of the sets to be used in extracting it are decided upon. It is customary to use four sets with posts of 7 ft. 2 in. in the clear, which gives a little clearance under the bottom of the filled area above for booms and spiling. When it is necessary to vary this dimension of 7 ft. 2 in., the top set is made shorter, or possibly longer, rather than the bottom set where headroom is more necessary.

ENLARGING WINZE FROM UPPER LEVEL

The first operation consists of enlarging some winze which has been previously sunk from the level above and has communication with an open gangway through the filling in and above such level. This winze must be enlarged to take two square sets, one for a filling chute and the other for a ladderway. It will then serve as a starting point for the underhand stoping. In this mine

the winzes are all 5x6-ft. openings in solid ground. The first operation of enlarging consists of catching up the timbers of the gangway through the fill on the level above. This is done by supporting with booms the caps of the sets which will be undermined, the booms themselves being held under the caps of sets farther back. A common way of doing this is illustrated in Fig. 3. Another method is shown in Fig. 4, in which a single boom is stood in the middle of the gangway. The posts of such booms must be well "spragged" against the sides of the drift. With these sets caught up, the winze may be enlarged in three ways.

In self-supporting ground the sides of the winze may be stripped by drilling down holes; when the enlargement has been carried through to the gangway of the filled square-set floor 30 ft. below, timber is built up from this floor, and the timbers of the gangway above till then supported on booms, are caught up and blocked. This method is shown in Fig. 5.

When the ground is not strong enough to stand unsupported for a height of 30 ft., the sets are carried down from the level above by hanging, as shown in Fig. 6.

Finally, the winze may be enlarged by raising from the lower gangway and carrying up the timber as work proceeds. This involves the blasting out of the timber already set, but is a convenient method for the miners. Fig. 7 illustrates the procedure.

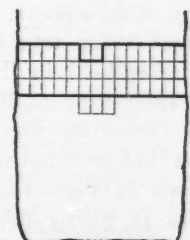
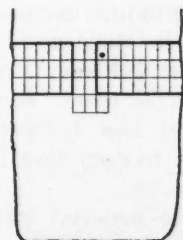
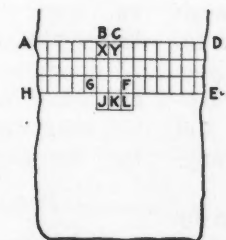
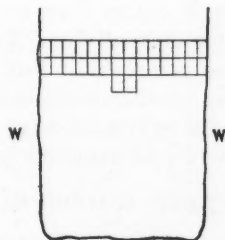
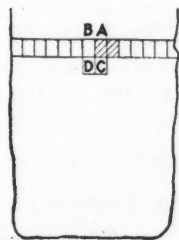
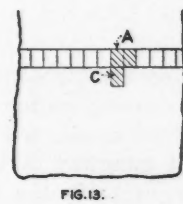
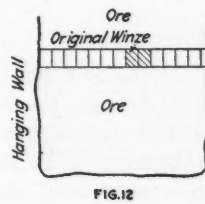
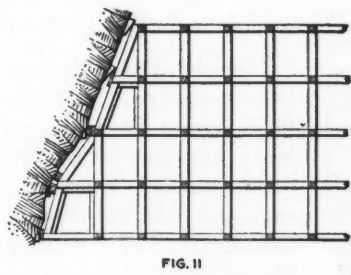
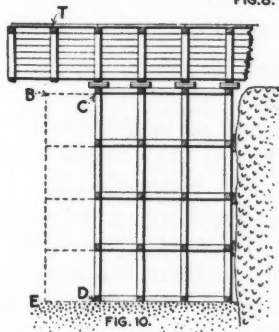
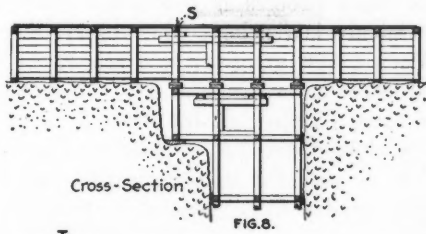
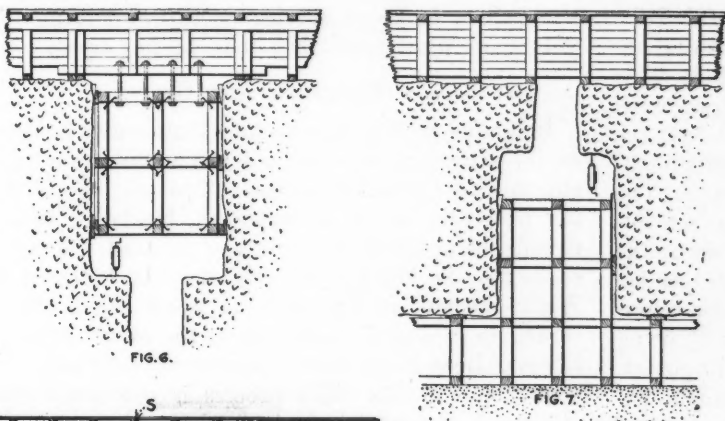
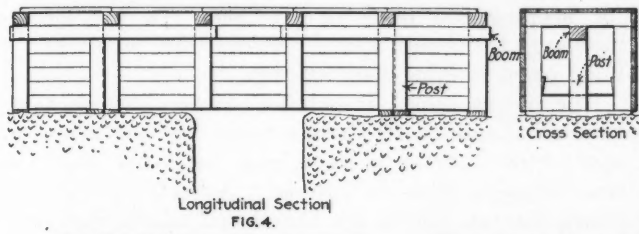
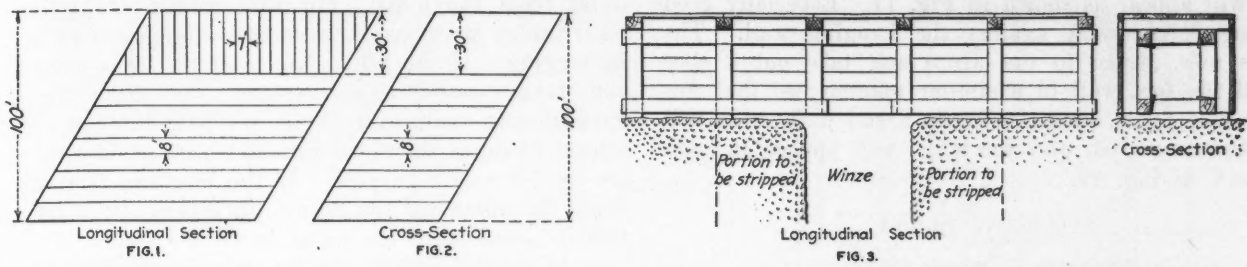
BEGINNING OF UNDERHAND STOPING

After the winze has been opened and timbered, the method of carrying on the underhand stoping is most typically described for a lode about 60 ft. in width. The first operation consists of taking out a block of ground opposite to the top set of the winze and working toward one of the walls. Fig. 8 shows this operation taking place toward the hanging wall. This operation would undermine one of the sets of the upper gangway, which must therefore be caught up with a boom, as shown at *S*. The ground is extracted by drilling short holes with light burdens. A new set is stood in the excavation and caught up with a boom from the winze set as shown in Figs. 8 and 9. A 6x10-in. crosspiece *A* supports the two caps and is itself supported by the boom *B*, which rests on a post *C*, with its other end caught under the winze timber at *D*. The two legs *F* are supported by the two caps *E* and themselves support two lower caps *G*. For this purpose there are used iron dogs of 5/8-in. square iron, 15 in. long, with 4-in. points on them as at *K*. Such dogs are useful for closing up the joints as well as for suspending the timbers.

After this set has been well blocked, the piece of ground below is taken out, another set suspended and blocked, and the operation continued until the top of a buried set on the filled square-set slice is reached. Unless the last suspended set fits exactly, it is supported on the buried set by means of blocking, and the top set being now supported from below, the boom can be removed. The stope now looks as shown in Fig. 10.

Another section of ground, *BCDE*, of Fig. 10, is taken out in a similar manner, and this operation is repeated

*An abstract of an article by Andrew Fairweather in the Proceedings of the Australasian Institute of Mining Engineers, No. 13, 1914.



ENG. & MIN. JOURNAL FIG. 14

FIG. 15

FIG. 16.

FIG. 17

FIG. 18.

FIGS. 1 TO 18. ILLUSTRATING ENLARGING OF WINZE AND REMOVAL OF SUCCESSIVE SLICES

until the hanging wall is reached. At this point angle timbers usually have to be employed, and the completed stope will appear as shown in Fig. 11. Especially good blocking is necessary against the hanging wall. The miners now return to the winze and take out a slice toward the foot wall in a similar manner; so that finally a slice 60 ft. long, 30 ft. deep and 6 ft. wide will have been removed, and the stope will appear in plan as shown in Fig. 12.

SUCCESSIVE SLICES

The original winze from which this work takes place will have been chosen, as near as possible, about 40 or 50 ft. from the end of the orebody. The next operation consists of taking out what is called a "leading" set, marked *C*, in Fig. 13. Whereas the slice just removed was under an open gangway on the upper level, successive slices will be largely under old filled stope bottoms. If these bottoms consist, as they should, of 14-ft. timbers, 4x10 in., with joints broken, the operation is not difficult. The ground is removed by careful drilling and blasting, and the timbers of the bottom are caught up with a boom held under a cap in set *A*. This boom is edged forward as new timbers are exposed until sufficient area at the top for the set *C* is opened out; the excavation is then continued down until enough ground has been removed to accommodate the entire set *C*. The ground under *C* is next removed and successive sets installed. In the next step the ground to one side of the block *C* is excavated as, for instance, *D*, Fig. 14. As before, the bottom timbers must be picked up with booms which may be extended from either set *C* or set *B*, being open on two sides, and being more conveniently got at, this block is more cheaply removed. The slice is extracted toward one wall and usually a second party of miners is put in to work toward the other wall from the block *C*, thus doubling the output from the stope and decreasing the time for which the sets must remain unfilled. The first party of miners will complete their work before the second and will then return and take out a leading set on a new slice so that faces are available for two parties again, and the stope appears in plan as shown in Fig. 15. This third slice is removed in a similar fashion and the fourth slice is started. At this point the stope will appear as in Fig. 16.

FILLING

The three completed slices are now to be filled. Since, however, communication must be kept open, the sets *XY* are not filled at all, and at the bottom and top floors the double-set gangway is left open between *XY* and *JK*. Thus, in Fig. 17, the heavy lines surround the areas which are filled on the top and bottom levels; while in Fig. 18, the heavy lines indicate the outline of the filling on the two middle floors. A longitudinal section through the original winze would show the stope as in Fig. 19. The filling is held in the set by 2x10-in. Oregon pine planks, spiked horizontally inside the posts. It may happen that the work has disclosed new ladderways and chutes, so that it is not necessary to keep open the gangways shown in Figs. 17, 18 and 19.

Whereas in filling most of the material will run by gravity, the last 4 or 5 ft. requires handling with a shovel and is somewhat expensive, since the stope must be solidly packed to the caps of the top set. When

removing ground next to filled sets, great care is necessary not to cut out the spragging of the filling by material from the blast. For this reason, old collar or other timber is wedged between the caps against the 2x10-in. lagging. If the filling has to stand for a long time and takes considerable pressure, the posts may be strengthened against breaking by tying into the filling behind them, as shown in Fig. 20; bolts or fencing wire are used for this purpose. If the blocking is good between the pillar and the filling, the sets of the latter may remain sound until the pillar is worked; when it comes time to work, however, the tie rods are of great service for keeping the posts in position. To provide good blocking, the small space between the pillar and the filled block is filled with tailings.

The ore as mined is handled on the bottom floor of the underhand stope, shovels being used as far as possible; while cars on a 15-in. gage track are used where some distance must be covered. As new chutes are exposed, the old chutes are abandoned unless they are so situated as to be of service in future mining of some pillars, in which case they may be left open.

FINISHING THE STOPE

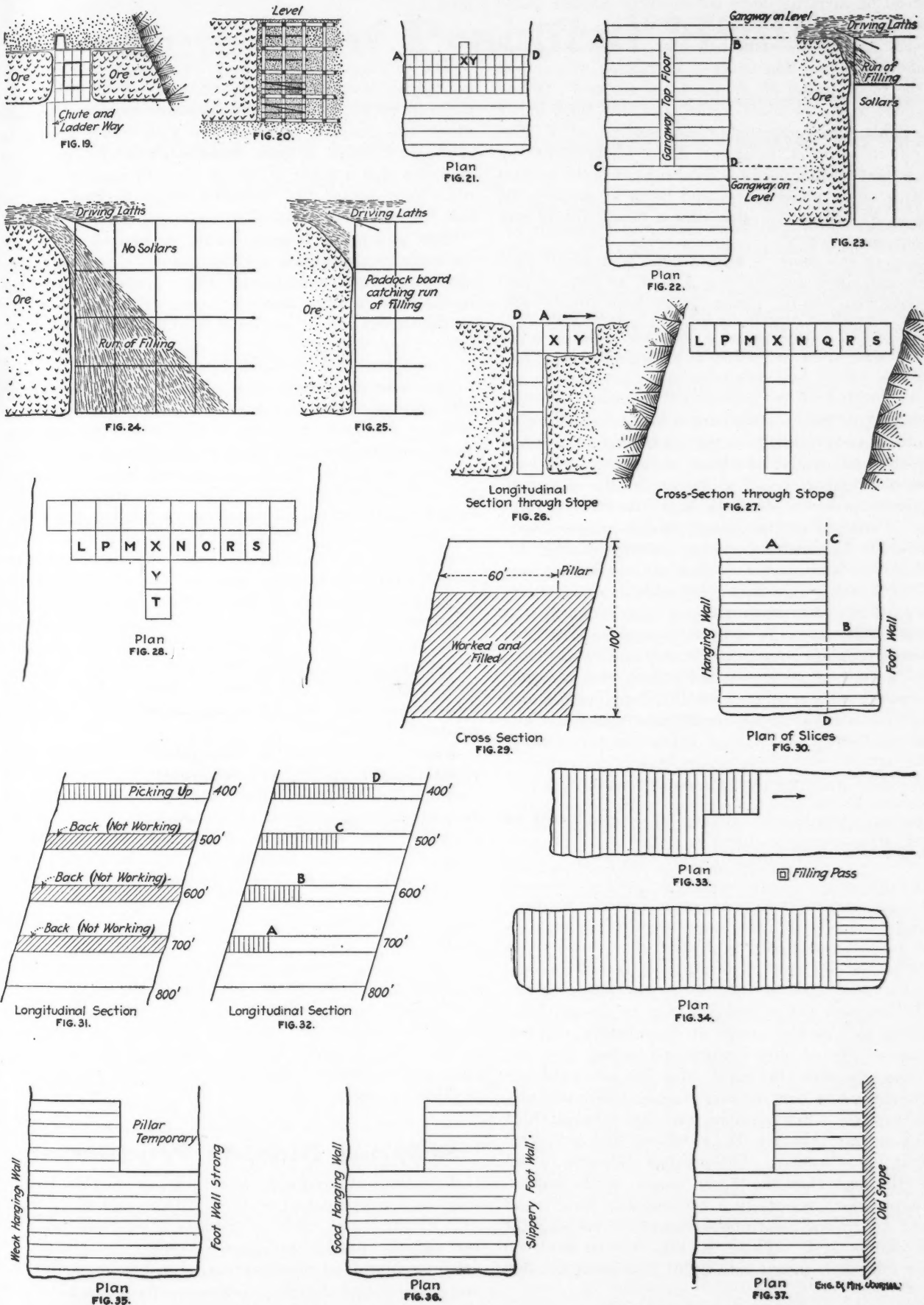
Referring to Fig. 16, the fourth slice will be completed by the miners as the previous three slices were extracted and mining continued to the end of the stope. As mining proceeds, filling is continued, blocks of three slices usually being filled at one time, although blocks of two slices may be filled if the timber shows signs of weight. While the end of the stope is being filled, the miners return to *X* and *Y*, open out in the other direction and remove slices in the same manner as described. This is shown in Fig. 21. The process is continued until the other end of the orebody is reached, when everything is securely filled. When a new gangway is reached, the old gangway itself is filled as shown in Fig. 22. Thus, while slicing is going on from *CD* to *AB*, the central gangway shown is kept open, but when *AB* is reached, the new gangway to the right is used for communication and the longitudinal gangway in the filled ground is itself filled.

CATCHING UP POOR BOTTOMS

Usually, the operation is not so simple as has just been described. For one thing, the bottoms of the old filled stopes do not usually consist of long timbers well laid; they may be light timbers, may have rotted or may be a jumbled mass of waste and some blocking. In such case, the bottoms must be caught up by spiling and booming. When rocks are encountered, these must be blasted out as lightly as possible, as there is always danger from a run of filling from the old workings. Under these conditions, it is a rule that the miners must cover their top floor with collars and lag up two adjacent posts half way; then if a run does occur, it is stopped short before extending over all four floors. Figs. 23, 24 and 25 illustrate the principle of this. In this difficult work of spiling, more trouble is encountered with the leading sets than with the others in any one slice, for the reason that the others can be attacked from two sides.

PRECAUTIONS AGAINST RUNS OF FILLING

A further precaution against runs of filling consists of always keeping the top floor at least one set in advance of the lower floors in either direction. This arrange-



FIGS. 19 TO 37. ILLUSTRATING PRECAUTIONS TAKEN IN REGARD TO FILLING, QUESTIONS OF PILLARS AND RELATIONS OF LEVELS

ment is illustrated in Figs. 26, 27 and 28. Thus, in Fig. 26, instead of carrying down the block of ground under *X*, room for set *Y* is first made. Then sets *M* and *N*, in Figs. 27 and 28, are extracted, when *X* may be carried down another floor. The order of extraction would then be *P*, the block under *M*, *L*, the block under *P*, *Q*, the block under *N*, *R*, the block under *Q*, *S*, the block under *R*, etc. This slice completed, a new leading set *T*, Fig. 28, is put in before *Y* is carried down. The advantage of this is that such a set as *Y* is always on solid ground while *X* is being undermined, and helps to support the timbers of *X*, and at the same time a filling run of any great size is prevented.

Drilling in this work is always done with small steel and light machines, and blasting is made as light as possible. Sullivan 2½-in. piston drills have proved efficient, but a hammer drill for putting in a horizontal hole should find an excellent field here.

THE USE OF PILLARS

The length of the slices in this work is limited to 60 ft., approximately. With longer slices, before a block is completed and ready for filling, the timber will have taken such weight as either to fail or become distorted. Consequently, where the lode is more than 60 ft. wide, the slice is stopped at that length and a pillar of solid ground is left for future working as shown in Fig. 29; this pillar is to be extracted as soon as possible, but kept behind the working face by an interval of 50 or 60 ft., as shown in Fig. 30, where faces *A* and *B* advance at about the same rate. It will be seen from this that the sectional area of exposed back is reduced from what it would be if the face *A* were carried clear to the foot wall; whereas at the same time the face *B* is kept near enough to *A* so that a long unsupported space along the line *CD* does not occur.

CONFUSION BECAUSE OF PREVIOUS POOR MINING

Before this operation of picking up is conducted on any level, it is necessary that the stopes above be completely exploited. Subsidence is sure to occur and in upper levels gangways would be closed, grades destroyed and working rendered expensive or impossible. Furthermore, any trouble in a lower stope upon which picking-up work is going on would probably run through to an upper stope; a big run of filling, for instance, could easily cause a collapse of the sets in the upper stopes.

Due to irregular and erratic working in the past, this rule cannot be followed except at considerable expense. The cheapest ore of upper workings having been extracted, the expensive "fag ends" were left to accumulate and their extraction now requires considerable heavy preparatory expense. Furthermore, they are situated high in the upcast air where work is difficult and is carried on only at low efficiency. The greatest difficulty is met with in the fact that the lower stopes must wait on those above, which results in a considerable curtailment of output and means continuous repairs in keeping the lower workings open. Thus, in Fig. 31 the work on three lower levels is shown held up by that above the 500 level.

It is not necessary, however, to wait for the completion of the work on the 500 slice before the 600 slice is attacked. Thus, in Fig. 32, work is shown begun in the

lower levels, but kept behind the work on the upper level.

GENERAL DIRECTION OF WORKINGS

The picking-up operation in any one stope should be carried on toward the chute through which filling material is to be delivered; so that the openings through which this material is moved horizontally are always in solid ground and in good repair. Thus, in Fig. 33, it is shown that a pillar is left on the side nearest the filling chute, while the advanced stage is kept on the side farthest therefrom.

This picking-up stoping should be carried on toward the main haulage shaft, so that the outlying stopes may not be cut off by subsidence. This, of course, would not apply where all the stopes are served by a drift in the country rock, which is not liable to become closed.

DIRECTION OF SLICES

The long dimension of any slice should be parallel with the short axis of the stope. That is to say, in an ordinary oreshoot, the width of the lode being less than its length, the slices run parallel with the width and are, in effect, crosscuts. If, for any reason, the dimension of the oreshoot parallel to the strike is less than its dimension across the strike, slices are run parallel to the strike. The main reason for this is that the hanging wall usually runs parallel to the long axis, and the crosscut system meets it on a short span only, so that no great length of hanging is left unsupported between filling operations. Furthermore, when the slices run parallel to the shorter axis, the effect, due to the cutting through of the ground, is less pronounced. Thus, when a stope arrives near the end of the orebody, the direction of the slices is turned 90 deg., and the end taken out as exhibited diagrammatically in Fig. 34.

When it is necessary to leave pillars, the weaker side should be worked first and the stronger side left as the pillar. The strength of the side will depend on the nature of the ore, strength of the adjacent wall, and the distance from old stopes. Where the hanging wall is weak, therefore, the hanging side will be worked first, as shown in Fig. 35. Where the hanging wall is strong, or there is no hanging wall, while the foot wall is slippery, the pillar is left on the hanging side, as shown in Fig. 36.

Where work is being prosecuted next to an old stope, the latter should be met by the ends of the slices. Where the ground is too wide for a single space, the pillars should be left on the side away from the old stope, as in Fig. 37. In actual mining, conditions are so various that a compromise between these various requirements is often necessary.

✻

Sulphur Dioxide Production

A method of producing pure sulphur dioxide is outlined in a recent patent of H. K. Moore and R. B. Wolf (U. S. pat. 1,091,689). Combustion products containing sulphur dioxide are passed through a solution of calcium chloride or other solvent, cooled to about 32° F., and the sulphur dioxide is subsequently extracted from the refrigerated solution and liquefied, *in vacuo*. The solvent is preferably circulated continuously from an absorbing chamber to a vacuum chamber, and *vice versa*.

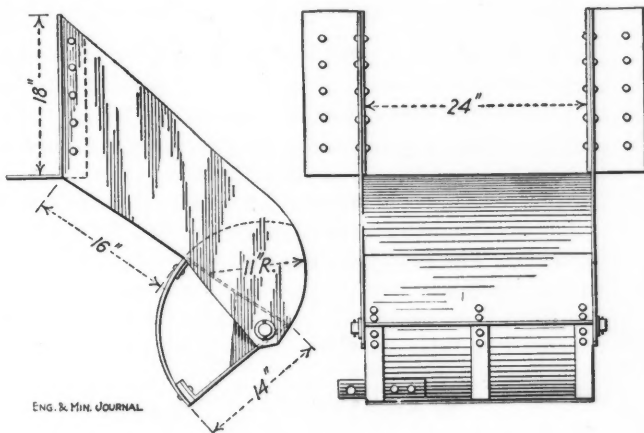
Details of Practical Mining

Ore Chute and Gate

By J. R. THOENEN*

The accompanying sketch shows the front and side views of an ore chute for use where the bin supplies mixed fine and coarse ore. The chute proper is made of one piece of 1/4-in. steel plate, with bottom extending 6 in. into the bin to protect it from wear of running ore. Two wing plates of 1/4-in. steel are riveted on the vertical sides to protect the sides of the chute, and for the same purpose, a piece of angle steel may be placed on top of the opening. In this instance, the bottom of chute is 16 in. long, but may be altered to suit the existing arrangement of timbers.

The gate is hung on a 1 1/2-in. round-iron axle supported in holes bored through the sides of the chute. The sketch shows the chute open and the gate down. The gate itself forms the lip of the chute. A timber is placed under



ORE CHUTE AND GATE

the gate, so that when open, the gate rests upon it and is flush with the bottom of the chute. The gate is worked by a short detachable lever (not shown), which is rounded at one end to fit in the hole in the short piece riveted to the bottom of chute gate. A hole through a lever, which fits over the end of the axle, forms the fulcrum. Washers and pins are provided to keep the axle in place.

The gate is made of two pieces of 1/4-in. steel plate, one bent in the arc of a circle of 1 ft. radius, the other flat with one edge turned over 2 in. at a little less than a right angle. These two plates are riveted together with countersunk rivets. The gate bearing for the axle is provided by a small web piece riveted at each end to the upper plate and lower brace. Three 1/4x2-in. braces support the under side of the gate.

When the gate is well centered, so that the arc forms a true circle with the center of the axle as its center, there is practically no trouble with fines causing the gate to stick.

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Accuracy of Stadia Surveying

By L. HALL GOODWIN*

The results of several important boundary surveys done by the stadia have been published, which indicate a high degree of accuracy for that method when carefully applied to long surveys. The reason for this is that with proper determination of instrument constants and careful work in the field, all of the errors are balancing, and in accordance with the accepted theory of errors the percentage deviation in a survey actually approaches zero as the number of observations, that is, the length of the survey, increases. In looking up the subject, however, I was unable to find concise data concerning the accuracy of this method in shorter surveys, such as would be used in running traverses from which to tie in surface detail; therefore the summary in the accompanying table and a discussion of the results obtained in running 19 short traverses for that purpose may be of interest.

The object of this survey involving these traverses was to plot a large amount of surface detail on an old map, the ground already being laid out by long traverses with permanent iron-pin monuments which had been located by taped surveys. All of these traverses had been closed and balanced and were precise, but many new and shorter traverses had to be run in order to reach all points. The method employed in this new survey was to take azimuth and position from two of the iron pins, and then run a stadia traverse which would most advantageously cover the ground, either closing on the two original stations or on any other two of the old survey. Either case gave the closing error of the traverse, as all traverses were computed and plotted by coordinates; furthermore, those traverses run between different iron pins had to check results obtained by careful taping.

SUMMARY OF THE RESULTS OF NINETEEN STADIA TRAVERSES

No. of Traverse	Latitude		Departure		Distance	
	Numerical Total	Closing Error in Feet	Numerical Total	Closing Error in Feet	Total	Closing Error in Feet
1	2759	0.5	1195	0.1	3245	0.5
2	1030	0.3	929	0.1	1745	0.3
3	11074	1.9	2286	3.1	11580	3.6
4	1841	1.6	2838	0.3	3771	1.6
5	1014	0.6	2068	1.1	2409	1.3
6	1480	1.9	2430	0.5	3164	1.9
7	4246	4.0	2622	1.7	5650	4.3
8	2660	2.4	1290	0.9	3345	2.6
9	904	0.9	1037	1.1	1668	1.4
10	3860	4.3	2887	1.3	5097	4.5
11	4360	0.2	1618	4.5	4833	4.5
12	904	0.8	354	0.5	1025	0.9
13	1655	0.5	1039	2.4	2431	2.4
14	1294	1.1	1763	2.0	2309	2.3
15	765	1.5	1669	2.0	2027	2.5
16	1677	0.6	1457	3.2	2692	3.3
17	2775	2.3	1506	4.2	3429	4.8
18	876	1.6	858	1.7	1511	2.3
19	1570	3.1	2380	3.2	2595	4.4

In the accompanying table these traverses are arranged according to the decreasing precision of their results, and the results are summarized by giving the total numerical sums of latitudes, departures, and distances, and the corresponding errors in those factors. This arrangement

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was given to show that the results do not seem logical in many cases; for instance, in traverse No. 3, the apparent error in departures was much greater than that in latitudes, although the ratio of those two factors themselves would suggest that the reverse should be true; this is simply because the errors in latitudes happened to be balancing to a greater extent than those in departures.

When traverses are closed as these were, any large error in reading angles will be disclosed, and the small errors of fractions of a minute will largely balance each other, and in no case will they result in deviations comparable to those introduced by the stadia readings. Therefore, the accuracy obtained depends on the reading of the stadia rod and the application of the law of averages. The latter will take care of itself; the error in reading the stadia will increase as the distance increases, but not in direct proportion.

It was found that with the instrument used on this work, under ordinary conditions of light and wind, distances ranging up to 700 ft. could be read directly with a precision of 1 ft., but for longer distances the error increased rapidly, so that, in general, direct readings of a 1000-ft. course were not trusted. In reading courses over 700 ft. in length the transit was set roughly half-way between the two stations, the distance read to each station and the two results added to obtain the length of the course.

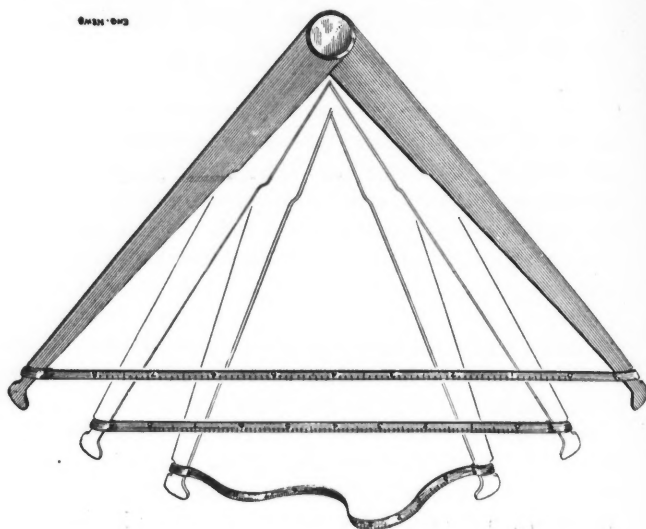
For this purpose the transit need not be set accurately on line. For longer courses two or more intermediate set-ups were made. All distances were read at least twice—once when the station was set, again when the rodman was giving a backsight for angle reading. It is far better to take several fairly careful readings of the rod and average those readings, than to rely on one reading which is thought to be particularly accurate because of special care in taking it. The several readings for each course were added and averaged, but were weighted by the surveyor as he thought they should be: tenths of feet were carried in the averaged results, although no attempt was made to read the rod closer than one-half foot.

It is my opinion that the stadia method, when used with proper care and with proper attention to small details, offers a means of rapid surveying which may be also highly accurate. In fact, for many classes of work it can be made more accurate than careless tape surveying, and for a given survey piece the time consumed in doing the most careful stadia work is less than that consumed in the most careless taping. Traverse No. 7, for instance, was run along the side of a steep bluff over numerous small gulches, where if taping had been used a large amount of time would necessarily have been consumed in securing anything like the accuracy of 8 parts in 10,000 which was so easily obtained by stadia. The 19 traverses summarized were not selected from a longer list, but represent practically all that were run in this survey; it will be noticed that 14 of them, or about three-quarters of the total, had an apparent precision of one part in 1000 or better; the stadia method when used in this class of work is usually credited with a precision of about one part in 500.

The good results obtained in this work, if they may be called good, were largely due to the practice of limiting to about 700 ft. the length of single sights upon which dependence was put and taking at least two readings of each distance.

Ingenious Proportional Scale

A device for measuring or transferring dimensions, worked out by F. J. Winters, is described in *Engineering News*. As shown, it consists of a piece of narrow elastic webbing stretched between the points of a pair of firm-joint straight-leg calipers. A scale inked on the webbing



PROPORTIONAL SCALE OF HAT TAPE AND CALIPERS

can be stretched or shortened as desired by changing the spread of the calipers. The device is particularly useful in picking the scale from a drawing on which it is not specified but on which some specific dimension is shown. It should be available in mining where work has to be transferred from old maps, a frequent chore in Mexico.

The elastic band is simply elastic hat tape about $\frac{3}{8}$ in. wide. The markings must be made with a fine brush on the stretched tape; a pen pulls the tape out of line. Since the tape tends to lose its quality of uniform stretch, it should be replaced about every three or four months.

Ventilating Pipes

A useful novelty in ventilating equipment, especially adapted to the wide connecting drives, raises and winzes of the district, is described by H. Bottomly of the Boksburg Inspectorate, Transvaal, in the Annual Report of the Department of Mines and Industries of South Africa. The system has been recently applied at the State Mines, its inventor being the manager, Graham Bell.

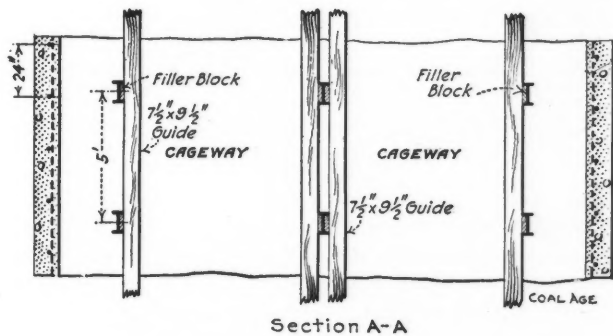
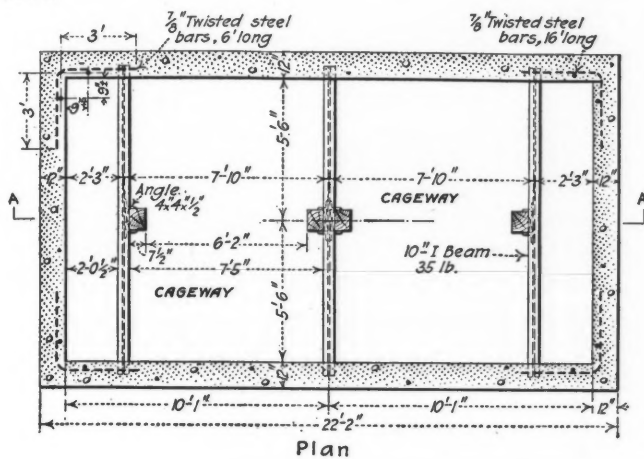
The device consists of $\frac{1}{8}$ -in. steel plates, 6x4 ft., bent to U-shapes, 18 in. across and 18 in. deep. The sections are inverted and laid on the floor of the drive, loose ground being placed against the contact with the rock to insure a tight joint. Sections are machine rolled and are capable of being bolted together in a tight joint, assisted by a gasket of tarred cloth.

Area available in these pipes is 2 sq.ft., which is far superior to the 10-in. galvanized-iron pipes in common use, and their comparative immunity from damage places them above anything else in use for the purpose at the present time. The manager has tried galvanized-iron pipes at 10d. per ft., and corrugated-iron bratticing along the main connection drives at a cost of 5s. per ft., but has given both up for the steel pipes now in use, which cost 3s. 7d. per running foot and require practically no maintenance.

Explosive boxes have also been devised and adopted by Mr. Bell. These have a pitched roof, so that they cannot be used as a seat or candle rest by the miners. Mr. Bell's action has been accelerated by two recent accidents due to the burning of gelatin boxes, the cause of which has not been discovered. Fortunately, no deaths resulted from these accidents. The style of explosive box not subject to the danger of burning is a precaution against accidents which may have serious results.

Rectangular Concrete Shaft Linings

Two concrete-lined shafts recently sunk by the Bunsen Coal Co., of Danville, Ill., are illustrated herewith. The dimensions and arrangements of the two shafts are exhibited in the drawings taken from *Coal Age*, Nov. 7, 1914.



PLAN AND SECTION OF MAIN SHAFT

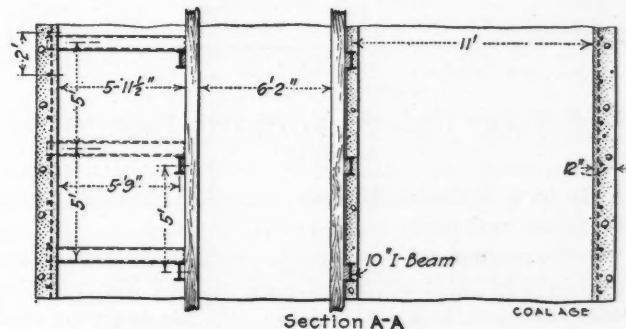
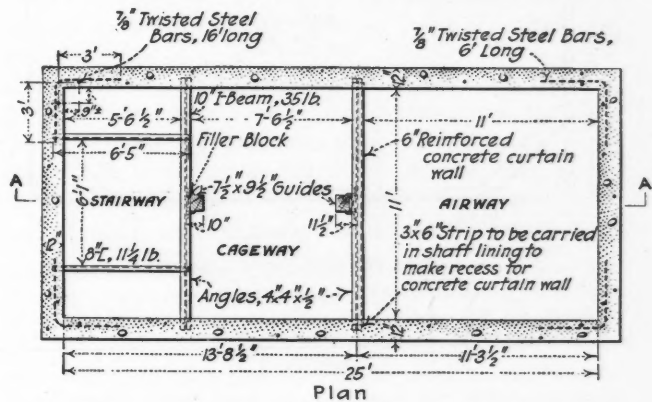
In the main shaft the thickness of the walls for 89 ft. down from the collar is 18 in., and thence to the bottom, 12 in. In the auxiliary shaft the 18-in. walls extend down for 79 ft. The walls in both shafts are of plain concrete except the corners, which are reinforced vertically, each with two lines of 7/8-in. by 16-ft. twisted steel bars, back of which are placed 7/8-in. by 6-ft. bars laid horizontally and spaced every 2 ft. for the entire depth of the shaft. The concreted depth of the main shaft is 225 ft. and of the auxiliary, 215 feet.

The dividers or guide supports are all 10-in. I-beams weighing 35 lb. per ft. The reinforced-concrete curtain wall separating the airway from the cage compartment in the auxiliary shaft was poured 7 in. thick and extends from top to bottom of the shaft. Its reinforce-

ment consists of plain 3/4-in. rods spaced 9 in. center to center, staggered along the full flange length of the I-beam dividers. These rods are connected to the top and bottom flanges of the I-beams by means of nuts on the threaded ends.

The forms used for the lining in each shaft were of the company's design, made and put together at the shaft site. A description of those used for the main shaft only will be given. The sides and ends were composed of 1 1/2 x 10-in. tongue-and-groove yellow-pine boards, surfaced on both sides, and cut into lengths making the section 2 1/2 ft. high. Nailing strips 1 1/2 x 12 in. extended around the top and 1 1/2 x 4 in. placed at the bottom formed cleats for the several units and held the matched boards securely in place. The top piece extended a distance of 1 in. above the top of the form on the inside for the reception of the next form section.

For stiffening the forms and supporting the concrete until it should set, a steel frame consisting of 4x4x1/2-in. angles was placed midway of each section and attached to the form boards by means of 3/4-in. bolts spaced 13 in. center to center around the entire section. The steel



PLAN AND SECTION OF AUXILIARY OR AIR SHAFT

framework was stiffened at the corners with 4x4x1/2-in. angle bracing; while 3/8-in. splice and gusset plates were used for bolting together the several units composing the frame.

To insure easy removal of the forms and to increase the thickness of the walls, the corner pieces were cut on a 45° angle with a 5-in. bevel face. The vertical edges of each unit, including the forms and angle frames, were also cut on a 45° bevel, while 6x10-in. pockets were made in the top of every other form for the reception of the 10-in. I-beam dividers which are spaced vertically 5 ft. center to center. The completed 2 1/2-ft. section, including the steel frame, weighed 2080 lb., and the heaviest unit 400 pounds.

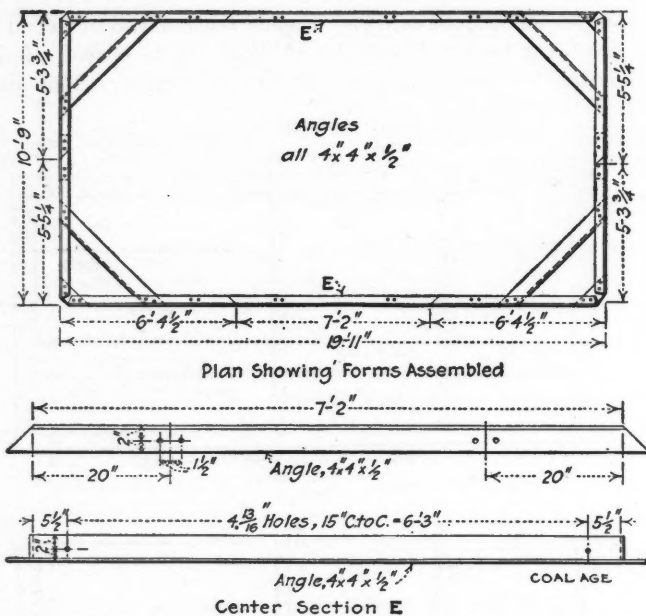
The designs of the steel frames are illustrated. That

for the auxiliary shaft provides for the reinforced-concrete curtain wall.

One 10-hp. portable cubical concrete mixer with 5x7-in. vertical steam engine attached, having a capacity of 11 cu.ft., was placed at the top of each shaft. The method of concreting was the same in each case. No concrete was poured until the bottom of the shaft was reached.

At the auxiliary shaft it was necessary to use a floating double-deck scaffold for the placing and removal of the forms in the airway. No forms were removed from the work under a period of 48 hr. The 8x10-in. dividers supporting the temporary lining were removed as the concrete lining advanced; these were replaced after each form was in position with 4x6-in. temporary supports for the forms until the concrete had set.

Both lines of 4x6-in. temporary support were carried on 1½x4x10-in. blocks attached to 1½x10-in. vertical wall plates cut in 5-ft. lengths. These plates extended back of the forms. Four 1½x2½x10-in. blocks attached



STEEL FRAME USED FOR STIFFENING FORMS IN MAIN SHAFT

to the back of the wall plates cleared the steel angles on the forms and made a substantial support.

In the main shaft the concrete yardage per vertical foot for 12-in. lining walls was 2.5 cu.yd., and 3.8 cu.yd. for walls having a thickness of 18 in. In the auxiliary shaft the 12-in. walls averaged 2.8 cu.yd. per vertical foot and the 18-in. walls, 4.3 cu.yd. All of the concrete work was composed of one part cement and five parts of clean river gravel. Cement for the entire work was the "Universal."

The progress of work at the main shaft was as follows: Concreting started Aug. 7, 1914, and the collar was reached Sept. 8, 1914. The concreting included the placing of 15 ft. of 8-ft. span arch for the sump tunnel and 30 ft. of 18-ft. 2-in. span arch for the bottom cage landing approaches from the empty and loaded sides. The entire work done in connection with the concreting of the shaft-lining walls occupied a period of 4½ weeks, which was an average of 50 ft. per week.

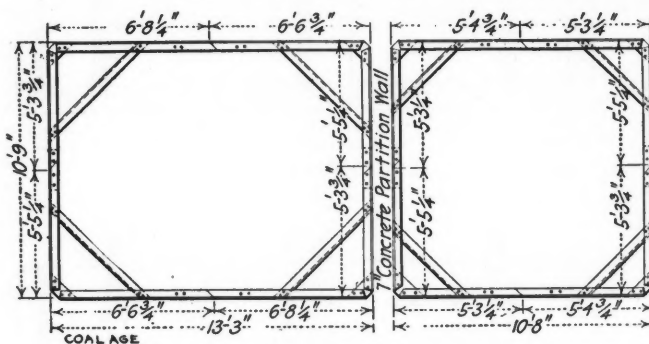
On the auxiliary shaft concreting started Aug. 7, 1914, and the collar was reached Sept. 30, 1914. This

process included the placing of 15 ft. of a 10-ft. 4-in. span arch at the bottom cage landing and 15 ft. of a 17-ft. 6-in. span arch leading from the bottom of the air compartment. The total work done in connection with concreting the shaft lining and the pouring of the concrete curtain wall occupied a period of 6.7 weeks, which was an average of 32.4 ft. per week and 129.6 ft. per month.

Accident-Prevention Score-Board*

An interesting and novel plan for stimulating interest in the safety-first movement is used at the plant of the Dodge Mfg. Co., Mishawaka, Ind. It consists primarily of a contest between foremen as to which shall make the best monthly and annual showing from a safety viewpoint, and its outstanding feature is a score board 24 ft. long, standing just inside the main gate of the factory, on which are shown the departments, foremen, percentages for month and year, and rank of the various competing divisions. The starting point is 1000 both for year and month, and each division is penalized according to its accidents, minor accidents of less than one day's absence not being considered. Each day's absence bears a percentage charge in proportion to the total number of "man-days" per month per division.

The use of this score board has resulted in the fostering of great interest among individual employees and foremen. Departmental loyalty has shown itself to be the



STEEL FRAME USED IN FORMS FOR AUXILIARY SHAFT

foundation upon which the whole plan rests. Although it was originated for the use of an industrial concern, there seems to be no good reason why it could not be applied to mine, mill or smelting-plant organizations.

Welded Wire Hose Bands

Galvanized steel-wire hose bands, electrically welded, are being marketed by J. S. McChesney & Co., Chicago, and when properly tightened, have withstood a direct pull on the hose of 600 lb. The bands are supplied in various lengths for different sizes of hose. They secure the hose to the nipple and may be used on steam, compressed air or vacuum lines using rubber hose.

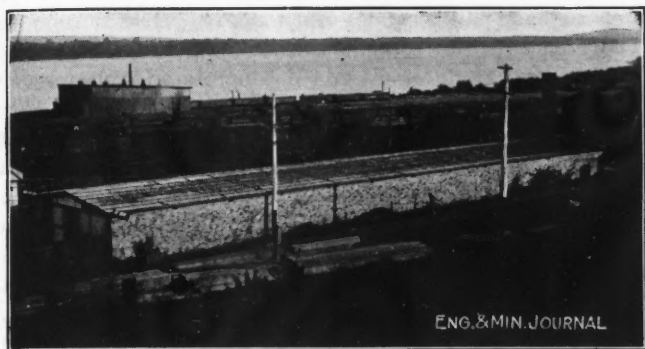
This device should find a ready use around mines, especially for the purpose of making quick repairs. It is being used in large quantities by the Canadian Copper Co. and the Utah Copper Co., in addition to many railroads and industrial concerns.

*Abstracted from a report by W. L. Chandler, supervisor of insurance, Dodge Manufacturing Co., Mishawaka, Ind.

Details of Milling and Smelting

Thaw House for Concentrates

The concentrates from the mills of the St. Joseph Lead Co. are smelted at Herculanum, Mo. On account of the high moisture content of the lead concentrates, difficulty was experienced in unloading during winter weather. The mills of the company are at Bonne Terre, Rivermines and Leadwood, the distance from the mills to the smelting works ranging from 31 to 38 miles. In consequence, the concentrates frequently arrive at the smelting plant



THAW HOUSE AT HERCULANEUM, MO.

in a frozen condition during a few weeks of each winter. The thaw house holds eight 50-ton cars and is heated by a small coal-fired furnace connected with 350 ft. of 48-in. pipe. It has removed a source of much annoyance during some of the winter months, putting the concentrates in condition, not only for unloading, but also for sampling with a post-hole auger.

Jones' Method of Treating Zinc Residues

Archibald Jones, of Bartlesville, Okla., has been granted a patent (U. S. Pat. 1,112,010) for a method of treatment of zinc residues. The process consists of concentrating the residues by burning off the contained carbon, simultaneously volatilizing the zinc and catching the latter in the cooled outer layers of the mass.

The operation is conducted on a checker-work of bricks; underneath is a main flue with cross branches through which air is delivered by an ordinary fan blower. The residues are drawn from the retort and placed on the checker-work while hot, so that they will ignite more readily. As the residues contain from 30 to 40% of carbon, extraneous fuel is not often needed except, perhaps, immediately adjoining the cross-flues, for the purpose of more readily initiating the ignition of the mass. With the elimination of the carbonaceous material by combustion, the zinc is volatilized and entrapped in the outer crust of the pile as zinc oxide.

At the completion of the operation the crust is broken off and treated in retorts in the usual manner for the contained zinc. The remainder of the pile constitutes a sintered mass, containing other metals such as gold, sil-

ver, copper or lead, and may be readily broken into lumps suitable for smelting, this material being now relatively free from zinc and carbon. The sintering may be done in an open pile or within confining walls, as for instance, within a suitable kiln.

Leaching-Plant Construction*

Reinforced concrete seems to offer many advantages for large leaching vats. It has long been used at the works of the Pennsylvania Salt Co., at Natrona and at Philadelphia, for leaching small tonnages of chloridized copper ores. The solutions there are a mixture of sulphate and chloride of copper and contain from 1 to 2% of free acid. No protective coating or lining has been used for the concrete although a new vat constructed at Philadelphia is lined with chemical brick laid with cement.

The stronger acid solutions used in leaching the Ajo ores necessitated some protective covering for the concrete. A paint of this character is made by Toch Brothers. It is known as "R. I. W. No. 44" and is advertised to have the following properties:

- (1) It stands heat up to the point of carbonization.
- (2) It withstands sulphuric acid, 20° strength, for two months without showing the slightest sign of decomposition.
- (3) It withstands the action of 15% sulphuric acid; 10% copper sulphate, at a temperature of 135° F., for six months, without showing any sign of decomposition. Withstands influence of caustic soda up to about 10% strength.
- (4) Two coats will last for several years on the interior of stand pipes. Steel must be clean and dry before material is applied.
- (5) Has a record of three years and four months on the interior walls, floors and ceilings of storage battery rooms where the vapors of sulphuric acid are condensed twice a day. Three coats were applied.

The dates of its longevity are simply minimum dates, as the material lasts much longer than our statements indicate.

The protection of these concrete vats was submitted to Toch Brothers and they recommended the following specifications:

Make your concrete a 1:2:4 mix, using an aggregate graded up to 1½ in., adding 3 lb. of "Toxement" for each bag of cement necessary to complete the operation. After the concrete has set up thoroughly dry, clean the surface and then apply one coat of R. I. W. No. 89, allow about 36 hr. for it to dry, then apply a second coat of R. I. W. No. 89. Care should be taken after the first coat is applied so that every particle of the surface is thoroughly and completely covered. R. I. W. No. 89 is constructed slightly different from R. I. W. No. 44 in order to meet your specifications.

To make a concrete vat acid proof, it must first be made waterproof. For this purpose they recommended "Toxement," a patented preparation of their own which is advertised to be "a colloidal double resin and silicate of calcium and aluminum."

A second method of waterproofing concrete was obtained from Bull. No. 46, U. S. Department of Agriculture. In this method crude petroleum or preferably residuum is mixed with the concrete as follows:

For most purposes where damp proofing is required, 5%

*Excerpt from a paper read by Stuart Croasdale at the Utah meeting of the A. I. M. E.

of oil based on the weight of the cement in the mixture is all that is necessary. For each bag of cement (weighing 94 lb.) 4.7 lb. or about $2\frac{1}{2}$ quarts of oil are required.

Mix the concrete in proportions of 1 part cement to 2 of sand and 4 of broken stone or gravel. Add water and thoroughly mix until no trace of oil is visible on the surface. If oil-mixed mortar is desired, prepare in the same manner without the gravel.

The use of 5% of oil increases the time of the initial set by 50% and the time of the final set by 47%.

Concrete with 10% oil has 75% of the strength of plain concrete at 28 days. At the end of one year the strength of 1:3 mortar suffers but little from the addition of oil in amounts up to 10 per cent.

Oil-mixed mortar containing 10% of oil is absolutely water tight under pressures as high as 40 lb. to the square inch. Oil-mixed mortar is effective as a water-proofing agent under low pressures when plastered on either side of porous concrete.

Tests were also made on the acid-resisting qualities of the following brick, which might be used for lining concrete vats: Ordinary wire-cut shale brick from El Paso; "acid-proof tile" from El Paso; low-temperature firebrick from El Paso; "star" firebrick from Pueblo, Colo.; silica brick from Pueblo, Colorado.

These bricks were allowed to stand three months in 10% sulphuric-acid solution; in 5% sulphuric acid and 5% copper-sulphate solution, and in 10% copper-sulphate solution ($10\% \text{CuSO}_4 + 5 \text{H}_2\text{O}$). There was no apparent disintegration or injury to the physical structure of any of these brick at the end of the test.

Chemical analysis of the solutions likewise showed that none of the brick had been appreciably attacked by either acid or copper-sulphate solutions. The solutions from the silica brick contained some gelatinous silica, which probably came from the decomposition of the sodium silicate used as a binder, but this did not weaken the brick.

Two concrete storage tanks were made for holding wash water, in order to bring it up to normal strength (about 10°B.) of acid to be used as a lixiviant. In practice it would be better to build these tanks of steel or wood and line them with lead, but in this experimental plant, concrete was used to determine its efficiency as well as that of acid-proof paints. Both of these tanks were made of oil-mixed reinforced concrete. They were 5 ft. in diameter and 5 ft. in depth, with walls 8 in. thick. One was plastered inside with "Toxement" mortar and the other with oil-mixed mortar. Both were painted inside with R. I. W. No. 89 paint as specified. For better protection from abrasion, the bottoms of these tanks were covered with $\frac{1}{2}$ in. or more of hot asphalt and sand, troweled smooth and compact with a hot iron like street paving. Five leaching vats were also constructed, as follows: Vat A, 5 ft. in diameter and 5 ft. in depth. Concrete, mixed with "Toxement" according to the Toch specifications. Plastered inside with cement mortar mixed with "Toxement." Painted inside with three coats of R. I. W. No. 89 paint. A false lining of wood was made to set inside this vat, but it was impracticable to retain this lining without scarring the paint, so it was abandoned at the start. It was also impossible to keep the paint from being worn off by the ore, so the vat was given one coat of asphalt dissolved in gasoline and then lined with El Paso common brick. The bricks were laid in hot asphalt, and hot asphalt and sand were poured between the brick lining and the concrete. The bottom was covered with asphalt and sand, troweled smooth while hot.

Vat B. Same construction and dimensions as Vat

A. This was given two coats of hot asphalt, which was difficult to apply and on cooling contracted and left pin holes of uncovered cement. A thin paint was then made by pouring hot asphalt into gasoline and a coat of this was applied to the concrete. On top of this was placed asphalt and sand, troweled smooth while hot.

Vat C. Same dimensions as Vats A and B, but made of oil-mixed concrete and plastered inside with oil-mixed cement mortar. A priming coat of R. I. W. No. 89 paint was applied to the concrete. On top of this was placed a coat of hot asphalt followed by a coat of asphalt paint as described under Vat B. The bottom was made of hot asphalt and sand, as already described.

Vat D. This was rectangular, 5 ft. by 8 ft. by 5 ft. in depth. It was made of oil-mixed concrete and plastered inside with oil-mixed cement mortar. The protective coatings were one coat of R. I. W. No. 89 and two coats of asphalt paint as described above. The bottom was covered with hot asphalt and sand.

Vat E. Made of oil-mixed concrete and plastered inside with oil-mixed mortar. Diameter 5 ft. and depth 10 ft. Protective coatings, one of R. I. W. No. 89 and one of asphalt paint. Bottom covered with hot asphalt and sand. The capacity of Vats A, B and C was between 3 and 4 tons, respectively. Vats D and E each held a little more than 8 tons. Three solution or precipitating tanks, 5 ft. in diameter and 5 ft. in depth, were made and protected in the same manner as Vat E.

Of the two methods recommended for waterproofing concrete, viz., by the use of "Toxement" and by the use of crude oil, the concrete mixed with crude oil appeared to be less attacked by the acid solutions at the end of two months' service than that mixed with "Toxement," although the difference was scarcely noticeable.

So far as could be observed, the acid-resisting qualities of concrete and plaster prepared with either "Toxement" or oil were not any better than those of ordinary concrete and cement plaster made with siliceous sand.

Acid-resisting paint known as "R. I. W. No. 89," prepared especially for this work, was of no value whatever in protecting the concrete vats from the 10% sulphuric solutions, the weaker lixiviant in the leaching vats or the neutralized copper sulphate in the precipitating tanks. Asphalt applied hot or as a paint was likewise useless as a protective covering for the cement plaster under any of the above conditions. One difficulty in retaining this on the walls of the vats was the high temperature of the water used for washing the ore, which averaged 100°F.

The use of such warm wash water may be criticized, but there was a possibility of the water supply coming from hot springs or wells, if developed near the mine, so it was thought best to put the asphalt coverings to the severest test. Asphalt that would soften and run from joints between bricks or from walls under the heat of the sun might be brittle enough to crack at night and allow the acid solutions to get at the cement behind it.

With the exception of Vat A, all the leaching vats, acid and precipitating tanks may be considered as operated for the entire two months on the cement plaster alone, for at no time did the protective covering last more than 24 to 48 hr. on the leaching vats and on the acid and precipitating tanks the paint would come off in patches after a few hours' or a few days' exposure to the solutions. At the end of two months the "Toxement" plaster, $\frac{1}{2}$ in. thick, was disintegrated to the concrete in

places on Vat *B* and the oil-mixed plaster of the same thickness was disintegrated nearly to the concrete on vat *C*. In the acid storage tanks both the "Toxement" and oil-mixed plaster were dissolved in patches by the 10% acid solutions and the solutions leaked through the 8-in. concrete walls. These holes were patched with ordinary cement and sand plaster and also with straight cement, both of which held the solutions successfully for several weeks.

One of the storage tanks was replastered with cement and sand and thoroughly coated with paraffin, which was forced into the plaster with a hot iron. When filled with dilute acid lixiviant, the paraffin came off immediately and was of no value whatever as a protective covering.

A plaster recommended by the Standard Oil Co. was also tried on the acid-storage tanks. It was composed by weight, of 10 per cent. litharge, 20 per cent. short-fiber asbestos, and 70 per cent. sand. These were mixed into a mortar with 40° silicate of soda and applied in the usual manner. This plaster immediately disintegrated on filling the tank with water. The tank was then replastered with the same materials and filled with dilute acid. So long as the plaster remained covered with acid, it was a satisfactory protection, but on exposure to air it began to disintegrate.

Some of the leaching vats were plastered with ordinary cement and sand mortar and painted with several coats of crude petroleum. Each application of oil was allowed to soak into the cement and become perfectly dry before another coat was applied. This was done at the close of my experiments and I had no opportunity to test its merits.

The brick lining in Vat *A* proved to be satisfactory. With the exception of where the asphalt was melted from the joints by the hot wash water, no deterioration could be noticed. This was due to the irregular size and shape of the common brick used for the lining and could be avoided by using pressed brick of uniform size which would permit of thin joints. In a large vat the brick would also be laid flat instead of on edge.

The sand and asphalt bottoms were entirely satisfactory when they were pressed solid with a heavy hot iron muller like that used in street paving. If this was not done, they were porous and spongy and no protection against the solutions.

As now developed by the limited operation of the experimental plant, ordinary or oil-mixed concrete will be entirely satisfactory for leaching vats, wash-water and neutralized copper-sulphate solution tanks. These can be made tight and acid resisting by lining with pressed brick of uniform size, laid in asphalt and backed with hot asphalt poured between the brick and concrete. Vitrified brick would be less porous and preferable if they can be obtained straight and uniform in size. The vats should be plastered inside with cement and sand mortar before putting in the brick lining.

The cement we used in construction came from the regular run of the mill at El Paso and contained more or less free lime. It is my belief that with cement and other materials containing no free lime, a concrete vat can be built and lined with brick, laid with thin joints of cement and sand mortar, that will be entirely satisfactory for acid leaching. After the bricks soak full of mineral salts, there is very little if any transfusion of the corrosive solutions to the concrete back of the lin-

ing and they form a protective coating for both ore and solutions.

Oil-mixed cement plaster will last two or three months without patching or renewal. A brick lining laid in oil-mixed cement mortar would probably last longer than plaster, but the asphalt and brick lining is recommended if it can be held in place. The cracks that form after construction are the most serious, if not a fatal defect in concrete for leaching vats. These are often so small that they are scarcely noticeable and yet are sufficient to start a leak that is almost impossible to stop, even with asphalt itself.

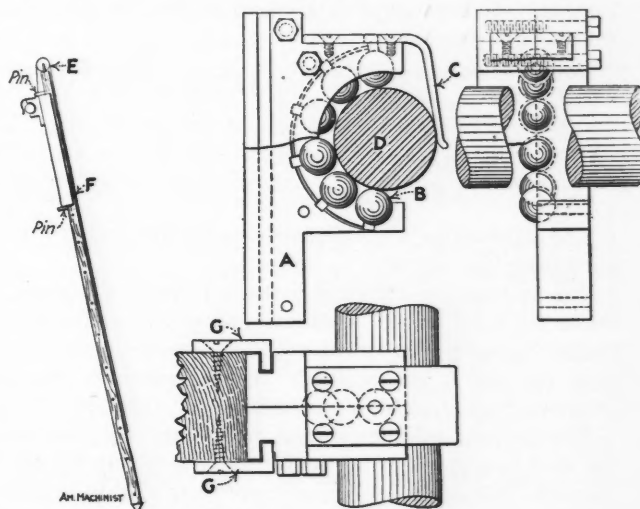
The shape of the vats is immaterial, although for economy of construction and operation a rectangular concrete vat is preferable. The tailings can then be removed from the top and the bottom of the vat made solid with no openings.

The bottoms of the vats should be paved with sand and asphalt, thoroughly pressed down with hot iron mullers or otherwise to make a *compact* covering. On top of this should be a brick paving laid in asphalt. The storage or acid-mixing tanks for the 5% to 10% acid solutions should be made of steel or wood and lined with lead.

✱

Ball-Bearing Shaft Ladder

With all the various styles of ladders used in the shop there is always more or less difficulty in placing them up against a shaft in motion, one fault being that the foot of the ordinary ladder is in constant danger of slipping. Ladders with heavy shoes attached are cum-



BALL-BEARING SHAFT LADDER

bersome and difficult to handle, as iron shoes generally weigh from 5 to 12 lb. each.

The illustration shows a device, described by J. A. Duckstone in the *American Machinist*, that can be applied to any height of shaft without changing the slant of ladder. The casting *A* has a semicircular opening in which the balls *B* are held. These rest upon the shaft *D* and do away with the friction which wears the wooden ladder.

The latch *C* prevents any possible slipping. The device has a track *F* which fits in the groove made by the two angles *G*, a rope and pulley moving the ball bearing to suit any height of shaft.

The Assayer and Chemist

Quick Method to Precipitate Tin Electrolytically

By LEON HUMPHREVILLE*

In the ENGINEERING AND MINING JOURNAL for June 6, 1914, there is a communication from R. L. Hallett with reference to a quick method for determining tin. Mr. Hallett mentions the electrolytic method with oxalic-acid solution, which he, however, rejects as being too tedious for technical analysis.

I thought it might be of interest to describe the electrolytic method with ammonium-sulphide solution as originated and used at the Aix-la-Chapelle Polytechnicum, which is admirably adapted for rapid technical analysis.

The sulphide method to precipitate tin electrolytically, which was first brought out by A. Classen, in his well known work, "Quantitative Analyse durch Elektrolyse," seems to be little known and applied. Although it has not reached the state of perfection for scientific purposes which one could wish, it is for technical analysis amply sufficient.

The conditions for the quick determination by the ammonium-sulphide method, which are set forth in the book, "Elektroanalytische Schnellmethoden," by Prof. A. Fischer, collaborator of A. Classen at the Polytechnicum, are as follows:

Form of electrode	Net electrodes
Electrolyte	16cc. $(\text{NH}_4)_2\text{S}$ and 20cc. Na_2SO_3 (40%)
Volume of solution	120cc.
Metal precipitated	0.2-0.3 gram
Temperature	60° C.
Potential	4 volts
Current strength	5.5 amp.
Revolutions of stirrer	600 r.p.m.
Duration of precipitation	25 minutes.

The apparatus and electrodes are illustrated in the accompanying figures.

The ammonium sulphide is made from an ammonia solution of 0.91 sp.gr. Ordinary ammonia contains sufficient impurities to impair the accuracy of the results from the electrolytic method. The ammonia is therefore prepared from ammonia gas secured in cylinders.

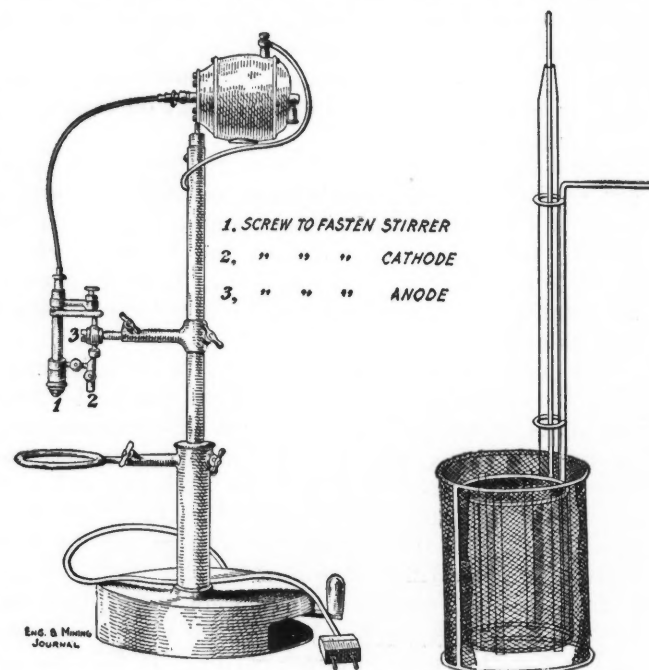
The sodium sulphite should render the solution colorless and is added before beginning the precipitation; in case the color should not disappear more should be added.

The precipitation should be started before the stirring is begun. The amperage may vary a little, but it is important that the voltage be exactly four volts, otherwise the tin will take on a dull gray color, due to the presence of more or less sulphur, and not possess its normal bright, metallic luster. The precipitated tin always contains very small quantities of sulphur, which do not, however, affect the accuracy of the results within a limit of 0.05%. The platinum cathode must be first coated with copper, as platinum alloys with tin. The copper is in turn coated with tin, against which the potential of generation of hydrogen ("überspannung") is sufficiently high to prevent the latter being formed and interfering with the pre-

cipitation of the tin. Cadmium has been proposed and successfully employed as a substitute for the double coating of copper and tin described. The cadmium is precipitated out of a cyanide solution like silver, an operation requiring one to two minutes.

It is not possible to precipitate pure tin electrolytically out of a solution containing other metals, and it must therefore be first separated from them as in quantitative analysis. This can be done most advantageously by securing the tin as sulphide, which can then be dissolved in ammonium sulphide and submitted to the electrolysis.

The total duration of the analysis depends on the material analyzed and may vary from $\frac{3}{4}$ to $1\frac{1}{2}$ hours. The



APPARATUS FOR QUICK PRECIPITATION OF TIN

electrodes are most quickly and easily freed from tin by immersing them in a mixture of hydrochloric and oxalic acids. The one unpleasant feature of the analysis is that the ammoniacal solution attacks the brass parts of the apparatus. This can, however, be very easily prevented by covering the latter with a rubber hood. The Gebrüder Raacke, Aix-la-Chapelle, manufacturers of the apparatus, were kind enough to place the illustrations at my disposal.

Cobalt in Steel

A process for the determination of cobalt in steel is given by P. Slawik (*Chem.-Ztg.*, 1914, p. 514). One to two grams of drillings are dissolved in dilute hydrochloric acid, oxidized with potassium chlorate and the excess of acid evaporated. The solution is treated with zinc-oxide emulsion, added in small portions at a time, carefully avoiding excess, until the precipitate coagulates. The

*Polytechnicum, Aix-la-Chapelle, Germany.

volume is made up to 500 c.c., and 250 c.c. are filtered. The solution, containing only cobalt, nickel and manganese, is concentrated to 100 c.c., treated with 20 c.c. of strong hydrochloric acid, and the cobalt precipitated by 30 c.c. of a 2% alcoholic solution of nitroso-β-naphthol. The precipitate is strongly ignited and weighed as Co₃O₄. In the case of nickel steel the ignited precipitate should be dissolved and the precipitation repeated.

Assay of Cobalt Silver Ores

The method of assay used by the Ledoux laboratory of New York was recently described by A. M. Smoot in the *Bulletin* of the Canadian Mining Institute, in a discussion of a paper by Mr. Campbell. This method is entirely different from the straight scorification method used at Cobalt. Quarter- or half-assay ton portions of pulp are taken, the former weight if the sample contains over 2000 oz. per ton, the latter if the silver is less than this. The pulp is treated in beakers with strong nitric acid added a little at a time until danger of frothing is past. About 75 c.c. of acid is required for 1/4-a.t. portions and 100 c.c. for 1/2-a.t. portions. The solutions are heated on a steam bath until red fumes cease to be generated and then they are diluted with 200 c.c. of distilled water and allowed to stand until cold—best over night.

It is important that the solutions be allowed to stand before they are filtered because with certain ores containing much arsenic together with some antimony and lime, a white crystalline coating appears on the bottoms and sides of the beakers which cannot be detached by washing or even scraping. This coating contains a little silver and if it is not allowed to form in the original nitric-acid solution it forms later on in the process and makes trouble. Insoluble residues are filtered off and washed thoroughly. If there is any coating on the sides and bottoms of the beakers which cannot be readily detached with a piece of filter paper, it is treated in the beaker with a hot solution of caustic soda, which quickly disintegrates it. The caustic-soda solution is acidulated with a little nitric acid and washed into the filter with the soluble residue.

Most of the silver is dissolved by the original nitric-acid treatment and passes through the filters as silver nitrate, but a little remains with the insoluble. If the insoluble residues are large in amount, they are dried and burned in crucibles, fused with sodium carbonate, borax glass, litharge and a reducing agent. If they are small, they are dried on scorifiers and scorified with test lead and borax glass. In either case, the lead buttons from the insolubles are reserved. Standard sodium-chloride solution is added to the nitric-acid solutions containing most of the silver in amount sufficient to precipitate all silver as chloride, but avoiding any considerable excess of the precipitant.

The silver chloride is stirred briskly until it agglomerates and then allowed to stand for an hour until it settles and the supernatant liquid becomes clear. If it remains cloudy, rapid stirring is repeated and it is again allowed to settle. The clear solutions are filtered through double filter papers and the silver-chloride precipitates transferred to the filters by a water jet and there washed slightly with water. The beakers are washed well with a jet and any traces of silver chloride remaining in them are wiped off with small pieces of filter paper which are

placed in the filters. Filters containing the silver chloride are transferred to scorifiers which have been glazed on the inside by melting litharge in them and pouring away the excess. The glazing is done to prevent the porous scorifiers from absorbing moisture from the damp paper, and as a further protection, a small disk of pure sheet lead is placed beneath the filter papers.

The scorifiers are transferred to a closed oven heated to about 250° to 300° C., where they are dried and the paper is slowly charred until it is practically all consumed except a small amount of carbon. This method of burning the filter papers is an essential step, since it avoids losses of silver chloride which are apt to occur if the burning is done rapidly in a muffle. Fine test lead is sprinkled over the burned silver-chloride residues and the lead buttons resulting from the crucible fusions and scorifications of the corresponding residues insoluble in nitric acid are added. Scorification is then conducted at a low temperature so as to obtain 15-gram lead buttons. These are cupelled at a low temperature, taking care, in the case of large silver buttons, to avoid "spitting" at the end of the cupellation.

This combination method, properly conducted, yields results higher and more concordant than can be attained by any all-fire process. It is, nevertheless, a commercial assay and is acceptable to the smelters since it does not include slag and cupel corrections. Inasmuch as all impurities likely to effect variations in the volatilization and slag losses are removed prior to the fire work, the results of assays made on different days and in different conditions are more uniform than when the fire assaying is done directly on the untreated ores.

Small amounts of bismuth occurring in the Cobalt silver ores are a source of irregularity in that bismuth is retained to some extent by silver after cupellation. In the combination method, bismuth is eliminated before any fire work is done. It is also essential that the test lead shall be free from bismuth. Bismuth-free lead can be obtained, but most brands of test lead contain sufficient bismuth to interfere seriously with accuracy in silver assaying.

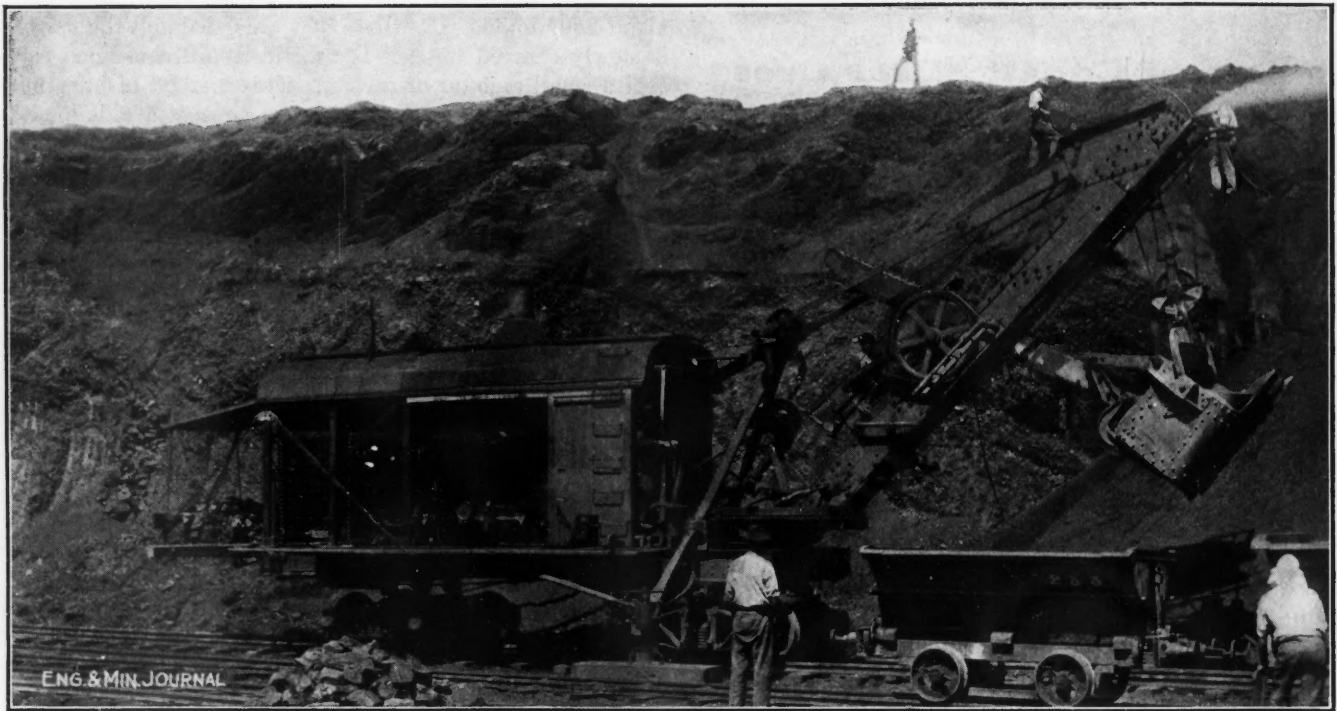
The following example, taken at random, of a recent assay made in our laboratory will serve to show the concordance of assays by the combination method:

	Weight	Oz. per ton
Charge 1/4 a.t.	823.0 mg.	3292.0
	822.4 mg.	3289.6
	823.2 mg.	3292.8
	824.5 mg.	3298.0
	<hr/>	
	3293.1 mg.	3293.1

Four assays are made of each individual sample and as the amount taken, being 1/4 or 1/2 a.t. for each determination, is far greater than the amount which can be taken for the direct fire assay, the sample is represented better and variations are thus reduced in effect. Metallic scales from the four samples are assayed separately by the all-fire process, using 1-gram charges, and when the amount of scales is small as many assays of each sample are made as the amount of scales will permit, but in cases where the amount of scale is large, six 1-20-a.t. portions are used.

Tellurous Acid Can Be Detected in Presence of Telluric by making the solution to be tested alkaline and then acidifying with acetic acid. According to Browning and Mining (*Am. Journ. Sci.*, 1913, p. 72), tellurous acid gives a precipitate, telluric gives none.

Photographs from the Field



BUCYRUS STEAM SHOVEL AT WORK IN OLD DUMPS, WALLAROO & MOONTA MINES, SOUTH AUSTRALIA



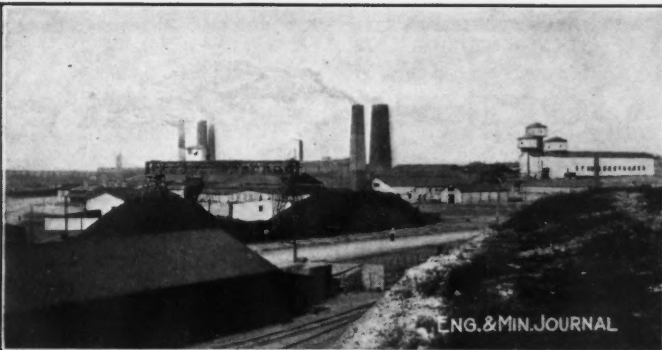
TAYLOR'S SHAFT, WALLAROO MINES

Entrance to electric-pump chamber and sump at 2430-ft. level

Man skip at 2430-ft. level



ENG. & MIN. JOURNAL

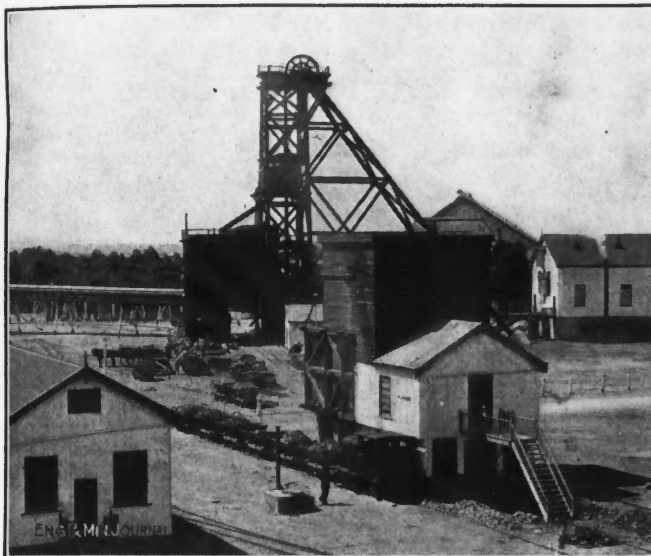


ENG. & MIN. JOURNAL

PORT WALLAROO, SOUTH AUSTRALIA

The Jetty

The Smelting Works



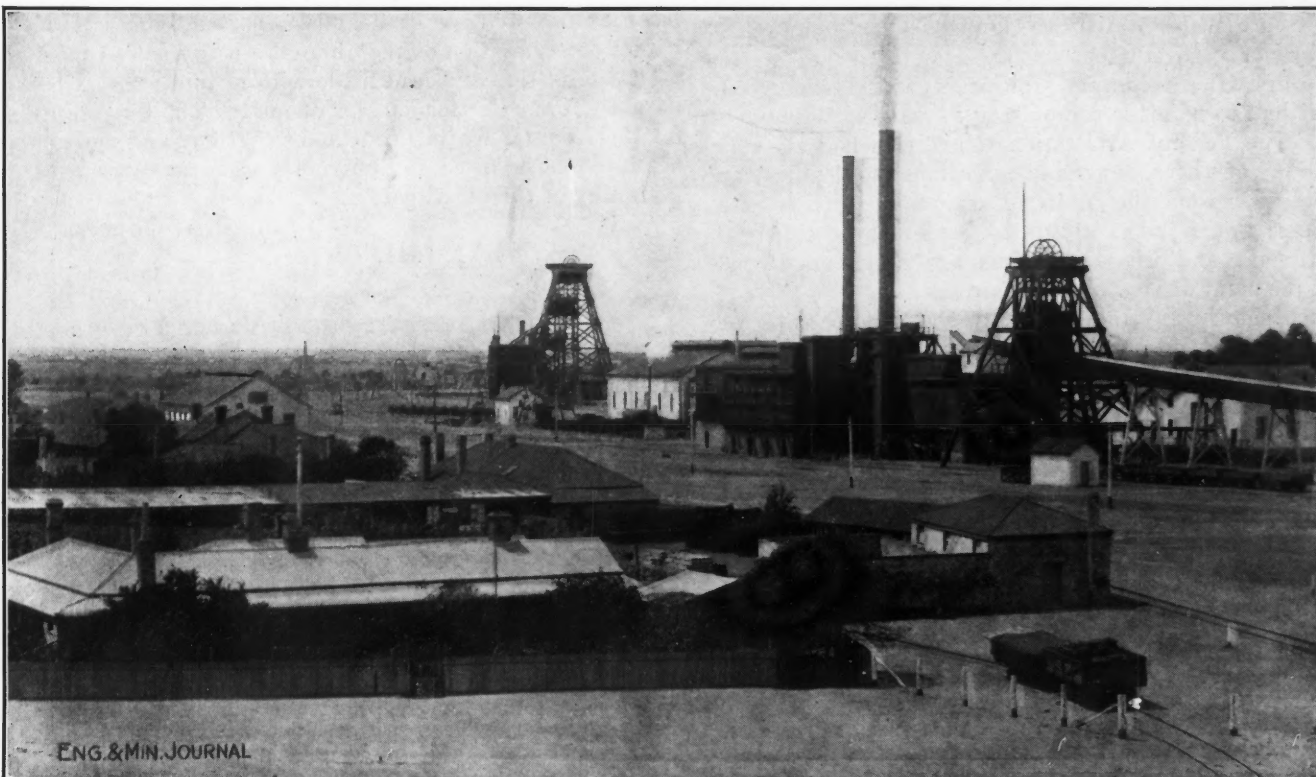
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HEADFRAME AT YOUNG'S SHAFT

HEADFRAME AND ORE BINS AT TAYLOR'S SHAFT



ENG. & MIN. JOURNAL

WALLAROO & MOONTA MINES, SOUTH AUSTRALIA
General View of Wallaroo Mines

Correspondence and Discussion

Australia under Labor-Union Rule

In the JOURNAL of Oct. 31, p. 800, there appears an article headed "Australia under Labor-Union Rule," which contains many misstatements. I feel sure that your JOURNAL does not desire to misrepresent the facts, hence this letter to you. I am the Panama-Pacific Exposition Commissioner here and also Trade Commissioner for the State of New South Wales, Australia.

The opening lines of the article make the statement "that the labor unions have got about everything they want and that they have captured the governments of several of the states." This shows absolute want of knowledge of the position. It is true that the "Political Labor Party" is the governing power of the Australian Commonwealth and also in the states of New South Wales, Western Australia and Tasmania, but it is not true that this political party is a "Trade Unionist Party" and the suggestion is also equally untrue that the arbitration laws under which the hours and conditions of almost every industry are fixed were passed by Labor governments.

Arbitration laws have been in force in some of the states for 15 years and in the Federation as a whole, for seven or eight years, in each case long before the Political Labor Party had secured the reins of government. The arbitration laws were passed in the Australian parliament by the Deakin government, which was a government composed from the Protectionist Party and in the State of New South Wales by the See Government, also a Protectionist Party government.

We first tried voluntary arbitration; it did some good, but it had to be made compulsory to make it fully effective. The Federal Arbitration Court, which deals with the fixing of wages, hours and conditions in all industries extending beyond the limits of one state, consists of a Supreme Court judge, appointed for life by the federal government and whose decisions are never questioned from the point of view of their fairness.

Each side in any industry fully states its case to the board or court in any manner it pleases, by evidence or otherwise, and the board or court then fixes the conditions for the industry concerned, for three years. In every award, provision is made for overtime, and I defy your informant to point to any case that will bear out the statement about the ship being detained because the hour came to cease work before the last bar of copper was loaded. On the other hand, I can quote hundreds of cases where men have worked 20 hr. in one stretch to allow a ship to get away on time and such cases are recurring every day in any port you care to mention in the Australian Commonwealth.

The Socialists in Australia, who represent the extreme section of political thought, are a very small entity and invariably vote and work against candidates of the Political Labor Party. It is a fact that the Trades Unionists as a body were the originators of the idea of industrial arbitration, which you will admit is an appeal to calm judg-

ment and reason as against the old brutal method of strikes, and are its greatest supporters and advocates to this day, but it is also a fact that the employers of labor in Australia would not go back to the old system on any account, as the arbitration awards give fixity of conditions which were never wholly in existence before.

NEIL NEILSEN.

San Francisco, Calif., Nov. 4, 1914.

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Lead and Radio-Lead

The notes in the JOURNAL of Sept. 1 and Nov. 7 on "Lead and Radio-Lead" are interesting to me because some years ago I found an unexplained difference between lead made by different processes. There was then a certain brand of white lead made from leads produced in Carinthia and in the American hearth (in Missouri), and it could not be made from any other lead, American or foreign. The only difference was that the lead from which this exceptionally fine white lead could be made was produced in furnaces in which the slag was not melted. It was drawn off as a thick agglomerated mass.

When this slag was put into a shaft furnace and a thin-running slag made the lead was no longer fit for this especially fine brand of white lead. At that stage of the chemical game I could only guess that one of these leads was an allotropic form of the other, like palladium and allopalladium, which seem to be the same chemical element, but crystallize in different systems. It seems to me that the study of lead and radio-lead should begin with a determination of the difference between lead made with a solid slag and lead made with a fluid slag. I believe Dr. Chandler made a lot of analyses of these leads for the Atlantic White Lead Co. of that day and perhaps he would be allowed to contribute these analyses as a beginning of the investigation.

JOHN A. CHURCH.

New York, Nov. 7, 1914.

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Prisoners of War

The editorial and the discussion which have appeared in the JOURNAL, regarding the use of prisoners of war as laborers, renders a recent article by Roger W. Babson in the New York Sun of peculiar interest. He appears to feel that the country making the best use of its prisoners should ultimately win, judging from the following:

On the other hand the capture of large numbers of able-bodied male prisoners by any one country is a factor tending to prolong the war so long as these captures are more or less evenly balanced. Such prisoners are of value not so much in handicapping the enemy as in providing the country making the capture with workers for their factories and fields while their own men are at war. If Germany has 250,000 able-bodied prisoners these, without doubt, have been put to work to take the place of Germans at the front in mines, mills and public improvements. Considering the fact that these prisoners need not be paid and can be fed for a few cents a day, they are of much economic value in enabling nations to prolong the war.

A. A. NASON.

New York, Nov. 16, 1914.

Wisconsin Zinc Conditions

CHICAGO CORRESPONDENCE

The general feeling among mining men elsewhere, perhaps, is that the lead and zinc districts of Wisconsin and Missouri are inactive, with operations far below normal. This is not true in the Platteville, Wis., district, at least, as revealed by a recent trip. Certain mines have been closed, but in most cases this was because the orebodies were exhausted, and not because of unfavorable conditions of labor, spelter price, etc. In some cases, the places of these former producers have been filled by new mines and mills recently put in commission, and more new work is contemplated or actually under way.

The general sentiment of the mining men around Platteville is optimistic, a feeling based largely on the theory that the price of spelter will average 5c. per lb. for the next few years. If that price does prevail, mines can be opened, mills built and a profit made on operations in that district. And it should be remembered that in computing costs on a 5c. market, the possibility of lean years with spelter at $4\frac{1}{4}$ to $4\frac{3}{4}$ c. has been considered as well as the higher prices, and discounted accordingly.

The Wisconsin operators are not having difficulty in selling their product, and this indicates that the smelters are still willing to add to the stock on hand. From this it is concluded that if the latter are willing to hold the bag, there is no good reason why production, exploration and construction should not continue at a fair rate. This is actually what is happening.

The following figures are interesting and indicative: Out of approximately 48 possible producers in the district, 27 mines are working today; 13 are closed, probably temporarily, i.e., their orebodies are not exhausted and resumption depends upon the market or local conditions; the other eight are doubtful, they may or may not be working, but if working, it is probably on a small scale. The following roasting plants are in operation: Linden Zinc Co., Linden; National Zinc Co., Cuba City; Campbell Separator, Cuba City; Empire Roaster, Platteville; Mineral Point Zinc Co., Mineral Point; Joplin Separating Co., Galena. The zinc-oxide plant of the Mineral Point Zinc Co., at Mineral Point, is also operating.

This year at least four new plants or mines were placed in commission. The New Coker mill of the Mineral Point Zinc Co., at Livingston, started to operate in October, as did also the North Unity Mill of the Vinegar Hill Zinc Co., at Day's Siding. More recently, the Wisconsin Zinc Co. started its mill at the Champion mine at Benton. The Frontier Mining Co. commenced to operate its Grotkin mill at Benton last summer. These are all new operations.

Other new construction is planned for the district. The Kissler mine, near Platteville, has sunk a shaft and will erect a mill in the near future. The ground at the Hird mine, near the Grotkin at Benton, has been drilled and will be worked. This means the construction of a mill there in the course of a year or two. The equipment required for these mills will include Blake-type crushers, rolls, elevating pumps, bucket elevators, belts, trommels, samplers, jig screens and pulsating devices. The mills and mine headframes in this district are constructed as a unit, and this means that usually new mine surface equipment is installed when a mill is built. This equipment would include a small electric hoist, pumps, sheaves,

grizzlies, and possibly a small compressor. Electric power is used almost universally and motors would be required for the mill. The jigs are built on the ground. It is not unlikely that the Wisconsin Zinc Co. will build a new roaster, and this would be a plant of some consequence.

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White Island Sulphur Operations Destroyed by Eruption

A volcanic eruption is reported at White Island in the Bay of Plenty, about 35 miles off the coast of New Zealand, on or about Sept. 17. This disturbance, reported by a pilot of a passing ship, is supposed to have destroyed the works of the New Zealand Sulphur Co. and the 10 or 11 men at the property at the time of the eruption. The workings are said to have fallen into the crater, and the company's camp, situated about a quarter of a mile away, and its wharf are reported to have been buried. Readers of the JOURNAL may recall some excellent pictures of the crater in the issue of Nov. 1, 1913. About this time the sulphur-mining operation, which had been initiated by the White Island Sulphur Co., was taken over by the New Zealand Sulphur Co. The deposit has long been known in New Zealand, but the frequency of eruptions and the difficulty of obtaining workmen had deterred many from undertaking its exploitation.

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Chino Copper Co.

The report of the Chino Copper Co. for the third quarter of 1914 shows a production of 11,491,120 lb. of copper, divided into 5,087,750 lb. in July, 3,165,501 lb. in August and 3,237,869 lb. in September. Besides the copper contained in concentrates, there were 286,693 lb. contained in smelting ores shipped during the quarter. Reduction of output is due to a policy of voluntary curtailment which was inaugurated on Aug. 6, to the extent of decreasing operations and output to one-half normal capacity after that date.

Total tonnage of ore treated for the quarter was 390,000 tons, an average of 4239 tons per day. The average grade of the ore was 2.165% copper, and average extraction was 68.04%, corresponding to a recovery of 29.46 lb. per ton of ore milled. Concentrate production amounted to 34,220 tons containing an average of 16.276% copper.

Cost per pound of net copper produced in milling operations, after allowing for smelting deductions and without allowing credit for miscellaneous income, was 7.81c. During this quarter for the first time, the amount of gold contained in concentrates was sufficient to be given consideration in smelter settlements under contract terms, and net credits from this source amounted to 0.10c. per lb., thus reducing the net cost per pound of producing copper, after crediting gold value, to 7.71c. Cost of net copper per pound produced from both milling and shipping ores for the quarter was 7.74c. If miscellaneous earnings derived from various sources for the period were credited to the cost of producing copper, the cost would be reduced to 7.37c. per lb., this cost including administration, general and all other charges, as well as the regular charge applied to the extinguishment of mine development and stripping expense. Total income from milling profits, crude ore profits and miscellaneous incomes amounted to \$566,495. Dividends paid amounted

to \$433,400, leaving a net surplus over dividend requirements of \$133,095. Earnings were based on carrying price of 12.4344c. per lb. for copper, and the total amount on hand and in transit, sold and unsold, at the end of the quarter was 23,273,719 lb. Operations were free from interruption or unusual incident, except as to the curtailment of production already mentioned.

Gold and Credit

The question of gold shipments from New York to London, which, since the outbreak of the war, has been the chief disturbing factor in international finance, renders some remarks by J. A. Hobson in his book, "Gold, Prices and Wages," published in February, 1913, of peculiar interest. Mr. Hobson wrote:

What the holder of a credit-note wants is a security that the full purchasing power it claims to represent shall be realizable. If a bank, or a government which he knows to be able to secure for its notes this purchasing power, issues them, they are to him "as good as gold," even though he is aware that gold could not be got for all of them. His final preference for gold, so far as he has one, is based upon some fear or doubt lest some other persons in the world, from whom he might wish to buy, may entertain some distrust of his credit-note, preferring gold. To that extent the freedom of its purchasing power would be limited. But the credit system stands in the last resort upon the confidence in the ability of the issuer to place the holder of a note in possession of such forms of real wealth as he requires, when he wants it, and in amount such as he expected to be able to obtain when he received the note. Gold is only a requisite to the credit system so far as it is useful to sustain or increase this confidence.

It is a conventional utility, a serviceable check on possible abuses of credit issue, but not in the strict scientific sense an economic necessity in the working of the credit system by which modern commerce is conducted. For international commerce, at any rate with backward countries, it may long be needed. But it ought to be no longer necessary even for international payments between members of advanced commercial nations. There is no reason why the Clearing-House system, which has dispensed with gold in the internal credit operations of the country, should not in the early course of time be extended in the shape of an International Clearing House, all balances on foreign trade between members of civilized nations being paid in Clearing-House certificates.

Such an extension, clearly thinkable, if not easily feasible, makes it evident that gold is not intrinsically essential to the manufacture of credit. The notion that some single valuable commodity must always stand as the background to sustain the credit system has no real validity. Gold, indeed, is not even now dependent for its position as money upon such general appreciation of its value as a commodity. Gold has, indeed, a high but very limited use for the arts. But this value could by no means support its pecuniary position. People do not ultimately "look to the gold" behind the credit-notes because they know that in it they would have something intrinsically valuable and serviceable. They do not say to themselves, "I will insist on five gold sovereigns instead of a Bank of England note, because I know that, if the worst comes to the worst, I can melt down my sovereigns and make ornaments or stop teeth with them." In fact, of course, any wide attempt to get industrial use out of sovereigns withdrawn from currency would soon defeat its end by driving down to a very low level the exchange value of gold for uses in the arts.

Ontario Ore Shipments

Shipments of ore and metals from Ontario, Canada, during the period of nine months ended Sept. 30, 1914, according to the Ontario Bureau of Mines, were as follows: Silver, 19,448,018 oz., valued at \$10,082,229. Pig iron, 495,161 tons, valued at \$6,444,215. Nickel, 18,085 tons, valued at \$4,023,556. Gold, 196,934 oz., valued at \$3,942,848. Copper, 11,585 tons, valued at 1,664,896. Cobalt and nickel oxide, 852,014 lb., valued at \$454,687. Cobalt ore, 95 tons, valued at \$26,563.

Mohawk Mining Co.

The report of the Mohawk Mining Co., Mohawk, Mich., for 1913, shows a production of 5,778,235 lb. of copper, which was sold at an average price of 15.36c. per lb. The production in 1912, before the strike, was 11,995,598 lb. The profits for 1913 were \$123,839, compared with \$656,435 for 1912. After paying dividends amounting to \$500,000, a surplus of \$521,155 was on hand at the end of the year. There were 395,100 tons of rock hoisted, of which 7.2% was discarded as waste, leaving 366,458 tons treated, which produced 8,018,000 lb. of mineral or 5,778,235 lb. of refined copper. This gives a yield of 15.76 lb. of copper per ton of rock stamped. The total cost of producing copper was 13.22c., made up as follows: Mining and milling, including transportation, 10.42c.; smelting, freight, and marketing product, \$1.16c.; construction and strike expense, 1.64c. per lb.

Some tests were made with a Hardinge mill over an extended period and the results indicate that until increased power, and that at a lower cost per unit, is secured from the plant by utilizing the exhaust steam from several stamps in a low-pressure turbine, the best recovery would be effected by using Hardinge mills instead of Chilean mills.

The following schedule of time was adopted on Dec. 1, 1913: For underground men; men leave surface at 6:45 a.m.; half-hour for lunch at noon; and reach surface at 3:45 p.m. Night-shift men leave surface at 8:30 p.m.; lunch at midnight for one-half hour, and reach surface at 5:30 a.m.

German Iron Trade

The iron trade of Germany, from all accounts obtainable, is at a low ebb, though the Krupp and other works making war material are extremely busy. The regular trade, however, is small, and the important Lorraine-Luxemburg district is said to be completely closed down. The export trade is cut off and there is nothing to take its place. The latest official figures we have received are for September, and in that month the make of pig iron was a little less than one-third of that reported in September, 1913. Iron and steel works—with the exception of those directly employed on war material—have lost many men who are in the army, but their services do not seem to be especially needed for the present. An effort is made to keep up appearances in the trade, but the evidence of the production figures is strong.

Steel Resumption

There has recently been in evidence a decided picking up in the operations of the steel mills. At Gary three blast furnaces, 12 openhearth furnaces, 215 coke ovens and all the rolling mills except the rail mill resumed Nov. 16 and gave employment to about 5000 men. More recently, the South Chicago plant of the Illinois Steel Co. resumed operations in rail mill No. 1 and the structural mill, giving employment to 2000 men that had been idle since spring.

Tin Ore Equivalent to 84 Tons of 60% tenor, was produced in the United States in 1913. Most of this was taken out by the York Dredging Co., according to the U. S. Geological Survey. The consumption of the United States was estimated at 53,315 tons during the said period.

Editorials

The Porphyry Coppers

The reports of the porphyry copper-mining companies for the third quarter of 1914 have lately been coming in, and are particularly interesting for what they show as to the effect of curtailment upon cost of production. Let it be noted, however, that the curtailment was not inaugurated until after the first month of the quarter had passed.

Utah Copper Co. milled in the third quarter 1,466,606 tons of ore, as compared with 2,006,157 tons in the second quarter. The average grade of the ore and percentage of extraction in milling were practically the same in the two quarters, being respectively 1.4356% and 68.13% as compared with 1.4573% and 68.44% in the second quarter. The average cost per pound of copper in the third quarter was 7.76c., compared with 7.539c. in the second quarter. Messrs. MacNeill and Jackling in their report remarked that, considering the circumstances, the cost of production in the third quarter was quite satisfactory, "lower in fact than was to have been expected."

Chino milled 390,000 tons, averaging 2.165% copper, and yielding 68.04% in the third quarter, compared with figures of 587,900, 2.165%, and 66.89%, respectively, in the second quarter. The average cost in the third quarter was 7.81c., compared with 7.66c. in the second quarter. This was on milling ore alone. The payment for the first time for some gold in the concentrates and the increased shipment of smelting ore made the average cost of all the Chino copper a little less in the third quarter than in the second quarter. However, the results from the milling ore alone are the ones upon which attention should be fixed. The important increase in the mill extraction is suggestive. Does this mean that a better result was obtained in driving things not quite so fast?

Ray milled 546,734 tons, averaging 1.691% copper, with a mill extraction of 67.47%, as compared with 764,040 tons, averaging 1.786% copper, with a mill extraction of 68.69% in the second quarter. The cost of production per pound of copper in the third quarter was 8.849c., an increase of about 0.2c. over the second quarter. In this case there was not only a smaller tonnage of ore milled, but the ore was of lower grade and the percentage of mill extraction was lower. The cost of mining and milling per ton of ore was materially reduced.

Nevada Consolidated milled 599,126 tons of ore, averaging 1.52% copper, compared with 831,589 tons, averaging 1.38% copper, in the second quarter. The average cost per pound of copper was 9.59c., compared with 10.73c. in the second quarter. The improvement in the grade of the ore milled is, of course, an explanation of the reduced cost of production per pound of copper.

Miami has not yet published its figures, but it is understood that its cost of production in the third quarter was about as low as anything recorded previous to the curtailment. Here, again, there was an improvement in the percentage of mill extraction, and in this case the improvement was very great and is attributed largely by the

management to the reduction in the intensity of the rate of milling.

Let it be noted that in giving these cost figures we have reference only to direct operating costs, no allowance for amortization of plant or interest on capital being included. It is evident from these figures that drastic curtailment has not greatly increased cost of production in any case, while in certain cases there have been decreases.

It would be easy from *a priori* reasoning to draw the deduction that such a result might be ascribable to the selection of a higher grade of ore than the average, or to the improved extraction in milling by reason of less intense operation, but the evidence that we now have does not warrant anything of that kind, although in certain cases those have been decisive factors. The only general deduction that is permissible, we think, is this: The porphyry coppers are conducted on so enormous a scale that even the smallest of them is far beyond the size of the unit of maximum efficiency. It is well known that in most kinds of mining and metallurgical work there is a unit of maximum efficiency, beyond which nothing is gained in the quotient by increasing the divisor. In the matter of fixed charges and general expenses, the quotient is, of course, directly affected by changes of the divisor, but in the cases of the porphyry coppers the divisors are always so big that the quotients are always small anyway, and the changes are but trifling. When the curtailment was inaugurated early last August, the question of its probable effect upon operating costs was discussed by mine managers with a good deal of fear and trepidation. It is gratifying to everybody, but especially to the managers and the stockholders of these companies, that the actual result has proved to be so much better than anybody expected.

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A Coming Revolution in the International Zinc Business

We have lately hinted several times about important developments pending in the zinc industry. Something more definite may now be revealed: The Australian production of zinc ore has heretofore gone to Germany for smelting. The war interrupted that business, and that interruption, temporarily very inconvenient to the Australian producers, inspired new plans, as a result of which Germany will lose this smelting business permanently.

Negotiations are now in progress between the Zinc Corporation and other Australian producers for a combination of their interests in the smelting of their output. Negotiations are further in progress whereby the American Smelting & Refining Co. will unite with those Anglo-Australian concerns for the erection of new smelting works. The Australian ore has been in recent years the largest single source of spelter in the world and the smelting of it has been the mainstay of the German zinc-smelting business. The impending change will, therefore, constitute nothing less than an industrial revolution.

We understand that the terms practically have been agreed upon, but have not yet been signed, although consummation is expected shortly. The new smelting company will have something like 1000 tons of zinc concentrates to smelt daily, besides a large tonnage of lead concentrates. Certain seaports in Wales and certain seaports on the Atlantic Coast of the United States are being considered as places for the new smelting works. The conditions on each side of the Atlantic already have been carefully considered by the engineers of the projectors, and are now the subject of further consideration, no decision having yet been made. We think, however, that at present there is a leaning toward the American side of the Atlantic. If this should be the decision, the Panama Canal will have been a strongly contributing factor. If this development comes about, the United States will become the predominant factor in the zinc-smelting industry of the world, and New York may surpass London as a primary market for spelter the world over.

Licensing Engineers

Hearings are being held at Pittsburgh, Harrisburg and Philadelphia on a bill which is to be introduced in the Pennsylvania Legislature providing that engineers must be licensed by a state examining board before taking charge of any engineering work in the state. The bill is general in its character and applies to all classes of engineers—civil, mining, electrical and mechanical. It has been prepared by a commission appointed a little over a year ago by Governor Tener, the members being Prof. John P. Jackson, of the State College; Samuel A. Taylor, George S. Webster, F. Herbert Snow and J. Murray Africa. Of these, Professor Jackson is the best known in the engineering world. Such accounts as we have seen of the hearings already held seem to indicate that engineers generally have not taken as much interest in the proposed law as might have been expected.

At Pittsburgh those who did appear were generally opposed to the bill, some urging that it is unnecessary and that it would impose unreasonable requirements upon engineers; others intimating that it would have a tendency to bring the engineering profession in Pennsylvania into politics, and expressing fear that the examining board might be too political in its constitution.

It is to be hoped that more interest will be taken in the later hearings and that engineers will take some pains to see that at least a good working law may be presented to the next Legislature, which, it is thought, will be very likely to pass any bill which may have the approval of the commission and the governor. Even those who are opposed to any enactment of the kind must see that if there is any probability of its passage it would be much better to have it put into reasonable and fitting shape, so that it may not be unjust or oppressive to the profession.

The licensing of engineers is not a new proposition, though we do not remember that it has ever been brought up before in Pennsylvania. Bills providing for such licenses have been before the legislature of New York several times, and though none has been passed, the probability that a law would be enacted has been so strong that the large engineering societies have taken the matter up, with a view to putting such law into the best possible shape, as we have said above. Of course, it

comes under the police power of the state, and the legislature may prohibit unauthorized persons from acting as engineers in the design, construction and operation of buildings, mines, etc., just as it can—and does—prohibit unauthorized persons from acting as physicians, or in another grade, from operating steam engines and boilers.

The present tendency is to regulate all professions, and perhaps the wonder is that a class so prominent as engineers should have been exempted from special rules so long. In Pennsylvania, for instance, the mine foreman, the fireboss, and even the miner have to pass some kind of an examination and receive certificates before they enter on their work. It would seem, then, not unreasonable that the mining engineer, who lays out the mine, decides on its equipment of machinery and plans its ventilation, should be called on to prove his competence before proper examiners.

Good Metallurgical Efficiency

The excellent work that has been done at the Granby smelting works at Grand Forks, B. C., during the last fiscal year, is revealed in the company's annual report recently issued. Last year 1,225,745 tons of ore were treated at this plant at a cost for smelting and converting of \$1.28 per ton. This is slightly lower than the record of any former year, according to W. A. Williams, superintendent of smelting works. The metallurgical losses were the same as during the previous year, while the silica in the slag was higher. Careful metallurgical work and unremitting attention to details are also evidenced in the excellent operating record, which shows that out of a possible eight furnaces running 365 days, an average of 7.93 was operated last year. The superintendent, W. B. Bishop, and his staff are to be congratulated on these results, as are also the Granby stockholders.

Another interesting report of metallurgical efficiency comes from Cherryvale, Kan., where the Edgar Zinc Co. has three furnaces out for repairs after a campaign of eight years. This is something extraordinary in the annals of zinc smelting, and is an interesting testimonial to the good work of the late J. C. Dodd, a former manager of the plant, who built and operated these furnaces.

The purchasing of military supplies by the European governments appears to be conducted in a singularly inept and inefficient manner. We understand that each one of the allies has its own purchasing commission at headquarters, and has its own subordinate commissions in this country. Instead of there being any effort to pool issues, the buyers for the respective governments actually bid up prices against each other. These buyers, moreover, do not seem to know how to go directly to the producers, from whom they can buy most cheaply, but employ middlemen, who are reaping great profits. Overtures about this military business come to the producers through some very peculiar quarters. If commercial business were done in this way, merchants would shrug their shoulders; that the military business is so conducted appears to be simply a case of stupidity. With the present organization of business in the staples, there is no need to pay big commissions to brokers and middlemen. Is the cost of the war so light that Great Britain, France, and Russia can afford to throw away money?

BY THE WAY

Part VII of the series of articles on Modern American Rock Drills is omitted for lack of cuts, and will appear in the *JOURNAL* of Dec. 5.

In a recent issue of the *New York Times* there appeared on the first page an important announcement regarding a new type of submarine to be built for the United States Navy. In describing this wonderful fleet-submarine it is stated, "The motive power will be Diesel international combustion engines."

The good story about the snakes of Ireland has some excellent paraphrases. One of the best is due to the late George W. Maynard, who told of the territorial secretary in the early days of Arizona, who received a voluminous blank form from one of the departments in Washington headed "Fish Statistics." The territorial secretary of Arizona was requested to fill this out. He returned the blank to Washington with the following indorsement: "The last known fish in Arizona was seen about 10 years ago going up the dry bottom of the Hassayampa River, with a canteen under his fin, looking for water."

At the meeting of the New York Section of the Mining and Metallurgical Society, Nov. 19, Prof. J. F. Kemp delivered a masterly address, reviewing the theories of ore deposition. In the course of this he genially referred several times to Prof. Joseph LeConte, as "Uncle Joe," and to Prof. John Newberry as "Uncle John." In taking up the important work of Prof. J. H. L. Vogt, of Christiania, Norway, Professor Kemp said that Professor Vogt was a dear friend of his, and he told of visiting him in Christiania. It appeared that Professor Vogt was the guide, philosopher and friend of all his students. They went to him with all their troubles, consulted him about getting married, and when necessary borrowed money of him. "Vogt, what kind of a professor are you?" asked Kemp. "Well," said Vogt, "there are two kinds of professors. One kind are privy councilors, the other kind are 'uncles.' I suppose I am an uncle." We may add that Professor Kemp is one of that kind, too. We are quite sure that when he is a little older, some of the young fellows will be referring to him as "Uncle Jim."

"Leeches," writes an Arizona engineer, "are not confined to the *genus Hirudo* mentioned in our zoölogies. There are other varieties; the mining and metallurgical leech, for example. Some operators do not contribute one iota to technical literature, yet they and their technical staffs scan closely the pages of all the technical journals for possible improvements or results of experiments which have been contributed by their confreres. But they recognize no obligation to contribute their share to this fund of technical experience. . . . Their church apparently teaches that it is more blessed to receive than to give." There are undoubtedly a few companies that operate on the principle of taking all and giving none, but the stigma lies, we believe, with the directors of these operations and not with the members of their technical staffs who are frequently restrained from announcing the results of their research or practice by the take-what-you-can-get-

but-give-nothing policy of the company. However, there have been engineers and metallurgists who have had the courage to insist on their right to promulgate purely technical information, and we know of several instances where engineers declined to mortify themselves by asking for information from other operators or visiting other works, while their companies would not reciprocate.

The war recently raging around Antwerp brings to recollection many historical occurrences in connection with that city's varied existence, says the *Brass World*. In 1576 Antwerp was the richest city on earth and one of the strongest. The Duke of Alva, commander of Spain's conquering armies, made it his seat of power. His failure to pay his troops stationed at Alcest caused a mutiny and in the autumn of that year several thousand Spanish soldiers entered Antwerp and sacked it. From Nov. 3 to Nov. 6, a scene of unimaginable horror was enacted. At the end of the fighting, the mutineers had slain 9000 of the city's citizens and soldiers and had seized \$15,000,000 in money, jewels and other treasure. The conquerors found themselves enormously rich and proceeded to dispose of their wealth in many strange ways. For instance, one private soldier gambled away 10,000 gold pieces in a single morning. Another, more thrifty, forced an Antwerp goldsmith to fashion his stolen gold coins into a suit of armor, a sword, scabbard, buckles, etc. Anticipating the popularity of a black-nickel finish, he had his armor, gilt-and-guilt-begotten, painted black to look like iron, so that he would not be robbed. When, months later, he tried to sell his precious armory, he found that the goldsmith had made an alloy and had kept for himself most of the gold. Thus has mind always triumphed over matter and a little knowledge of metallurgy proved to be profitable.

Our British friends who have been anxiously peering upward to discern the new Zeppelins that the "Most Dangerous Spy" has described to them, may be relieved by some common sense and scientific knowledge expressed by Sir William Ramsay, who says in a letter to the *London Times*: "Reports founded on statements in a book named 'The Secrets of the German War Office' are current that new Zeppelins are to be launched by the Germans, containing a gas 15 times lighter than hydrogen, and made of a metal as rigid as steel and three times lighter than aluminum. As regards the first statement, little would be gained by filling an airship with a gas of no weight at all, if such a gas were possible. The buoyancy of a balloon is due to the replacement of air by a gas, hydrogen, $14\frac{1}{2}$ times as light as air. If the imaginary gas had no weight at all, the buoyant power would be increased only to $15\frac{1}{2}$, instead of $14\frac{1}{2}$. As for a metal existing of which the density is only one-third that of aluminum, chemists would agree that it is in the highest degree improbable that such a metal exists. There are excellent reasons for believing that no light metal remains to be discovered." Some critical persons may be disposed to say that sodium (sp.gr. 0.97) is about one-third the density of aluminum; potassium (sp.gr. 0.865), less than one-third; lithium, about one-quarter. But none of these is of any great strength, resistant to corrosion or of good working qualities. We would go miles to see a potassium-sheathed Zeppelin hit a first-class rain-storm.

PERSONALS

Karl Eilers has returned from an extended trip of inspection through the West.

Ex-Senator W. A. Clark, of Montana, recently visited his Sunset mines near Wallace, Idaho.

H. E. Tuttle, assistant general manager of the Edgar Zinc Co., has resigned that position.

Arthur Feust, superintendent of the Cedro mine in Nicaragua, is returning to the mine from New York.

R. B. Lamb has returned from Renfrew County, Ont., after examining molybdenite deposits, and is now in Cobalt.

George O. Argall and Gilbert Rigg have been elected to membership in the Mining & Metallurgical Society of America.

Morris B. Evans is in charge of construction of the new cyanide plant of the Javali & Escandalo Mining Co. in Nicaragua.

A. G. Burrows, of the Ontario Bureau of Mines, has returned to Toronto after several months in field work in the Porcupine gold district.

Cyril Knight, assistant provincial geologist of Ontario, has returned to Toronto after spending the season mapping pre-Cambrian areas north of Lake Huron.

W. B. DeWitt, for several years foreman at the Queen stamp mill, Sheep Creek, B. C., has leased the Ore Hill and Summit gold properties, situated in the mountains a few miles above Sheep Creek.

C. Vey Holman, of Caribou Gold Mines, Nova Scotia, formerly state geologist of Maine, has been elected a life member of the Association of Harvard Engineers. Mr. Holman was a member of the class of 1882 of Harvard College.

Erskine Ramsey, vice-president and chief engineer of the Pratt Consolidated Coal Co., was recently injured at the launching of the first coal barge of his company near Tuscaloosa, Ala. He is reported to be making a good recovery.

J. P. Lake, formerly with the San Carlos mine, has succeeded George Fairbairn as manager of the Babilonia Gold Mines, Ltd., in Nicaragua. He has started the new cyanide plant working the old tailings dump, while the mine is being unwatered.

J. D. Galloway, assistant to the provincial mineralogist for British Columbia, has returned to Victoria after having spent the greater part of the field season of this year investigating mining conditions in country through which the Grand Trunk Pacific Ry. passes.

E. Gautard arrived in New York recently from Paris. He was formerly superintendent of the Schneider Works, Creusot, France, where most of the French heavy armament is made. At present he is consulting engineer to that company and is empowered to make purchases.

Dudley Michel, instructor in First Aid to the Injured for the British Columbia Department of Mines, who has been engaged in his duties among metal miners at a number of mines in West Kootenay and Boundary districts, recently went from Rossland to Kimberley, East Kootenay.

W. B. Bishop, superintendent of the Granby Consolidated Co.'s copper-smelting works at Grand Forks, B. C., has gone to the company's new smeltery at Anyox, Observatory Inlet, to take charge of copper-smelting operations there during the absence for a time of T. Wakely A. Williams.

Walter Harvey Weed, who purchased the Horace J. Stevens "Copper Handbook" business, following the death of Mr. Stevens, and has continued the business at Houghton, Mich., since that date, has determined to move the office of publication of the "Handbook" to New York and the work now is under way.

Prof. Robert H. Richards will be tendered a complimentary dinner in Boston on Nov. 27, in recognition of his 50 years' service as a devoted alumnus and teacher of the Massachusetts Institute of Technology, and in expression of the respect and affection in which he is held by the corporation, faculty, and alumni of the institute.

W. G. Trethewey, discoverer of the Trethewey and Coniagas silver properties at Cobalt, has joined the airmen's corps for service in the British expeditionary force. Mr. Trethewey has been a liberal subscriber to war relief funds and has placed his yacht, on which he was cruising in the Mediterranean when the war broke out, at the disposal of the Admiralty.

Owing to the consolidation of the Raritan Copper Works with the Anaconda Copper Mining Co., the latter's special laboratory at Perth Amboy, will be closed and Dr. Edward Keller, for 22 years the metallurgical representative of the company, will take charge of the sampling and chemical departments of the Raritan Copper Works. Mr. Andrews, heretofore in charge of the chemical department, has been placed in charge of the casting-room of the works.

OBITUARY

Otto Koehler was shot and killed at San Antonio, Tex., Nov. 12. He was 58 years old, born in Germany, and had lived in the United States 40 years. He made a fortune in the brewing business at San Antonio, a large part of which he invested in Mexican mines.

James Ray Whipple died at Niles, Calif., Nov. 7, aged 41 years. He was born in Alameda County, Calif., graduated from the University of California in 1903, and immediately went to Alaska, where he was connected with the Eagle, the Kensington and the Perseverance mines, finally becoming assistant manager of the Alaska Gastineau Mining Co. He was in charge of the construction of that company's mill at Sheep Creek until September when illness compelled him to go to California for treatment. He was well known in Juneau, where he had lived for 11 years and was highly esteemed by his friends and associates.

SOCIETIES

Society of Chemical Industry—A meeting of the New York Section was held at Rumford Hall, New York, Nov. 20. The program for the evening was: "Manganese Steel," by John H. Hall; "Titanium and its Effects on Steel," by George F. Comstock.

Canadian Mining Institute—A meeting of the Toronto Branch was held at the Engineers' Club, Oct. 31. The following officers were elected for the ensuing year: Chairman, A. J. Young; secretary, R. E. Hore; executive committee, F. C. Loring, Dr. W. G. Miller, C. E. Smith, D. A. Dunlap, Jas. McEvoy, H. E. T. Haultain and J. P. MacGregor.

American Institute of Mining Engineers—The first meeting this year, of the Chicago Section, organized last winter, will be held on the first Friday in December at the Chicago Engineers' Club. The principal subject of the meeting will be the potash and carnolite industries as affected by the war. H. W. Nichols, assistant curator of geology, Field Museum of Natural History, Chicago, is secretary and treasurer of the section.

American Institute of Chemical Engineers—The annual meeting will be held in Philadelphia, Dec. 2-5, with headquarters at the Hotel Adelphia. The meeting will include business and technical sessions and visits to chemical plants. Among the papers scheduled which are of especial interest are the following:

"Ore Flotation, a New Hydrometallurgical Development." Illustrated by demonstrations of working models. Dr. S. P. Sadtler and S. S. Sadtler.

"Hydrometallurgical Apparatus and Its Use in Chemical Engineering." John V. N. Dorr.

"The Chemical Industries of Japan." Illustrated with lantern slides. Jokichi Takamine.

"Feldspar as a Possible Source of American Potash." Dr. Allerton S. Cushman and Dr. George W. Coggeshall.

American Mining Congress—The Utah Chapter of the American Mining Congress meeting at the Commercial Club, Salt Lake City, Nov. 13, adopted an appeal to the United States government protesting against the making of copper contraband of war. The meeting was presided over by George H. Dern. R. C. Gemmill presented the resolution, which approves a resolution adopted by the Commercial Club on Nov. 12, in which is set forth the great loss and injury already suffered on account of the inability of copper producers of the state to export copper, owing to war conditions existing in Europe, and the disaster which will ensue to the entire people of the state of Utah, if such conditions shall continue; the government of the United States is requested to use its good offices to assure to the producers of copper the right to export the same in neutral ships to neutral ports. A copy of the resolution has been sent to the Secretary of State.

Editorial Correspondence

BUTTE—Nov. 19

The Exposition at San Francisco, as well as that at San Diego, will present excellent mineral exhibits from Montana. Manager E. P. Mathewson, of the Washoe works, was to leave for California, Nov. 21, to make arrangements for installing them, and also the exhibit of the Anaconda company in the main building at San Francisco. The Anaconda company will show all the stages and processes of copper production, concentration and smelting. W. A. Clark will have an exhibit covering the zinc industry in all its details and the East Helena smelting plant will show its materials and products.

The Unions are showing renewed activity. A committee of three of the Butte Mine Workers' Union has been calling at some of the mines, advising miners to pay up their dues, but using no violence or threats. Mining companies do not allow the committee to approach the shafts, but on the night of Nov. 11 the committee met the miners on the railroad track some distance below the North Butte mines as they were going on shift. The men were not stopped but the committee spoke to each as he passed. In the same manner a number of men going to work at the Anaconda mines were accosted. The committee also visited the Leonard mine, where the same method was employed. The miners spoken to made no comment and most of them did not reply to the suggestions offered. The old union of the Western Federation, at a meeting held in Butte, Nov. 17, addressed a resolution to President Wilson asking for Federal supervision of mining. The President is urged to recommend at the forthcoming session of Congress the enactment of a law declaring coal and metal mines and smelting plants, engaged in interstate commerce, to be public utilities charged with the public interest, and providing that whenever a dispute shall arise between an employer and his employees in these industries, upon application of either party, a representative of the Department of Labor shall proceed to take charge of the property and operate it in strict compliance with the state laws, paying wages obtaining at the inception of the dispute, accounting for all receipts and expenditures, but making no remittance to the employer until the dispute shall be adjusted, when, if any increase shall be granted the employees, it shall apply from the inception of the dispute.

Railroad Developments in Montana contain elements of interest to the mining industry. It is reported that the work of electrifying the Milwaukee from Harlowton, Mont., to Avery, Idaho, started last spring, but discontinued in July, will begin again at once. It is stated that the contract for the work between Deer Lodge and Three Forks has been let to the Montana Power company, 114 miles out of the total of 485 to be electrified. At the time work was stopped a number of jurisdictional labor disputes had arisen. The question was brought up as to whether or not men who were employed in digging post-holes and placing the posts in position were entitled to the wage scale paid electricians or should come under the head of the workmen ordinarily employed in such work. The difficulty was recently put up to the electricians and straightened out. The completion of the line between Deer Lodge and Three Forks by next spring will be followed, it is expected, by the extension of electrification to the rest of the division. It is reported also that electrification of the Great Falls terminals will follow.

Control of the Gilmore & Pittsburgh road in Montana and Idaho has been obtained by the N. P. This road recently completed is said to have cost \$15,000,000. Its purchase gives the Hill system a less expensive and quicker route to San Francisco. The plan is to build south from Butte to Armstead through the Wise River country, over the Grasshopper Range into Idaho and then meet the Gilmore & Pittsburgh tracks. From the southern end of the Gilmore & Pittsburgh an extension is to be built to the Western Pacific, which is controlled by the Hill interests and which takes the Hill freight across Nevada, and then connection is to be made with another Hill line to San Francisco.

Madison County is experiencing a mining revival. Mining men have turned their attention to the possibilities of developing the mineral resources in Goodrich and Bear Gulches, eight miles north of Twin Bridges and in the little camp of Rochester, 12 miles northwest of Twin Bridges.

The Rochester Camp has the Watsecca mine, in years past a producer of gold-lead ore, with a credit mark of more than a million dollars. Owing to water troubles at depth, this pioneer producer was closed down nine years ago, with large ore reserves in the lower workings. The Corbin Copper Co. of Butte ceased operations six months ago on account of the water problem. Rumors assert that negotiations are under way for the purchase of these two properties and the holdings of several other claim owners.

In Bear Gulch the properties developed by Messrs. Higgins and Bielenberg have shown the presence of gold, copper, silver and lead ores, requiring the installation of a modern amalgamating and concentrating plant. The indications are highly promising and point towards the making of a great producer within a short time. The Florida-Giant Mining Co., under the management of C. M. Lane, is developing another promising property, showing large bodies of high-grade gold ores for the treatment of which a cyanide plant is now being installed. Among the stockholders of this company is J. B. Foraker, son of Senator Foraker of Ohio. The Moffat Tunnel company is pushing development work at its property under the supervision of Joe Moffat. An extensive tonnage of copper ore has been blocked out.

The Goodrich Gulch district also has come into the limelight, rich gold ore being extracted from a narrow vein on the Little Goldie claim, operated by Messrs. M. R. and Joe Ostronick. This has started development work on several other quartz properties along and near the gulch. The Grand View Mining Co., headed by H. Schmidt and associates, is driving a long tunnel on its property on Bald Mountain at the head of the gulch. Goodrich Gulch, besides its quartz properties, contains a large area of placer ground. The estate of N. Vallentine, of New York, and L. G. Adams and Frank C. Lavigne, of Spokane, own 21,000 ft. along the bed and rim of the gulch. In addition to the present equipment \$25,000 will be spent next season to start production on a large scale. This placer mining enterprise is the work of Mr. Lavigne, a successful mine operator of high repute.

SALT LAKE CITY—Nov. 19

In the suit brought by Utah Copper against Salt Lake County, the United States circuit court of appeals, at St. Paul, has reversed the decision of the local Federal court, according to which the company was granted judgment of \$29,000 for taxes paid under protest. The court of appeals has remanded the case for a new trial, unless within 60 days the company shall accept \$1766 as satisfaction of the judgment. Utah Copper, in 1912, sued the county treasurer for recovery of \$36,000 in taxes alleged to have been paid on an excess assessment on the net proceeds of mines, made by the state board of equalization. The company contended that the cost of improvements at the Magna and Arthur mills, and the cost of stripping, new rights-of-way, etc., should be deducted from the gross proceeds of mines, to arrive properly at net proceeds before levying assessment. The county held that these costs were in the nature of permanent improvements, adding to the intrinsic value of the property. Another suit of the same nature, for \$31,000 for taxes paid under protest in 1913, is pending between the company and the county. Taxes for 1914 have also been paid under protest.

SEATTLE—Nov. 18

At Nome a good deal of complaint has been voiced over the failure of some of the operators to pay their men. In some cases this seems to have been caused by the failure to extract enough gold wherewith to pay and in others it is the result of a disinclination to give up any proceeds once obtained. Some men have not been paid at all, others have a part of their wages owing; one man has \$1000 due him. A certain dredge is reported to have made an extraction of \$160 for the season but this may be too high. It is stated the promoters of this enterprise intend to sell stock on the Outside this winter.

The Government Railroad in Alaska will pay for itself according to Thomas Riggs of the Engineering Commission; he states that exclusive of coal which may be hauled for the army and navy and for private consumption, the proposed

road would carry enough other freight and passengers to pay for the entire cost of the project. The figures on possible freight, carefully compiled by the members of the Commission, when embodied in the report, will doubtless have their effect next year, when it is expected that a fight will be developed in Congress against the appropriation of the \$35,000,000 necessary to complete the construction. Fairbanks alone, according to Mr. Riggs' figures, will provide more than 15,000 tons of freight, exclusive of coal. One of the greatest possibilities for freight development, he stated, is the haulage of coke for a smelting plant that probably will be constructed as soon as such coke is available. The Prince William Sound ores furnish all the fluxes necessary for successful smelting operations and the installation of a reduction plant and a railroad will relieve the independent miners from the excessive transportation charges incurred in carrying their ores to Puget Sound. Many low- and medium-grade mining properties which are now inoperative would then become producers.

A New Bunk House of the Alaska-Juneau is about finished in Last Chance Basin. The house was erected by the A. W. Quist company, of Seattle, and nothing looking toward the comfort of the men has been overlooked. It is three stories in height with shower and tub baths and toilets on each floor. The rooms are all 12x12 ft. and contain two beds each, of iron hospital style, equipped with springs, mattresses, pillows, pillow cases and comforters. Each room has two windows and a transom, and is furnished with shelves, clothes hangers, tables and chairs. A small rug is placed on the floor in front of each bed. Steam heat and two lights with 10² ft. extensions, allowing for individual reading lights, are in each room. The company furnishes everything, including changes of bed linen twice a week and a full janitor service, at an average price of \$4 per month for each man. The floors in the halls are covered with linoleum. Separated from the main building by a few feet are the heating plant and change room and the kitchen and dining room. The dining room is 25x53 ft. and will seat about 125 men at a sitting, which will accommodate all the men occupying the bunk house at present. The kitchen is large and commodious, with plenty of light, and as everything is off the floor, it can be kept perfectly clean. It is equipped with a three-oven Lang hotel range. Opening off the kitchen is a large pantry and storeroom. The heating plant is in a separate building 21x66 ft., with a concrete foundation. It is equipped with a 36x75-in. grate, American Ideal boiler, which will furnish hot water for the baths and for heating purposes. The change room is situated at one end of the heating plant building and will be equipped with individual lockers. A large breakwater is being constructed just above the bunk house to keep Gold Creek from flowing under the house and making it damp. The house is fitted with a sprinkler system for fire protection.

At Fairbanks many outfits are preparing for winter work. The lower end of Fairbanks Creek will be especially busy, a number of operators taking out winter dumps, with others preparing to open cut next summer. On 21 Below, McNamara & Polson will prospect all winter, and if conditions warrant, will work the ground extensively next season. At the mouth of the creek, Mike Stjepovich has just completed a three-mile ditch, and will put an open cut plant on his ground in the summer. On 15 Below, the Number Fifteen company expects to take out a good-sized dump. Stewart, Larson & McGillivray, on 18 Below, have started prospecting and in the spring will put on a big crew of men. Wilhelm (Bill) Gertz and partner, on 8 Below, will take out a dump during the cold months. On the same claim, the McClellans will also work all winter. On the upper end of 7 Below and the lower end of 6 Below, Ludwig Johnson is prospecting, with a view to putting in an open cut plant. While there are no operators on 5 Below at the present time, several people are reported to be looking over the property, and may put a plant on the ground within a short time. John Griffin and Charles Grille are going to open cut on 4 Below next summer. On 3 Below, John Hermansen, during the winter, will take out a pillar left by Charles Larson. On 2 Below, John Griffin and Charles Grille are prospecting with a hand-drill, preparing for open cut work. Jacobson & Pearson, on 2 Below bench, are reported to be preparing to take out a dump. On discovery, there will be four different outfits working. Anderson and Coal Oil Johnson, Ed Johnson and John Shrivvers, Charles Wilde, and John Green and partner will take out dumps. Eagan & Griffin have contracts already for 3000 cords of wood, and expect to land a few more before there is enough snow on the ground to haul it. They have sublet one contract for 500 cords to P. H. Thelin. In addition to the wood to be hauled for the placer operators, Eagan & Griffin have a contract for 700 cords to be delivered to Crites & Feldman, the quartz men.

RENO—Nov. 19

Sentenced for Arson at Tonopah, Nov. 16, after confessing, Boris Thomassen was given 20 to 21 years in prison. Thomassen confessed setting the fire that destroyed the Nevada Theater and numerous other buildings, Oct. 29. He is a member of the I. W. W. His confession and dictograph records, taken while he was confined with other suspects arrested at the same time, it is stated, implicate several other members of the organization.

Prospecting in Nevada looks rather attractive now, especially since certain minerals, of which there is a limited supply in this country, have increased in value. Heretofore, prospecting has been confined almost exclusively to gold, silver and copper, and over most of the state has been carried on for these only superficially, higher-grade deposits alone being worked. As proof of this, there may be cited the recent gold discovery four miles north of Tonopah and the revival of the old mines of Aurora, now being worked for low-grade ore. Southern Nevada should be an exceptionally good field in which to prospect for the precious metals, and prospecting has been stimulated recently by the discoveries of platinum in gold ore. Systematic prospecting for zinc, which is being produced in important quantity in one district, should disclose many other deposits of commercial grade. Mercury is being produced in Nye County and ore has been found in several places in Humboldt, Mineral and Nye Counties; in fact, a mineralized belt extends from Humboldt into Nye, which should be carefully prospected. The early reports that the price of antimony would rise considerably led to the immediate resurrection of one old mine and the discovery of a new deposit, said to be of commercial grade and to be exceptionally free from harmful impurities. It is doubtful if the value of manganese has ever been thought of by prospectors in Nevada. The search for potassium salts has not been abandoned by the U. S. Geological Survey, and efforts in that direction are also being put forth by individuals. The latter will undoubtedly be encouraged by the success of American Trona in California. Large deposits of barytes, marble, building stone, lime and shale for cement, etc., are known to exist, but for these there is no local market and transportation facilities are inadequate. For the same reasons, no doubt, iron has been neglected, but in this case the means of transportation would be forthcoming if ore in sufficient quantity and of required grade were found. While the probability of finding good coal is not great, the reward would be so substantial that more effort might be profitably expended on this form of prospecting. The rewards to prospectors in Nevada in the past have been great, but the field is still so large that future efforts, if applied along systematic and scientific lines, should meet with equal success.

HAILEY, IDAHO—Nov. 19

The Wood River district in general is thriving. The Pulaslki Mining Co., operating the Noonday properties near Ketchum, has just completed the test run of the new mill designed by J. M. Callow and built by the General Engineering Co. of Salt Lake City. It was accepted and is now off for a steady run. There is about two years supply of ore in sight. The gold is recovered in the form of concentrates on Wilfley tables and vanners. Crushing to 20 mesh is accomplished with a ball mill. The capacity is 25 tons of ore a day. The Independence Mining Co. has closed down for the year, leaving the orebodies in better shape than at any time in the history of the property, after the season's extraction of silver-lead ore. The mill operated steadily and the concentrates averaged 65% lead, 140 oz. silver and \$15 gold. Superintendent Allen got disgusted with the market for metals, and deciding to shut down rather than to sacrifice his resources. A new shaft is being sunk from the 500 level, an underground station having been cut. Progress for 150 ft. shows a continuous streak of ore from 18 in. to 4 ft. in width, more than half of it first-class.

Leasers on the several old properties in the Smoky district are all in from their season's work, leaving their product mostly on the dump and in the bins. Zinc is the predominant metal there, and its recovery is easy, since it is a clean sulphide, but the market was too rapid and the boys lay down and started a watchful waiting game; they are taking the winter for it.

It is understood that engineer Robert T. Tustin has, after considerable delay, been able to conclude a bond and lease on the famous Ceresus gold and copper mine, four miles south of Hailey. This property has been a large producer, and on the 700 level there has been encountered a vein parallel to the gold vein but dipping opposite to it, i. e., to the north. It shows lead-silver ore, varying from 2 to 12 ft. between the walls, and accompanied by massive siderite. The 800 and 850 levels have been opened on this vein and stoped for a part

of the way; the bottom of the 850, the lowest working in the mine, was recently sampled by some engineers, one of whom let slip the word that for a distance of 185 ft., the track was torn up in order to cut trenches every 5 ft., and that the average width of the streak for the entire distance was 11 ft. a good part of it first-class ore, carrying besides the usual percentage of silver for each unit of lead, from \$2 to \$6 in gold. It is reliably stated that the foot-wall discovery of the continuation of the Cræsus gold vein, on the 800 level indicates virgin territory east of the shaft between the 400 level and the discovery on the 800. A serious disturbance occurred at the 400 level and desultory work failed to reveal the continuation of the vein on its dip; this was offset to a great extent by the coming in of the lead vein. It was while working on the latter that the gold vein was recovered on the 800. A fair sampling has, according to report, showed an exceedingly high average tenor. The gold is contained in a tough pearly quartz accompanied by iron pyrites. The Kilpatrick brothers, of Beatrice, Neb., own the controlling interest in the Cræsus. The property is equipped with a modern mill operated by electric power. It is stated that an offer for the property of \$250,000 was refused at one time, and it is supposed that Mr. Tustin, who is a keen buyer, has had to meet that price or something like it. It is stated that a full crew will be put on duty for 24 hr. a day, beginning about Dec. 1.

The Minnie Moore Mines Co., at Bellevue, under the management of Irvin E. Rockwell, has operated its mill during the year on low-grade silver-lead-zinc ores from the Queen shaft, making a successful separation of the two metals, shipping a 44% zinc product and a 60% lead product carrying 80 oz. of silver. It is stated that but for the entanglements of title surrounding a minority interest in the group of claims, an attempt would be made to put the property on a substantial basis. Much will depend also, it is stated, on the future of the zinc market, since the product will not yield expenses and a profit without a normal price for the concentrates. In the meantime the operation has been closed indefinitely.

Development work on the Eureka Development Co.'s properties in the Bullion district has been continuous during the summer and will be continued throughout the winter. It is in charge of W. A. Wilson, of Salt Lake City. This property when producing yields high-grade silver-lead ore. Explorations are being directed toward other possible oreshoots to the east of the main vertical shaft, toward the old Idahoan ground, which was one of the famous producers of the Wood River region during the '80s, when the Bullion district as a whole yielded almost \$20,000,000 in silver and lead in about six years. The Mayflower, Jay Gould (formerly owned and operated by the gentleman of that name) Bullion, Red Elephant, O. K., Durango and some smaller groups all faulted within 300 ft. below grass roots and were abandoned during the silver panic. Since then no persistent attempt to open up these properties has been made until Mr. Wilson tackled the Eureka which, however, lies on a vein system parallel to these great producers and on the foot-wall side.

DULUTH—Nov. 21

The Hill Interest plans for the Hill holdings continue to attract attention. It is rumored, with some apparent foundation, that M. A. Hanna will act as the Great Northern's sales agent. It is the intention of the Hill organization to push development work so that the ore tonnage hauled by the Great Northern will suffer no shrinkage.

HOUGHTON—Nov. 21

The White Pine is exceedingly rich, according to the stories coming from the miners working there. Miners who were transferred there from the Calumet conglomerate say that in some respects the White Pine is even better than the conglomerate, considered the richest lode in the district. The Calumet officials, however, do not show any undue excitement or enthusiasm. They point out that while the lode is rich, it is faulted and broken and worst of all, it is exceedingly narrow. Furthermore the mining is expensive. On the other hand the assays show increasing richness with depth. The White Pine work is attracting attention to other territory in the vicinity. Some exploration work is being done about nine miles southwest of the White Pine on the property of S. L. Smith, of Detroit, and according to reliable information, the diamond-drilling shows pretty good results.

Calumet & Hecla has practically established an employment bureau that will operate for both the parent company and all of the subsidiaries. Its main office will be at Calumet in an extensive addition to the main office of the Calumet & Hecla, which is now being erected, and which will contain as well the offices of the electrical and motive department. The application of the workmen's compensation law in Michigan and of other laws on physical requirements make the em-

ployment of new men a much more serious matter at all mines than in the old days when a man simply called at the captain's office and if the captain had enjoyed his lunch was pretty sure to get a job. This new central employment bureau will keep complete card records of all of the men at work at all of the mines under its jurisdiction. These will be on file and when any mine needs men for special work, they will be available.

Water Shipments of copper will cease by the first of December, with the close of navigation on the Great Lakes. The freighter "North Sea" will clear before that date with close to 6000 tons of copper. In the month past the cleanup of refined copper from the docks of Portage and Torch Lakes has been the most unusual for fall that this district ever saw. All summer long the smelting yards and the docks were loaded with ingots; the supplies were larger than have been carried in years. And early in the fall there was no evident intention of shipping the metal. Now practically every available pound of copper that can be dug up is being started for Buffalo. This last cargo may have some difficulty in getting through, as the ice already is forming in the upper lake channels. Local authorities on the metal situation assert positively that every pound of metal shipped from Houghton has been sold and that none is going into storage. Orders for immediate delivery came with a rush while the price was under 12c., with practically all purchases for domestic consumption. Some of the companies report that in addition they already have orders booked for December, January and even February.

MARQUETTE—Nov. 21

A Tax Conference, called by the Crystal Falls Taxpayers' Association, will be held at Marquette, Dec. 15, to protest against the attempt of the Michigan State Grange to saddle upon the iron and copper mines of the Upper Peninsula a tonnage-tax law. Measures to combat the proposed legislation will be outlined. Each of the mining counties will be represented by delegates, as will the several commercial clubs and similar organizations. The Upper Michigan legislators will be in attendance also. The Crystal Falls association was originally organized to protest against the relative taxations on mine and general property at Crystal Falls. It was brought into being because the general taxpayers insisted there was discrimination in favor of the mines. That the association is now taking the lead in the forthcoming conference is significant as showing that not all the opposition to the tonnage tax comes from the mines. The sentiment against it is well diffused among all classes of taxpayers. For this there are two reasons. The man who has even a superficial knowledge concerning the mining industry realizes the practical difficulties in the equitable application of the tonnage-tax principle without the incurring of an expense for administration that would be prohibitive. Again, the general taxpayer naturally objects to a plunge into conditions that would mean an entire revamping of the present system. There has been, of late years, a fair equalization of the tax burden in the mining counties, and it is to be doubted whether, even at the expense of the mining companies, the lot of the general taxpayer would be improved by the levying of a tonnage tax. The opposition to the proposal in Upper Michigan extends from the mining companies even to the granges in many of the counties. Its widespread nature will, it is hoped, be given due weight by the remainder of the state.

CRYSTAL FALLS—Nov. 21

Disastrous 1914 was especially disastrous for the Crystal Falls-Iron River region, the high phosphorus ore characteristic of these districts finding little demand. Nevertheless, a good deal of construction and development work was carried on.

The Hill Top adjoins the old Crystal Falls mine on the east. It was taken over early in 1914 by the Cuyhoga Iron Co., of Cleveland, and a contract let to J. H. Grant, of Buhl, Minn., to mine and ship 25,000 tons during the season. The ore not proving up to grade, only about 6000 tons was mined, this from an open-cut, and work was suspended.

The Warner mine shaft was sunk an additional 200 ft. this year and some drifting on the orebody done. The work showed the ore to improve with depth both in quality and quantity. Some crosscutting of the formation was done on the bottom level. But after work had been carried on for nine months the pumps were pulled and the mine allowed to fill with water. The property needs new equipment for proceeding with the work, but it was no doubt due to the condition of the market that work was suspended at this time.

The Bates mine of the Bates Iron Co. has had an expensive experience with water problems; these seem now to be finally overcome, and during the season past the company has carried on exploratory and development work in a small

way. A little mining has also been done, but no shipments have been made from the property as yet, although a good deal of ore is being carried in stock. Considerable diamond drilling has been done underground, but no information can be had as to the results of this work.

Of the Davidson mines, No. 1 has been worked in the usual manner throughout the year. Shipments were made during the first six months of the season, but not from stock. A new Nordberg electric hoist has been installed. Some underground drilling has proved a new lense of ore south of the original formation. This shaft is now wholly electrically equipped, including an air compressor, hoist and pumps. Work at No. 2 went on in about the same way. This shaft was sunk 100 ft. and some development work was done. This is one of the few shafts sunk on an incline, the shaft following the dip of the ore lense. This was done to avoid the extra cost of cross-cutting to the orebody.

Oglebay-Norton, in the Crystal Falls-Iron River region, has done little work this year. The Chatham mine was worked in January only. A small shipment was made from stockpile and the mine was kept free of water. At the Berkshire also mining was carried on in January only. A little work was done on the new hoisting shaft and a new changehouse was completed. Shipments of 21,400 tons were made. The pumps ran all year. The Bristol, which has been the heaviest shipper and the most actively worked mine in the Crystal Falls field, was worked the first five and one-half months of the year only. Sinking the shaft 100 ft. was the only development work done. Shipments from stock consisted of about 150,000 tons. The mine has been kept pumped out and the machinery has been all overhauled.

Pickands-Mather has worked its Casplan steadily all year and mined about 300,000 tons. This is one of the largest orebodies in Iron County and is the first mine in this district to be worked on the top-slicing system, in common use on the Mesabi range. A large amount of ore is carried over in stock. It will be necessary to close the property for a time to repair and retimber No. 1 hoisting shaft. The Fogarty saw no active mining this year. In July a surface cave let one level fill with sand and gravel, and this took several months to clean up. Shipments were small, all from stock. Some diamond drilling was done underground, the holes all going over to the east. It is generally understood that the results were satisfactory and a large deposit of ore shown. A drill has since been set up on the surface to check the results of the underground drilling. The Bengal was idle throughout the year. A small 11,000-ton stockpile was shipped, the steel headframe was housed, a small timber-shaft completed and the mine pumps kept running. The Baltic was also idle. A stockpile of 44,000 tons was shipped and the pumps were kept running.

At Amasa, the Hemlock mine, one of the old mines of Iron County, has for years been the principal source of revenue for the little hamlet of 700 people. The work at the mine this year consisted in taking out some pillars and floors and removing a portion of the ore that can be obtained from the Michigan mine on the south. This work will be completed in the early part of 1915. Some shipments were made, those from stock being only enough to make room for that hoisted from underground. January or February, 1915, will see the end of the Hemlock mine for all time. This was one of the first Lake Superior iron-ore investments of Pickands, Mather & Co., if not the first. It has produced an ore of peculiarly good character for fixing and fluxing purposes, its low phosphorus and moisture contents finding for it a ready market at all times. The Hemlock will have produced, all told, 2,150,000 tons.

The Porter mine is the original find in Iron County of the Longyear-Hartley interests and was discovered by diamond drilling about four years ago. It is in Sect. 22, T. 44 N. R. 33, about three miles south of Amasa. It is said to contain 1,000,000 tons of high-grade ore, much of it of bessemer quality. A vertical shaft 5x15 ft. inside timbers has been started at the south end of the orebody; it is said that the surface consists of about 70 ft. of sand and gravel, and no trouble is expected in reaching the ledge. Only a small and temporary plant is now installed. The property is in charge of M. E. Richards, general manager.

Of the Wickwire mines, the Cortland was worked only during the first five months of 1914, the work consisting of some exploration and a little mining of ore remaining in floors and pillars. The shipments were 17,699 tons. When the work was completed, the equipment was all removed and the lease surrendered. At the Homer, the work consisted of completing the erection of mine buildings and equipment. The steel headframe and the fireproof brick buildings with steel-

girder roofs are all substantial and modern. The mine is electrically equipped throughout. An initial shipment of 9700 tons was made, but development work on the orebody and a crosscut to the McGovern orebody to the west comprised the work carried on underground. Only a small crew is employed at present. This is probably the wettest mine in the group north of Iron River. A large flow of water was encountered while sinking this shaft and some trouble was experienced with quicksand. This tract of land was diamond drilled by the Niagara Mining Co., a subsidiary company of Rogers-Brown, and was then sold to the Wickwire company for a large cash bonus. It gives promise of being the best property of the Wickwire company in the district. At the Wickwire mine, the shaft was sunk 100 ft. and additional crosscutting and drifting carried on at the new level. The mining consisted of taking out some pillars and floors. Shipments of 18,700 tons were made from mine and stock, and some ore is still in stock. A little diamond drilling was done underground in the search for new orebodies. The Virgil was idle all year. Some diamond drilling was done from surface to check up underground ore measurements. The stockpile was cleared up with shipments of 10,300 tons.

Corrigan-McKinney at the Armenia mine, two miles east of Crystal Falls, completed in June the taking out of the remaining shaft pillars. The property is now dismantled and all ore is shipped. At the Baker some ore was mined during the first half of the year and shipments of 122,000 tons have been made. The Tobin was idle all year. The shipments from stock amounted to 55,000 tons, with a small amount still remaining. The Great Western, headquarters for Corrigan, McKinney & Co., on the Menominee and Gogebic ranges, was also idle all the year. The company offices, warehouses, shops and laboratories are maintained here. A shipment of 11,000 tons was made from stock, but a large amount still remains in stock. It is said this will be consumed by the owners in the large Cleveland plant now nearing completion. The Dunn, the oldest active mine in the Crystal Falls district, has now reached a vertical depth of 1800 ft. It was worked in a small way all year, the principal work being the sinking of the shaft 200 ft. and drifting to the orebody. A small production was hoisted and shipped, as well as some ore carried for some time in stock. At the Tully the underground work has consisted in sinking No. 1 shaft 100 ft. deeper, developing the new level in a small way, driving a rock crosscut to No. 3 shaft and raising in the rock to meet this shaft, which is finally in solid ledge and completed. This work has taken two years and necessitated overcoming many obstacles; it is an accomplishment of merit. The installing of permanent hoisting equipment and additional boilers, the erection of a new headframe at No. 1 shaft and the building of a number of new dwellings for employees constitute the new work at this mine for the year past. Shipments of 49,000 tons were made, some from mine direct and some from stock.

The Rogers mine of the Munro Iron Mining Co. (Rogers-Brown) has probably the largest orebody in Iron County opened up to the present time, and it is in a virgin field situated on Sect. 29-43-34. The property is surrounded by the White, the LeRoy, the Michaels and the Blair, all of which have been well drilled and have shown large quantities of ore of good quality, demonstrated to extend down for 1800 ft. The Rogers was the first to sink a shaft and open up the ore, and had to resort to reinforced concrete in going 120 ft. to the ledge. Development of the orebody has proceeded at a moderate rate, since the water encountered was much greater than ever known before in the vicinity. The flow now ranges between 3700 and 4000 gal. per min., and there seems to be no let-up at the present time. The Rogers is well equipped in every respect, buildings and machinery being all of permanent kind, and all the equipment based on an output of 600,000 tons a year. The mine made its first shipment this year, sending forward 27,000 tons. The system employed to win the ore will be top-slicing, necessary on account of the great width of the orebody. No new equipment was added this year, the only additions being in the way of dwellings for employees. Diamond drilling to the southwest of the Rogers on the White continues to show this ore basin to be larger than ever. One drill was employed here all year. The Hiawatha was worked at the usual rate for the first nine months of the year, when a mine fire in the slate hanging wall forced the east side of the mine to be bulkheaded. Early in October all active mining was suspended. Shipments were made from mine product the first six months of the shipping season and some shipments were made from stock. A new lift of 125 ft. was sunk and a small amount of drifting and crosscutting was done. The Chicagon was also worked for nine months, shipping the usual production. The sinking of the hoisting shaft another 125-ft. lift was the only work of note.

The Mining News

ALABAMA

TENNESSEE COAL & IRON (Ensley)—After shutdown of several months, except for week of visit of Iron & Steel Institute, steel mill was to go into full operation Nov. 23 for one week.

ALASKA

AS DELEGATE to Congress from Alaska, Wickersham was elected by 2000 plurality over Bunnell.

MATANUSKA COAL port tests carried on at Bremerton Navy Yard concluded Nov. 13. Were made on board armored cruiser "Maryland." No reports to be made until steaming trials at sea are completed.

HUGHES & EVERMAN (Fairbanks)—Operators will open, during winter, large block of ground on upper Engineer Creek; estimated to run \$1 per sq.ft. Small winter dump will be taken out.

BERING DREDGING CO. (Shelton)—Company operating on Kougarok River below mouth of Taylor Creek, using hydraulic lift, will next season install dredge at mouth of Henry Creek. J. Mathews manager.

SOLOMON DREDGE (Solomon)—This boat, J. A. Mallock manager, has worked out all its ground and will probably move next season. Dredge has averaged about 60,000 cu.yd. per month; is driven by steam generated by crude oil. Cost of handling gravel about 14c. per cu.yd.

SEWARD DREDGING CO. (Solomon)—Dredge on Solomon River did little work this season owing to alterations found necessary. New engines of Diesel type installed, together with other improvements which will greatly reduce operating costs. Dredge in active operation since 1905. Webb & Hall owners.

BROWN & CO. (Fairbanks)—Paystreak, believed continuation of rich paystreak worked by Jack Prest and others on Hands-Across-the-Sea ground, found in shaft of this company. Many dollar-pans taken from face and \$30 nugget recently obtained in pan. Ground on upper Vault Creek, owned by Winterbottom & Anderson.

HANDS-ACROSS-THE-SEA ASSOCIATION (Fairbanks)—Jack Prest, whose lease on this claim was successful during season just closed, recently disposed of interest in lease to Beattie & Martin, well known Vault Creek operators who will sink two new shafts and take out large winter dump. Ground 200 ft. deep, runs \$6 to \$8 per sq.ft. of bedrock. Paystreak averages 9 ft. thick, 60 ft. wide.

CRITES & FELDMAN (Fairbanks)—Operators purchased Willis five-stamp Hendy mill on Chatham Creek and removed it to their property on right limit of Moose Creek, tributary of Fairbanks Creek. Several cleanups made to date reported satisfactory. Air drills and steam-driven compressor also purchased. Mine has large reserve of ore developed, opened by two adits, each more than 500 ft. long, and several shallow shafts. Ore from upper adit dumped directly on mill grizzly, that from lower adit will require elevating. Planned to install small steam winch to haul mine cars up short incline.

ARIZONA

Cochise County

CALUMET & ARIZONA (Bisbee)—Directors have determined upon payment of Christmas dividend. Action based on general belief that worst is over so far as metal situation is concerned and fact that C. & A. production has been sold for two months ahead. Said that at no time in history of property has supply of commercial ore been assured equal to that uncovered last few months. Company officials are practically determined upon stock-issue plan to finance recently acquired Cornelia property.

Gila County

MIAMI (Miami)—Company has answered with general denial, allegations contained in bill of complaint of Minerals Separation, filed against it about a month ago.

INSPIRATION (Miami)—Now reported production should begin about March. Capacity of mill 10,000 tons, governed for some time by hoisting capacity. No decision made on use of license held to operate flotation plant under Minerals Separation patents. Understood some ores may be leached.

Pima County

SAN XAVIER MINE (Twin Buttes)—This mine, belonging to Empire Zinc, continues to keep about 30 men at work on development only. No ore, either zinc or copper, shipped for some time. Reported immense tonnage blocked out.

TWIN BUTTES MINING CO. (Twin Buttes)—Meeting of directors held in Tucson recently. President W. A. Barber, of Sheboygan, Wis., and Past-President David S. Rose, of Milwaukee, Wis., present. Intentions of company in regard to future operations of property not made public.

PAYMASTER (Twin Buttes)—This old-time producer of southern Arizona again operated on small scale by leasers. Property has produced several hundred thousand dollars' worth of lead-silver ore. Mr. White, leasing on one claim of group, has two carloads of high-grade ore ready for shipment.

BAXTER-ROSSI GROUP (Twin Buttes)—Bush & Baxter, leasing, continue to open up high-grade copper ore. This is new strike, blind lead encountered while doing assessment work and promises to be one of the biggest strikes in dis-

trict. Ore found a few feet below surface widens out with depth and value increases. Shipping car a week, maximum quantity allowed by smelter.

Santa Cruz County

ORO BLANCO DISTRICT unusually quiet, little mining going on. William Partridge working on claims of J. S. Andrews, taking out some rich gold-copper ore; has made one shipment to smelter, with another car about ready.

CALIFORNIA

Amador County

KENNEDY (Jackson)—Moving pictures taken underground by direction of Charles H. Dunton, gathering mineral exhibits and having pictures made for display at Panama-Pacific Exposition. Said that gold brick containing \$17,000, representing seven days' production of mine, will also be shown.

Butte County

OCHER DEPOSITS near Stirling may be reopened. Application for samples received by Eugene E. Foren, formerly foreman of mine. Property operated several years ago; material produced of good grade.

Calaveras County

BOWLING GREEN (Vallecito)—New hoist and mill recently installed in successful operation under management of Luke Sanguinetti. Large body of pay gravel disclosed. Thirteen-day cleanup produced 61 oz.

Kern County

LAST CHANCE CANON, about 25 miles northeast of Mojave, reported showing evidence of placer mining development. Several years ago district attracted attention, but was abandoned at time of big strike at Randsburg, which developed Yellow Aster.

Nevada County

UNION HILL (Nevada City)—Mine unwatered, sinking in progress. Property was operated by L. B. Doe and others, who spent large amount in unsuccessful development. Recently bonded to new company, which, under superintendence of A. D. Cox, is putting it in order to resume development. Shaft will be deepened 300 ft. before drifting begins.

Tuolumne County

MOHICAN (Sonora)—Mine closed down temporarily because of too much water. Pumps will be installed, and as soon as mine is unwatered, development will be resumed.

CUB BEAR (Etna)—Property located on Cow Creek being developed in a practical way; 500 tons extracted. Purposed to continue work through winter and to increase extracted ore to 1000 tons before installing mill. Property owned by Siskiyou syndicate.

COLORADO

Boulder County

GOLD HILL MINING CO. (Rowena)—New concentrating and cyaniding mill placed in operation. Is at portal of Craig Tunnel, equipped with 30 stamps, Wilfley tables, tube mill for regrinding and continuous decantation system of cyaniding. Concentrates will be reground and cyanided. Mill will have capacity of about 100 tons.

UNITED STATES GOLD CO. (Sugar Loaf)—Main shaft of Livingston mine being unwatered, first and second levels now open. As fast as made accessible, levels cleaned out and repaired. They extend northwesterly into Sphinx property. Expected that extension of levels will develop ore ranging in value from \$40 to \$60 a ton; attempt will be made to reopen famous "Potato Patch" oreshoot. Estimated that Sphinx and upper workings of Livingston will yield large supply of milling ore. Steel for new Herreshoff roaster arrived and machinery in process of erection. Materials for fireproof building on ground and they will be completed as soon as roaster is in place.

Clear Creek County

ONEIDA-STAGG MINING & MILLING CO. (Freeland)—Company now successful in securing enough cyanide to operate for six months mill which has been in readiness several weeks. Working force being organized and mill will be placed in commission in near future. About 5000 tons awaits treatment.

Lake County

RED LIGHT district of Leadville reported wiped out by fire morning of Nov. 19. Heavy damage, old-time wooden shacks burning readily.

San Miguel County

JUNTA (Telluride)—Mill repaired and 30 stamps dropping on ore from Orion and Wasatch properties in La Junta Basin. Arrangements made to carry on development throughout winter.

SUFFOLK (Ophir)—Following recent examination of mine and dumps, leasing company organized to take over property and operate mine, tramway and mill. Average grade low, but small margin of profit expected.

TOMBOY (Telluride)—Building for new cyanide plant completed and being painted. Much of machinery installed. Riveting of steel cyanide tanks now in progress. Plant will increase recovery from ores from Montana property.

BLACK BEAR (Telluride)—Lower terminal of new tramway finished and work in progress on upper terminal in Ingram Basin. Construction will be completed in about 30 days. Old workings of mine being cleaned out and repaired.

San Juan County

BIG GIANT (Silverton)—Contention tramway extended to this mine in Arastra Gulch and property will soon be in active operation. Old workings have been cleaned out and retimbered where necessary. Recent development has opened considerable milling ore. New compressor installed.

AMY TUNNEL (Silverton)—Crosscut tunnel will be advanced 700 ft. to develop Belle group in Maggie Gulch. Tunnel will cut main vein at considerable depth. This vein over 20 ft. wide in places and surface prospecting indicates it will yield large tonnage of cyaniding ore. D. R. Jones superintendent.

IDAHO

IDORA (Wallace)—Shoot of galena ore reported encountered in raise into Tuscumbia property on Sunset Peak.

ROCKFORD (Mullan)—Another contract for 100 ft. drifting let. At depth of 800 ft. company driving to catch vein uncovered above.

REINDEER-QUEEN (Mullan)—Important strike of chalcopyrite milling ore reported. Adapted to flotation process, gangue heavy spar.

MICHIGAN

Copper

CALUMET & HECLA (Calumet)—New dredge laid up for winter after cutting channel through sand piles up to classifying house. Work demonstrated that dredge will meet all requirements and do its work satisfactorily. A quarter section of No. 2 regrinding plant in commission for some time, working satisfactorily.

SUPERIOR (Houghton)—Fire at surface plant will stop all production for month or six weeks. Entire wooden structure over boilers and compressor plant destroyed; fully covered by insurance. Rebuilding started at once. Boilers and compressors loaded on cars and shipped to Calumet for overhauling at C. & H. shops. All married men of Superior force will be put at work on reconstruction of plant. Figured one boiler can be fired within month and hoisting started from stopes already opened.

WINONA COMPANY (Winona)—Capt. John Broan, head mining captain for Winona and King Philip mines, now working 35 of best miners on tribute. Sending five cars per day to Point Mills plant of C. & H. Rock runs 22 lb. copper to ton, at least 30% better than average of Winona during regular operations. Captain and men figured out a living from 17 lb. per ton, more than elated over conditions. Supt. Seeber giving 70 of men employment in woods cutting hardwood for shipping to Stratton Hardwood Handle Factory at Atlantic.

Iron

JONES FURNACE—Sample of first product analyzed showed only 1.6% manganese, while slag contained about 10%. It was hoped product would contain enough manganese to be classed as spiegeleisen.

VANADIUM ore reported in Michigan. John Thompson, of Chicago, has put crew of men to work, 35 miles northwest of L'Anse, on a vein said to carry vanadium. Vein has thickness of 24 in. at surface. Mr. Thompson in search of manganese ores when he made discovery. First vanadium ore found in Lake Superior country.

LAKE ANGELINE (Ishpeming)—Sixty men laid off Nov. 14, but most of them placed at work again Nov. 23 on short time. All employees will now work only about two-thirds time. By spring ore in mine will be taken out and property closed down. Was thought all work would stop by first of year, but by working the men shorter hours time is extended. By spring new mine of company at Iron Mountain Lake will be bottomed and many of the men will be transferred there to start drifting and raising.

MINNESOTA

Cuyuna Range

ARMOUR NO. 2 (Ironton)—By decision of district court, H. J. Kruse recovers \$16,381 from Chester D. Tripp, representing one-half of royalties paid on Armour No. 2 mine, operated by Rogers-Brown Ore Co. Trial previously mentioned in "Journal." Kruse was formerly superintendent for Rogers-Brown on Cuyuna and Tripp was president of company. Both have severed connections since litigation started.

Mesabi Range

LA RUE (Nashwauk)—Considerable retimbering will be done in No. 3 shaft, one crew working all winter on this work. At mill some experimental work will be done on one of new Wetherbee concentrators. Large settling basin will also be constructed for mill waste.

MISSOURI—KANSAS—OKLAHOMA

GALENA ROYALTY CO. (Galena, Kan.)—Company struck another good zinc prospect in drilling on Muir land. Company fast developing tract of land; as soon as good drill holes are found they are subleased to miners who sink shafts and mine on royalty. Company has several tracts to drill.

CLERMONT (Galena, Kan.)—A. G. Barton, of Galena, has taken over mill and 40-acre lease held by Snyder Bros., of New Richmond, Ohio. Clermont was formerly good producer, but mines for some time have not been paying. Mr. Barton comes as practical mining man, and after making repairs on mill and applying up-to-date methods to running mines believes they can be made to pay.

HARTFORD MINES (Galena, Kan.)—Company sinking mill shaft to encounter lower run of ore struck in drilling at 276 ft.; struck the body of ore in shaft recently, still sinking in it; ore high-grade 10 to 12% as hoisted. Deepest mining in Galena district, indicates what many contend, that there is lower run of good ore, which, however, will require heavy machinery and capital to mine. George Elliott, superintendent.

MONTANA

Beaverhead County

BOSTON & MONTANA DEVELOPMENT (Butte)—Supt. Hopkins, of company's Elkhorn mines, reports finding vein of good copper ore in working tunnel just beyond 1000-ft. mark. This is third vein cut in course of driving double-track tunnel. No one of three known to outcrop on surface.

POLARIS (Dillon)—Twenty-one tons high-grade copper and silver ore shipped to Anaconda by Corbet & Bowman, listed at \$90. This old mine, 40 miles northwest of Dillon, has history. Several fortunes spent in exploiting group of claims without dollar's worth of ore to the good. Company now working recently struck rich vein and expects to make it paying property.

Fergus County

BARNES KING (Kendall)—According to preliminary statement from Superintendent McGee, production of North Moccasin mine for October shows increase in receipts over September. From 3955 tons of ore mined and milled, approximately \$30,000 worth of gold bullion taken, increase per ton of \$1.18. Report shows better ore being encountered. Cost of mining and milling something over \$4 per ton, leaving net profit of about \$13,000. At company's Plegan-Gloster mines near Marysville, work gone on steadily; mill will be ready for operation in January. Old boilers and steam plant in shape and can be utilized if found impracticable to get electric power this fall.

Jefferson County

MONTANA-RADERSBURG MINING CO. (Radersburg)—Articles of incorporation of this company to operate Summit mine, 10 miles northwest of Radersburg, in Elkhorn Mountains, filed in Helena, Nov. 11, by A. E. Spriggs, of Helena, and associates. Shaft down 530 ft. Electrical equipment will be installed at once and 100-ton concentrator erected to treat ore in sight. Company incorporated for \$300,000, has \$100,000 in treasury; \$75,000 of this set aside for working capital.

Silver Bow County

EVELINE (Butte)—This old mine said to have produced more than \$500,000 worth of gold and silver in '80s, but idle since 1893, purchased by W. A. Clark. Understood price was about \$25,000. Mine lies north of west-side reservoir of Butte water company.

PILOT-BUTTE (Butte)—Vice-President Jahn reports to stockholders that conditions are highly satisfactory. In addition to large copper-ore reserves, company also has big deposit of zinc and silver ores which will be treated in Timber Butte mill. Drifting on copper vein 15 to 20 ft. wide in progress. Shaft vein carries same grade of ore width of 5 ft. During course of development, 20 cars of ore per month are shipped. No decision in pending controversy with Anaconda yet rendered by court, in consequence of which, company decided to prove this vein by raising on it from 1800-ft. level or from point where two veins meet.

NEVADA

Douglas County

GOLDEN GATE (Gardnerville)—Mill resumed operations recently for run of considerable duration.

Elko County

CYANIDE PLANT, it is stated, will be added to concentrating plant now in operation at Good Hope. Concentrating plant will be entirely remodeled. Good-grade antimony ore recently discovered in this district.

Esmeralda County

JUMBO EXTENSION (Goldfield)—Drifts on 1017-ft. level driven for length of 130 ft. on 7-ft. shoot of ore assaying \$100 per ton, according to statement of J. K. Turner, engineer-in-charge. New raise being lifted from this level. Stopping being done on intermediate above 1017-ft. level; smelter controls show ore assays \$65 to \$70 per ton. In addition to high-grade ore, large tonnage of milling-grade ore developed, especially on 700-ft. level, where considerable work is now under way. Milling-grade ore left on dump for future treatment. Present daily production 50 tons. Gross earnings for October estimated \$101,500.

Humboldt County

CONDITIONS IN ROCHESTER good. Winter supplies arriving in good time; Codd railroad, delayed by unforeseen difficulties, will be completed by time big mill is ready to operate; time of many lessees extended, and milling-grade ore can be mined at profit as soon as milling plant is in operation.

STAR PEAK (Mill City)—Contract for 400 ft. of tunnel driving to be let. Raises from 90- and 140-ft. levels being lifted to surface. Winter supplies being hauled to mine and extensive snow sheds, connecting bunk- and cook-houses, blacksmith shop and dump, being built. In spring, capacity of mill and tramway will be increased and tailings, now impounded, treated by cyanidation.

Mineral County

RAWHIDE producing steadily and considerable development work under way. Nevada New Mines Co. treating 60 tons daily, ore said to assay \$22 to \$30. National Milling Co. treating 35 tons daily. Several properties under development and some shipping-grade ore being mined. Placer mining in old Squattertown and on Grutt Hill.

AURORA CON. (Aurora)—Mill recently started after alterations, again closed for further changes. Stated large amount of clay in ore causes excessive sliming; treatment of this slime in milling process not yet satisfactorily solved.

NEW MEXICO

Bernalillo County

GALENA KING (Albuquerque)—Work resumed at mine south of Coyote Springs after suspension of two months. Company developing by tunnels, contemplates erecting mill. E. N. McCloskey president.

Grant County

CHINO COPPER COMPANY (Hurley)—Company experimenting with flotation; unit installed and in operation treating slimes.

EMPIRE ZINC (Hanover)—Work begun Nov. 17 on two-compartment shaft for Thunderbolt Mountain property. Trestle to be erected across Hanover Gulch and Santa Fé railroad in construction of tramway to property.

McGEE MINES (Fierro)—Camp established in Shingle Cañon, two miles above Fierro by T. B. Fisher and associates. Will work lead-zinc property under lease and bond. Other small zinc properties in region being operated.

B. V. N. MINING CO. (Silver City)—Company being incorporated to work Silver Hill mine at Pinos Altos, on extension of Langston. Messrs. Bettes, Vinot and Noble, of Silver City, N. M., incorporators. Company purposes drifting to end-lines of claim, extending No. 4 tunnel and later sinking shaft.

OREGON

MAMMOTH MINING CO. (Sumpter)—Liens for labor and supplies filed against this company, amounting to over \$1500. Last year mine was worked by Mr. Bodelson under lease.

BAKER GOLD MINES CO. (Sumpter)—Company has leased Last Chance from Cornucopia Mines Co., has equipped mine with machinery and will begin extensive operations soon.

FLAGSTAFF MINE—Operations renewed on this property, idle for some time. John G. Cleary of Boston, representing owners, after spending few days at mine returned East. Stated company would do extensive work.

SEWELL (Holland)—Company of Salem and Portland men has purchased this mine, on Althouse Creek. Represented by Gregor, Collard & Buckmann, who have had property under working bond for some time. New vein of fine copper ore reported found by new owners, orebody showing entirely across face of tunnel. Expect to begin immediate shipments to smelters.

SOUTH DAKOTA

MOGUL (Terry)—Merrick conveying weigher installed in cyanide plant. Experiments being made with canvas bags for clarifying solution from Dorr thickeners tanks before sending it to zinc boxes. Mill operating steadily at about 150 tons daily capacity.

HOMESTAKE (Lead)—Work proceeding rapidly on installation of new hoisting plant, electric generating station and boiler plant. Engine house at B. & M. shaft, built of brick, with steel roof, practically finished. All machinery and structural steel for shaftcase and headframe delivered. Erection will begin shortly. Foundations, retaining walls and side walls for concrete electric generating station complete and roof girders being erected. At boiler plant, finishing touches being put on extensive foundation work; number of shafts sunk to hardpan and later filled to top with concrete.

TENNESSEE

TENNESSEE COPPER (Ducktown)—Reported London mine, closed Aug. 15, will be reopened about Dec. 1.

UTAH

Beaver County

MOSCOW (Milford)—Ore recently opened in main drift from 800 level of main shaft thought to be extension of shoot in Back vein in old workings 400 ft. higher up. Expected connections between old and new workings will be completed in month; 800 level of new workings corresponds with 1100 of old. During October 15 cars of high-grade silver-lead ore shipped from above and below 800 level of old workings.

Juab County

VICTORIA (Eureka)—Working forces reduced and shipments curtailed. Report denied that operations are to be suspended.

EAGLE & BLUE BELL (Eureka)—Large station on 1700 completed Nov. 16 and drifting started to north. Between 75 and 100 tons of ore shipped daily.

CENTENNIAL-EUREKA (Eureka)—Winze being sunk on vein, which carried gold at surface; 270 ft. lower down tunnel being driven to cut vein at greater depth.

KNIGHT-CHRISTENSEN MILL (Silver City)—Contract given to Traylor Engineering & Manufacturing Co., of Allentown, Penn., for exclusive manufacture and sales agency of patented machinery used in Knight-Christensen process.

EAGLE & BLUE BELL (Eureka)—New station on 1700 being cut, and drifting will soon be started to reach ore north of old workings on 1500, and to make connections with winze sunk in ore from that level. High-grade silver-lead ore being shipped; October output 61 cars.

CHIEF CONSOLIDATED (Eureka)—Repairs to shaft completed, and new guides being put in. Development work being done on 1400, 1600 and 1800 levels, where number of strong fissures are being drifted on. Said to be possibility of Chief acquiring old Scotia in western Tintic, owned by Boston & Tintic Mining Co.

MAY DAY (Eureka)—Thirty cars silver-lead ore taken from lease in Chief Consolidated ground and ore followed back into May Day ground, where it is 3½ to 4 ft. wide, and about 12½ ft. high. Drifting being done, and as much as possible left standing. No ore of this character being shipped at present, though a little zinc from 300-ft. level is being mined and marketed. Griggs-Carter-Castleton cyanide plant still operating on low-grade ore, and reported to be making small profit.

Salt Lake County

UTAH CONSOLIDATED (Bingham)—Working forces reduced 50%, but this has not materially affected tonnage. Regular shipments of lead ore being made, though output of copper is less.

CARDIFF (Salt Lake)—Recently opened crebody drifted on for 130 ft. with ore still in face. Winze sunk from upper workings in ore is about 200 ft. ahead. Strike considered one of most important made in the Cottonwoods in recent years.

Summit County

DALY WEST (Park City)—New mill started, expected daily output will shortly reach normal. Hoist for main shaft arrived.

SNAKE CREEK TUNNEL (Park City)—During October 328 ft. driven, with two shifts working. Progress slow owing to hard rock and low air-pressure. Both igneous rock and limestone cut, some of latter exceedingly siliceous. Two small orebearing fissures cut. Much of rock impregnated with pyrite.

WASHINGTON

MILL to be built by operators of Rich Bar and Golden King gold-mining properties near Oroville. Will cost \$25,000 and have capacity of 50 tons. Machinery being bought. Developments in camp favorable. Rich Bar working 6-ft. vein. Golden King has 130-ft. shaft, to be continued to 500 ft., has 9-ft. vein. Coaba mine also to begin operations soon.

HECLA COPPER-SILVER (Chewelah)—Company shipped from Spokane four-drill compressor, 35-hp. boiler, 25-hp. hoist and small electric-lighting plant. Will sink 200-ft. shaft and drift about 200 ft. J. C. Argall president, Fred F. Foster general manager.

CANADA

Ontario

VIPOND (Schumacher)—Mill producing \$25,000 a month. Refinery will be built.

ALEXO (Porcupine)—Nickel mine has resumed shipments to Mond Nickel Co.

FOLEY-O'BRIEN (South Porcupine)—Mine will install small plant to replace that destroyed by fire.

CANADA REFINING & SMELTING CO. (Orilla)—Plant for treatment of high-grade Cobalt ores expected to resume operations.

TEMISKAMING (Cobalt)—Mill started Nov. 16 at half capacity after 3½ months' shutdown. Mine has 5000 tons broken ore in stopes.

CART LAKE (Cobalt)—Company operating Gould lease has exhausted orebodies, but will continue development. Has produced only 130,000 oz.

McKINLEY-DARRAGH (Cobalt)—New high-grade vein developed to depth of 55 ft. estimated to run 7000 oz. per ton for width of 4 in.

KERR LAKE (Cobalt)—Further draining of lake suspended until spring, as heavy mud proved more difficult to handle than expected.

JUPITER (Schumacher)—Mine under option to McKinley-Darragh being developed at 400- and 475-ft. levels, both new. Results satisfactory and McKinley-Darragh expected to exercise option.

GOLDFIELDS (Larder Lake)—Mine closed for indefinite period. Marks final cessation of operations in district. Company will, however, continue to operate hydro-electric plant which supplies Huronia company with power.

CROWN RESERVE (Cobalt)—Rich stringer cut on Silver Leaf near Lawson boundary. Silver Leaf under lease to Crown Reserve and receives 35% of net returns. Directors will again cut dividend probably to 12%; now 24% a year.

DOME (South Porcupine)—Extensive campaign of diamond drilling previously announced, now beginning. Six drills will be operated, five on surface and one under ground, and whole known orebody 1700 ft. long and 400 ft. wide will be systematically drilled in 100-ft. blocks, with object of finding if mill can be further enlarged at once so as to increase profits and cut down costs.

Yukon

YUKON FREEZEUP at Dawson came late this year, morning of Nov. 15. Unusually mild and uniform weather for last two months, little snow.

MAYO CAMP will be active this winter. McWhorter silver properties on Galena Creek will ship 1000 tons to riverbank at Mayo. Placer mines will also be busy.

YUKON GOLD (Dawson)—Hydro-electric plant on Twelve-Mile River closed down Oct. 25 after longest and most successful season. Last dredge to shut down out of company's fleet of eight was No. 9, on Eldorado.

MEXICO

Sonora

NORTH TIGRE (Esqueda)—This mine, adjoining Tigre mine on north, leased to United Mines Co.; 50-ton mill just completed. Company purchasing power from Tigre.

CENTRAL AMERICA

Nicaragua

JAVOLI & ESCANDALO MINING CO. (La Libertad)—Company intends to install 150-ton cyanide plant. Ignatius O'Reardon, general manager, purchasing machinery in New York. Morris B. Evans in charge of construction.

SOUTH AFRICA

EAST RAND PROPRIETARY—Skip containing three whites and 17 natives being hoisted in Driefontein section fell to bottom of shaft, over 600 ft. Two whites and 11 natives killed, the others injured. Hoisting engineer disappeared; warrant issued for arrest.

The Market Report

METAL MARKETS

NEW YORK—Nov. 25

Copper, lead, spelter and tin have all been stronger this week, general improvement in the demand for consumption being the governing factor.

Copper, Tin, Lead and Zinc

Copper—The advance has gone further through the influence of continued good buying for domestic consumption, together with some export business. On Nov. 20, and again on Nov. 23, there were sharp advances between the beginning and end of the day. Domestic consumers have entered into contracts so far ahead as February. During the last day or two, reports have been current of 12½c., regular terms, for copper. In fact, that price has been reported as realized, but only on deliveries in Europe and on some distant deliveries here. During the last two days copper has been freely available at 12½c., regular terms, and the sales effected have averaged about 12½c., net cash, New York. Thus, near the end of November the copper market finds itself on the same basis as at the end of July, but with a 50% curtailment in production. The sales during our last week of record have been large, but not so large as in the previous week. From 20 to 30 millions of pounds is probably a reasonable estimate.

Business among the brass makers and rollers of sheet copper is reported very good. Some improvement is reported from the wire drawers.

The copper producers have not relaxed their efforts to obtain through the State Department a recession by Great Britain from its previous position respecting copper shipments to neutral countries. An important brief by Dr. Moore has been filed and pressure is being exerted from several quarters where the restriction of copper production has been felt keenly.

Base price of copper sheets was advanced ½c. Nov. 19 to 17c. for hot rolled. On Nov. 23 it was advanced ½c. more, and is now 17½c. per lb. for hot rolled and 18½c. for cold rolled. Full extras are charged and higher prices for small lots. Copper wire is 13@13½c. per lb., carload lots at mill.

The Union Minière du Haut Katanga, which formerly had its general offices in Brussels, now has them at the offices of the Tanganyika Concessions, Ltd., in London. The production of the Katanga mines is now at the rate of 1000 tons a month, and arrangements are being made to start work on the new smelting plant as soon as possible.

Tin—The market has resumed its advance; spot and near-by material is very scarce, and is held at a considerable premium. A good consumptive demand developed for future deliveries, which were quoted about 2c. per lb. below spot. The close is firm.

Receipts of Bolivian tin ore and concentrates at Liverpool in October are reported by H. A. Watson & Co. at 1481 tons; Nigerian, 29; South African, 50; total, 1560 tons, equal to 944 tons metallic tin.

Tin output of the Federated Malay States in October is reported at 60,869 pikuls. For the 10 months ended Oct. 31, the total was 41,537 long tons in 1913, and 40,321 in 1914, a decrease of 1216 tons this year.

Lead—The A. S. & R. Co. raised its price to 3.90c., New York, on Nov. 19. Independent producers were not taken so much by surprise this time, contraction in the New York-St. Louis differential having foreshadowed a further advance. By the same mark the failure of the differential to remain quite so narrow as previously indicates that no further advance by the leading interest is expected right away. A good business has been done right through the week, the total tonnage reported being fairly heavy. Some interesting export business has been going on. One producer reports an order from South America for the first time. Corroding lead is now commanding the full premium of 10 points.

Spelter—A moderate business is reported as having been done every day. The demand was larger than last week and the aggregate of transactions was larger, which explains the further slight advance. Otherwise there is nothing new to

report. Some export business was done, and on Nov. 25, the London price advanced to £25%, which was regarded hopefully for the market here.

Exports and Imports of Metals other than iron in the United States nine months ended, Sept. 30, as reported by the Bureau of Statistics, Department of Commerce:

Metals:	Exports		Imports	
	1913	1914	1913	1914
Copper, long tons.....	320,595	305,177	140,851	110,601
Tin, long tons.....	1,006	543	36,977	34,055
Lead, short tons.....	38,476	49,711	48,475	17,556
Zinc, short tons.....	8,136	24,946	5,856	838
Zinc in ore, short tons.....	5,132	140	10,440	5,664
Nickel, lb.....	21,862,707	21,474,688	35,601,333	28,197,471
Antimony, lb.....	63,620	27,109	12,810,829	11,665,698
Aluminum, lb.....	44,535	18,939	19,655,571	11,831,103
Quicksilver, lb.....	54,022	27,000	.....	.....
Platinum, oz.....	1,191	143	91,944	60,683

Copper, lead, nickel and antimony included metallic contents of ore, matte, etc. Exports included reexports.

DAILY PRICES OF METALS

NEW YORK

Nov.	Sterling Exchange	Silver, Cts. per Oz.	Copper		Tin		Lead		Zinc	
			Electrolytic, Cts. per Lb.	Cts. per Lb.	New York, Cts. per Lb.	St. Louis, Cts. per Lb.	New York, Cts. per Lb.	St. Louis, Cts. per Lb.		
19	4.8750	49½	11.95 @ 12.05	32½	3.90	3.77½ @ 3.82½	5.15 @ 5.20	5.00 @ 5.05		
20	4.8788	49½	12.00 @ 12½	32½	3.90	3.77½ @ 3.82½	5.15 @ 5.20	5.00 @ 5.10		
21	4.8788	49	12.00 @ 12½	33	3.90	3.77½ @ 3.82½	5.15 @ 5.20	5.00 @ 5.10		
23	4.8825	48½	12.20 @ 12.40	33½	3.90	3.77½ @ 3.82½	5.15 @ 5.20	5.00 @ 5.10		
24	4.8988	49½	12.00 @ 12½	34	3.90	3.77½ @ 3.82½	5.15 @ 5.20	5.00 @ 5.10		
25	4.8850	49½	12.00 @ 12½	34½	3.90	3.77½ @ 3.82½	5.15 @ 5.20	5.00 @ 5.15		

The quotations herein are our appraisal of the markets for copper, lead spelter and tin based on wholesale contracts; and represent, to the best of our judgment, the prevailing values of the metals specified as indicated by sales by producers and agencies, reduced to basis of New York, cash, except where St. Louis is given as the basing point. St. Louis and New York are normally quoted 0.15c. apart. The quotations for electrolytic copper are for cakes, ingots and wirebars. Electrolytic copper is commonly sold at prices including delivery to the consumer. To reduce to New York basis we deduct an average of 0.15c. representing delivery charges. The price of electrolytic cathodes is usually 0.05 to 0.10c. below that of electrolytic; of casting copper 0.15 to 0.25c. below. Quotations for lead represent wholesale transactions in the open market for good ordinary brands. Quotations for spelter are for ordinary Western brands. Silver quotations are in cents per troy ounce of fine silver.

LONDON

Nov.	Silver	Copper				Tin		Lead		Zinc	
		Spot		3 Mos.	Best Sel'td	Spot	3 Mos.	£ per Ton	Cts. per Lb.	£ per Ton	Cts. per Lb.
		£ per Ton	Cts. per Lb.								
19	22½	53½	11.70	54	*	135½	135	18½	3.97	25½	5.49
20	22½	54½	11.79	54½	*	136½	136	18½	3.99	25½	5.49
21	22½	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
23	22½	55½	12.00	55½	*	139½	138½	19½	4.18	25½	5.49
24	22½	55½	12.04	55½	*	140	138½	19½	4.18	25½	5.49
25	23	55½	12.00	55½	*	142½	140½	19½	4.16	25½	5.57

*No quotations.

The above table gives the closing quotations on London Metal Exchange. All prices are in pounds sterling per ton of 2240 lb., except silver which is in pence per troy ounce of sterling silver, 0.925 fine. Copper quotations are for standard copper, spot and three months, and for best selected, price for the latter being subject to 3 per cent. discount. For convenience in comparison of London prices, in pounds sterling per 2240 lb., with American prices in cents per pound the following approximate ratios are given: £10 = 2.17c.; £15 = 3.26½c. = £25 = 5.44c.; £50 = 10.88c. Variations. £1 = 0.21½c.

Other Metals

Aluminum—The market is more active and demand seems to be improving. Current quotations are firmer, at 19@19.50c. per lb. for No. 1 ingots, New York.

Antimony—There has been a moderate business and prices are firm. Ordinary brands—Chinese, Hungarian, etc.—have sold at 13½@14½c. per lb. during the week. Cookson's is quoted at 17@17½c., and 18c. is now asked.

Quicksilver—Business has been steady, but not especially active. Representatives of the California producers quote \$52, and importers report sales at about that figure.

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

The export of nickel ore and matte from New Caledonia, also of chrome ore, has been prohibited by a recent Decree. Special exemption from this decree may, however, be granted under conditions to be determined by the French Ministry for the colonies.

Gold, Silver and Platinum

Gold—The \$100,000,000 gold pool in support of exchange transactions is being gradually closed up and the money returned to the subscribers. Of the total amount, only \$25,000,000 was actually paid in.

Iridium—Supplies are still rather below the demand and the position of the market is unchanged. Most sales are on private terms.

Platinum—The market is quiet and is a little lower, with considerable range in prices. Current quotations are \$44@46 per oz. for refined platinum; for hard metal, \$48@53 is asked, according to quality.

Silver—The market has been firmer the last few days owing to some fresh orders, the origin of which is not known here at present. No speculative interests as yet seem to be taking hold of the situation.

Gold and Silver Movement in the United States, 10 months ended Oct. 31, as reported by the Department of Commerce:

	Gold		Silver	
	1913	1914	1913	1914
Exports.....	\$74,563,059	\$207,998,150	\$53,896,586	\$42,452,890
Imports.....	51,590,693	45,876,812	29,968,758	20,340,603
Excess, exports...	\$22,972,366	\$162,121,338	323,927,828	\$22,112,287

Exports of merchandise for the 10 months were valued at \$1,662,685,841; imports, \$1,548,429,652; excess of exports, \$114,256,189. Adding the excess of gold and silver makes the total export balance \$298,489,814 this year.

Zinc and Lead Ore Markets

PLATTEVILLE, WIS.—Nov. 21

The base price paid this week for 60% zinc ore was \$44 per ton. The base price offered for 80% lead ore was \$45@46 per ton. No sales of lead ore were reported.

SHIPMENTS WEEK ENDED NOV. 21

	Zinc Ore, lb.	Lead Ore, lb.	Sulphur Ore, lb.
Week	4,014,420	.....	172,000
Year	148,951,710	4,444,950	30,146,750

Shipped during week to separating plants, 3,871,340 lb. zinc ore.

JOPLIN, MO.—Nov. 21

Blende, high price \$47; assay base, 60% zinc, \$42@44; metal base, 60% zinc, \$41@43; calamine, base, 40% zinc, \$21@23; average, all grades of zinc, \$40.78 per ton.

Lead, high price \$49; base, \$42@47 per ton of 80% metal content; average, all grades of lead, \$44.64 per ton. Lead offerings advanced \$5 per ton at the week-end.

The production of this district continues about 1500 tons per week short of an average output.

SHIPMENTS WEEK ENDED NOV. 21

	Blende	Calamine	Lead	Values
Totals this week.	10,252,620	824,440	1,711,030	\$264,050
Totals this year..	462,646,550	35,016,770	79,963,600	11,499,210
Blende value, the week,	\$215,490; 47 weeks, \$9,224,820.			
Calamine value, the week,	\$10,370; 47 weeks, \$410,700.			
Lead value, the week,	\$38,190; 47 weeks, \$1,862,690.			

On Sept. 30 there were 286 furnaces in blast in Great Britain, against 290 on June 30. The average number in blast for the quarter ended Sept. 30 was 281, being 12 less than in the previous quarter.

IRON TRADE REVIEW

NEW YORK—Nov. 25

There is no question that there is a growing confidence in the iron and steel markets and a better feeling, though actual changes have not been great.

In some lines orders begin to come in more freely, though buyers are close about prices and want their orders filled at low figures. Some manufacturers are inclined to hold back, believing that a reduction in wages must come and that still lower quotations will be possible. Structural-steel business is improving and there is more demand for bars and wire. In export business, some fair orders have been placed and others are under negotiation, with a prospect of resulting business.

Pig-iron buying is better, and demand is gaining both for small and large lots. In Eastern territory there is a noticeable call for foundry iron; in the West the demand is more for basic pig. Prices do not advance, but they are more firmly held than for some time past, at the present level.

Efforts are being made to arouse apprehension about the supply of ferromanganese, but users do not seem to be disturbed, and material is available at recent prices.

PITTSBURGH—Nov. 24

The improvement in sentiment that has been so marked since the early days of November, in sharp contrast with the hopeless feeling that characterized September and October, has not been accompanied thus far by any noticeable increase in the buying of steel products generally. There has been no further decrease in steel buying in the past two or three weeks, but as the mills have lately been running partly on old business their operations have had to be curtailed further, and the steel industry as a whole is now operating at only about 35% of its capacity, against fully 40% the first week in November. The present percentage of operation is the lowest in the history of the steel industry. Some improvement in buying is generally expected within the next fortnight or so, but no great increase is to be looked for before the turn of the year.

Steel prices have continued to decline slightly here and there, and the general level is as low as at the low point just three years ago, the lowest level for steel prices since 1898. Wire products are quotable on the basis of \$1.55 for nails, the market before the recent advance, the advance never having been paid on any considerable tonnage. Plates are down to 1.05c., and shapes and bars are not firm at 1.10c. Railroad spikes are down to 1.35c. Sheets are easy at 1.85c. for black and 2.85c. for galvanized, with contracts for first quarter being made on this basis.

The leading interest has sold over 100,000 boxes of tin-plate for export in the past few days. The Carnegie Steel Co. yesterday made an initial shipment of 2000 tons on an order for 10,000 tons of 3¼-in. steel rounds for shrapnel for France, and the Jones & Laughlin Steel Co. has an open order for similar material that may amount to an equal tonnage.

Pig Iron—The heavy buying reported lately from the Buffalo district has not extended to this district, except to the extent that the American Steel Foundries has bought 7500 tons of basic, and foundry iron consumers are evincing more interest, without putting out many definite inquiries. The steel foundry purchase was for shipment December to March inclusive to Alliance and Sharon, the price delivered Sharon being \$12.75, indicating a basis of \$12.50, Valley, for all the iron. There is a rumor that Cherry Valley furnace at Leontonia may be blown in Dec. 1. We quote: Bessemer, \$13.75; basic, \$12.50; No. 2 foundry and malleable, \$12.75@13; gray forge, \$12.50@12.75, f.o.b. valley furnaces, 95c. higher delivered Pittsburgh.

Ferromanganese—The steel trade is much more concerned about the lightness of steel demand and consequent small requirements in ferromanganese than it is in reports of English embargoes on the alloy or the ore. Ferromanganese is quoted at \$68, Baltimore, on contract, subject to possibilities of shipment, while small prompt lots might be had at between \$68 and \$75, Pittsburgh.

Steel—Pittsburgh mills have weakened somewhat on billets and sheet bars and would now quote as low as the Youngstown mills. There is no demand for prompt, and none for first quarter. We quote the market largely nominal at \$19 for billets and \$19.50 for sheet bars, f.o.b. maker's mill, Pittsburgh or Youngstown. Rods are \$25, Pittsburgh, and not strong at that.

FOREIGN IRON

Pig-Iron Production in Germany in September was 518,184 metric tons, against 1,590,849 tons in September, 1913. For the nine months ended Sept. 30 the total make was 14,455,886 tons in 1913, and 11,996,652 in 1914; a decrease of 2,459,234 tons, or 17% this year.

Steel Production of Germany, seven months ended July 31, in metric tons:

	Basic	Acid	Total
Converter.....	6,281,431	58,816	6,340,247
Openhearth.....	4,141,811	207,976	4,349,787
Direct castings.....	142,412	64,420	206,832
Crucible.....	.....	54,021	54,021
Electric.....	.....	63,789	63,789
Total.....	10,565,654	449,022	11,014,676

The total number of steel works reported in July was 242. Steel production was not reported monthly previous to the present year.

British Imports and Exports of Iron and Steel nine months ended Sept. 30 are valued by the Board of Trade returns as below:

	Exports	Imports	Excess
Iron and steel.....	£33,976,229	£9,582,502 Exp.	£24,393,727
Machinery, hardware, etc.....	39,228,065	10,944,129 Exp.	28,283,936
Totals.....	£73,204,294	£20,526,631 Exp.*	£52,677,663
Totals, 1913.....	87,290,799	23,108,534 Exp.	64,182,265

Quantities of iron and steel exported were 3,724,606 long tons in 1913, and 3,179,726 in 1914; decrease, 544,880 tons. Quantities imported, 1,611,493 tons in 1913, and 1,467,512 in 1914; decrease, 143,981 tons.

IRON ORE

One cargo of Swedish ore is now afloat for Philadelphia, but it is understood that no more will be shipped for a time.

Hearings before the Interstate Commerce Commission on iron rates from Lake Erie ports to furnaces in the Pittsburgh and Wheeling districts have been postponed.

Hearings are going on before the Interstate Commerce Commission on protests against the 60c. rate now in force from mines in the Lake Superior region in Minnesota to the upper ports.

COKE

Coke production in the Connellsville region for the week is reported by the "Courier" at 206,314 short tons; shipments, 210,387 tons. Shipments of Greensburg and Upper Connellsville districts, 30,464 tons.

Coal passing through the Sault Ste. Marie Canal for the season to Nov. 1 was: Anthracite, 1,827,211; bituminous, 11,323,334; total, 13,150,545 short tons, a decrease of 3,561,457 tons, or 21.3%, from last year.

Coal and Coke Tonnage on Pennsylvania R.R. lines east of Pittsburgh and Erie, 10 months ended Oct. 31, in short tons:

	1913	1914	Changes
Anthracite.....	8,711,723	9,205,279	I. 493,556
Bituminous.....	42,662,163	40,346,167	D. 2,315,996
Coke.....	12,012,363	8,324,007	D. 3,688,356
Total.....	63,386,249	57,875,453	D. 5,510,796

Coal Production of Austria nine months ended Sept. 30, in metric tons:

	1913	1914	Changes
Coal.....	12,333,017	11,700,541	D. 632,476
Brown coal.....	20,612,130	18,337,727	D. 2,274,403
Coke.....	1,909,235	1,771,938	D. 137,297
Briquettes.....	326,683	304,762	D. 21,921

Of the briquettes reported this year 163,399 tons were made from brown coal or lignite.

SAULT STE. MARIE CANAL

Freight passing through the Sault Ste. Marie canals in October was 7,740,055 net tons. For the season to Nov. 1 the total freight reported was: East bound, 36,398,565; west bound, 14,375,115; total, 50,773,680 short tons, a decrease of 20,218,888 tons, or 28.5%, from 1913. The number of vessel passages in 1914 was 17,065, giving an average cargo of 2975 tons. The mineral freight included in the totals was, in short tons excepting salt, which is in barrels:

	1913	1914	Changes
Coal.....	16,712,002	13,150,545	D. 3,561,457
Iron ore.....	44,710,520	30,297,986	D. 14,412,534
Pig and m'd iron.....	340,970	211,936	D. 129,034
Copper.....	77,492	60,584	D. 16,908
Building stone.....	6,181	.....	D. 6,181
Salt, bbl.....	603,685	651,256	I. 47,571

CHEMICALS

NEW YORK—Nov. 25

Arsenic—The market is quiet, with little business forward. Quotations are about \$4 per 100 lb. for both spot and futures.

Copper Sulphate—Business is moderate and the market is quiet and unchanged. Current quotations are \$4.35 per 100 lb. for carload lots and \$4.60 per 100 lb. for smaller parcels.

Nitrate of Soda—There is nothing doing in nitrate this week. Prices are nominally unchanged at 1.85c. per lb. for November and December and 1.87½c. for 1915 deliveries.

Imports and Exports of Chemicals in the United States, nine months ended Sept. 30, in pounds:

	Imports		Exports	
	1913	1914	1913	1914
Arsenic.....	5,615,876	3,171,867	66,000	700
Bleach.....	47,429,019	29,185,862	13,260	12,654
Potash salts.....	37,217,581	25,065,751	1,000,277	481,655
Acetate of lime.....	.....	.....	57,261,340	41,514,968

Exports include reexports of foreign material. Imports of soda salts are not given in quantities; values were \$242,374 in 1913, and \$460,023 this year.

STOCK QUOTATIONS

The quotations given below are all established since Nov. 10, except the following: Argonaut, Brunswick, Boston & Corbin, Cedar Talisman, Chollar, Con. Nev-Utah, Corbin, Golden Cycle, Iron Cap, Mutual Mining, Puebla S. & R. Co., Savage, Standard Silver Lead, Stratton's Independence. In general, the stock markets have shown improvement during the week:

COLO. SPRINGS Nov. 23		SALT LAKE Nov. 20	
Name of Comp.	Bid.	Name of Comp.	Bid.
Acacia.....	.02½	Beek Tunnel.....	.04½
Cripple Cr'k Con.....	.007	Black Jack.....	.02½
C. K. & N.....	.03	Cedar Talisman.....	\$.00½
Doctor Jack Pot.....	.07½	Colorado Mining.....	.08½
Elkton Con.....	.39½	Crown Point.....	\$.00½
El Paso.....	.80	Daly-Judge.....	4.10
Flindley.....	.067	Gold Chain.....	.06
Gold Dollar.....	.02½	Grand Central.....	.62
Gold Sovereign.....	.07	Iron Blossom.....	1.10
Golden Cycle.....	\$.100	Little Bell.....	.10
Isabella.....	.11½	Lower Mammoth.....	.01½
Jack Pot.....	.06	Mason Valley.....	.25
Jennie Sample.....	.02	May Day.....	.08
Jerry Johnson.....	.02½	Opohongo.....	\$.01½
Lexington.....	.003	Prince Con.....	.16
Old Gold.....	.01	Silver King Coal'n.....	2.35
Mary McKinney.....	.35	Silver King Cons.....	1.45
Pharmacist.....	.009	Stour Con.....	.01½
Portland.....	1.04	Uncle Sam.....	.02
Vindicator.....	1.08½	Yankee.....	.02

SAN FRANCISCO

Nov. 23

Name of Comp.	Bid.	Name of Comp.	Bid.
Comstock Stocks.....	.....	Misc. Nev. & Cal.....	.....
Alta.....	.05	Belmont.....	4.37½
Belcher.....	.70	Jim Butler.....	.69
Best & Belcher.....	.05	MacNamara.....	.02
Caledonia.....	.30	Midway.....	.05
Challenge Con.....	.04	Mont.-Tonopah.....	\$.37
Chollar.....	\$.02	North Star.....	.17
Confidence.....	.15	West End Con.....	.55
Con. Virginia.....	.12	Atlanta.....	.31
Crown Point (Nev.).....	.29	Booth.....	.04
Chollar.....	.01	C.O.D. Con.....	.04
Hale & Norcross.....	.01	Comb. Frac.....	.10
Mexican.....	.29	Jumbo Extension.....	1.65
Occidental.....	.85	Pitts.-Silver Peak.....	.34
Ophir.....	.70	Round Mountain.....	.38
Overman.....	.14	Sandstorm Kendall.....	.08
Potosi.....	.01	Silver Peak.....	.10
Savage.....	\$.05	Argonaut.....	\$.250
Sierra Nevada.....	.06	Brunswick Con.....	\$.150
Union Con.....	.06	Central Eureka.....	.20
Yellow Jacket.....	.38	So. Eureka.....	\$.180

N. Y. CURB

Nov. 23

Name of Comp.	Cig.
Beaver Con.....	.22
Big Four.....	.05
Blue Bell.....	.03
Bradent Copper.....	.51
B. C. Copper.....	.50
Buffalo Mines.....	.62½
Can. Cop. Corp'n.....	1.25
Can. G. & S.....	.03
Caribou.....	.17
Chambers Ferland.....	.12
Con. Ariz. Sm.....	.31½
Cons. Nev.-Utah.....	.11
Coppermines Cons.....	.11
Davis-Daly.....	.75
Diam'field-Daisy.....	.05
Ely Con.....	.01
Florence.....	.43
Goldfield Con.....	1.50
Greene Cananea.....	.23
Kerr Lake.....	.41
La Rose.....	.1
McKinley-Dar-Sa.....	.62
Mines of Am.....	2.18½
Mutual Min. pf.....	.12½
Nevada Hills.....	.27
New Utah Bingham.....	.51
Nipissing Mines.....	.51
North Star.....	.19
Ohio Copper.....	.09½
Oro.....	.09
Puebla S. & R.....	.12½
Stand'd Oil of N.J.....	.387
Stand'd Silver Lead.....	1.14½
Stewart.....	.11
Tonopah.....	.7
Tonopah Ex.....	2.54½
Tonopah Merger.....	.37
Tularosa.....	.1
West End Ex.....	.01
Yukon Gold.....	.21

BOSTON CURB

Nov. 23

Name of Comp.	Bid.
Bingham Mines.....	\$.04½
Boston & Corbin.....	\$.25
Boston Ely.....	.5
Butte & Lon'n Dev.....	.27
Calaveras.....	.1
Calumet-Corbin.....	.11
Chief Cons.....	.70
Corbin.....	\$.90
Cortez.....	\$.10
Crown Reserve.....	.74
Eagle & Blue Bell.....	.82
First Nat. Cop.....	1.14
Houghton Copper.....	.2
Iron Cap Cop., pf.....	\$.475
Majestic.....	.20
Mexican Metals.....	.18
Nevada-Douglas.....	.50
New Baltic.....	.75
Oneco.....	\$.30
Raven Copper.....	.10
Smokey Dev.....	.15
So. Lake.....	.11
Tonopah Victor.....	.17
Trethewey.....	.14
United Verde Ext.....	1.11

TORONTO

Nov. 23

Name of Comp.	Bid.	Name of Comp.	Bid.
Balley.....	.01½	Poley O'Brien.....	.15
City of Cobalt.....	.30	Hollinger.....	18.50
Conlagas.....	5.00	Imperial.....	\$.00½
Peterson Lake.....	.28	Jupiter.....	.11½
Right of Way.....	.02	McIntyre.....	.25
T. & Hudson Bay.....	25.00	Pearl Lake.....	.02
Timiskaming.....	.10½	Poreu. Gold.....	.06
Wettlaufer-Lor.....	.03½	Preston E. D.....	.01
Big Dome.....	.620	Rea.....	.10
Dome Exten.....	.06½	Seneca Superior.....	1.50

LONDON

Nov. 11

Name of Comp.	Cig.
Camp Bird.....	£0 6s 6c
El Oro.....	0 11 6
Esperanza.....	0 8 9
Mexico Mines.....	4 0 0
Oroville.....	0 7 6
Santa Ger't'ds.....	0 10 0
Stratton's.....	10 0 6
Tomboy.....	1 0 0