

ENGINEERING AND MINING JOURNAL

A Weekly Journal of the Mining and Mineral Industries

November 19, 1921

**The
Tailing Air Lift
of the
Chino Copper Co.**

By H. G. S. Anderson

Old Tyopa

By D. F. McCarthy

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Bentonite is a clay-like mineral whose properties and uses are not widely known. On page 819 under "Consultation" will be found a study of this mineral made by the United States Bureau of Mines.

**The Discrepancy
Between
Drilling and
Dredging Results**

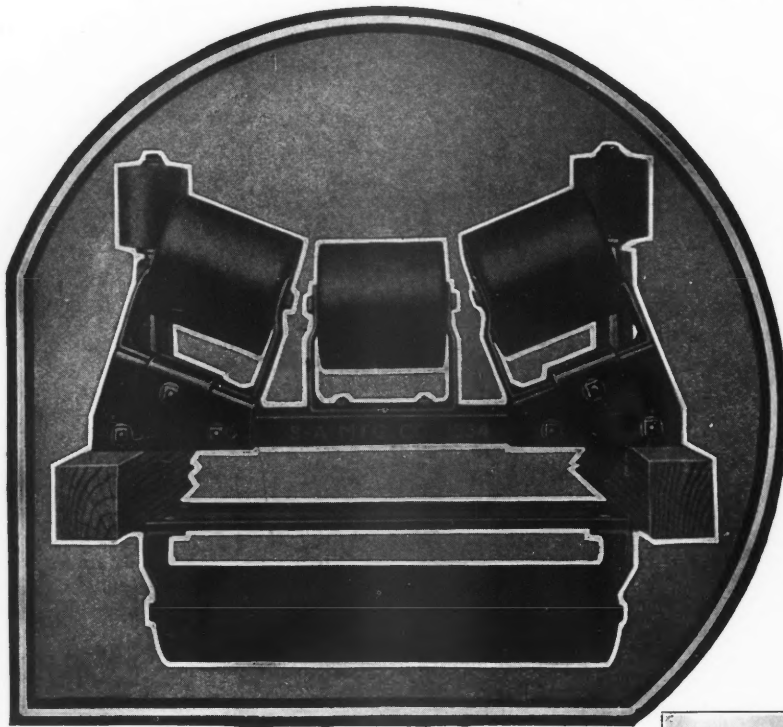
By R. G. Smith

**Biography of
Alfred James**

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S-A UNIT BALL BEARING CONVEYOR CARRIERS FOR ALL SERVICES

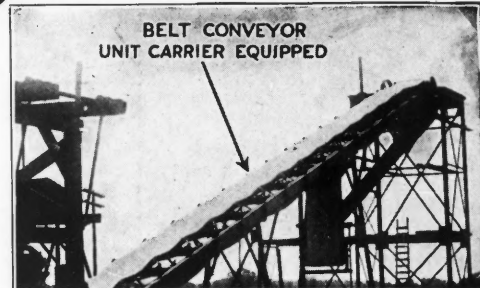


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The Disarmament Conference

WE ARE JUSTIFIED in believing that the Disarmament Conference in Washington is one of the most critical events of modern times, and one of the great pivotal periods of all history. We have witnessed in our time the greatest of all human cataclysms, the World War; we have witnessed the drama of the Peace Conference and its pathetic evidence that human nature is apt to be too low in stature, and too weak, to carry out heroic rôles and wise universal plans. These were the first two parts of the great drama set for our times, large enough in import to interest even the Martians, if they be by any chance intelligent onlookers. The third act, in Washington, may close the play, and let us go home to peace and the welfare of the period that has no dramatic history. It depends on the actors. For ourselves, we are optimistic.

Mr. H. G. Wells, with probably the most detached and broadest of the intellects of our period, joined to the acute observation and logical deduction of the scientist (he began as a zoologist and astronomer), has recently pictured the stage setting with his own unrivaled force and sincerity. Mr. Wells is on the whole, perhaps, not optimistic. He sees civilization as sinking at the present time—he sees us slowly and surely submerging, as the civilization of the Roman world did at the beginning of the Dark Ages, when, had it not been for the monasteries, those lighthouses and fortresses of culture, we should not have had even the kindling to start the fires of modern learning.

There is no question that we have just escaped such a complete shipwreck, and by a series of miracles which might be dramatically at least featured as divine interventions; but we do not visualize, with Mr. Wells, the ship as settling under her injuries at the present moment. We visualize her as slowly rising, and with good handling well able to weather the waning storm. This does not minimize the grave and decisive character of the Washington Conference. But there are certain advantages which warrant optimism. We have the advantage of experience and of past mistakes, and, therefore, we have certain reefs well charted. And we have the greatest of all advantages, that of the co-operation and guidance of public sentiment.

In Paris, national thought and sentiment was not asked for, even from democratic and enlightened America; even our own representatives sent us word to mind our own business—that supermen were on the job. Well, we are individually very limited, the greatest of us. Feisal, now king of Arabia, was in Paris at the Peace Conference, and met the great figures of the world—Lloyd George, Wilson, Clemenceau, and the rest. He was asked his impressions of them. "They loom up larger," said the Arab, "from the desert."

It is, we believe, the solemn truth, and, moreover, there is no justification for democracy unless it be true, that the collective thought and aspirations of the people

are wiser and safer than those of its chosen leaders, paradoxical though the axiom may superficially appear. Therefore, the press and the various other methods the people possess to make themselves vocal should be vociferous, in America, in Europe, and in Asia. Let the leaders ask, "Do we want war?" and listen; and they will hear the thunderous reply of Noes which will decide the question. There never would have been a world war if the leaders had asked the people, and listened. There never will be another if they hear the voice of the multitudes. Therefore, let it be raised without invitation.

Is this an editorial for a mining journal? Man, the working of your mines, your bread and butter, depends on it. You may have lived high for a few years, while your products were being used for destroying wealth. But you are just now weathering the bitter reaction; and if the poisonous stimulant is repeated, it will kill you, quite as Mr. Wells has told you.

The Proposed Mining Law

AN ESPECIALLY VALUABLE CONTRIBUTION to the discussion of the proposed new mining law bill is that by Mr. H. G. Moulton, which will be found on page 804. Mr. Moulton writes from an earlier extensive background of experience as a surveyor; and has, moreover, as we happen to know, investigated through the Government Land Office the present conditions as to resurveys, before setting his pen to paper. His presentation is so careful as to go far toward being practically conclusive in regard to the surveying requirements of the law. It is clear that they should be modified according to existing circumstances and in the interests of simplicity and practicability. It is also clear that when these minor requirements of the law are adjusted, the bill should be strongly supported by every one, from prospector to capitalist, and passed; for it is a simpler and more equitable machine than the old law with which we have so long struggled.

The Gold Bonus

SECRETARY MELLON and Senator Oddie, of Nevada, have each made long declarations regarding the gold bonus, Secretary Mellon severely criticizing it and Senator Oddie making a rebuttal. There is still much that can be said on both sides of the controversy, which has had its period of intense discussion and then of quiet.

Outside of the American Mining Congress, champion of the gold bonus, interest in the issue has subsided. Engineers to whom we have spoken lately are of the opinion that the bonus has a small chance of becoming law. In these expressions the wish has obviously not been father to the thought, and possibly we are too frank in stating so. Plainly speaking, the possibility of the enactment of the McFadden Bill does not ap-

pear as good as when the bill was first promulgated in March, 1920. The irrefutable argument that commodity prices have come down and that the trend is still downward has dampened the powder of the gold bonus advocates.

The increasing interest manifested in gold mining in the United States and Canada, and the possibility of gold mining being one of the first metal mining industries to revive, are also considerations that have affected the probability of the passage of the legislation sought. It is becoming increasingly problematical whether, in view of greatly altered domestic business conditions, legislation which was considered eminently fair a little over a year ago has not now changed in character.

The McFadden Bill, it will be recalled, ostensibly provides for the protection of the monetary gold reserve of the United States, protection that is no longer required and which would be very weak were its sole strength in a greater gold production. The stimulation of domestic gold mining is secondary. The act provides for a \$10 bonus per ounce until May 1, 1925, and an annual adjustment of the bonus thereafter based upon a commodity index number. Presumably the provisions of the bill are to be in force until the act is repealed or modified. In its present form it would provide an assurance to gold producers for an indefinite period of a fixed price for their product plus a premium whenever the general price level is unusually high.

The question may naturally be asked, Is it necessary to compensate gold miners for the next five years and longer for the losses sustained during the war? Would not such legislation create resentment among the producers of other metals who do not benefit by the advantage of a fixed price for their product? Copper, zinc, and lead producers were extraordinarily prosperous during the war, but their profits have been dug into greatly by the present curtailment of activity. Should a revival be deferred much longer, it is doubtful if the copper companies—to take an outstanding example—will have profited greatly by the war and its aftermath. Whereas gold mining was depressed during the war, it has reached the stage in a cycle looking to increased activity.

Gold unquestionably derives a great advantage from its ready marketability, its fixed price, and the freedom it consequently gives the gold miner from the marketing worries that ordinarily beset the non-ferrous metal producer. Surplus stocks of gold do not disturb the gold miner; they perturb the financier. A willing consumer is always available to the gold miner in his own and other governments. Of course, gold miners have paid a heavy price for their advantage, but we fancy few would be willing to surrender this advantage in return for the speculation that would be introduced in their operations by a fluctuating price for gold—assuming such a fluctuating price to be possible. The benefit which gold miners obtain in normal times is doubtless a stimulant to the present activity in the North American gold mines.

We do not know whether the McFadden Bill will be passed, but we do not advise any operator placing too great a reliance on that event. If it should become law, so much the better for the gold-mining industry; but if it should fail, our composure should not be too much disturbed, as conditions in gold mining are returning to normal. The improvement is not shown in production necessarily, but in the preparations that are being made

to reopen closed mines and the increased attention given gold by prospectors.

Possibly the McFadden Bill would stand a better chance in a modified form. March, 1920, was the psychological time to press the passage of the McFadden Bill. Then relief was urgently demanded by existing conditions in the gold-mining camps; but many changes have taken place since.

Universities and Commencements

THE MOTIVES which send a student to one university or college and not to another may be comparatively superficial or inspired by logical reasoning. In any event, when he elects to attend a given school both he and the school assume certain responsibilities. On his part, he agrees to accept the prevailing order of things as it is in the school. On the part of the school, there exists by implication at least the responsibility for developing the student's latent possibilities to the greatest extent, within obvious limitations. The student is in the position of a buyer who makes a preliminary payment and expects to receive his purchase in installments, continuing his payments as he goes along.

Some schools endeavor to make clear to the student just what they purpose giving him. This is usually done by assembling the students who have entered a given course, at which time either the dean or other person in charge outlines to them the entire course in a more or less comprehensive way. Sometimes excellent advice is given and often the rules of the game are laid down. Other schools by a system of advisers induct the student into the mysteries of schedules and courses, and still others leave it to him to ferret out these matters from catalogues and printed directions. There thus appears to be a real need to describe in some way the purchase the student is about to make.

Granting that the student has survived the many vicissitudes of the four or more years required, he at last reaches the finale. The student has made his payments in cash, brawn, brains, and other ways, and the school has delivered the goods. Both parties have a grand celebration, much more elaborate than the passing of a good cigar or the "eats" and the cigars which occasionally enliven a commercial transaction. You know all about commencements, the preliminary student marching around the campus, the official program, with its music, its academic procession, its speeches, and the university president passing the sheepskins, and lastly the "doings" of the brand-new graduates.

So far, this is all very well and is strictly in good form, but we venture to raise the question whether the school has completely met its full obligation and whether part of the relatively large amount of time devoted to commencement festivities cannot be utilized in a more practicable way. There exists in every well-established school a nucleus of the teaching force in each department which consists of mature men who have spent considerable time in acquiring knowledge of their several specialties and in understanding the conditions which their end-product or graduates must face. We believe that these men should visualize the after-career of their graduates and prepare a brief that would embody a consistent scheme of future study extending out the various avenues which have been partly built and paved in the school work.

As an exemplification, a number of successful careers should be presented, together with detailed analyses of

the ways by which success has been achieved in each instance. The brief should be concise, pithy, and comprehensive. These briefs should not be standardized, but each should reflect the personality of the man preparing them.

As a student approaches commencement there is an emotional period during which he is especially susceptible. Let advantage be taken of this by having each major instructor present to the particular group of students his plan for future development and his analysis of the elements of success. In our judgment such a procedure would add an important element to the commencement which it now lacks.

Service Information

THE MINE OPERATOR, generally speaking, is fairly resourceful, making the most of the equipment that he has and conducting the management of his property to the best of his ability. The extent of his operation usually determines the number of his subordinates, each of whom is given the responsibility of a part of the work to be performed. Naturally, a great organization, with its various ramifications, is able to conduct certain research work that must be left undone by smaller companies, which, either through lack of capital or by reason of limited needs, do not find it convenient to do so. On the other hand, many problems—particularly those relating to the operation of machinery—have concerned others than those that actually make use of such; and it is the privilege of the small—as well as the big-scale operator to take advantage of the research work done by the manufacturers.

We have at different times called attention to the information disseminated by manufacturers with regard to their particular products. Such information is not scattered broadcast without study, for the results presented represent much painstaking research under actual conditions.

It must be remembered that the mine-machinery manufacturer faces competition at every turn, regardless of the merits of his product. His existence depends not only on his ability to "produce the goods" but to keep step with, or a little in advance of, the requirements of the mine operator. And this he does by an intense study of the latter's problems. Any doubts on this question may be settled by casual questioning in any of the mining districts, where it will be found that the distribution of "service" engineers, representing the various manufacturers, is a liberal one.

Nor does the work stop there. Information relating to mine problems is carefully compiled and reported to the general manufacturing plants, where careful investigations are made, the findings resulting in new machines, appurtenances, methods, or suggestions.

Recently we had an opportunity to study a number of "service information sheets" which are issued periodically by a large manufacturer of drilling machinery, and we were impressed with the thoroughness that this company is showing in promoting the interest of the users of its products. The following are a few of the points mentioned: Increasing the life of pistons by replacement of rotation sleeves; reducing hammer-drill piston breakage; proper lubrication; the mistake of using dull drill bits; disadvantages of high pressure; proper assemblage of parts; the tempering of drill steel, and the general care of drill machines.

Some of these pointers may be "old stuff," but, for the

most part, they are all worthy of the consideration of every mine operator, for these service bulletins have not been prepared without careful consideration of the multiplicity of detail with which the miner must deal.

We recall a certain slogan used extensively by a well-known automobile concern: "What comes after the purchase price?" Obviously, in this case, *service*, for our drill-machine friends are not content to place their wares in the hands of the mine operators and let it go at that. Rather, they realize that by assuming a responsibility in the operation of the machine that they produce they will not only be aiding the miner but themselves.

Engineer Member, California Industrial Accident Commission

THE ENGINEERING COUNCIL of San Francisco has passed a resolution indorsing the idea of having an engineer as one of the members of the Industrial Accident Commission of California. The Metal and Mineral Producers' Association of California and other engineering and business organizations are also indorsing the same suggestion. A committee has been appointed to present the resolutions to Governor W. D. Stephens and to enlist his attention.

Hitherto the Industrial Accident Commission has represented in its membership business and labor men and one political affiliate. It seems to us that at least one engineer should be upon this commission, as an engineer is peculiarly fitted by reason of his contact with industry and the nature of his work to participate in the administration of the industrial compensation act.

We can see no reason for political representation on this board. We express the hope that Engineering Council and other organizations will succeed in getting an engineer on the commission.

Marketing

THERE ARE IN GENERAL two kinds of buyers, the one indifferent and the other shrewd enough to get greater value for his money. There are also two kinds of merchandising, one charging a high price on account of the number of indifferent buyers and the other making a price that produces a large volume of sales. In the mining industry, as well, this situation no doubt prevails.

In the buying and selling of metals in the major-metal markets, most of the transactions are between principals who have made an intimate study of conditions, metal stocks, trend of prices, and industrial needs. On the one hand, is the desire to sell at the highest price, and on the other the desire to buy at the lowest. The differential between the two desires is not 100 per cent, as in the instance of the retail merchants noted before, but is exceedingly small. The advantage is with the seller when demand is keen and with the buyer under reverse conditions. This intelligent marketing restricts the profits of a mining company in the direction of the sale of its product. Only by an equivalent shrewdness in buying and utilizing its supplies can additional "profit" be made by the company. Good management will add still another "profit." The two combined are necessary in many instances to tide over a buyer's market, and in the case of low-grade properties may make the difference between success and failure.

WHAT OTHERS THINK

Revision of the Mining Laws

House Resolution 7,736, introduced by Mr. Arentz last July, represents a praiseworthy attempt to revise the mining laws of the United States so that they will be in line with modern conditions. In general principles the measure is thoroughly sound, and it is entitled to the support, in principle, of the mining fraternity. As to some minor points, however, it would appear that modifications should be made in the interest of prospectors and mine owners.

I am most fully in sympathy with the fundamental thoughts which have found expression in this legislation, but I have also in mind the specific problem of the prospector or locator of small means unable to employ engineering talent in connection with the original location of mining claims. This letter is written from a background of early professional experience as a United States deputy mineral surveyor and in connection with mine surveying, railroad location, and such work, involving location and tracing of land lines in the western United States and to some extent in Canada. It is also written from a background of sympathy with, and understanding of, the operations and limitations of the average prospector and small operator.

I think all can agree on the wisdom of dropping from our mining law the requirement of discovery during the first five-year period. The common practice in the past has been to locate mining claims in more or less regular blocks, making technical discoveries to fill the requirements of the law. It is much better to recognize in law the custom sanctioned by long practice, which accepts the most nominal mineral showing as satisfying the requirements. Locators and United States mineral surveyors should not be compelled to stultify themselves by making statements as to the existence of mineral, direction of vein, and similar matters which are only technically true and which may have no substantial basis in fact.

The limitation of the length of time for which a claim may be held without discovery and application for patent to a period of five years, with an extension for a further period of five years on payment of \$50 per acre annually, is based on sound theory; the terms should, however, be given thorough consideration in the light of all objections that may be raised, and perhaps it may be better either to extend the five-year period or to reduce the annual payments for the extension period, so as not to put too great a burden upon the man of small means who must of necessity work slowly. On the other hand, it must be recognized that the prospecting and development of mines in the United States in the future will be carried on in a different way, and on a more extensive and expensive scale, than in the past, and that the real importance to the mining industry of the individual prospector and small operator will not be as great from now on as during the earlier days of the development of mining districts. Nevertheless, full justice should be done to the man prospecting or operating on a small scale and with limited resources so far as is consistent with the best interests of the

mining industry as a whole, which is unquestionably the inspiration of the spirit of this measure.

To require that when mining claims are located upon surveyed lands they shall conform to the subdivisions of the public-land surveys is not of enough importance to insist on its inclusion in the bill, and, on the other hand, it would impose real hardships on locators. The system of public-land surveys represents a gradual development, and though much of the work of the early surveyors was creditable when considered in the light of the instruments available, the difficulty of operation in remote districts, and other handicaps, the technique and results of the old methods seem rather crude when compared with modern surveying practice. Even where the old corners were set with reasonable accuracy, they have often been destroyed by the action of the elements, by forest fires, or by lumbering operations and other human agencies. It is difficult enough for a United States deputy mineral surveyor to retrace land lines and connect mineral surveys with corners, and the prospector should not be put to the expense of hiring surveyors for this purpose.

Surveys made since June 30, 1910, and also resurveys since that date, are in first-class condition and marked with permanent monuments, normally consisting of iron pipes driven into the ground, filled with concrete and capped with brass. On land surveyed or resurveyed since June 30, 1910, it would be entirely practicable to locate in accordance with land lines, but surveys and resurveys since that date represent only a small proportion of the total surveyed areas in the western mining states. If this requirement is to be left in the law at all, it should not be made mandatory except in cases where land has been surveyed since June 30, 1910, and discretion given to the General Land Office to designate districts in which locations must conform, and others in which locations need not conform, to the lines of the public-land surveys.

In connection with patent proceedings, the bill provides that where claims are upon surveyed land and conform to legal subdivisions no further survey or plat shall be required. This provision may well open the way to much litigation. The law as to boundaries is that monuments govern as against courses and distances. It has also been thoroughly established that the original corners established by the Government surveyors must stand as the true corners which they are intended to represent, whether in the places shown by the field notes or not, and that, with certain exceptions, the quarter-quarter corners not established by the Government surveyors shall be placed on the straight lines joining the section and quarter-section corners and midway between them. Therefore, let it be assumed that title has been established through location to the southwest quarter of the southwest quarter of a given section, and that after many transfers and elapse of a considerable period of time the ground becomes part of the property of a large mining operation, and either through the discovery of a body of high-grade ore or through the location of permanent improvements the

exact determination of the boundary lines may become a matter of the first importance. By that time the west quarter corner, and perhaps even the southwest section corner, may have disappeared, and the same may hold true of the quarter corners and section corners on any of the other sides. As the boundaries of the fractional part must be determined by lines connecting points halfway between the original locations of the section corners and quarter corners, there may be ground for much litigation over the original positions of these corners, with consequent effect on the boundaries of the claim.

To prevent such possibilities, the land office should issue patent not to an aliquot part of a section by description but to a given area of ground suitably and permanently monumented, so that thereafter, under law, monuments may govern and the boundaries always may be subject to determination as straight lines joining existing monuments established by the authority of the United States Government at the time patent was issued. It would not be enough to make such survey and plot optional on the ground that the locator could assume the risk if he should so choose, for the reason that transfers of titles might ultimately affect the position of innocent parties having no option in the matter. In determining questions of ownership in which an exact establishment of boundaries may be of importance, no locator should be given an option to neglect necessary precautions in establishing such boundaries. As the law now reads, though clearing most of the ambiguities which have in the past been fruitful of much litigation, it has left here an opening through which much unnecessary litigation might conceivably result.

The requirement that where patents have been or shall be issued for claims upon unsurveyed lands, the Surveyor General, in extending the public survey, shall adjust the same to the boundaries of said patented claims so as in no case to interfere with or change the true location of such claims as they are officially established upon the ground, is right in spirit in that it recognizes the ownership of ground in accordance with existing monuments, but it is ambiguous in wording. Presumably the intent is that the land lines stop at the intersection with the boundaries of the patented ground and pick up again at the further boundaries. If this specific wording has not already received the approval of the General Land Office, it might be advisable to make sure that it is submitted to that office for consideration, to make sure that nothing in it modifies existing laws and regulations governing the surveys of public lands, for the practices and regulations of the General Land Office represent in every detail the results of long experience and gradual development, and for many years it has functioned smoothly and efficiently; therefore, the language of this bill, in so far as it affects the public-land surveys, should be subjected to the scrutiny and await the final approval of the General Land Office, so that it may as far as possible harmonize with existing practices and regulations.

I wish it understood that none of the above observations are to be taken as other than friendly criticisms of certain details of an otherwise admirable measure; also, that the foregoing comments as to the difficulty of retracing the lines of early land surveys are in no way intended as reflections upon the past work of the land office—only as a recognition of the difficulties under which such early surveys were carried on and a recognition of the fact that the possibilities of error were

greater than today, and that aside from any question of the possibility of really careless work, the lapse of time has destroyed much necessary evidence, and therefore in many sections locators cannot find the lines of the public-land survey without going to expense prohibitive to the average prospector. H. G. MOULTON.
New York.

Drilling Results and Dredging Returns

In your issues of Oct. 22 and 29, there appears an article, "Drilling Results and Dredging Returns," by Charles W. Gardner. After reading this article it seemed to me that, according to Mr. Gardner, it would not be wise to put much reliance in results that were arrived at by drilling. At least this is the impression the article gives, but I really don't think that Mr. Gardner intended it to be as strong as this, because in one of his recent reports on a placer mine that I happen to have before me he states: "By using this drilling factor in computing our results, we believe them conservative, and our experience is that its use is likely to give an estimate fairly close to the actual results to be obtained by dredging." This conclusion certainly does not agree with Mr. Gardner's long list of drilling discrepancies.

In his article, Mr. Gardner first tells us that he will consider the various conditions and causes affecting the accuracy of the results obtained, but he does not do so, and we are left where we were in the beginning. Drilling results were more or less inaccurate when drills were first used for this work, but I do not see why this should be so now, when the apparatus has been much improved and we have become more experienced.

It seems to me that the factor of 239 ft. as equaling a cubic yard, which Mr. Gardner states Mr. Martin used in drilling with the Empire drill, accounts for some of the differences. Whenever I work with Empire drills, I always use the factor 385, which is found by taking the inside diameter of the cutting shoe instead of the outside, from which the factor of 239 was evidently computed. The factor of 385 is the one in general use with all the Empire drill work that I know of, and the inside of the cutting shoe is used in determining this factor.

Mr. Gardner has certainly collected a lot of data on drilling, and it is a good subject to bring up for discussion; but so far he does not get us anywhere as to the real reasons for the discrepancies, and the whole matter is all the more confusing when one considers that from Mr. Gardner's data the same drill, the Keystone, was used in almost all instances.

I think that it is simply the personal element that is to blame for most drilling discrepancies in many instances cited by him, excepting in Mr. Martin's case, where it is clearly evident to me that he used the wrong factor in figuring his drill results.

New York.

E. F. WILSON.

In *Engineering and Mining Journal* of Oct. 22 appears the first installment of my article on "Drilling Results and Dredging Returns," and I notice in the eighth line of the first column of page 649 that you have used the word "inexperienced" when in the text the word "experienced" was used. The sentence should read: "The drill operations are frequently left entirely to a crew of *experienced* men, as the general conditions are well known and no close supervision is given to the work."

San Francisco, Cal.

CHARLES W. GARDNER.

The Tailing Air Lift of the Chino Copper Co.

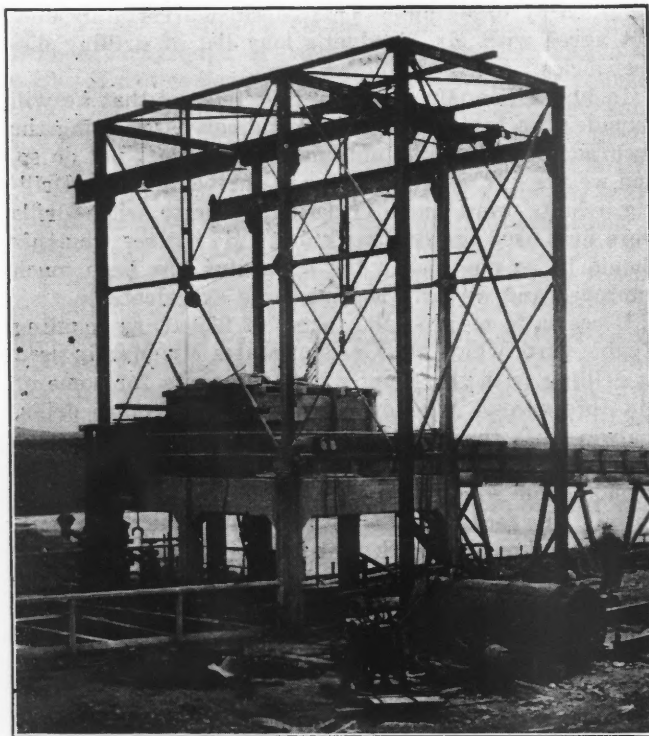
Recently Developed Plant Capable of Raising Over 12,000 Dry Tons Per Day a Distance of 40 Ft. Exceeds Expectations, Saving 50 Per Cent of the Operating Cost of Bucket Elevators

BY H. G. S. ANDERSON

Assistant General Manager, Chino Copper Co., Hurley, N. M.

Written for *Engineering and Mining Journal*

THE AIR LIFT has been receiving increased attention recently in the metallurgical and chemical industries, owing to its simplicity and reliability. It is somewhat of a paradox, however, that the very factors which are strongly in its favor are often the indirect cause of its being condemned. The most important of these factors is the presumption that it requires too great an amount of power compared with other types of pumps and elevators often used for the same service. This impression is commonly



SUPERSTRUCTURE
GENERAL VIEW OF THE AIR LIFT, SHOWING

traceable to the fact that the simplicity of the system has made it possible for many installations to be made without a sufficient knowledge of the important details necessary for efficient operation.

It is not my intention in this article to contend that the power consumption of the air-lift system is less than, or even equal to, that of other systems for the same service. The following description of results achieved should, however, be of great interest to millmen having similar problems, as the data are taken from a plant which is probably the largest of its kind in operation and which was designed to keep the power costs as low as possible, as well as for the purpose of obtaining continuity of service and freedom from excessive repair costs.

During 1918 a bucket-elevator plant was designed to

elevate the tailing discharge from the concentrator of the Chino Copper Co. at Hurley, N. M., a height of approximately 40 ft., to transport this tailing through launders to an area where additional tailing disposal space was available. Construction work was begun and a large pit was excavated to provide for a sufficient number of bucket elevators to elevate a maximum of 12,000 tons of tailing daily. Concurrently with this preliminary construction work, the theoretical and practical considerations involved in an air lift to elevate the same amount of tailing were discussed. The problem of tailing disposal was one destined to become increasingly important throughout the life of the mill, and it was decided to investigate carefully the economical possibilities which the air lift offered, before construction of the bucket-elevator plant had progressed too far. Cost data covering the operation and records of bucket elevators handling the same class of material were available from past operations. The air lift seemed to be a radical departure from current practice, but the final estimate of the probable cost of operation indicated that a sufficiently large saving would be made to justify the installation of the air-lift plant instead of the bucket elevators. The air-lift installation would also be of considerable experimental value for future use, as successful operation might indicate that it would pay to abandon elevators for future installations in the mill and perhaps replace some of those already in use.

The final cost of the air-lift plant, as it stands on the construction accounts, is the same as the estimated cost of the bucket-elevator plant, for the reason that the site already selected was used for the installation of the air-lift plant, and all of the initial construction costs, primarily chargeable to the partly finished bucket-elevator plant, were charged against the air-lift installation. If the advisability of using an air lift had been more apparent when construction work was begun upon the bucket-elevator plant, the tailing air-lift site would have been changed to a location more favorable to that type of installation, and the original estimate of 75 per cent of the cost of the bucket-elevator plant would have been more nearly approached.

Comparative estimates of the bucket-elevator and tailing air-lift plants to handle the 12,000 dry tons of tailing daily indicated that the first cost of the air-lift plant would be approximately 75 per cent of the first cost of the bucket-elevator plant, and that the cost of operation of the tailing air lift would amount to approximately 72 per cent of the cost of operating the bucket elevators. The advantage, from all points of view, indicated the desirability of installing air lifts instead of bucket elevators.

The air-lift plant was installed and placed in operation in July, 1919. During July and August of that year extensive tests were carried on to determine the most economical operating conditions, the efficiency

that could be obtained, and such other useful information as might develop. During the succeeding sixteen months, from September, 1919, to December, 1920, inclusive, accurate costs were kept on the operation of the air-lift plant and on a bucket-elevator plant operated under practically the same conditions of lift and capacity, in the mill itself.

Table I illustrates a comparative estimate that was made in 1918 on a basis of 12,000 dry tons' daily capacity, and Table II the actual comparative costs based on an average capacity of 5,000 dry tons daily for the sixteen-month period beginning September, 1919, and ending Dec. 31, 1920.

TABLE I. ESTIMATE MADE IN 1918 ON BASIS OF 12,000 DRY TONS' DAILY CAPACITY

Plant	Estimated Life Twenty Years Tons Elevated in Twenty Years	Estimated Operating Cost per Dry Ton per Year	Estimated Total Operating Cost
Elevators.....	87,600,000	\$0.011756 (a)	\$1,029,825
Air lift.....	87,600,000	.008483	719,612
Estimated saving.....		\$0.003273	\$15,511
			\$310,213

(a) Actual cost of elevating the same class of material by bucket elevators previous to 1918.

TABLE II. BASED ON ACTUAL AVERAGE TONNAGE OF 5,000 DRY TONS DAILY FOR SIXTEEN MONTHS

Plant	Tons Elevated in Sixteen Months	Actual Total Operating and Repair Cost, Sixteen Months	Actual Cost per Dry Ton Elevated	Equivalent Cost per Year at Full Capacity	Estimated Operating and Repair Cost, Twenty Years
No. 3 elevator (a).....	2,459,300	\$48,078.47	\$0.01954	\$85,585.20	\$1,711,704
Air lift.....	2,207,922	21,798.90	.009873	43,243.74	864,874
Actual saving			\$0.009667	\$42,341.46	\$846,830

(a) Actual cost of operation and repairs of elevators elevating the same material substantially the same distance in the mill of the Chino Copper Co.

The operating costs per dry ton for both the air lift and the elevators, shown in Table II, are higher than the estimates of Table I, owing to the increased cost of various factors entering therein, but the difference in costs realized by the air-lift plant—practically one-half of the costs of the elevator—proved to be even greater than that expected when the original estimate was made in 1918.

In designing the plant, the compressors were equipped with recording tachometers, recording air gages, meters on the electrical auxiliary equipment for the condensers, and all necessary instruments so that accurate daily records could be kept. All costs of labor required for operation and repair of the plant and compressors were carefully kept and included in the detailed costs shown. More detailed figures covering a summary of the conditions under which the air-lift plant operated during the sixteen-month period are given in Table III, Table IV, and Table V.

The actual dry tonnage handled was determined definitely by subtracting the tons of concentrate from the tons of ore milled. The revolutions of the air compressor were determined from the tachometer and speed-counter readings, and the cubic feet of air and isothermal horsepower, which vary in direct proportion with the speed, were ascertained by the use of proper factors. The number of gallons of pulp handled and the consequent water horsepower depended entirely upon the dilution of the pulp itself, which averaged about 15 per cent solids by weight. This factor of 15 per cent solids by weight was used throughout, and

TABLE III. SUMMARY OF RESULTS. AIR-LIFT OPERATION, 1919-1920

Period	Average Wet Tons	Average Dry Tons	Discharge Column	Average R.p.m.	Average per Minute															
					Wet Tons	Dry Tons	Cu.Ft. Piston Displacement	Actual Air, Cu.Ft.	Gallons Pulp	Cu.Ft. Actual Air per Gallon	I.Hp. in Steam Cylinders	Auxiliary Hp.	Total Hp.	Water Hp.	Efficiency to I.Hp. in Steam Cylinders	Efficiency to Total Hp.				
1919																				
September.....	31,505	4,726	A-B	75	21.9	3.28	1,311.7	1,082	4,766	0.227	131	13.1	144.1	53.0	40.5	36.7				
October.....	26,053	3,908	A-B	75	18.1	2.71	1,311.7	1,082	3,942	0.274	131	13.1	144.1	44.0	33.6	30.5				
November.....	36,445	5,473	A	86	25.3	3.80	1,504.1	1,240	5,514	0.225	150	15.0	165.0	61.3	40.8	37.2				
December.....	29,560	4,434	A	75	20.5	3.08	1,311.7	1,082	4,472	0.242	131	13.1	144.1	49.6	37.9	34.4				
1920																				
January.....	22,675	3,401	A	67	15.7	2.36	1,171.8	967	3,431	0.282	117	11.7	128.7	38.1	32.5	29.6				
February.....	26,827	4,024	A	76.5	18.6	2.79	1,338.0	1,102	4,059	0.272	133	13.3	146.3	45.0	33.8	30.7				
March.....	34,725	5,209	A	88	24.1	3.62	1,539.1	1,269	5,254	0.241	153	15.3	168.3	58.4	38.0	34.7				
April.....	34,895	5,234	C	97	24.2	3.64	1,696.5	1,400	5,280	0.265	170	17.0	187.0	58.6	34.5	31.3				
May.....	35,907	5,386	C	103	24.9	3.74	1,801.5	1,485	5,433	0.273	180	18.0	198.0	60.2	33.4	30.4				
June.....	32,982	4,947	C	93	22.9	3.43	1,626.6	1,341	4,990	0.269	162	16.2	178.2	55.4	34.2	31.1				
July.....	35,260	5,289	C	95	24.5	3.67	1,661.6	1,370	5,334	0.257	166	16.6	182.6	59.1	35.6	32.3				
August.....	34,107	5,116	C-A	100	23.7	3.55	1,749.0	1,442	5,160	0.279	175	17.5	192.5	57.3	32.8	29.8				
September.....	39,186	5,878	A	102	27.2	4.08	1,784.0	1,470	5,928	0.248	178	17.8	195.8	65.8	37.0	33.6				
October.....	34,750	5,213	A	88	24.1	3.62	1,539.1	1,269	5,276	0.240	154	15.4	169.4	58.6	38.0	34.6				
November.....	31,985	4,796	A-B	86	22.2	3.33	1,504.1	1,240	4,839	0.257	150	15.0	165.0	53.7	35.8	32.5				
December.....	18,700	2,805	B	66	13.0	1.94	1,154.3	952	2,830	0.336	115	11.5	126.5	31.4	27.3	24.8				
Total.....	14,719,480 (a)	2,207,922 (a)			85.7	22.0	3.30	1,498.9	1,242	4,793	0.2595	150.2	15.0	165.2	53.3	35.5	32.2			
Average.....	31,723	4,758																		

(a) Based on actual days air lift was in operation.

TABLE IV. OPERATING COST. TAILING AIR-LIFT PLANT

Period	Dry Tons Lifted	Power		Compressor Labor Operating	Plant Repair Labor	Supplies			Cost per Ton Lifted	
		Steam	Electricity			Compressor	Plant	Total		
1919										
September.....	127,123	\$589.94	\$120.97	\$181.00	\$5.16	\$23.78	\$7.92	\$928.77	\$0.007306	
October.....	81,286	528.44	109.99	119.80	1.53	.....	.....	759.76	.009347
November.....	125,887	696.71	104.76	131.27	.....	131.27	30.00	1,094.01	.008690
December.....	135,680	790.56	167.38	173.63	5.84	30.38	12.60	1,180.39	.008700	
1920										
January.....	105,440	698.43	94.94	171.89	13.63	24.74	.....	1,003.63	.00952
February.....	116,700	805.85	120.89	154.54	85.98	58.74	45.93	1,271.93	.01090	
March.....	158,870	993.97	122.78	184.37	50.00	76.06	53.09	1,480.27	.00932	
April.....	157,030	1,089.20	135.02	168.36	40.00	52.32	50.00	1,534.90	.00977	
May.....	166,970	1,230.91	134.41	169.46	45.00	34.30	39.65	1,653.73	.00990	
June.....	148,420	1,159.19	149.76	159.35	27.93	37.24	3.20	1,536.67	.01035	
July.....	163,960	1,229.63	155.48	181.64	22.84	47.86	8.36	1,645.81	.01004	
August.....	161,670	1,238.38	170.02	162.26	59.61	69.06	27.39	1,726.72	.01068	
September.....	176,340	1,090.22	145.19	167.27	.....	93.37	4.59	1,500.64	.00851
October.....	161,590	1,150.40	167.84	174.23	7.40	78.19	30.00	1,608.06	.00995	
November.....	142,976	1,072.86	158.58	174.65	66.20	65.59	40.00	1,577.88	.01104	
December.....	77,980	795.73	185.21	167.39	60.00	67.40	30.00	1,305.73	.01674	
Total sixteen months.....	2,207,922	\$15,160.42	\$2,243.22	\$2,641.11	\$491.12	\$890.30	\$382.73	\$21,808.90	.....
Average per dry ton lifted.....		\$0.00687	\$0.00102	\$0.00120	\$0.00022	\$0.00040	\$0.00017	\$0.009878	.....

variations above and below this amount, which occur at times, are the principal cause of the variation in efficiency, or quantity of air per gallon of pulp, shown in this table.

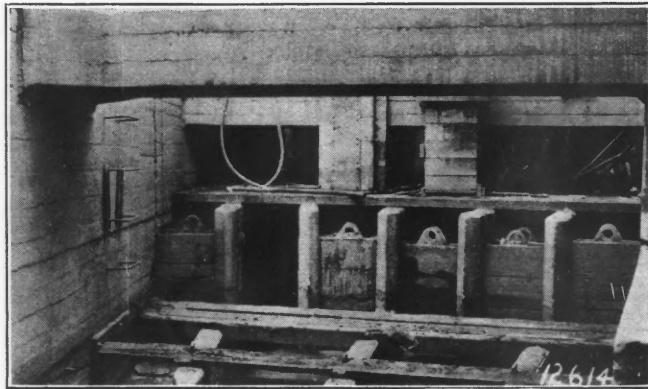
In the table of operating costs (Table IV), the charges for steam consumed and auxiliary electrical power were taken from the regular power-house records. The compressors operated condensing and were equipped with a barometric-type condenser plant of the proper size to serve them. They were also connected to the service condensers, serving the large generator engines in the power plant, and, in so far as possible, were

TABLE V. COMPILED FROM TABLE III

Year	(a) Duty, Foot Pounds Per 1,000 Lb. Steam, Compressor Only	(a) Duty, Foot Pounds Per 1,000 Lb. Steam, Including Auxiliaries
1919		
Sept.	54,900,000	49,900,000
Oct.	45,500,000	41,300,000
Nov.	55,300,000	50,450,000
Dec.	51,500,000	46,850,000
1920		
Jan.	44,250,000	40,200,000
Feb.	46,050,000	41,900,000
March	51,800,000	47,100,000
April	46,900,000	42,600,000
May	45,550,000	41,400,000
June	46,500,000	42,250,000
July	48,500,000	44,100,000
Aug.	44,500,000	40,450,000
Sept.	50,250,000	45,700,000
Oct.	51,500,000	46,850,000
Nov.	48,700,000	44,250,000
Dec.	37,100,000	33,750,000
Average	48,050,000	43,700,000

(a) Duty computed on basis of 14.6 lb. average water rate for compressor and approximately 10 per cent additional for condenser auxiliaries. Steam conditions 170 lb. gage pressure; no superheat; 4 in. Hg absolute back pressure.

served by these condensers, the auxiliary power being proportioned. The operating labor charge covers two hours of the time of one operator on each shift. This operating labor was practically constant, regardless of the tonnage of tailing lifted, and for that reason the cost per ton lifted tended to decrease as the mill tonnage was increased. The items of labor and repair and supplies include lubricating oil, grease, and like neces-



INLET GATES

saries for the air compressors, all repairs necessary for occasional cleaning of the submergence pits, and material and labor used in making slight alterations in piping found by experience to be advantageous for convenient operation.

Before making a careful study of these tables, the design and operation of the air-lift plant should be understood thoroughly, for that will assist greatly in an understanding of the characteristics of the air lift in general, as well as of this particular installation.

The tailing is carried from the mill through a tunnel about 300 ft. long and discharged into a large sump shown in elevation in Fig. 1. The discharge of this tunnel, shown at the left of the drawing, is provided

with a fall of about three feet to accommodate a sampler operated by compressed air. From this point the tailing flows through a launder to the submergence pit shown at the right of the elevation drawing. A shaft was first sunk to a depth of 103 ft. 4 in. This shaft was then lined with concrete, and six submergence pits, each 42 in. in diameter, were constructed within this space. This design was adopted because it was thought that the solid material might settle around the bottom of the air-lift discharge columns, causing them to choke, and that it would therefore be necessary to provide other individual pits so that any one of them could be

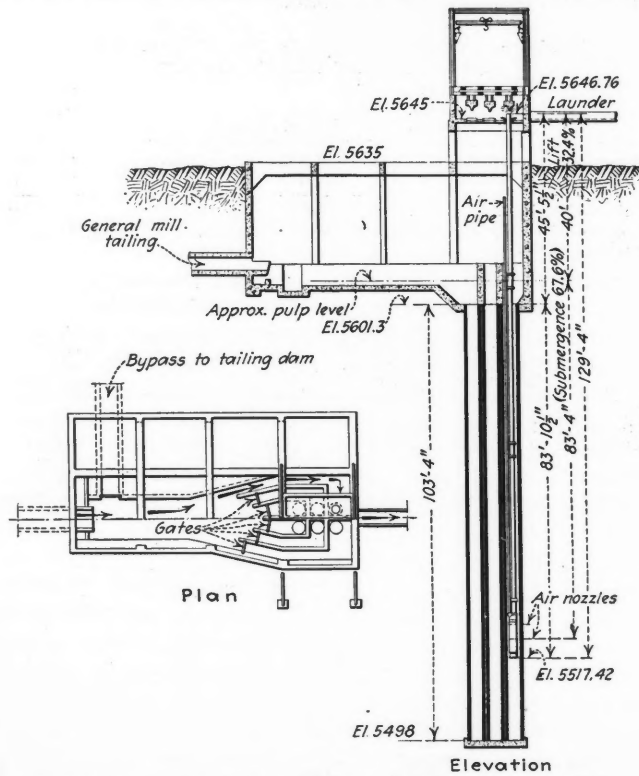


FIG. 1. GENERAL ARRANGEMENT OF TAILING AIR-LIFT PLANT

discontinued and cleaned independently of others that might be in operation. Individual launders and gates were provided for each pit, so that any one or any combination of pits could be operated independently of the others. This arrangement is shown in the plan on Fig. 1, the arrows indicating the flow of the material to the proper right-hand pit as the gates are set.

During the tests, and also in subsequent operations, it was demonstrated that the air lifts were practically free from the danger of choking. The pits cleared themselves after as much as thirty-two feet of sand had been allowed to settle above the bottom of the foot piece. It is evident from the experience gained in this installation, that individual submergence-pit construction is unnecessary and that a single submergence pit, large enough to accommodate all of the various sizes of pipe required for flexibility of service, would be much cheaper in first cost and just as satisfactory in operation.

All of the discharge columns empty into a common, concrete discharge box. Each discharge column is provided with a concrete, umbrella-type deflector, which is suspended from timbers fastened to the top of the concrete box by a yoke and wedge. A steel superstructure, as shown in the illustration, carries an overhead

crane, which serves the six pits, so that the pipe can be removed from any one of the pits without disturbing any of the others which may be in operation. The handling of the discharge columns by this superstructure has not been as satisfactory as it should be, and in another installation the design would be altered materially.

The air-lift discharge columns are made up of standard wrought-iron pipe, flange coupled. They have been in operation for sixteen months, but show no appreciable wear, either from abrasion or chemical corrosion. To take care of the varying tonnages, three sizes of discharge-column pipe are installed, as shown in Fig. 2. For each one of these discharge columns there is a corresponding set of efficiency curves, similar to Fig. 3, which shows column "A" only, which have been compiled from tests and which show the economical range of capacity. These curves are based on data taken during the tests made in July and August, 1919. The capacities at that time were accurately measured in a 63,000-gal. displacement tank which was provided for that purpose. The indicated horsepower was taken from both the air and steam cylinders of the compressors. Samples of the pulp handled were taken and the

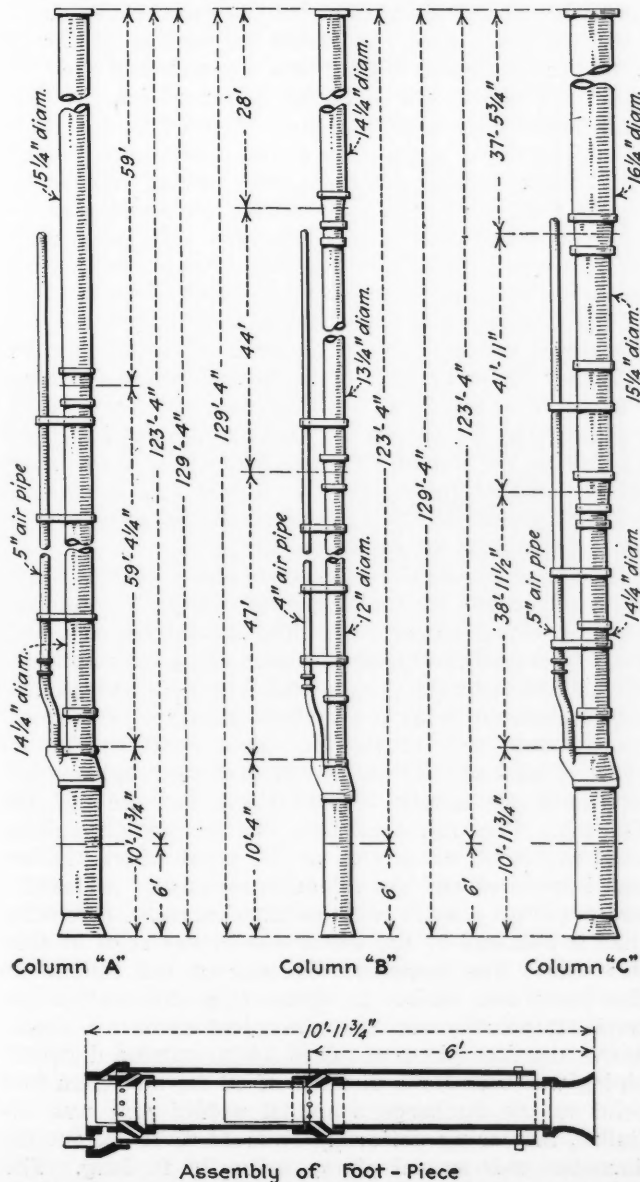


FIG. 2. ARRANGEMENT OF LIFT COLUMNS.

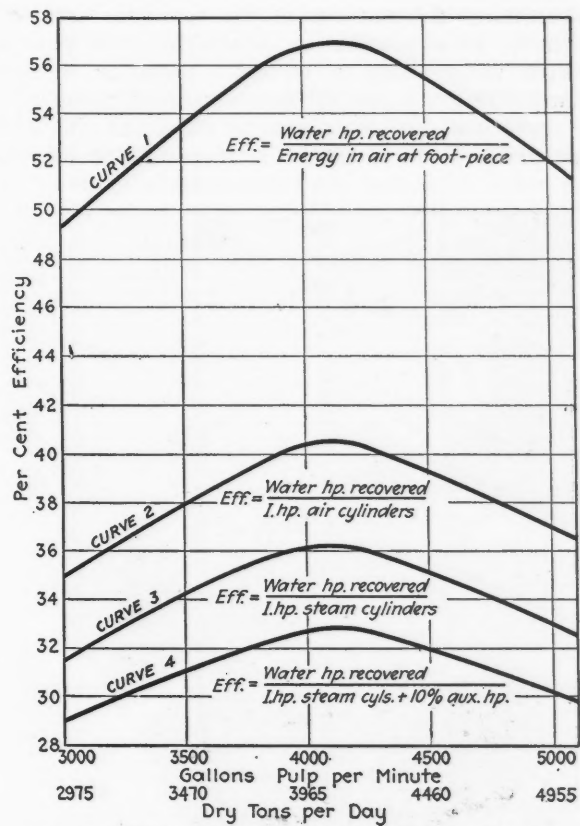


FIG. 3. EFFICIENCY CURVES FOR COLUMN "A"

specific gravity and percentage of solids by weight carefully determined. For publication, the curve was plotted on the basis of:

1. Water horsepower referred to isothermal horsepower in the air entering the foot piece.
2. Water horsepower referred to indicated horsepower in the air cylinders.
3. Water horsepower referred to indicated horsepower in the steam cylinder.
4. Water horsepower referred to indicated horsepower in the steam cylinders, plus 10 per cent for condenser auxiliaries serving the compressor.

This was done for the convenience of the reader, as there is some confusion of the term "air-lift efficiency." To the practical man, Curve No. 3 is of principal interest, including as it does the over-all efficiency of the compressor. This should be the accepted basis of comparison, but as a matter of fact, Curve No. 1 is more commonly used. From a theoretical standpoint, Curve No. 1 is of interest because it shows the efficiency of the air lift as a pump, and gives the percentage of energy actually recovered from that supplied, although, unlike other pump efficiencies, there is no way of segregating pipe friction from the static head to be overcome, and no credit is given the pump for this factor. It is also of interest that tests were run with clear water under the same pumping conditions, and it was found that about 10 per cent better results, or from two to four unit percentage better efficiency, could be obtained with the clear water than when handling pulp. In the series of eighty tests made to determine efficiencies, a submergence of 67.6 per cent was found to be the most desirable.

Examination of these curves shows that each discharge column has a peak efficiency at some fixed capacity, but the range in either direction at which acceptable efficiency is obtained is sufficient to provide

for ordinary fluctuations in the tonnages treated in the mill. It is possible to obtain the same peak efficiencies when using a constant diameter discharge column lifting a somewhat less tonnage of material, but the curve will drop more sharply on either side of the peak whenever the tonnage is increased or decreased than when a tapered discharge column is used. The



DISCHARGE DEFLECTORS

principal reason that there is a wider range of capacity without much loss in either direction away from the peak efficiency is due to this tapered discharge column. As shown in Fig. 2, the increases in diameter in the discharge columns have been made at convenient joints, but if the diameter of a discharge-column pipe had been uniformly increased from the foot piece to the point of discharge, the efficiency would have been further increased. One and sometimes two mill sections are frequently placed in operation, or vice versa, without changing discharge columns or without any readjustment of the air compressor, and the increased or decreased load is taken care of automatically by the air lift without particular attention. This increase or decrease in tonnage is likely to involve as much as 3,000 to 4,000 dry tons of tailing. When lifting the smaller tonnage of tailing, as illustrated by the discharge column "A" shown in Fig. 3, so large an increase or decrease as stated above is somewhat too great to keep the efficiency at the highest point, and should not be practiced on these smaller discharge columns. However, on the larger discharge columns the change in efficiency by such a large increase or decrease in the flow of tailing will not be so great and would be permissible without changing to a larger or smaller discharge column.

The curve shown in Fig. 3 was taken from Table III,

discharge column "A," and shows that the range of capacity, at an acceptable efficiency, is between 3,500 and 4,800 gal. of pulp per minute. Between these points, the highest efficiency to be obtained by this particular column is only 2 per cent lower than that of the maximum efficiency to be obtained by this discharge column as shown in Curve No. 4. The equivalent tonnage of tailing corresponding to the number of gallons of pulp per minute is from 3,470 to 4,600 dry tons per day. This air lift may be operated within lesser or greater limits, depending upon the range of efficiency desired. When a greater or lesser capacity than that shown to be most economical is desired, a larger or smaller discharge column should be used. It will be noted in Table III that during the sixteen months' period of operation, the discharge columns were changed only a few times.

The Kimball type of foot piece, illustrated at the bottom of Fig. 2, consists of an inner discharge tube surrounded by an annular air chamber and equipped with nozzles leading from the air chambers to the discharge columns. The open bottom in this type of foot piece seems to be the secret of the freedom of the air lifts from choking, as it permits all solid matter to drop out of the air chamber when the column is in operation, and when it is not in operation the sand settles on the outside. This same sand seals the bottom of the air chamber and keeps the air passage open and ready to start the air lift when the air is turned into it. The only appreciable wear that has occurred in the entire plant has been in the foot pieces, two of which have worn badly around the air nozzles, owing, apparently, to the high velocity of the entering air and the resultant sand-blast effect. It is thought that this can be overcome to a large extent by the proper selection and design of material of which these nozzles are made.

The Ingersoll-Rand Co. designed a foot piece and discharge column for the purpose of increasing the efficiency of the air lift. This foot piece and discharge column was installed, but has not yet been tested exhaustively, for the reason that the present industrial depression has caused a gradual decrease in the tonnage milled, so that the tonnage of tailing was by far too small to permit the foot piece and discharge column to be tested out at its rated capacity.

The Ingersoll-Rand foot piece is shown in Fig. 4 and is of somewhat the same general design as the foot pieces previously described. The special features consist of a long, bell-shaped inlet permitting easy entrance of the liquid at the bottom of the foot piece and gradual acceleration up to the point where the air is introduced. In the main body of the foot piece, a slight Venturi effect is used and the air is introduced through numerous small air nozzles located above the neck of the Venturi. The object of this was to prevent sudden acceleration of the column at the point where the air was introduced and the volume consequently increased; and to permit a much more gradual increase in velocity than is obtained by the use of one or two rows of nozzles only. The increased diameter of the column at this point also assists in eliminating this sudden increase in velocity and the consequent hydraulic shock. Above the foot piece, standard 14-in. outside diameter piping was used for a distance of 43 ft., and from this point to the discharge a special welded pipe was installed, increasing uniformly from 14 to 16 in. outside diameter, this special piping being 76 ft. long. The object of the design of this entire column was to elimi-

nate to the greatest possible degree any sudden changes and consequent hydraulic shock due to the admission of air at any one point in the column and to the sudden change in diameter obtained with ordinary increasers.

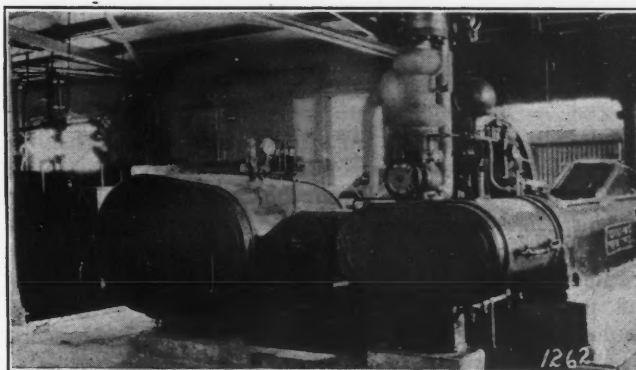
As stated above, up to the present time it has not been possible to make accurate tests to determine the increase of efficiency that this design would effect, but it is expected that the power consumption will be cut down from 5 to 10 per cent and the efficiency increased from 2 to 4 unit per cent.

The plant supplying compressed air to this air-lift installation is in the main installation house, is 530 ft. from the air lift, and consists of two Ingersoll-Rand, Imperial Type XPV-4 steam-driven air compressors having compound steam cylinders 13 and 29 in. in diameter and duplex single-stage air cylinders 22 in. in diameter by 20 in. stroke. Either of these air compressors is capable of operating the air lift to very nearly maximum capacity. In selecting these machines, careful consideration was given to economy; this type being chosen because of the low water rate which it showed and the practically flat economy curve down to half speed or somewhat less at which the compressor might be operated a large part of the time. One of the most interesting and valuable features of the entire plant is the method by which these machines automatically maintain the most economical speed to take care of the variations in the tailing tonnage from the mill.

These compressors are usually fitted with oil-pressure

tonnage and until the air pressure and the pulp level again become normal. This feature practically eliminates constant attendance. The mill shift foreman makes an inspection trip every two hours, and the power-plant engineers make occasional inspections of the air compressor. This attendance is all that is necessary for the entire installation.

The automatic governor control eliminates the neces-



AIR COMPRESSORS

sity for any elaborate float system or throttle system in the air lines, which are wide open from the air compressor to the air lift at all times. The entire controlling device is in the power house at the compressors, and the power-house operator can tell at all times very closely the conditions under which the air lift is operating, merely by looking at the pressure gage and tachometers attached to the air compressors.

The operation of this air lift and the economy which it has demonstrated over that of the bucket elevators has considerably exceeded expectations, and it is evident that this device, when properly installed, is one of the cheapest methods of lifting pulp or other solutions, judged from an operating standpoint. The first cost, compared with other methods, will have to be determined for each installation. Difficulties in operation which it was expected might develop have been conspicuous by their absence, and it has not been found necessary to change materially any of the important details of the installation.

In conclusion I should record the fact that during the sixteen months of actual operation it has been demonstrated that the operating cost by the air-lift plant is only 50 per cent of that of the bucket elevators lifting the same material in the mill. This plant has the additional advantage of occupying less floor space and of possessing a greater range of capacity, and therefore greater flexibility, and greater continuity of service. It most thoroughly deserves, to say the least, more consideration in future designing of mill plants than it has been given heretofore.

Acknowledgment is hereby made to E. J. Franklin, consulting mechanical engineer for the Chino Copper Co., who supervised the general design of the air lift and who directed personally a very comprehensive series of eighty tests to determine efficiencies; to H. T. Abrams and H. A. Campbell, of the Ingersoll-Rand Co., whose helpful suggestions have contributed largely to the success of this installation; to Henry Merry, formerly chief draftsman for the Chino Copper Co., who collected and compiled the data for this article; and to those many other employees of the Chino Copper Co. whose keen interest and aid have so largely influenced the successful operation of the air lift.

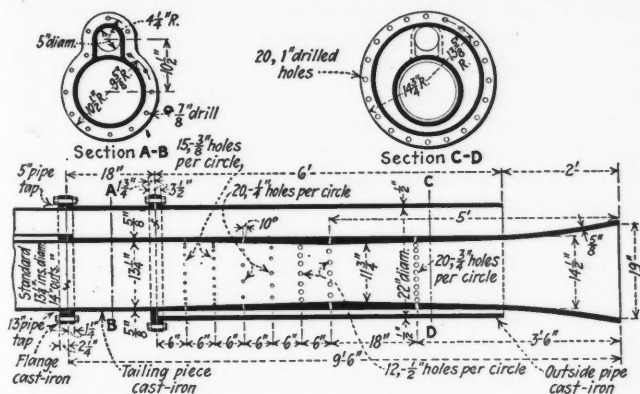


FIG. 4. THE INGERSOLL-RAND FOOT PIECE

governors acting on the high-pressure steam cut-off, and controlled both by the speed of the machines and the air pressure. In ordinary service, as the air pressure decreases, the governor acts to increase the speed of the machines, and vice versa. In this case exactly the reverse action was required, and the governor was altered so that an increase in pressure would increase the speed of the machine, and a decrease in pressure would cause the machine to slow down. By this action, the pulp level, shown in Fig. 1, is maintained constant within one or two feet, regardless of the fluctuations of the tailing tonnage from the mill. As the air pressure depends entirely on the hydrostatic pressure, and varies as the pulp level rises or falls in the submergence pit, the method of control operation may be readily understood. As an example, if an additional mill section were placed in operation, the tailing would come to the submergence pit much faster than the air lift had been handling the tailing, and the pulp level would gradually rise. The resultant increase of pressure acts immediately on the air compressor, increasing its speed until a sufficient volume of air is supplied to lift the increased

The Discrepancy Between Drilling and Dredging Results

The Nature of the Clay, Gravel, and Gold, the Operating Methods Employed, Crew Efficiency in Dredging and Other Factors Exert Important Influences — Prospecting Not Entirely To Blame — Dredge Recovery Should Be Studied

BY R. G. SMITH*

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AFTER considering Mr. Gardner's paper,¹ with its numerous instances of wide variation between prospecting and dredging results, it is little wonder that the question "Why?" is so often propounded in connection with dredging operations. As an argument against the theory advanced by Mr. Hutton and also against the prevailing belief that the drilling results are in error whenever the recovery and prospecting disagree, I wish to bring out a few points to substantiate the statement that the drilling should not be held responsible for the whole burden of failure in all cases.

There are only two possible causes for the variation which the practical operator is endeavoring to overcome: first, incorrect drilling results; second, incorrect recovery factor; or a combination of the two. The two interlock in a way, for as far as the valuation of a property is concerned, it is immaterial what drill factor is used, provided the proper recovery factor is chosen to go with it. However, the prospected value of a piece of ground *should* represent the actual gold content, and the recovery factor the percentage of that value recovered in dredging. General practice does not adhere to this principle. The operator is usually inclined to use a drill factor varying from .27 to .33 on a 7½ in. drive shoe and a recovery factor of 80 to 100 per cent. Instances of over 100 per cent recovery are frequent, and the drilling results are credited with the joy they caused in the same manner that they are blamed for the gloom that is spread when the recovery is only 50 per cent.

In defense of drilling, it becomes necessary to take up first the second stated cause of discrepancy, "incorrect recovery factor." Under conditions existing at present two cases are to be considered—recoveries under 100 per cent and recoveries over 100 per cent. In outlining the conditions that cause a loss of precious metal or a lowering of the recovered value per cubic yard, no special attempt will be made to prove or verify the statements, for the facts are well known to all familiar with dredging operations.

NATURE OF FORMATION

First: Presence of Clay.—As a general rule gold is not found in the clay, but a concentration often occurs above the clay bed. The two are mixed and carried into and through the screen. Samples of the larger clay balls taken from the stacker generally show little or no gold, but these larger balls of clay, being lighter and larger, do not roll in the screen with the material with which the gold associates. It is the smaller particles, sliding along with the fines in the screen, that may be expected

to carry particles of gold, and a sampling of the fines that pass through the screen onto the stacker is a difficult operation. Under such conditions, it is unlikely that 100 per cent of the gold will get into the distributor. That clay is a gold robber on the tables is a conceded fact, and the small balls of clay, with the particles of gold which they pick up, will be carried beyond any riffles on a dredge. With a clay and gravel formation, the efficiency of the save-all is lowered, for the spill from the buckets is not broken up, and large amounts of unwashed material will find a resting place in the bottom of the pond.

Second: Presence of Clay and Soil Overburden.—This is a condition that causes muddy water, and muddy water as an element of gold saving is far from being 100 per cent efficient. The effects of muddy water are probably more conspicuous in this field than elsewhere, and it is not difficult to realize what such a condition implies. On one occasion where the overburden consisted of about 50 per cent of the total depth, it became necessary to shut the dredge down until the pond could be cleared up. The thickness of the water can be realized from the fact that it would not flow in a wooden flume set on a grade of one-half foot in 100. The pump suction, four feet below the water surface, picked up material ½ to ⅝ in. in diameter. The recovery may be expected to vary directly with the condition of the water.

Third: Cemented Gravel.—Seldom does the condition arise where a dredge is able to dig cemented gravel which will not be disintegrated in the screen. It is possible, however, and may contribute to the loss.

Fourth: A Hard Bedrock.—Where this condition occurs, there is generally a concentration on bedrock, and unless some of this bedrock can be dredged it is impossible to clean it thoroughly. The gold in crevices will not be recovered, nor will it be possible to clean out all potholes. Where abrupt depressions in the bedrock run parallel with the face, it will often be impossible to follow them.

NATURE OF THE GOLD

First: Fine and Flakey Gold.—It is hardly necessary to mention this occurrence. All practical operators are familiar with the difficulties in saving this class of gold. Fine gold is carried in suspension in muddy water and is even known to be lighter than the mud, the latter settling first and leaving the gold concentrated on or near the surface.

Second: Rusty or Coated Gold.—Where the method of gold saving relies to a greater or less extent on amalgamation, the presence of rusty or coated gold signifies a lowering of the percentage of recovery.

The conditions encountered in the operation of dredges are undoubtedly responsible for the greatest

*Address delivered before the California Dredge Operators' Association, Sept. 27, 1921, Natoma, Cal.

¹"Drilling Results and Dredging Returns," by Charles W. Gardner, published in *Engineering and Mining Journal*, Oct. 22 and 29, 1921.

losses or lowering of the unit of value. Among them are:

First: Gravel Left Between Cuts.—The gravel that is left on the bottom between the various cuts of the dredge is often responsible for a wide variation between prospecting expectations and recovery. This is a hidden condition, and one therefore often neglected. The slope of the sides of a dredge cut in tight clay and gravel is about $\frac{1}{2}$ to 1. The angle of repose of loose tailings is less than 45 deg., which is a 1 to 1 slope. In 54 ft. depth of ground, therefore, the width of the cut has been decreased $13\frac{1}{2}$ ft. on each side, a total of 27 ft. over possibly a face of 360 ft. or 7.5 per cent of the bedrock area. The greater the angle between the dredge and the side of the cut when the bucket line is in the corner, the greater will the slope of the side become. Wide swings, where the spud sets farther away from the side of the cut, cause this condition and materially increase the triangular block of undredged ground.

Second: Gold Saving.—The conditions imposed on the art of saving gold make the results obtained seem remarkable. In recovery of gold by dredge, no quartz-mill practice is possible. The product is fed to the tables in a most uneven manner. It is generally either a "feast" or a "famine" of material. The grade of the tables is constantly changing. The quicksilver is soon coated with the various substances passing over it, so that it is unfit for the duties which, in efficient operation, it must perform. And even after the precious metal has been retained, it is again subjected to the raking, scratching and hosing down of the clean-up crew, which is seldom 100 per cent efficient.

Third: Depth of Digging.—Unless the method of measuring the digging depth is determined with care and accuracy, the resulting value per cubic yard is bound to be uncertain and unsatisfactory. The dredge crew will generally see to it that the yardage figures are up to expectations. Moreover, the method of calculating the average depth is often in error. It is quite common practice to record the depths on each shift, regardless of the number of times the dredge was stepped ahead, and the average depth calculated as the means of the three shifts. With two cuts varying in depth, this method will always result in giving a greater average depth than is actually the fact. It works only one way. Where the bedrock is soft and the digging easy, the tendency is to dig deeper than is necessary by swinging into the higher bedrock and uncalled-for distance. In shallow ground an extra foot or so may be dredged to allow for flotation. All such actions tend to reduce the recovered value per cubic yard.

Fourth: Water Supply.—From the time pumps are installed until they are replaced, their efficiency is constantly diminishing. This is more noticeable where the pond water is muddy. The result of such a condition is twofold. First, the gravel in the screen is not getting the washing it would with pumps in good condition. Second, the diminished supply of water on the tables indicates that gold-saving conditions are hampered. A given class of material will give the best recovery while flowing over riffles with a certain grade and a certain amount of water. Vary either the grade or the amount of water, and the recovery is bound to be adversely affected. Both of these conditions are present on a dredge.

Fifth: Crew Efficiency.—This is an item that may mean much in the amount of gold saved or lost. A dredge crew seldom consists of men familiar with gold

saving. Their main purpose and object is to keep the dredge running and to deliver the maximum amount of gravel. It matters little to them whether the tables are piled high with sand and no water is present or whether the pumps are kept going and scouring the riffles when the bucket line is idle. Oil and grease present no terror to them. An instance of this came up a few days ago. A bucket of grease and waste collected from drip pans was taken off the dredge and emptied on the ground ahead of the dredge. When discovered the bucket line was about to carry enough grease into the screen to give it a thorough covering from end to end. The oil and grease that is left on the ground to be dredged all goes into the screen and onto the tables. It would be far better to throw it into the pond. Are the winchmen pulling into the corners; are they cleaning the bedrock correctly, or are they doing things in the easiest manner? These are items that cannot have personal supervision all the time, and hence the efficiency of the crew influences to a marked degree the recovery per cubic yard.

PRACTICAL EXAMPLES

Examples of measured losses are not as common as examples of estimated recovery factors, but the following denotes what may be expected if the subject is given careful consideration. In making the computation the assumptions have been that one cubic yard of loose gravel is equivalent to 0.75 cubic yard in place, and that the ratio of screened to unscreened material is 1 to 1. These assumptions are approximately correct.

On an Oroville dredge, two samples taken from the entire discharge from top to bottom gave average value of sands of 10.2c., equal to 5.1c. loose or 6.8c. per cubic yard in place.

On another Oroville dredge, two samples from the entire discharge of one side gave average value of sands of 3.9c., equal to 1.95c. loose, or 2.6c. in place. The dredge recovered about 15.0c. per cubic yard, or 85 per cent of the total.

The sand pile of one of the dredges which had sunk in the Natoma field was systematically sampled. The sand averaged 5.8c., equal to 2.9c. loose, or 3.9c. in place. The dredge was recovering 8.5c. per cubic yard, or 69 per cent of the total.

Several samples from the entire discharge of one side of a Natoma dredge, while digging in gravel only, gave average value of 3.7c., equal to 1.85c. loose, or 2.5c. in place. The dredge was recovering 7.8c., or about 15.0c. from the gravel only, or 85 per cent of the total.

Extensive samples of the entire discharge of another Natoma dredge gave an average value of 11.7c., equal to 5.85c. loose, or 7.8c. in place. The dredge was recovering 19.0c. per cubic yard, or 70 per cent of the total.

In redredging tailings of the Oroville field where no virgin ground was encountered, the recovery was 2 to 3c. per cubic yard of tailings, or 2.5 to 4.0c. in place. The original recovery estimated at 12.0c. per cubic yard represents 75 to 82 per cent of the total. In this instance the same methods of operation and gold saving were employed as in the first working.

Charles Janin, in his Bureau of Mines Bulletin 127, "Gold Dredging in the United States," says, "The loss of gold in tailings is less than the loss in front of the boat both from bucket spill not caught in the hopper and save-all and from failure to properly clean bed-

rock." If this statement were made from known facts, there is reason for assuming a considerable loss in front of the boat.

THEORETICAL RECOVERY SELDOM ATTAINED

The only deductions or conclusions that can be made from all these facts are that the actual percentage of recovery is far less than supposed. In cases where the recovery is estimated at 75 to 100 per cent, the actual recovery is possibly nearer 50 to 75 per cent. In other words, the value of the drill holes is low. The fact is borne out by numerous instances of recoveries exceeding 100 per cent. It is just as logical to assume that the drill results are low in such cases as that the drill results are not reliable. A fluctuating recovery factor, depending on conditions as enumerated, should not be made a constant and the drill factor a variable.

In substantiation of the deductions set forth, note the following results obtained by sinking shafts over drill holes and rocking the gravel from the entire shaft very carefully. These drill holes were put down by various drillers in a firm gravel, containing some clay. No water was present, and the shafts stood without timbering. Drill values were figured with the factor 0.30.

—Depth in Feet—		—Value in Cents—		Per Cent of Drill Value
Drill	Shaft	per Cubic Yard Drill	per Cubic Yard Shaft	
56	55½	4.8	4.6	96
57	56	3.6	4.0	111
52	52	4.7	7.5	160
50	49	5.4	10.3	191
48½	48	5.2	7.4	142
Average (5)		4.75	6.76	142

—Depth in Feet—		—Value in Cents—		Per Cent of Drill Value
Drill	Shaft	per Cubic Yard Drill	per Cubic Yard Shaft	
49½	48½	12.3	16.6	135
49½	48½	14.6	16.6	114
54	54	11.6	21.2	182
Average (3)		12.83	18.13	141

In similar but shallower ground, two miles distant, the following results were obtained:

—Depth in Feet—		—Value in Cents—		Per Cent of Drill Value
Drill	Shaft	per Cubic Yard Drill	per Cubic Yard Shaft	
29½	30	6.8	8.0	118
34	34	5.7	6.7	118
27½	27½	6.1	8.0	131
35	35	7.4	10.5	142
Average (4)		6.52	8.34	128

—Depth in Feet—		—Value in Cents—		Per Cent of Drill Value
Drill	Shaft	per Cubic Yard Drill	per Cubic Yard Shaft	
35	35	10.3	15.7	152
38½	38½	20.5	27.8	136
32	32	20.6	25.0	121
Average (3)		17.13	22.94	134
Total average (15)		8.63	12.03	139

The significant fact to me is not the variation from 96 per cent to 191 per cent, as pointed out in Mr. Gardner's paper, but the fact that groups of three to five checks varied less than 10 per cent from the general average of percentages. Note the following results obtained by the dredge previously cited as shut down on account of the muddy condition of the pond. The dredged area, consisting of some 224 acres, was drilled systematically. The north and south halves were dissimilar only in the amount of overburden:

Acres	Dredge Conditions	Recovery per Cubic Yard	Per Cent Recovery Over Drilling
113	Much soil, muddy water	6.0c.	89
111	Water conditions good	6.8c.	106

The 111-acre area also contains several high holes. Does the 17 per cent difference in the recovery factor mean that the drilling was necessarily in error?

It is not the intention to create an impression that the results of one drill hole or even several drill holes will give reliable information of the value of the ground any distance away. In fact, even shafts around drill holes show a wide variation in value comparisons. The following variation in different depths was the rule rather than the exception in the tests noted in preceding paragraphs:

Depth	—Value per Cubic Yard—		Per Cent of Drill Value
	Drill	Shaft	
0-19	2.6c.	6.4c.	245
19-28	15.6	9.8	63
28-34	0.9	3.4	380
0-34	5.7	6.7	118

Such results are due mainly to the uneven distribution of gold through the gravel, and no method of computation can be expected to eliminate this condition. The actual or nearly actual gold content of any firm gravel deposit, however, can be determined primarily by drilling, for the law of averages will compensate for the discrepancies in individual drill holes. The plan of drilling to a constant average, as suggested by Mr. Hutton, is highly indorsed, for the accuracy of results relies almost entirely on averages.

INCORRECT DRILL RESULTS

The nature of some deposits practically precludes the possibility of driving casing and consistently removing anywhere near the correct amount of core and gold content. Such are loose sand and gravel deposits of present river channels and old tailings, and especially those containing water. The operations are subject to many obstacles.

The results of several shafts put down over drill holes in loose tailings were generally much higher than the drill values, but no consistent method of figuring by using core or measured volumes could be deduced. This was to be expected, for no one hole could be indicative of the value of the surrounding gravel.

Another instance occurred in dredging loose river bar gravel. The drilling was done as carefully as possible, measured volumes were considered in determining the value of the holes, and subsequent dredging gave 50 per cent recovery. Dredging conditions were practically ideal.

Some deposits have a very uneven distribution of the gold. Drilling can easily be in error if the constant average has not been reached. The presence of heavy gold subjects drill values to much the same error as does spotted ground.

In view of the above-mentioned conditions and factors inseparable from the prospecting and dredging of auriferous gravels, it appears to be useless to endeavor to derive a factor or method of computing drill values that will compensate for the variable recovery factor. As previously stated, the present factor used in computing drill values serves its purpose sufficiently well, provided the proper recovery factor is used in conjunction with it. It therefore appears that a study of dredge recovery might yield far greater results for future valuation of dredging ground than would a study of drilling. The drilling factor varies with the different formations encountered, but it can be approximately determined by the engineer for any block of ground under consideration. The factor which he cannot as-

sume, with any great degree of accuracy, is the recovery factor.

The study of this subject will undoubtedly yield no definite figures, for a determination of actual loss is impossible when the contents are unknown, but it may tend to decrease the unexpected discrepancies so often encountered in the gold-dredging industry.

The Re-treatment of Rand Tailings

A plant for the re-treatment of Rand tailings with a view to the extraction of the remaining gold and other minerals has been erected at the dump of the old May Consolidated Mine, according to the *South African Journal of Industries*. The plant has passed from the experimental stage, and has now only to be proved on a commercial scale.

The cleaning of the sands and classification of the concentrates form the basis of the system. The sand from the dump is tipped into two hoppers which feed two Ondra patent concentrators. These concentrators consist of inclined planes, divided by projecting ribs into five compartments. The sand on entering the concentrator is projected up the inclined plane by water issuing from nozzles situated at the base of the concentrator. The object of the concentrator is to classify the projected particles according to their weights. Thus, the heavier particles are caught on the lower ribs and the lighter particles are projected further up the inclined plane. Above every rib the collected material is drained off through a slot in the floor of the concentrator and flows over a sieve which is rocked sharply. The sieves vary in mesh from about 1,200 per inch in the uppermost one to about 800 in the lowest one, and serve to classify particles of a similar weight according to their diameters or specific gravities.

The overflow from the sieves is practically pure silica. The underflow contains a certain amount of silica, the metals, and heavier valuable minerals. According to the inventor, the underflow from the three divisions is much richer than that of the top two divisions. The overflow is collected in a sump and pumped to four dewatering cones. The clear water from the cones is collected and used again. The underflow from the Ondra concentrator is gravitated into two cones: one for the lower three divisions, and another for the upper two divisions—upward currents of water in these cones serve to effect a further concentration. The overflow goes to the dewatering cones, and the underflow is pumped onto Wilfley tables. Four of these are installed: one to serve the underflow for the cone serving the top two divisions of an Ondra concentrator, and three for the cone serving the bottom three divisions.

The concentrates obtained from the underflow of the cones are then divided by the Wilfley tables into high-grade concentrate, middlings, and tailings. The tailings are pumped to the dewatering cones.

The middlings are stored in the meantime, and will be treated again later on with the aid of tube mills.

The high-grade concentrate is, according to the inventor, to be further classified. This unit of the plant is not yet installed and made public. In any case the final concentrate from here will contain most of the gold, which will be extracted by amalgamation in trommels. Two of these are at present installed.

Occurrence of Platinum in South Africa

Found in Diabase Alloyed With Platinoids and Possibly Iron—Chromite Absent as Well as Minerals Usually Associated

By E. M. WESTON

Written for *Engineering and Mining Journal*

RECENTLY had the opportunity of inspecting properties in the northeastern portion of Cape Colony known as the Transkei, and situated south of Natal and between Basutoland and the sea. The area examined lies about eighty miles north of Queenstown and around the villages of Cala and Ingobo. The country rock consists of a series of mudstones, sandstones, and shales, including the cave sandstones and other rocks of the Stormberg series, a part of the Karoo series.

Exposed beds show seams of anthracite coal with only about 3 per cent ash and lying apparently about 800 ft. lower than the impure coal seams worked for some time near Indive. Ironstone beds also occur. These beds are traversed by numerous younger dikes of apparently the ordinary diabase and gabbro so common in South Africa. These dikes were apparently connected with overlying sheets now largely removed by denudation.

The area lies at an elevation of from 2,500 to 4,500 ft. and forms one of the flanks of the southern continuation of the Brakensberg Mountains, which rise to about 8,000 ft. It is bisected by many valleys and gorges, resulting in numerous tabular plateaus and hills and giving every facility for mining by adits and open workings. Water is plentiful, as is also native and imported timber, and the reserve furnishes abundant native labor.

About 180 miles north of this lie the Insiza norites and other intrusive rocks, the occurrence of which strikingly resemble that at Sudbury, Canada. In these rocks attempts have been made to work magmatic segregations of sulphide ores bearing copper and nickel, with gold, silver, and platinum; but so far the deposits exploited have proved too patchy to be payable.

Recent discoveries of platinum, however, present novel features. This metal occurs in certain of the diabase dikes near Cala in the native state alloyed with iridium and other platinoids, and also apparently alloyed with a large proportion of native iron. Except for the fact that in a few samples panned a heavy amber-colored mineral, probably zircon or topaz, was observed, no notable accessory minerals were found. There is very little pyrite present and no trace of chromite or other minerals usually associated with platinum. No microscopic examinations of the rocks have yet been made. These may disclose clues to an unusual occurrence.

With regard to the economic importance of the discovery, assays and pannings have been taken over very great widths in various places many miles apart, which have shown average values of several pennyweights per ton. Part of the dikes are soft and decomposed, and the deposits can be worked cheaply. The platinum can easily be recovered by concentrating the sands and passing the slimes over blankets or treating by oil flotation.

It is certainly a novel sensation to crush up road metal, which on panning shows a tail of crystalline platinoids. Most of the platinum is very fine, but nuggets up to three grams in weight occur. Too little work has been done as yet to permit any definite estimates of tonnage and values.

Old Tyopa

An Account of the Accidental Discovery of an Ancient Gold-Mining Camp in Northern Chihuahua—The True Tyopa, Famous for Its Bells, Situated in Sonora

BY DONALD F. MCCARTHY

Written for *Engineering and Mining Journal*

THE STORY OF OLD TYOPA, with its wealth of hidden gold stored away in the workings of an old mine, will bear further repetition, as well as the tale of the famous Tyopa bells, which are said to have been cast from an ore that contained the elements essential to their making, and of which I had heard much, years ago in southern Sonora. That there were many rich mines in that section of the Sierra Madre in the early days, there is little doubt, but the difficulties of successful development were too great to be overcome by the men who were in the country and knew of them at the time, and no success could have attended any mining venture there, owing to the hostile Apaches, who then overran the country.

Nor are the conditions any less formidable today than they were then, and though the Apache menace has long since disappeared, one equally as bad, if not worse, took its place, in that it then became a safe retreat for Mexican outlaws; and such it still remains.

It was about the time the Bisbee mines were found, and when the excitement of their discovery was at its height, that a man named John Carey found the ruins of an old mining camp near the main divide of the Sierra Madre, and a few miles from the Casa Blanca, an old landmark dating back to early Spanish occupation, and from which the ruins of Old Tyopa are but a few miles distant.

Carey had heard the old story of a fabulously rich gold mine in that section of country, that had been worked by the early Spaniards, who were afterward overcome by the Indians, their camp being destroyed and all of them killed, and that the gold so mined was stored away in the underground workings, and was still there if it could be found. He had gone in there alone with a saddle and pack outfit by way of the Janos trail, from Silver City, N. M., to the old town of Janos, in Chihuahua, and there took the Casa Blanca trail, which intersects the Janos trail at that point and bears west across the divide into Sonora.

The third day out from Janos, Carey reached the Casa Blanca, and beyond there a few miles, in the direction the trail was going, he sighted the ruins of Old Tyopa and camped there that night. But the loneliness and desolation of everything, as he beheld it the next morning, and the dread of being discovered by the Indians, the possibility of which dawned on him only then, caused him to become so uneasy and fearful for his safety that he stayed only the first day, left there after dark, and traveled all that night on his way back to Janos.

That the old mine he sought was in the heart of an Apache stronghold everybody knew, and just how he got in there and back as he did, was something on which he never cared to speculate. He said he never realized the desperate chances he had taken until he reached the old ruins, and how hopeless his plans had then become.

Carey described the place as being on the side of a

basin on the main divide, and said that the bed of the creek which runs through the basin had been terraced with a series of cement dams, stretching up the creek farther than he cared to go, to hold back the water, which evidently came only when it rained, and on the bank of the creek he found a place where he thought the ore had been ground in arrastres, but he said that the arrastres themselves were buried under wash caused by cloudbursts.

He did some panning below the old workings, which bore evidence of having once been worked as placers, and found considerable gold, but as to the mine itself he knew nothing, except what the float told him, and that disclosed but little in the way of gold.

The main workings, as he outlined them, might cover three or four acres, he thought, or more, though there were other places in line with them that showed signs of having been worked to a considerable extent also; but everything had caved in and was covered up with wash and overgrown with brush. He discovered nothing on the surface that would indicate the size or character of the vein or orebody, except that the float showed it to be a free gold ore.

Everything was in such ruin and so overgrown with vegetation that he could tell little about it; but that it had been extensively worked at one time could be readily seen, and from the size of the trees that had grown there since its destruction, it was apparent that it was very old.

The Casa Blanca, according to Carey, stands on high ground and commands a wide view of the surrounding country, and might have been a lookout post and possibly a fortification for the main camp, which is a few miles to the west and in plain sight. It derived its name, which means the White House, from the color of the rock of which it is built, and though it has long ago fallen into ruins, it remains the best-known mountain landmark on the trails crossing from Chihuahua to Sonora.

Old Tyopa met its fate at the time of the Indian insurrection of 1680, when the Pueblo tribes throughout the Southwest, beginning in and about Santa Fé, rose against the Spaniards, who had enslaved them for generations in the mines. The comparatively few who escaped massacre at the hands of the Indians were driven out of New Mexico and Arizona and far into Mexico. It was this retribution, so to speak, that overtook not only Old Tyopa, and brought about the destruction of that old camp and the annihilation of its inhabitants, but of all the others that are known to have been in existence throughout that section of the Sierra Madre up to that time, and which later disappeared.

The country I refer to covers the northern half of Chihuahua and Sonora, and is confined as a whole to the high slopes of the main divide of the Sierra Madre, and has long been known to the Mexicans as the *terrains incognito*, from its unknown character.

The Casa Blanca trail, which one time led across from the eastern to the western foothills of the Sierra Madre, was one of many such trails that crossed that divide, and these trails were old and well-traveled Indian highways when the Spaniards first came. It was due to those trails and the guidance of the friendly Indians who inhabited the valleys and high plateaus of the Sierra Madre that the Spaniards were so successful in their mining discoveries.

Old Tyopa, so called, is about sixty-five miles in an air line west of the old town of Janos, in northern Chihuahua, and is the beginning of the Casa Blanca trail going west.

TYOPA FAMOUS FOR ITS BELLS IN SONORA

The true Tyopa, whose history is one of the cherished traditions of the people of southern Sonora for the sweet-toned mission bells that were once cast from its ores, is on the headwaters of the Rio Mayo, in Sonora, about a hundred miles north of the town of Alamos, and well within the *terraino*, so called. It did not produce the character of ore generally believed to be in the mine at Casa Blanca, its ore being a chalcocite or copper glance containing about one-fourth gold and silver and three-fourths copper after being smelted.

The Tyopa bells, whose fame traveled far and wide, were distributed in chimes to many of the West Coast missions and were hauled with ox teams across the desert to the more remote missions of Arizona and New Mexico, and were even carried to Sitka, Alaska, where the Franciscans once maintained a mission settlement. But a later generation dismantled them, melted them down, and recovered the gold and silver they contained.

Principal Features of the Bulgarian Mining Law

Several Advantageous Provisions Characterize the Location and Holding of Claims—Services Of Legal Profession Limited

BY PAUL R. COOK

Written for *Engineering and Mining Journal*

MY experience in working under Bulgarian mining law has convinced me that it is the best mining statute in the world. It was passed in 1910, after a thorough study of similar statutes of various countries, and seems to have escaped the defects of the older mining laws, including those of the United States. Bulgaria, being a young nation, the same observation applies to most of the country's laws.

Mineral right is separate from surface right, so that it is possible to locate mining claims without regard to the surface ownership. Previous mineral discovery is not required, as in America, and this stipulation enables one to locate any ground on which one might think there was a chance of finding valuable coal or mineral products, the law allowing two years in which to find mineral. Under present conditions it is possible to get this two-year period extended. When mining becomes more active, these extensions of time will probably not be granted so freely.

During the two years or extended period the locator is expected to make a serious effort to find mineral and develop to the stage where production is possible. Hav-

ing demonstrated to the satisfaction of the government that he has performed the last-noted requirement, the locator is granted a "concession," which is the same as a United States "patent," giving him perpetual title to the property, whether he does any more work or not. Though the government is at present lenient about extending time, so that the locator does not lose ground for lack of work, on the other hand it is strict about granting "concessions," as this is considered an official approval by the government that the property is a producing mine.

Properties are forfeited upon failure to do the required work or otherwise to comply with law, in the following manner: The locator is first given formal notice by the Bulgarian Department of Mines, stating in just what respect he has "failed" to comply with the law; a date is set by which time he must begin work, and another date set by which time a certain prescribed amount of work must be completed, or the other requirements of the law observed. Failing to comply with the stipulations of this formal warning, the claims are officially declared void, a notice is published in the state's journal to this effect, and a day named (usually eight days ahead) on which the claims are open for relocation. If, upon the day set, at the opening of business at the district office at 8 a. m., there is more than one applicant, lots are drawn between those applicants holding conflicting location applications. During my stay in Bulgaria I obtained considerable ground under "failed perimeters." The term "perimeter" is synonymous with our "claim," as "concession" is synonymous with our "patent."

In many ways it is evident that the Bulgarian mining law was framed with the idea of avoiding all dispute and chance of litigation. There is no extralateral right dispute and litigation, and overlapping claims are forbidden. Any possibility of litigation over the right to locate is prevented by requiring each locator to establish formally such right before the Department of Mines before he can begin locating ground or even own mining ground by purchase. When such right is once established it is not later subject to question. The government records of ownership are kept up to date and are a guarantee that the person shown is the real owner. Legal transfer has to be made through the mining department.

Lawyers are considered "non-producers," and the necessity for their services is limited as far as possible, in other lines as well as in mining.

Coloring Jewel Stones to Order

Investigations now being conducted at the Rare and Precious Minerals Experiment Station of the U. S. Bureau of Mines at Reno, Nev., promise the development of a process for giving to naturally colorless gems the special tinting demanded by the jewelry trade and the fancier of precious stones. The method employed is the exposure of the stone to the emanations of radium. After several weeks' exposure to the emanations, yellow Cape diamonds have been converted to a beautiful light grass-green shade. Colorless Colorado topazes have been given a rich yellow tinting. The successful conclusion of the experiments should give impetus to the development of deposits of colorless gem material found in various parts of the West.

CONSULTATION

Bentonite, Its Production and Utilization

"Will you kindly tell me where bentonite is found, its market and uses?"

Engineering and Mining Journal is the occasional recipient of inquiries similar to the above. The following information taken from a recent Report of Investigation of the U. S. Bureau of Mines by R. B. Ladoo will serve as an answer to all of them:

The name bentonite has been applied to a group or series of claylike materials characterized by an alkaline oxide and alkaline earth content of 5 to 10 per cent, fine grain size, high absorptive powers, and usually very strong colloidal properties.

Bentonite probably represents no mineral of fixed composition, and its physical properties vary considerably. The type material from Wyoming is light yellow or greenish yellow in color, but from other localities it may be cream colored, white, gray, pink, dark brown, or even black. It is exceedingly fine grained, very plastic, and highly absorbent. The appearance may be dull or powdery, but a freshly cut surface usually has a waxy luster. Some varieties have the appearance of wax and may be cut into very thin, translucent shavings. The fracture of the type material is roughly conchoidal, that of other varieties is platy and shale-like, and still others have no typical fracture. Bentonite is highly absorbent; when wetted it will absorb more than three times its weight or seven times its volume of water. Some varieties when wetted with water expand to more than six times (some experimenters report eight times) their original volume. The wetted material is exceedingly smooth and soft and feels like soft soap. Unlike most clays, bentonite is easily fusible at a comparatively low temperature.

Under a high-power microscope bentonite seems to consist of extremely small, more or less rounded, grains of uniform size, but the texture of most varieties is so fine that individual grains cannot be distinguished.

BENTONITE USED TO SOFTEN WATER

Some, and perhaps all, of the minerals of the bentonite group have the property of allowing easy replacement of the alkaline and earth oxides, one with another. This property has been utilized by at least one company for the softening of certain types of hard water. If hard water containing calcium sulphate be passed through a mass of bentonite containing sodium, the calcium sulphate is changed to sodium sulphate (soluble) and the sodium in the bentonite is replaced by calcium. The process is reversible and the bentonite may be rejuvenated by passing through it a solution of sodium chloride. The sodium is restored to the bentonite and the calcium is in these operations removed as a chloride.

In Wyoming, bentonite occurs in the lower Benton formation of Cretaceous Age in many parts of the state, but the most important localities have been found to be in the Laramie and Big Horn basins. It occurs in beds varying in thickness from a few inches to more than five feet, usually both overlain and underlain by a shale of very dark color. The beds usually lie nearly flat and are exposed over wide areas. The commercial deposits are covered by only a few inches of weathered material, so that little stripping is required. Rough joints perpendicular to the bedding permit the material to be broken down easily.

The clay is removed by hand, shoveled in wagons, and hauled to the nearest railroad siding, where it is loaded

into box cars without further preparation. Some of the Wyoming bentonite is shipped to Chicago for grinding. The principal producers in Wyoming are at Rock River, Newcastle, Cheyenne, and Medicine Bow.

In California many deposits of bentonite have been reported, and at least one has been worked. In San Bernardino County, between Barstow and Daggett, a deposit of excellent, white, highly colloidal material has been opened by underground methods. The product is shipped to Los Angeles, where it is ground, sized by air separation and bagged for shipment. Near Otay, San Diego County, are found deposits of an exceedingly fine-grained waxy material, white or pink in color, resembling the typical bentonite in composition, grain size, and general characteristics, but lacking the property of staying in suspension indefinitely. Experiments have been made with this material as a substitute for fuller's earth in oil refining.

At Ardmore, in South Dakota, the Pierre shales contain strata of a gray, fine-grained, claylike material in nearly horizontal beds six inches to three feet thick. This material was originally known as bentonite, but as it differed somewhat from the Wyoming bentonite the name ardmorite has been applied to it. The principal difference seems to be that it will not stay in suspension indefinitely. The beds are overlain by two to six feet of black soil and usually underlain by thin bedded black shales. In mining, the surface material is stripped with a steam shovel. The beds of ardmorite are then drilled by hand, blasted with dynamite, and the loosened material is shoveled into motor trucks which transport it to the mill at the railroad. This material is used for the manufacture of a water softener, and the milling process is more complicated than is common in most bentonite treatment.

TREATMENT OF BENTONITE SIMPLE

The following description of the process was furnished by the company: The raw material is first allowed to age and weather in stockpiles in the open air. From the stockpiles the material is placed in thin layers on steam coils, where it dries and partly disintegrates. From the steam coils it goes to a hammer mill for coarse crushing, thence to screens to remove impurities and thence to disintegrators. From the disintegrators it is conveyed to a pug mill, where it is mixed with water and kneaded. The plastic clay is then fed to an extrusion press, where it is forced out through a die in small strings, $\frac{1}{8}$ in. to $\frac{1}{4}$ in. in diameter, resembling noodles. The strings of clay are placed in wire-bottom trays, racked on cars and slowly passed through a continuous steam-heated drying tunnel. The dried strings are sent to a hammer mill and thence to a screen, to remove the fines, which are sent back for reprocessing. The product then passes through a 6 x 60 ft. oil-fired, rotary kiln, where it is baked at a high temperature. The baked material is then rehydrated, with a hydrating solution, in large steel vats heated by steam coils. The rehydrated material is washed with water in cylindrical wooden towers, 3 ft. in diameter by 12 ft. high, again screened to remove fines, drained and either packed in barrels or put in storage vats.

At Belle Fourche, S. D., there is found a yellow, fine-grained, exceedingly plastic bentonite, closely resembling the Wyoming material, especially when wetted. In suspension in water it forms the peculiar jellylike mass common to the Wyoming bentonite.

Deposits of bentonite have been reported at various localities in Montana, Arizona, Utah, Texas, and Tennessee. Near Declo, Idaho, is found a very dark-brown material, closely resembling the Wyoming bentonite in every way except in color. The dark-brown color is apparently not due

Metallurgists of Note

Alfred James

FOR MANY DECADES British engineers have been predominant in the mining and metallurgy of gold, as Americans have been in the realm of copper. There are few gold camps in which British mining engineers cannot be found or which do not owe

some valuable improvement in process or machinery directly to their work or advice. One of the outstanding personalities in this field of endeavor for the last thirty years has been Mr. Alfred Trewartha James. Back in the times of the ancient Egyptians, prussic acid is said to have been used for poisoning those who were guilty of divulging the sacred mysteries of the priests. As far as we know this was the first commercial utilization of this deadly arrangement of the carbon and nitrogen atoms. Mr. James has devoted most of his life to putting them to better use. Though the cyanide process, essentially as we know it today, was devised by J. S. MacArthur, it is to Alfred James that credit must be given for a large part of its commercial development. At Oxford, Mr. James was an honor student in Latin and Greek. This classical training, however,

evidently did not prove the handicap for a scientific career which some modernists assume. We have always believed that it helps an engineer to surmount a difficulty if he can swear in more than one language. Doubtless Latin and Greek are as good as any others.

Mr. James' professional career began in 1886, when he was nineteen years old, with a job in the chemical laboratory of the Cassel Gold Extracting Co., Ltd., which was exploiting an electro-chlorination process. Later J. S. MacArthur joined the company and introduced his cyanide process, patented by himself in conjunction with R. W. Forrest and W. Forrest. In 1888, Mr. James was sent to South Africa to investigate and report as to the field there for the MacArthur-Forrest process. On his return to Glasgow he designed, for erection at the Salisbury Battery, the first cyanide plant in South Africa, with which a demonstration was to be conducted on refractory ores and concentrates by paddle agitation with cyanide solution in vertical cylinders. In 1890 he returned to Johannesburg and contracted to

treat 100 tons of Salisbury buddings and to demonstrate what he could do on Robinson pyritic concentrate and other material. These demonstrations were made before Messrs. Eckstein, von Hessert, Phillips, Jennings, Dormer, Davis, Williams, and Mitchell. The results were entirely satisfactory. The attention of Mr. James was next taken up with design of the first cyanide tailing plant in the world, at the Robinson mine, with a capacity of 120 tons a day, by gravitation percolation. This brought about the invention and designing of an automatic extractor box to handle 2,000 gal. per hour. Later, at the request of Mr. Jennings, he designed a plant for the Ferreira Co. New Zealand was the next step, Mr. James going there in 1892. In two years he had firmly established the cyanide process in that country, after which he came to Denver, Col., to consult with Philip Argall and others regarding the erection of a demonstration plant in the United States. On his return to South Africa in 1895 he was struck by the ineffective precipitation which had developed since his departure, which he remedied.

Later, the method of clean-up was also greatly improved owing to Mr. James' efforts. He was also largely responsible for the adoption of tube mills into South African practice.

For many years Mr. James has made his headquarters in London in consulting work, but he has paid frequent visits to South Africa, Australia, New Zealand, Mexico, Canada, and the United States. He has thus kept in close touch with developments in all parts of the world and has himself been responsible for many improvements. Always glad to give others the benefit of his experience, both by personal contact and by numerous published articles and a book, he has been in the vanguard of those who have opposed secrecy and mystery concerning metallurgical development and improvement in technical processes.

Alfred James has been a prominent member of the Institution of Mining and Metallurgy, of which he was president in 1908. He is also a member of the American Institute of Mining and Metallurgical Engineers.



ALFRED JAMES

HANDY KNOWLEDGE

Filter Notes

BY ALGERNON DEL MAR

Written for *Engineering and Mining Journal*

The cylindrical or drum type of filter, represented by the Oliver and Portland varieties, is well known and universally used. On account of its continuous action it has practically supplanted all other filters for certain purposes, but there is one detail of operation which often causes trouble. I refer to the means of keeping the pulp in suspension in the filter.

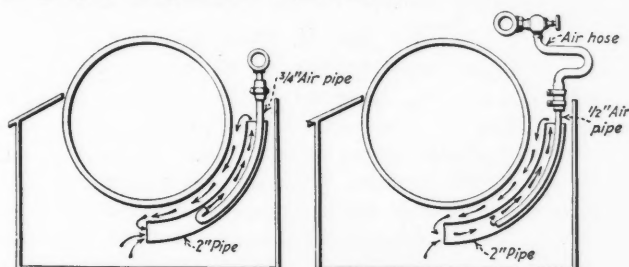


FIG. 1

FIG. 2

When treating a colloidal slime or a pulp approaching this condition there is no difficulty in keeping the slime in suspension, but when filtering a heavy quartz or concentrate slime the thick pulp will sometimes settle under the filter, particularly if the filter be inactive for a short time. When the pulp has once settled so that neither the paddles nor the air lifts will move it, the drum soon rides on the packed slime, the filter loses capacity as the packed slime is pressed against the face, then the belt slips, and the filter must be drained or dug out, depending upon what kind of material is being filtered.

Usually a filter is provided with a revolving shaft under the filter drum, to which are attached paddles which keep the pulp churned. Likewise, air pipes are provided on both sides, and in some instances under the paddles. All filters are not so fitted, for I have seen them with the paddles and without the air lifts; likewise without paddles but with air lifts. In one instance a filter had the usual paddles, on a solid shaft revolving at 75 r.p.m., and air lifts on both sides, but if for any reason the filter was idle for ten minutes, the zinc concentrate packed so tightly under the drum that the paddles could not turn, and the filter had to be cleaned out with a stream of water from a hose. At another mill where the filter had no air lifts, but had paddles, the pulp would at times pack and put the filter out of operation while the machine was running.

At another mill two 10 x 12-ft. filters were not provided with paddles but had air lifts as illustrated in Fig. 1. The air lifts were made of 2-in. pipes extending down and under the drum, the upper ends being a little below the level of the center of the drum. A 3/4-in. pipe with a 180-deg. turn at the inserted end, and connected to the air main by a union at the other end, extended into the 2-in. pipe about two-thirds its length. Four air lifts of this description on the opposite side of the filter from the discharge worked very well so

long as there was no interruption in the supply of air, but if for any reason the air supply failed for a short period, the lifts gradually "froze" and would not work. It was then necessary to disconnect the air pipes, clean them, and push them back into the 2-in. pipes. Often the lift would not work because the 2-in. pipe was also clogged. The only remedy for this was to drain the filter. Usually this was not an irksome job, as one filter was always in reserve and the filter could be drained into a sump tank, but at times the reserve filter was not in working condition.

This circumstance finally led to the method illustrated in Fig. 2, in which all the air lifts were made by inserting in the 2-in. pipe a 1/2-in. air pipe, joined to the air line with a hose so that the air pipe could be withdrawn or pushed down into the 2-in. pipe as far as was necessary, to start the circulation. This method of using air lifts without paddles worked well, but better results could be obtained with the use of comparatively high-speed paddles in connection with this air lift; then if the air supply ceased the paddles would keep the pulp in circulation, or if the filter stopped the air lifts would be operative. The paddle shaft should be independent of the filter gears, so that the paddles can revolve when the filter is not turning.

As drum filters, owing to the difficulties outlined, must at times be drained, it is important, when designing a mill, that the position of the filter be such in relation to the other machinery that this drained material (which may be in a highly dilute form, from washing out the filter) can be introduced into the flow sheet so as not to interfere with the continuous operation of the mill.

A few examples of current practice are here illustrated as hints to those operators who care to gain by the experience of others. Fig. 3 shows the position of

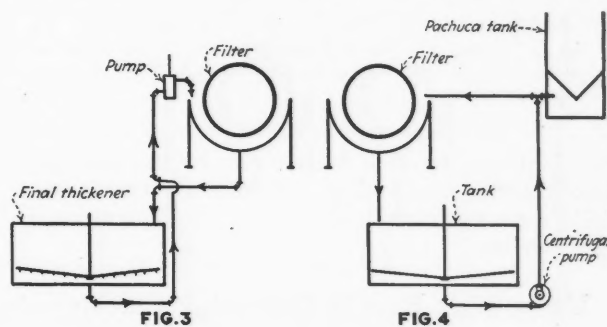


FIG. 3

FIG. 4

the filter in a fifty-ton all-sliming cyanide plant in Nevada, and, as will be seen, the filter can be drained into the last Dorr thickener, and so does not interfere with the capacity of the system. The filter must be of comparatively small diameter, as the diaphragm pump cannot lift a heavy pulp over 9 ft. above the surface of the pulp in the tank at ordinary elevations. Previous to the installation of this system, the pulp was drained into a tank and returned to the system with a centrifugal pump, but this was unsatisfactory, as the tank had no means of agitating the drained pulp and so

to organic material. This clay forms the characteristic gelatinous suspension.

In New Mexico, about thirty-five miles north of Santa Fé, near the Denver & Rio Grande R.R., are deposits of bentonite three to five feet thick. This material is of a pink or flesh color and has a waxy luster. It disintegrates rapidly in water to a soapy, flocculent mass, but it does not stay in suspension.

A deposit of bentonite about nine feet thick has been reported at Merritt, British Columbia. It is also stated that other deposits are known in the Nicola and Similkameen divisions of British Columbia.

Considering the unusual physical and chemical properties of bentonite, production has been remarkably small. From 1888 to 1895, the production averaged sixty tons per year, valued at about \$25 per ton f.o.b. cars. In 1902, the production rose to 1,200 tons, but the price dropped to \$5, later rising to \$6 or \$7 per ton. In 1919, the Wyoming production was at the rate of about twenty-five cars per year, valued at \$7 per ton. During 1920 and 1921, interest in bentonite increased greatly, new deposits were opened, and it is expected that the production will expand more or less rapidly. It is reported that powdered bentonite from Wyoming and California would sell in eastern markets at \$25 to \$30 per ton in car lots.

USES OF BENTONITE EXPANDING

Until recently the uses for bentonite were few and relatively unimportant. These seem to have been principally in the manufacture of the medical dressing, antiphlogistine; in the manufacture of a packing and dressing for horses' hoofs; as a retarder in the manufacture of gypsum wall plaster; as a filler in the manufacture of paper (at a mill in Denver); as a filler in soap; and as an adulterant in drugs and candies.

Within the last few years the unusual properties of bentonite have attracted considerable scientific attention, and systematic research has been undertaken to study this material and to develop the best methods for its utilization. The Forest Products Laboratory, of the Department of Agriculture, at Madison, Wis., has made rather exhaustive tests on the use in paper making of a high-grade variety of light yellow, colloidal, Wyoming bentonite, known as wilkinit. Their tests seem to show that the addition of small amounts of bentonite to the clay used as a paper filler greatly increases the percentage of filler retention in the finished product. Thus, in one test the retention with clay alone was 45 per cent; with 10 per cent bentonite and 90 per cent clay, 58 per cent; with 20 per cent bentonite and 80 per cent clay, 64 per cent; and with 100 per cent bentonite, 84 per cent. Some paper companies that have tried out this material claim the additional advantages of complete suspension in water and the production of a paper of superior "feel." Other paper companies admit some of the advantages of using bentonite but object to the yellow color of the Wyoming material and submit that the advantages are not sufficient to warrant the increased cost involved. It is reported that the Forest Products Laboratory is also experimenting on the use of bentonite for de-inking news print. Bentonite seems to absorb all the ink without affecting the pulp.

BENTONITE USED IN SOAP

In the manufacture of soap it has been proved that some bentonites can actually replace 25 to 30 per cent of the soap substance, producing a soap equal or superior to the ordinary soap. It should be noted that bentonite is not used in soap as an adulterant or scouring agent, but actually replaces part of the soap substance and increases the lathering and detergent properties.

Owing to the extremely fine-grain size of bentonite, the suggestion has been made that it would be suitable as a filler for rubber. It might also be used as a filler for phonograph records, textiles, cordage, and pressed and molded electrical insulation. It seems to have interesting possibilities in the manufacture of paint.

As an ingredient in gypsum and lime plasters, bentonite should add plasticity, but it would probably increase the

drying shrinkage. Its high plasticity suggests its possible application in ceramics, thus enabling smaller quantities of bonding clay to be used; and the possibility of replacing the bonding clay used in electrical and chemical porcelain, abrasive wheels, and graphite crucibles with bentonite is being considered.

It is reported that some bentonites make a superior adhesive paste, particularly for sticking paper to metal. It is claimed that labels pasted on iron with bentonite will not curl up and drop off.

The great affinity of bentonite for water has suggested the possibility of devising a method for using it to dewater crude petroleum.

The use of material of the general nature of bentonite as a water softener has already been partly described above. It is not definitely known whether all bentonites possess the property of softening water, but the usual presence of the alkaline oxides suggests this possibility. If this property is common to all varieties, it is probable that other uses based thereon may be devised.

Other uses suggested for bentonite are: as a base for massage creams, a base for the precipitation of lake colors; a base for printers' ink; as a heavy lubricant or grease (mixed with oil); and as a filler or dressing for leather.

ANALYSES OF BENTONITE

	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8
SiO ₂	60.64	57.98	58.68	59.84	60.18	63.20	54.00	55.22
Al ₂ O ₃	23.26	22.46	25.91	11.84	26.58	12.90	24.48	21.00
Fe ₂ O ₃	3.92	3.80	3.97	3.26	.....	2.46	3.00	3.61
TiO ₂	0.12	.....	.....	.....	.....	0.11	.....	.....
CaO.....	0.59	1.92	1.45	2.90	0.23	0.82	2.08	4.94
MgO.....	2.19	3.24	1.49	2.32	1.01	2.09	2.75	3.04
K ₂ O.....	0.37	1.35	.....	2.34	1.23	0.26	.....	.....
Na ₂ O.....	4.33	.....	1.39	2.13	.....	0.66	1.74	1.56
SO ₃.....	.....	0.75	0.11	.....	.....	.....	.....	0.43
CO ₂.....	.....	.....	Tr.	.....	.....	3.50 (a)	.....	Tr.
Cl.....	.....	.....	0.10	.....	.....	0.20 (b)	.....	.....
P ₂ O ₅.....	.....	.....	0.06	.....	.....	.....	0.71	.....
Ign. loss.....	.....	7.93	.....	10.50	.....	.....	.....	.....
H ₂ O.....	2.83	.....	6.84	.....	10.26	13.80	9.12	10.28
Totals.....	98.25	99.43	100.00	95.13	99.49	100.00	97.88	100.08

(a) Sand and like material. (b) Water soluble.

No. 1—Yellow, colloidal. Belle Fourche, S. D. Analyst, W. A. Selvig, U. S. Bureau of Mines.

No. 2—Yellow, colloidal. Medicine Bow, Wyo. Analyst, A. G. Van Eman, Owyhee Chemical Products Co., Chicago, Ill.

No. 3—White, colloidal. Near Barstow, Cal. Analysis from California Master Products Co., Los Angeles, Cal.

No. 4—White, fine grained. Otay, San Diego County, Cal. Analysis from Otaylite Products Co., Los Angeles, Cal.

No. 5—Type material from near Rock Creek, Laramie Basin, Wyo. Analyst, T. T. Read, Cassa Mining Co.

No. 6—From Big Horn Basin, Wyo. Analyst, R. C. Wells, U. S. Geological Survey.

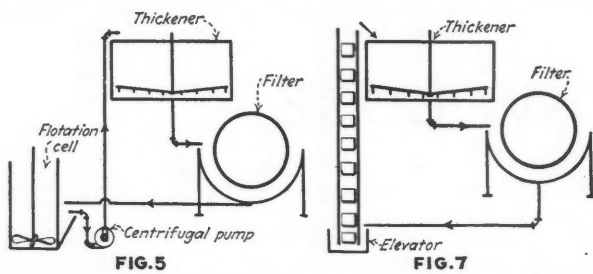
No. 7—Supposed bentonite. Near Shelbyville, Tenn. Analyst unknown.

No. 8—"Ardmorite," probably variety of bentonite. Ardmore, S. D. Analysis from the Refinite Co., Omaha, Neb.

Vanadium in Arizona

M. A. Allen and G. M. Butler, of the University of Arizona Bureau of Mines, have issued a bulletin (No. 115) on vanadium, with especial reference to its presence in the Southwest. The only Arizona mine actually producing vanadium concentrates at the date of the publication was the C. & B., controlled by Wilson & Stone, of Christmas. The mine is in Dripping Springs district, with Christmas as its shipping point. Most of the ore is vanadinite, returning, on 500 tons milled, from 1 to 3 per cent V₂O₅. Ore claimed to run from 3 to 5 per cent is found on the claims of the U. S. Vanadium Co., near Kelvin, vanadinite in granite, associated with wulfenite.

In the famous Cataract Canyon of northern Arizona the Northern Arizona Mining & Electric Power Co. has vanadium deposits of apparent importance, in connection with other oxidized lead ores. The mineral is reported from mines in at least nine of Arizona's fourteen counties and the bulletin gives a list of about forty claim owners.



had to be washed to the intake with a stream of water, and this thin pulp used for wash water in the last thickener.

Fig. 4 illustrates the system in practice at a large all-sliming cyanide plant in Mexico. The filter was drained into a cement tank with a revolving-arm agitator, which tank took the thickened pulp from two

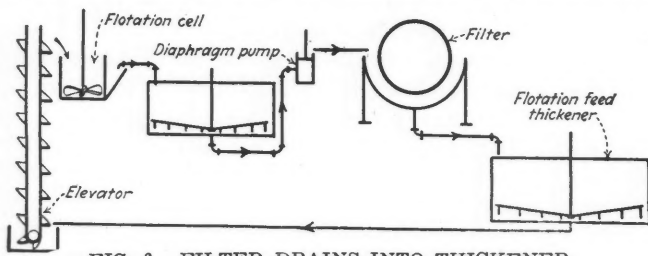


FIG. 6. FILTER DRAINS INTO THICKENER

Dorr thickeners and from which the pulp was elevated by centrifugal pumps to the Pachuca tanks. In this case the filter pulp, which had been fully treated, was returned to the system and either cut down the capacity of the mill or shortened the time of treatment of the pulp with which it was mixed in the Pachuca tank.

When filtering a flotation concentrate somewhat the same conditions are present as in an all-sliming cyanide plant. The filter should be drained so that the concentrate may be returned to the filter without interfering with the continuous feed of ore to the frothing machines and with the least possible labor.

In Fig. 5 is shown a lead-zinc mill flow sheet of the filter system in which the drained pulp from the filter goes to the first cell of the flotation system and must be re-treated. This is similar to the arrangement in Fig. 6, in which the drained pulp re-enters the system in the thickener feeding the flotation machine.

As a filter, to have capacity, must be fed with a thickened pulp, a Dorr thickener should precede the filter. All that is necessary is to have an elevator alongside the thickener which can be set in motion when required and by this means elevate the drained pulp into the thickener. Fig. 7 illustrates the method. I believe an elevator superior to a centrifugal pump for this purpose.

Using Slide Rule in Surveying Calculations

BY PAUL H. KEATING

Written for *Engineering and Mining Journal*

For rapid calculation of latitudes and departures of four significant figures or less, an ordinary 10-in. Mannheim polyphase slide rule is ideal. For example:

$$\text{Departure} = \text{Distance} \times \sin \theta$$

Without reversing the slide, set the bearing angle on the S scale to the cross hair on the back of the slide rule. The sine is automatically set off on the B scale, under unity at the right end of the A scale. Set the glass indicator on the measured distance on the A scale, and read the departure on the B scale.

A similar operation for latitude is accomplished by using the complement of the bearing angle. The results may be instantly checked by setting the departure over the latitude on the C and D scales, respectively, and the T scale shows the bearing angle on the reverse cross hair.

For example take the following: S. 35° 30' E. 72.5 ft. Set the S scale to 35° 30' on the cross hair on the back. The sine is under 1 at the right end of the A scale, .0581. On the A scale set the glass indicator to 72.5, and under it on the B scale is the departure, 42.1 ft.

For the latitude use the complement of the angle, 64° 30'. Or, which is as easy, set the bearing angle on the T scale to the cross hair on the back; set the glass indicator to the departure already determined on the C scale. The latitude is on the D scale under this departure.

Draining Water From Conveyor Belts

BY ROY H. POSTON

Written for *Engineering and Mining Journal*

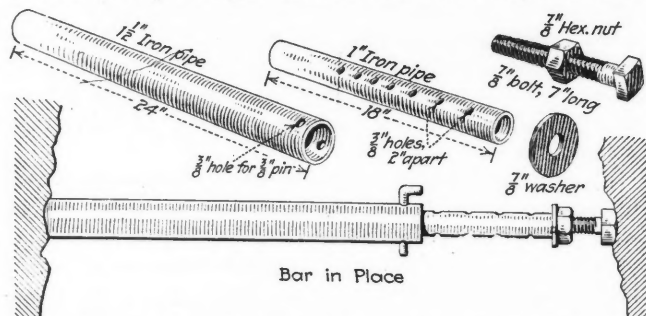
When conveying crushed rock, gravel, or other material that is water soaked it is usually desirable to get rid of as much water as practicable as soon as possible. If a belt is used, this may be accomplished by sloping it to one side for a horizontal distance of about 25 ft. The proper inclination should be determined by trial.

Telescope Bar for Narrow Stopes

BY CHARLES LABBE

Written for *Engineering and Mining Journal*

In a western mine where stringers of high-grade ore have to be followed off the main stopes and the width of such stringer stopes varies from 2 to 4 ft., little tim-



TELESCOPE BAR FOR SUPPORTING DRILLING PLATFORM IN NARROW STOPES

ber is used. For hand drilling and sampling the platform is supported by two telescope bars which can be quickly adjusted to any width of the stope. Two 2 x 12-in. boards 4 ft. long complete the platform. The bars are shown in the accompanying cut.

Insurance Benefits

Not so long ago the mining town of Britannia Beach, B. C., had a fire which destroyed the mill of the Britannia Mining & Smelting Co. Last week it suffered from an even more disastrous flood. This brings to mind a story that is told of two enterprising New Yorkers: "Such a policy I have!" said Ikey to Izzy, "It insures me against fire, *und* I had a fire; against *gonufs*, *und* I was robbed; against water, *und* yesterday I had a flood." "Izzy," replied Ikey after deep thought, "How do you have a flood?"

THE PETROLEUM INDUSTRY

Laws of Mexico Affecting Oil Development*

THE MINING LAWS of Mexico of Nov. 22, 1884, June 4, 1892, and Nov. 25, 1909, were based upon the constitution of 1857, and recognized the principle that the exclusive ownership of the petroleum deposits was vested in the owner of the land. These laws also provided for the acquisition of petroleum rights by foreign companies. It was in conformity with these laws that American capital purchased and leased petroleum lands in Mexico, expending more than \$200,000,000 in lands, leases, pipe lines, camps, pumping stations, tank ships, wharves, and other necessary equipment. On Feb. 5, 1917, a new constitution was promulgated which made a radical change in the petroleum laws of Mexico.

The Attorney General of Mexico has given the following opinion as to Article 27:

1. All landed property, whether of national or private ownership, urban or rural, comprised within the confines of the republic, shall be considered as covered by the term "lands and waters of the nation."

2. Only Mexican individuals and Mexican associations have the right to acquire lands, waters, and their appurtenances in the republic.

3. Alien individuals may acquire such property, either directly from the nation or from individuals—Mexican or alien—on complying with the conditions prescribed in Section 1 of the seventh paragraph of Article 27, when authorized by the state. Hence, even though compliance be had as hereinbefore provided, the state may deny aliens this right under the discretionary power vested in it by this provision.

4. Alien corporations shall in no event acquire such property.

As probably indicating the intentions of the government toward enforcing the nationalizing provisions of Article 27 of the constitution, notices have been sent to revenue collectors and registrars in the State of Vera Cruz instructing them not to receive for registration deeds wherein the owner of the land agrees to sell or lease to companies or individuals for the exploitation of subsoil products. The circular which was sent out by the government states that the Mexican government alone can legalize such transfers, "being of its direct domain all oils and minerals in the subsoil of the republic."

GOVERNMENTAL DECREES AND PROJECTED LAW

The executive sent to the Mexican Congress in December, 1918, a bill embodying a petroleum code, intended to put into effect the nationalizing provisions of Article 27 of the new constitution. To date the Congress has not passed this or any such measure. On Feb. 19, 1918, the President of Mexico, under authority of a congressional resolution conferring upon him extraordinary powers in the Department of Finance, issued the first of a series of decrees to enforce Article 27. The decree provided for the payment of rentals and royalty to the nation by the owners of petroleum lands, the registering of petroleum lands under penalty of confiscation, and the opening of lands not registered to the filing of claims by third parties. Against this decree

the United States, Great Britain, The Netherlands, and France made diplomatic protest. The taxes levied by this decree were referred to as "rentals" and "royalties," which terms by their very meaning must have conceded the national ownership mentioned in the new constitution, if the decree had been acknowledged by the property owners. On July 8, 1918, a decree was issued, which, with the amendments of Aug. 9, 1918, provided the means of terminating the present titles to oil lands under certain conditions, and the issuance by the government of licenses to drill on the lands, the title of which had been terminated. On July 31, 1918, the decree of Feb. 19 was reissued in a slightly different form, the date of Aug. 15, 1918, being set as the time limit for filing a statement of title.

In an attempt to enforce the provisions of these governmental decrees and the payment of the taxes exacted by them, others were issued later which suspended the drilling of new wells. In the meantime the companies had sought relief in the federal courts of Mexico, where the cases were decided against them. The cases are now being decided by the Supreme Court of Mexico on *amparo* proceedings instituted by the principal companies engaged in the petroleum industry. Pending action by the Mexican Congress, the principal oil companies on Jan. 4, 1920, petitioned the President of Mexico for the issuance of provisional permits to drill new wells and to complete those already begun, it being understood that the granting of such permits would in no manner affect the contentions of either the oil companies or of the government on the questions then in controversy.

PROVISIONAL PERMITS FOR DRILLING

A presidential order dated Jan. 17, 1920, provided for provisional permits to drill on the following basis: First, permits to be valid only until Congress enacts an organic law to carry out the provisions of Article 27 of the Mexican constitution; second, permits may include wells begun since May 1, 1917, whether finished or not; third, with the grant of a permit the Mexican government abandons no right or judicial principle which it desires to sustain and companies acquire no new rights; fourth, if companies do not comply with the organic law when enacted, their benefits under permits will cease; fifth, permits will not affect questions now before the courts concerning the application of Article 27 of the constitution, and of executive decrees and orders relating to petroleum, nor will they affect the discussion of pending petroleum legislation.

PROTECTING PROVISIONS OF NEW CONSTITUTION

Article 14 of the new constitution states: "No law shall be given retroactive effect to the prejudice of any person whatsoever." It is the contention of the Mexican government that this constitutional provision will fully protect the companies already interested in the petroleum industry in Mexico. However, it is difficult to harmonize the confiscatory effects of the various

*Excerpt of an article, "The Petroleum Industry in Mexico," by Roy H. Flamm, in *Commerce Reports* of Oct. 3.

decrees issued to carry out the provisions of Article 27 of the new constitution with the protection guaranteed by Article 14. It is to be hoped that any new petroleum legislation based on the constitution of 1917 will include an endeavor to bring the provisions of Articles 14 and 27 into harmony, to the end that oil properties legally acquired by foreign interests under the constitution of 1857 and the laws of 1884, 1892, and 1909 will receive the protection and guarantees afforded them by Article 14 of the constitution of 1917.

No American companies are developing oil in Mexico on any but privately owned property, legally acquired under laws of Mexico, and no American company, with two minor exceptions, possesses any rights to drill on any lands conceded by any government of Mexico. The American companies have in practically all cases made their contracts of lease or purchase with private owners of the land. There are probably between fifty and one hundred American companies which have holdings of supposed oil lands in Mexico acquired either by lease or purchase from the original owners. The amount of land so held is not less than 3,000,000 acres, and possibly double that amount. A conservative estimate is that 10 per cent of these lands contain oil.

SUPREME COURT INTERPRETATION OF ARTICLE 27

More than 150 cases of *amparo* were filed by the oil companies during 1918 and 1919. An *amparo* in the Mexican law corresponds in our laws to a request for an injunction on constitutional grounds. The *amparo* proceedings brought in 1918 were instituted against the decrees of Carranza, which made the nationalizing provisions of Article 27 of the constitution retroactive and confiscatory of properties owned before the constitution of 1917 was adopted. The *amparos* filed in 1919 were directed against a specific decree of Carranza, which provided that the lands of those companies which refused to file manifests, practically acknowledging a transfer of their properties to the government, would be subject to denouncement or filing and seizure by such other parties as might be authorized by the government.

On Sept. 26, 1921, the Supreme Court of Mexico officially handed down a decision on the proceedings in *amparo* brought by the Texas Co. in 1919. The decision, signed by the entire court, reads in part as follows:

Paragraph 4 of Article 27 cannot be regarded as retroactive, either in its text or its spirit. It does not attack acquired rights. No attack upon those rights is made in the text of the article, because it does not contain an express mandate regarding its retroactivity, nor can any such implication be read into it. No attack is made in the spirit of the article, because it acts in the same spirit manifested in other articles of the constitution, which, as a whole, recognizes the old principles upon which are based the rights of man, granting ample guaranties.

Considering Article 27 non-retroactive, we find it is in harmony with the principles set forth in the paragraphs immediately preceding it. These deal with private property. We also find it in harmony with the sections relating to petroleum, which follow it. From all this it is understood that according to universally applied rules which have been accepted for the interpretation of laws, Paragraph 4 of Article 27 is not retroactive in that it does not impair rights previously and legitimately acquired.

The Chief Justice in rendering the decision says:

Today's decision is as specific and far reaching in matters relating to oil as a judicial tribunal can render, and should establish the principle of law upon which the other *amparo* cases pending should be adjudicated.

It is believed that this decision in the Texas Co. case establishes a judicial acknowledgment that petroleum lands acquired prior to May 1, 1917, for purposes of

mineral development, on which denouncements were made subsequent to such date and in accordance with the Carranza decrees, are held to be not subject to such denouncement and not subject to any of the regulative decrees concerning denouncement. An *obiter-dicta* decision issued at the same time states that the lands above referred to are subject to the decrees relating to taxation, and that the president, in the use of his extraordinary powers and by proper decrees issued, may effect the taxing basis of the properties in question. The Supreme Court, however, did not find that President Carranza exceeded his powers when he issued the decrees resulting in the denunciation of properties of the Texas Co. under the provisions of Article 27.

NEW LEGISLATION BASED ON ARTICLE 27

A proposed new petroleum law based on the nationalizing provisions of Article 27 of the constitution has recently been presented to the Chamber of Deputies of the Mexican Congress, by a committee of the Congress. This proposed law provides that petroleum taxes will be of two kinds: A tax on the lands in which exploitation is carried on, and a tax on the production obtained. The tax rate is to be fixed once each year "by the respective income law." According to this proposed law there will be no future concessions granted for private pipe lines, such becoming common carriers. Article 19 states: "The parties interested in petroleum concessions executed after May 1, 1917, must subject themselves to the terms of this law within the term of one year from its date."

In the enactment of laws governing the development of any natural resource, such as petroleum, there are certain fundamental principles which should not be ignored. Before development can successfully proceed it is essential that the laws of a country shall fairly protect both the national interests of the government and the capital which it hopes to attract. Particularly should the mining laws affecting petroleum development be favorable to the industry, on account of the highly speculative character and prospective nature of the business.

The mining laws of a country usually have as their object the accomplishment of one or both of the following purposes: Revenue to the government or a development of the natural resources. The objects are not antagonistic, but the former may be, and sometimes is, made to defeat the latter purpose. Taxation for purposes of revenue may be made so high and onerous, and administrative restrictions so numerous, that development does not take place, the law thereby defeating the results desired, for neither is revenue derived nor is development accomplished. It is to be hoped that methods will be worked out by the Mexican government which will make the oil resources of the country available to the needs of mankind through means which will be fair to both the Mexican people, bringing them stability and prosperity, and to the foreign capital legitimately invested in Mexico.

Japan Importing Persian Oil

A contract for 50,000 tons of crude oil per annum has been made by the Teikoku Oil Co., of Japan, with the Anglo-Persian Oil Co., says the *Japan Gazette*. For the transportation of this oil two ships of 8,800 tons each have been constructed.

Book Reviews

Waste in Industry. By the Committee on Elimination of Waste in Industry of the Federated American Engineering Societies. First Edition; cloth; pp. 409; illustrated. Federated American Engineering Societies, Washington, D. C. McGraw-Hill Book Co., Inc., New York, sole selling agents. Price, \$4.

Taking oneself by the nape of the neck and holding oneself at arms' length and looking oneself over honestly and critically is worth doing once in a while. This introspection is wholesome for the individual. It gives a keener sense of values and is a corrective for that time-worn aphorism of the street—"swelled head." We are a great nation, yet a little honest introspection is not without its value to us individually and collectively. The recent report of Waste in Industry by the Committee on Elimination of Waste in Industry of the Federated American Engineering Societies is just that. It is a frank statement of findings in several of our industries by our own engineers. Herbert Hoover, referring to the report, says:

"We have probably the highest ingenuity and efficiency in the operation of our industries of any nation. Yet our industrial machine is far from perfect. The wastes of unemployment during depressions; from speculation and overproduction in booms; from labor turnover; from labor conflicts; from intermittent failure of transportation of supplies and power; from excessive seasonal operation; from lack of standardization; from loss in our processes and materials—all combine to represent a huge deduction from the goods and services that we might all enjoy if we could do a better job of it."

Six industries were studied in more or less detail. They were sampled and assayed. The report says that "management has the greatest opportunity and hence responsibility for eliminating waste in industry. The opportunity and responsibility of labor is no less real though smaller in degree. The opportunity and responsibility chargeable to outside contacts cannot be so clearly differentiated or evaluated." The report states that: "Over 50 per cent of the responsibility for these wastes can be placed at the door of management and less than 25 per cent at the door of labor, while the amount chargeable to outside contacts is least of all."

Engineers generally should read this report. For mining and metallurgical engineers there is little of direct value. For them, reading between the lines and visualization of their own industry in parallel is necessary. Nevertheless, I believe that the mining industry can profit considerably by a similar introspection. Can we truthfully state that management of mining enterprises is all that it should be? We know that labor has been responsible for waste in the industry. We also know that the methods of financing wildcat and other dubious ventures are open to considerable censure. No, we cannot say that the mining industry is unlike other industries in respect to management waste, labor waste, and

capital waste. Then there is room for improvement.

The principal value of this report is that it is a challenge to engineers. It opens up a vista of opportunity. If there is so much yet to be done in eliminating waste in industry, I can see the need for better and more engineering. I am of the opinion that engineers should study the following extract from this report:

"Engineers come in contact with and influence every activity in industry and as a body possess an intimate and peculiar understanding of intricate industrial problems. They are in a position to render disinterested service, and their peculiar responsibility is to give expert judgment wherever engineering training and technical skill are needed to reach a just decision.

"This report brings forward certain pressing problems concerning the solution of which engineers should hasten to assist. The assays of waste show first the need of definite and quantitative industrial information on a multitude of points. Science has pushed ahead in some directions; it lags behind in others. The duty of the engineer is pre-eminently a duty to enlarge the boundaries of knowledge. His lifelong training in quantitative thought, his intimate experience with industrial life, leading to an objective and detached point of view; his strategic position as a party of the third part with reference to many of the conflicting economic groups—and, above all, his practical emphasis on construction and production—place upon him the duty to make his point of view effective.

"It is peculiarly the duty of the engineers to use their influence individually and collectively to eliminate waste in industry."

G. J. Y.

Recent Patents

Flotation Reagent—No. 1,394,639. C. L. Perkins, Pittsburgh, Pa., assignor to Metals Recovery Co., New York. A compound flotation agent comprising a solution of a solid amino compound in a liquid amino compound readily miscible with water. No. 1,394,640 covers the use of a mixture of several amino compounds. It is understood that the flotation agents covered by these patents have shown great promise in the treatment of Utah Copper Co. and other ores, and that they will likely be used on a commercial scale at an early date.

Flotation Machine—No. 1,393,821. Yeikichi Otsuka, Tokio, Japan. A mechanically agitated flotation machine in which the beaters of the first compartments are adapted to mix the ore pulp and flotation agent without substantial aeration, whereas the beaters of the last compartments are provided with means for delivering air into the pulp.

Metallurgy of Vanadium—No. 1,393,748. A. H. Carpenter and G. A. Baumann, Sawpit, Col., assignors to The American Vanadium Corporation, Sawpit, Col. A method of precipitating vanadium compounds from solution by the use of an alkali-metal acid sulphate.

Technical Papers

Metallurgy of Copper—In the *Proceedings of the Australasian Institute of Mining and Metallurgy*, No. 42 (Melbourne, price not stated), is a description of a new metallurgical process for copper ores devised by W. H. Corbould. The process requires that the ores contain at least the minimum ratio of sulphur to copper, consistent with the production of sulphatizing roast conditions. The essentials of the process are as follows: (1) Dry grinding to 30 mesh in a special type of shear crusher and grinder, something on the order of a Symons disk grinder or a Braun pulverizer. (2) Agitation with acid solution produced within the process by electrolysis. (3) Purification of a portion of the "mother liquor" and electrolytic deposition of the contained copper, thereby producing sufficient free sulphuric acid in solution for the next charge of calcine and further requirements. (4) Partial purification of the remaining "mother liquor" together with the first wash solutions, and precipitation of the copper concentrates as hydrate by milk of lime. (5) Dissolution of the copper in the hydrate precipitate by means of a solution of ammonia, followed by distillation of the ammonia liquor, producing pure copper oxide, and recovering the aqua ammonia by condensation. (6) Reduction of copper oxide to metallic copper. (7) Treatment of the residue from (5) for the production of a byproduct and the recovery of any remaining copper. (8) Treatment of the washed slime residues from the ore charge for gold and silver by the cyanide process. (9) Use of producer water gas for the whole of the metallurgical operation as heating gas and to provide sulphate of ammonia.

Petroleum Engineering—The U. S. Bureau of Mines has just issued a report entitled "Petroleum Engineering in the Deaner Field, Okfuskee County, Oklahoma," by M. J. Kirwan and F. X. Schwarzenbeck. The report includes a history of the development and a description of the producing formations and geological structure of the Deaner field, and is amply illustrated with maps, cross-sections depicting the underground conditions, and sketches of various mechanical devices used in operating. The report has been issued in co-operation with the Bartlesville, Okla., Chamber of Commerce, which will distribute it at a price of 50c. per copy. Persons desiring copies should address the Bartlesville, Okla., Chamber of Commerce.

Map of Alaska—The U. S. Coast and Geodetic Survey has completed a new outline map of Alaska on the Lambert conformal conic projection, scale 1:5,000,000; dimensions, 17 x 26½ in. The map extends from the Arctic Ocean to the State of Washington, including all the Aleutian Islands and a part of Siberia. It is intended merely as a base map to which may be added any kind of special information that may be desired. For this reason, only national boundaries, the adjacent Canadian provinces, and the names of a few of the important towns are given. The map may be obtained for 25c. from the U. S. Coast and Geodetic Survey, Department of Commerce, Washington, D. C.

ECHOES FROM THE FRATERNITY

San Francisco Section, A.I.M.E.

The San Francisco section of the A.I.M.E. held a meeting on Nov. 9, with the mining students of the College of Mines, University of California. W. J. Loring, president of the American Mining Congress, and James M. Hyde, professor of metallurgy of Stanford University, made short addresses to the students and members.

Puget Sound Section of A.I.M.E.

A meeting of the Puget Sound section of the A.I.M.E. was held on Oct. 27 at the Engineers' Club, Seattle. Officers elected for the ensuing year were: Amos Slater, chairman; Charles Simenstad, vice-chairman; J. G. Murphy, secretary-treasurer, and H. Y. Walker and L. A. Levensaler on the executive committee.

The question of closer association with student associate members at the University of Washington and the problem of getting in closer touch with members of the institute in British Columbia and Alaska were also discussed. It was suggested that a meeting of the Puget Sound section be held in Vancouver, B. C., to increase contact with members who live in and near that city, but it was deemed advisable to find out, through members in Vancouver, the feeling of the Canadian Mining Institute, as the section wishes to co-operate with the Canadian Institute and not do anything the object of which might be misinterpreted.

British Columbia Mining Acts To Make New Provisions

Conditions in British Columbia indicate that there will be no legislation of great importance in its relation to the mining industry before the session of the provincial Legislature now in progress. There is a possibility that in the general adjustment of taxation, a problem which the legislators are soon to consider, some action will be taken with regard to mining. Even this, however, is but speculation and will come only if the mine operators are able to impress the government with the necessity of relieving them of some of the burden which, they claim, threatens to seriously hamper development.

Both the Mineral Act and the Placer Act are to be considered, but only for amendments of minor interest. The purpose in connection with these statutes apparently is to make provision for the realignment of the boundaries of some of the mining divisions of the province. Section 112 of the Mineral Act is to be made so to read as to give the Lieutenant Governor in Council power "to constitute any part of the province a mining division and declare by what local name it shall be known, and may establish therein a mining recorder's office, and may from time to time extend, reduce, subdivide, or annul any existing mining division or merge it in whole or in part in the consolidation of two or more mining divisions." No doubt has existed of the power to create new divisions, but this will give authority specifically to annul present divisions and to merge

annulled divisions with others. Section 114 sets out the procedure that shall be followed with reference to records and documents in the charge of officials of a division when it annulled or merged. The Placer Act is to be altered in the same manner, the idea clearly being to make the law apply similarly both in respect of placer and lode mining, where it is deemed expedient to alter existing mining divisions.

MEN YOU SHOULD KNOW ABOUT

Bulkeley Wells is in New York.

M. A. Newman is in San Francisco.

H. V. Winchell was recently in Salt Lake City.

Dr. C. K. Leith will be in New York on Nov. 22.

P. G. Spilsbury has returned to Phoenix from a visit to Clifton, Ariz.

George H. Garrey, consulting geologist of Philadelphia, is in Tonapah on professional business.

Thomas L. Chapman, of Los Angeles, has returned to Phoenix from a trip to Globe and to Lordsburg, N. M.

M. F. Fairlie, manager of the Mining Corporation of Cobalt, has returned from a visit to New York.

A. G. Larson, of Spokane, and R. H. Stewart, of Vancouver, B. C., were in Alaska on professional business during October.

G. C. Bateman, of Cobalt, recently addressed the Associated Boards of Trade for Northern Ontario on "The Mining Industry."

John V. W. Reynders has been elected chairman of the iron and steel committee of the A.I.M.E., succeeding the late Prof. J. W. Richards.

Kuno B. Heberlein, formerly president and general manager of the Penoles Mining Co., Mexico, has opened offices at 42 Broadway, New York.

Edwin E. Chase and son, R. L. Chase, of Denver, have been in the Katherine district of Mohave County, Ariz., and have gone to Tucson on mine examination work.

C. H. Brandes, formerly chief mechanical engineer and general purchasing agent of the American Metal Co., New York, has opened offices at 42 Broadway, New York.

George A. Morrison is now residing at Cranbury, N. J., following the cessation of mining at the International Nickel Co.'s Creighton mine, in Ontario, of which he was superintendent.

J. A. MacKillican, formerly superintendent of inspection for the Meriden Iron Co., has been promoted to the position of manager for the Meriden Iron Co. and the Mace Iron Mining Co. Mr. MacKillican fills the vacancy caused by the death of O. B. Warren.

A. H. Fahrenwald, of the U. S. Bureau of Mines, University of Idaho, left Moscow early in November for Reno, Nev., to which point he had been called for consultation upon some of the problems incidental to flotation of Nevada ores.

Graham B. Dennis, Frank M. Smith, Frank A. Ross, Frank C. Bailey, Leigh Nicholls, Oscar Cain, and W. H. Linney, all of Spokane, have been re-elected to the executive committee of the Northwest Mining Association for the ensuing year.

Sherwin F. Kelly, representing C. & M. Schlumberger, Prospection Electric, of Paris, has been carrying on a series of experiments with Schlumberger's method of applying electricity to the prospection for certain ore minerals, on the copper deposits of the Ducktown Sulphur, Copper & Iron Co., and of the Tennessee Copper Co., in the Ducktown basin.

Mining and metallurgical engineers visiting New York City last week included: Archibald Little, Detroit, Mich.; J. Gordon Hardy, Brookline, Mass.; F. H. Kay, Caracas, Venezuela; J. M. Longyear, Jr., Marquette, Mich.; Samuel E. Doak, Philadelphia, Pa.; H. A. Kee, Cobalt, Ont.; Chester A. Fulton, Baltimore, Md.; G. Sessinghaus, Denver, Col.; and C. L. Coburn, Pittsburgh, Pa.

SOCIETY MEETINGS ANNOUNCED

American Institute of Chemical Engineers will hold their annual winter meeting at the Southern Hotel, Baltimore, Dec. 6-9.

The Petroleum and Gas Committee of the A.I.M.E. has postponed its meeting scheduled for Dec. 10 until the annual convention of the institute in February.

Mining and Metallurgical Society, New York Section, will hold a meeting on Nov. 22 at the Harvard Club. The subject to be discussed will be, "Foreign and Domestic Mining Policy."

The American Petroleum Institute will hold its second annual meeting in Chicago, Ill., on Dec. 6, 7, and 8. Among the speakers will be Van. H. Manning, R. D. Benson, Frank A. Howard, N. A. C. Smith, R. E. Wilson, Dr. C. K. Francis, Thomas A. O'Donnell, Walter Teagle, Amos L. Beaty, D. W. Moffit, Edward L. Doheny, Edward Prizer, Frank Haskell, Paul Shoup, Louis Sands, and Edward C. Finney.

The American Society of Mechanical Engineers has announced a five-day meeting, Dec. 5 to 9, to discuss the following: The elimination of industrial waste, as recently reported by the American Engineering Council's committee headed by J. Parke Channing; education and training in the industries; management and gas power; fuel and material handling; professional engineering education for the industries, and textile, ordnance, and aeronautic sections.

OBITUARY

William Hatfield, pioneer mining man of Utah, died on Oct. 31, at the age of seventy-three. Mr. Hatfield was identified with the discovery of the Swansea and Bullion Beck mines.

THE MINING NEWS

The Mining News of ENGINEERING AND MINING JOURNAL is obtained exclusively from its own staff and correspondents, both in the United States and in foreign fields. If, under exceptional conditions, material emanating from other sources is published, due acknowledgment and credit will be accorded.

Leading Events

The study that is being given to the problem of finding new uses for copper is reflected in the current news in various ways; a factory is said to be planned in northern Michigan for making automobile gears of hardened copper after a process devised by Bruce A. Middlemiss. New Cornelia, it is said, may build a copper-rolling mill.

Reduction of freight rates on necessary supplies would aid mining communities. The Southern Pacific Ry. is said to be planning such a cut, affecting various camps in the Southwest.

The bill for liberalizing the War Minerals Relief Act

was under fire in the House last week. Representative Rhodes, chairman of the Committee on Mines and Mining, was forced by the opposition to propose an amendment that may cripple the measure.

Need for relieving the unemployed has finally become urgent in the Michigan copper country, and a scheme long planned is being put into effect. Industrial conditions in general are thought to be slowly improving, however.

The Interstate Commerce Commission has been asked to reconsider its important decision in the Gold Hunter freight rate case.

Southern Pacific Planning Cut In Rates To Aid Mines

Mining Towns on Branch Lines May Get Main-Line Traffic

A cut in freight rates is being formulated by the general traffic manager of the Southern Pacific R. R. These rates will apply upon iron and steel products, timber, coal, coke, and oil for mining camps in the Southwest. As soon as combinations with branch roads can be worked out, application will be made to the Interstate Commerce Commission to have the new rates made effective. Mining camps on branch lines like Clifton-Morenci, Globe-Miami, Ray, Ajo, and Jerome, in Arizona, and Santa Rita-Hurley and Tyrone, in New Mexico, will be given what is substantially main-line rates, effecting a saving in some instances of as much as \$8 per ton. The timber rates will apply from Pacific Coast points also.

Plan Factory To Make Gears Of Hardened Copper

Bruce Middlemiss Said To Have Devised Process Employing 3 Per Cent Alloy

It is reported from the Michigan copper country that a factory, in which more than a million dollars will be invested, is planned for the manufacture of automobile gears of hardened copper after a process worked out by Bruce A. Middlemiss. Mr. Middlemiss recently returned from Chile, where he was employed by the Guggenheim interests and where he conducted his experiments. His product, which consists of a 3 per cent alloy, is declared to be ideal for automobile gears and other important industrial uses. It has been subjected to severe tests and strains, to show its hardness and toughness. It is declared to be capable of withstanding great wear and will not chip or break.

Gold Prince Company Sued

The Gold Prince Mining Co. of Dos Cabezas, Ariz., has been sued in Tombstone by Louis McAvoy for \$11,451, alleged due for material and for assigned claims.

Boston & Montana Starts New Concentrator

The new 750-ton mill of the Boston & Montana Development Co., at Elkhorn, Mont., began milling operations on Nov. 12.

Unemployment Relief Now Urgent In Copper Country

Calumet & Hecla To Regulate This Work With Aid of Business Men

The Calumet & Hecla Mining Co. and subsidiary mines, which have decided not to resume operations this winter, will aid their former employees, tiding them over until such time as the price of copper warrants a reopening of the properties. Several thousand men are without means of support. The majority of them have been idle since April 1. Many were able to find temporary work during the summer or managed to live on their savings, but the time has come when assistance will be needed.

It is generally believed operations will be resumed in the spring in most of the Calumet & Hecla mines, but until that time the Calumet & Hecla will extend whatever aid is necessary. The cost of relief work will be large, but it is better, it is contended, to take this means of helping the men instead of reopening the mines at this time, which would only pile up copper for which there is no market and prolong the period of market stagnation.

Calumet & Hecla will use its organization in regulating the work of relief and will have the co-operation of the business men of the Calumet and Torch Lake districts. Men not formerly in the employ of the company and who are out of work will be assisted from a community fund.

Relief will consist of orders on stores for the necessities of life, such as food, clothing, and fuel. The women of the district will assist in supplying the clothing need, particularly for the children. An employment committee will co-operate to the extent of placing unemployed men in positions from time to time as work is found. The entire plan of relief will begin to function at once.

New Cornelia May Build Refinery And Rolling Mill

Proposed New Railroad to Tidewater Would Save Much in Cost of Hauling Fuel

J. C. Greenway, general manager of the New Cornelia Copper Co., recently stated at Ajo that his company, by construction of the proposed railroad to the Gulf of California (the Arizona & Sonora Ry.) would save \$300,000 a year on the transportation cost of the single item of fuel oil. It is planned to use lighterage for a while before constructing docks and wharves. Construction of the tidewater railroad, he said, is not wholly assured, but he considers the line essential in the interest of economical operation. He said that New Cornelia's plans include the possible construction of a refinery and copper rolling mill. About 320 men now are employed at Ajo of the normal force of about 1,000.

Wins Calumet & Arizona Prize for Suggesting Use for Copper

A prize of \$50 offered by the Calumet & Arizona Mining Co. for the best suggestion for increasing the uses of copper was won by Charles Clason, a Bisbee building contractor, who suggested that solid brass be used in buildings, instead of the present "shoddy" imitations of iron, washed with a brass solution, yet selling at a very high price. He has estimated that every dwelling should contain about 100 pounds of brass and that his idea, if carried out, would mean added copper consumption by 65,000,000 lb. a year. The Copper and Brass Research Association, of New York, is sending to Arizona points an exhibit of uses for copper and brass.

J. D. Wolf Appealing from Decision in Suit Over Flotation Patent

In the account of the case of J. D. Wolf against William M. Baldwin published in the *Engineering and Mining Journal* of Nov. 12, 1921, the ruling of the court was slightly misrepresented, according to Mr. Wolf. We

publish his full statement as follows: "J. D. Wolf, the plaintiff, an inventor, and owner of what is claimed to be the basic patent for aerial frothing flotation processes, sued William M. Baldwin, a capitalist, for breach of a contract to exploit and finance the patent. No question of any infringement of the patent was involved and its validity was admitted at the trial. The judge refused, as a question of law, to admit any testimony offered by the plaintiff as to his damages and directed the jury to award the plaintiff the sum of \$600 due to him for wages, about which there was no dispute, and, if they found there had been a breach of the contract, to award him a further sum of 6c. In accordance with this instruction of the judge, the jury found there had been a breach and awarded the plaintiff \$600.06. Mr. Wolf is appealing from the judgment."

Industrial Conditions Improved in Northwest

Greater Optimism Prevalent—Radicalism Disappearing—Discoveries of New Ore More Frequent

BY HILLIARD W. POWER

Spokane.—With the fourth quarter of 1921 well started, there is a much better tone prevalent in mining sections and districts of Oregon, Washington, Idaho, and British Columbia tributary to Spokane than was noticeable at the end of 1920. Though production and other activities have not materially increased as compared with a year ago, an undercurrent of optimism is appreciable; a realization among mining men and investors of the Northwest that the worst of the current depression has passed. It is felt, however, that recovery will be slow.

Compared with many other metal-mining areas, the Northwest has been

rather fortunate, inasmuch as silver has been an item of considerable importance in helping to keep the industry on a more even keel during the time of stress than would otherwise have been possible. Had it not been for the Pittman Act, mining in the Northwest would certainly be in a much worse condition than it is. With its continued aid, and the prospect of lead being the first of the base metals to show a marked recovery from the depression caused by the post-war readjustment period, the outlook is decidedly better than earlier in the year.

A factor of no small importance in the improvement anticipated is the willingness of labor to give a fair day's work for a fair day's pay. A tendency to radicalism, which appeared to increase as wages went up to the peak of two years ago, has waned to nothing but a shadow. In the silver-lead districts of British Columbia, where the One Big Union movement had reached threatening proportions in the spring of 1920, the O. B. U. element has been so thoroughly discouraged as to remain nothing but a memory. South of the international boundary line the popular sport of the radical element among laboring men of making things unpleasant and unprofitable for capital by I. W. W. activities has been succeeded by a pathetic desire to hold the job. Consequently, where, a year or two ago, radicals would sometimes make an effort to set fire to mine property, because there was a reasonable assurance of another job just around the corner, the same men now feel inclined to get out and fight any element that promises destruction of their jobs. Though wages in mining sections generally have not been readjusted to the pre-war basis, as have the prices of copper, lead, and zinc, the improvement in quality and quantity of work delivered has been most marked. There is also a willingness

on the part of common labor around mines to make an effort to become skilled, as it is noted that the competent man has much less trouble securing connection with a payroll than the laborer.

It has also been noted that new and important strikes have been more numerous lately. The majority of these are on prospects or partly developed mines. In a territory such as the Northwest, an epidemic of new finds almost inevitably follows or is contemporaneous with a period of acute business depression. The reason apparently is, that instead of sitting around waiting for something to turn up or for a capitalist to buy a group of claims, the owners are forced by necessity, like the hen, to go out and scratch for it. The majority, of course, find nothing; but there is always a certain proportion who do.

Reduction in freight rates on ores to the Bunker Hill smelter at Kellogg, secured only lately, is looked upon as a factor of no small importance in further improving mining conditions throughout this territory. There are indications of a brisk competition arising in the near future among large metallurgical interests for ore, particularly lead, and more especially lead ore or concentrates fairly free from zinc. All of this is to the advantage of the producer of silver-lead, which is the backbone of operating profits in the Northwest.

Mount Morgan Gold Miners Refuse Wage Reduction

By Reuters Agency

Brisbane, Oct. 31.—The members of the Rockhampton branch of the Australian Workers' Union have declined to resume work at the Mount Morgan gold mines under the award of the industrial arbitration court which reduced their wages by 20 per cent.

NEWS FROM WASHINGTON

By PAUL WOOTON
Special Correspondent

War Minerals Relief Bill Crippled

Measure Under Fire in House—Rhodes Forced To Propose as Committee Amendment That Funds To Meet Awards Must Be Reappropriated—Vote Blocked

AN EFFORT to kill the bill providing for the liberalization of the War Minerals Relief Act failed on Nov. 9, when the House voted down decisively an amendment by Representative Cramton, of Michigan, to strike out the enacting clause of the measure. Another amendment, however, provides that any funds to be used in meeting awards made under the bill must be reappropriated. This action all but thwarts the benefits expected to be derived from the legislation, as it is recognized that it will be difficult to secure the reappropriation of the funds necessary to meet new awards.

The House devoted practically its entire day to the discussion of the bill, which bears the number S. 843. The

bill passed the Senate on June 17. It has been on the House calendar since Aug. 2.

Representative Rhodes, the chairman of the Committee on Mines and Mining, explained that the bill had the support of all members of the committee. The principal reason for passing the measure, he declared, is to permit an equitable application of the relief intended in the original war minerals act. He took issue with those who contended that the proposed changes in the law would give rise to abuses and enable spurious claimants to benefit by it. He presented a statistical statement showing that the total amount of awards to Oct. 15 was \$3,355,008.37, and that the total amount of administrative expense to that date had been \$301,227.92.

When these amounts are deducted from the original appropriation of \$8,500,000, there remains \$4,843,763.71, the unexpended balance of the appropriation. The statement also shows that were the ratio of awards to continue in the consideration of claims which had been disallowed on the ground of no specific request or demand, the unexpended balance would be drawn on only for \$2,795,289.68. It was also pointed out that a considerably higher ratio of award could be made without exceeding the limit of the original appropriation.

There was little opposition to the provisions of the liberalization bill which would admit claims which were mailed prior to June 2, 1919, or to the authorization that payments be made in claims where clerical miscalculations had crept in. The opposition was centered almost entirely on the provision allowing a published request to be regarded as a cause for stimulation.

It was argued by those opposing the bill that the Government had encouraged industries of all kinds to make

provision for increased production. Labor was induced to undertake employment at points distant from home. When these plants were suddenly closed with the ending of the war no provision was made to compensate these men for the losses entailed by changes of habitation and the expense of return. The wheat grower took his losses. The cotton grower took his. No bill was introduced proposing to reimburse farmers and laborers. It was a discrimination in the interest of a small class of war contractors. Arguments to this effect were advanced by several members. A strong point was made of the contention that money could be found to compensate contractors, but could not be found for the compensation of ex-service men.

Representative Wingo, of Arkansas, the ranking Democrat on the committee, in addition to urging the passage of the bill, made a bitter attack on Philip N. Moore, a former member of the War Minerals Relief Commission, whom he held responsible for many of the troubles of the war minerals claimants.

Representative Cramton objected strenuously to any liberalizing of the existing law. He pointed out that the claims are not legal, but are simply claims in equity.

Representative Stevenson, of South Carolina, objected to the words "or published." He said that the Government could not be expected to back ventures which were undertaken without the exercise of good judgment, or those where there was not some specific knowledge of the possibilities of success.

Representative Husted, of New York, objected strenuously to the recognition of "a mere general request appearing in a newspaper." "Every industry in this country," he said, "was stimulated more or less by general requests. If you allow relief in such cases you will have no right to deny compensation to any

industry in the country. Farmers have a much better right to claim compensation on this basis because they produced not only at the public request of the Government, but the prices they received were fixed by law. In the case of these producers of minerals, there was no price limitation fixed by law. If you pass this legislation you open the floodgates for all kinds of claims, and you are going to establish a precedent which will inundate us and which we cannot deny with any shadow of justice."

Representative Vaile, of Colorado, declared that various Government agencies so stated the situation as to create a general impression that those who knew of deposits of war minerals and who did not work them were in fact slackers. The more conscientious people of the mineralized sections, he pointed out, did not wait for a peremptory demand from the Government, but unquestioningly attempted to carry into effect the published appeals of such men as Franklin K. Lane, Van. H. Manning, and H. N. Hurley.

Representative Arentz, of Nevada, read the text of characteristic announcements by Government agencies put out for the sole reason of stimulating the development of deposits of war minerals. "Over 1,200 metal mine operators," he said, "abandoned the projects they were carrying on at the time, and responded to the Government's appeal for their services and for the use of their personal funds and diverted their energies, and in most cases their all, in seeking out these little developed or virgin deposits." He called attention to the fact that few of these properties had reached the point of actual shipment prior to the Armistice and that the national Government had forgotten its promises to these patriots of the desert and of the mountains.

Representative Black, of Texas, who led the opposition, asserted that it is a proper function of Government to stim-

ulate production of all kinds, but that it is not a proper basis for claims against the United States. He declared that the passage of the bill would mean that all other claims against the War Department and other departments which had been disallowed either in whole or in part would then have reason to demand the reopening of their cases.

The point of order which forced the amendment which crippled the bill was made by Representative Stafford, of Wisconsin. He raised the point that the bill was in effect providing an appropriation, contrary to the rules of the House. This led to a long discussion of the parliamentary point involved. The Chair, admitting that it was a very fine point involved, upheld the point of order, which forced Representative Rhodes to propose as a committee amendment a clause providing that the balance of the appropriation must be reappropriated before payments could be made on any additional awards which may be made if the liberalized bill becomes a law.

Representative Graham, of Illinois, contended that the passage of the bill means the incurring of an additional liability of \$12,000,000. He condemned the liberalizing feature, but urged the adoption of the section which would give claimants the right of appeal.

Representative Sinnott, of Oregon, reviewed the history of the chrome development during the war. He said that chrome was developed with the express understanding that an embargo was to be placed on imports and that since it had been surreptitiously lifted by a Government agency, there could be no question of the equities of those who made the United States independent of foreign chrome supplies.

The bill reached the stage of a final vote, which was blocked by a point of no quorum by the opposition. It was expected that the final vote on the bill was to have been had on Nov. 16.

NEWS BY MINING DISTRICTS

London Letter

Zinc Concentrates Coming From Australia—City Deep Taxes—Another Anantapur Gold Company To Shut Down—Gold Discovery In West Africa Poor

By W. A. DOMAN

London, Nov. 4.—For many months firms interested in the spelter industry have been "at" the government with the object of inducing it to release some of the large stock of zinc concentrates which it has on hand in Australia. There are eleven firms or companies in this country equipped for the smelting of zinc concentrates, and at the present time not a single one is working. The trouble seems to be that the authorities are averse to selling at a loss. This, however, they must do, for their contracts were entered into during the war, when prices were high, and now a very serious drop is shown.

The intention of the smelters is, of course, to find employment for large

numbers of men. Whether this can be done profitably is not yet clear, for the price at which the government is willing to release the concentrates has not been divulged. Spelter cannot be produced here so cheaply as on the Continent, partly on account of the inexperience of the workmen, and partly because of the higher wage level. As concentrates are to be shipped from Australia it is thought that the government has in view a plan for assisting the unemployed, work being naturally preferable to a dole. There does not seem to be unanimity on the subject among the different firms, but the head of one of the most important has expressed the view that profits could not be earned with concentrates at 10/- to 20/- a ton. If this be correct, there would appear to be little hope of building up a remunerative smelting industry in this country.

A comparison of the working results of the City Deep and the Crown Mines for the September quarter is rather interesting.

	City Deep	Crown Mines
Tons crushed.....	263,000	590,000
Working revenue.....	£598,885	£966,746
Revenue per ton.....	45/7	32/9
Working costs per ton.....	29/7	24/9
Working profit per ton.....	16/—	8/—
Total working profit.....	£210,260	£235,639
Taxes.....	£33,272	£25,296

Although the figures are only estimated, the City Deep appears to be taxed much more heavily than the bigger Crown Mines. In each case, of course, the revenue and the profit include the excess price obtained for the gold above the standard. As the number of ounces is not stated, working expenses cannot be properly compared. The fact that 75.5 per cent of the revenue of the Crown Mines is swallowed up in costs, as against about 65 per cent in the City Deep, is explained by the lower grade of ore available at the former mine.

The Anantapur gold field has not proved a great producer. Various companies formed to exploit it have already gone under, and now the North

Anantapur Gold Mines is about to shut down. During the twelve months ended June 30, 8,800 tons of quartz was crushed, and from the various processes 11,299 oz. of gold was obtained, realizing £61,823, of which £30,355 remained as profit. The total dividends for the twelve months were 5/6 per share on the preference and 1/6 on the ordinary. There are only 25,000 preference shares of £1 each, and 91,253 ordinary shares of £1. No further discoveries of value were made last year, and the ore reserves are virtually depleted. There are about 40,000 tons of sand on the old dump which is receiving attention. As the company has funds in hand, a copper concession contiguous to the Rakha Hills Mines is being tested.

Johannesburg Letter

New World's Stopping Record Made, It Is Claimed—September Gold Output Announced

BY JOHN WATSON

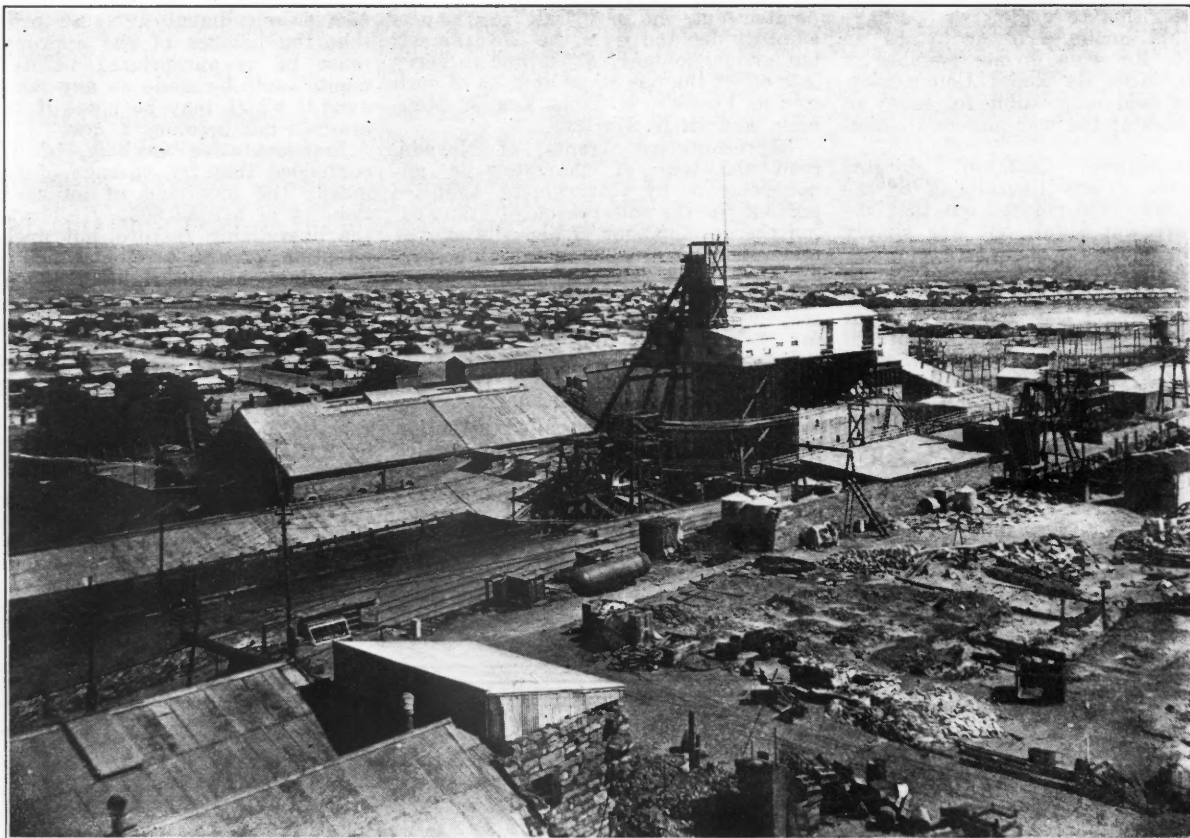
Johannesburg, Oct. 11.—It is claimed that the world's record for mine-stopping has been beaten. On the Van Ryn Deep a contractor broke a total of 248 fathoms between Sept. 2 and Oct. 1. There were twenty-six working shifts and seventy-eight machine shifts, with three machines. The fathoms broken per machine shift averaged 3.18. The stope width was 69 in. and the type of drill used was the Holman cradle hammer (C.H.2).

The rainy season here has barely

AUSTRALIA

Deal in Zinc Concentrates Effected—Rimu Gold Tries New Dredge—Mount Boppy Gold Closes Down

Melbourne—The British Board of Trade has concluded arrangements with the Electrolytic Zinc Co. of Australasia for the sale of 750,000 tons of zinc concentrates to be treated at the new Risdon works, in Tasmania. It will be remembered that the British government, to establish the zinc industry, entered into a contract with the Broken Hill producers to purchase their surplus concentrates after making provision for Australian requirements. The British industry, however, has not developed up to anticipations, and recently it has been found that the Continental



NEW MILL OF BROKEN HILL SOUTH, LTD., BROKEN HILL, AUSTRALIA, BUILT TO REPLACE THAT DESTROYED BY FIRE. CONCRETE HAS BEEN LARGELY USED IN THIS PLANT

The Aporoma Goldfields of Peru is in need of working capital. This is not surprising, seeing that little work has been done since the outbreak of war. It is proposed to raise £22,000, mainly to improve the water supply. Part of the amount has been underwritten.

To keep the East Rand Proprietary Mines in operation as long as possible, the directors contemplate reducing the monthly tonnage from about 120,000 to 100,000.

There is a good deal of talk about new gold discoveries in West Africa. At one place in particular, on a tributary of the Ancobra River, I learn that an alluvial area is being tested. Six pits have been sunk, and sixteen samples of 60 lb. each have been taken, and the average of the whole is said to be 17 dwt. Half a crown per cubic yard would be good—but 17 dwt! The syndicate interested is awaiting further information.

started. The month of September recorded a little over one inch of rainfall. Councillor Lourens has given notice of the following motion for the week's meeting of the Johannesburg Town Council: "That the council is of opinion that the only satisfactory solution of the water question is an additional supply of at least 10,000,000 gal. per diem from the Vaal River.

The gold production for September was declared Oct. 10 by the Transvaal Chamber of Mines, the total output being 691,096 oz. of fine gold, having a value of £3,801,028. September having only thirty days, accounts for the decrease of 20,430 oz. as compared with the August output. The price of gold for September has averaged £5 10s. per fine ounce. The August figure was £5 11s. 6d. The native labor returns show 187,375 total natives employed on gold, coal and diamond mines, being an increase of nearly 3,000 over August.

smelters can obtain supplies from other sources at a lower price than the British government was prepared to take. The fact that production at Broken Hill has recently been so much below normal has made it possible for the Electrolytic Zinc Co. to take over the large tonnage of concentrates which is still stocked at Broken Hill and Port Pirie. The terms of the purchase have not been disclosed, but they are officially stated to be satisfactory.

The Mount Boppy Gold Mine, the largest operating mine in the Cobar district, New South Wales, has closed down owing to the high cost of labor and supplies. The mine was controlled by a London company, and for many years was known as the premier gold producer of New South Wales. It was worked almost continuously for twenty-one years, and to the end of 1920 produced 420,965 oz. of gold, valued at £1,756,138.

The American controlled Rimu Gold Dredging Co. at Hokitika, New Zealand, has had a trial run of its new dredge, the South Hokitika, which is electrically operated, power being obtained from Lake Kaneira. The plant is said to be the most modern operating in New Zealand. The dredge master, Mr. Lewis, has had experience in similar plants in the United States.

CANADA

British Columbia

Carmi Mill To Be Completed Next Spring—Conditions in Slocan Improved.

Nelson—A contract has been let to Scrogie & Ewing, of Rossland, for driving 50 ft. of tunnel and 250 ft. of raise on the Granite, of the Granite-Poorman holdings.

Grand Forks—Owners of the Union mine may install a flotation mill to treat a large quantity of low-grade ores, running about 0.12 oz. gold and 11 oz. silver per ton.

Carmi—It is officially announced that the mill of the Carmi Mining Co. will be completed during the spring of 1922.

Sandon—A distinct improvement in mining activity is noted throughout the Slocan generally. Lessees at the Rambler-Cariboo have made their initial shipment, and the Rosebery-Surprise company, operating the Bosun mine, near New Denver, is again marketing concentrates. Marked activity prevails around the Utica mine, on Twelve-Mile Creek, with O. C. Thompson, lessee, preparing for active development this coming winter. Silversmith's mill construction program is nearing completion, and with the recent improvement in freight rates to American smelters and prospects of competition for the high-grade silver-lead ores of the Slocan by smelters, the mining situation has materially improved over what it was a year ago.

Trail—Ore shipments received at the Consolidated smelter the week ended Nov. 7 totaled 11,307 tons, the shippers being as follows: Horn Silver Mine, Similkameen, 43 tons; Grant, Woodberry, 2; Jesse Bluebird, Woodberry, 21; Josie, Rossland, 96; Molly Hughes, New Denver, 27; Ottawa, Slocan City, 26; Queen Bess, Alamo, 33; Rambler, 32; Violet, Woodberry, 4; and company mines, 11,023.

Stewart—All the towers in connection with the aerial tramway of the Premier Mining Co. have been completed, and most of the work at the upper end has been done. At present operations are being pressed forward on the bunkers at the dock. Additional and better storage and shipping facilities are to be provided at tidewater. The construction of a trail up the north fork of the Marmot River has been of much assistance to prospectors and claim holders in that district. The owners of the Idaho Group expect to ship about twenty tons before the spring.

Ontario

Nipissing's October Production Good—Wright-Hargraves Declares First Dividend—Gold Found in Gauthier Township

Cobalt—In October the Nipissing mined ore of an estimated net value of \$258,768, but did not ship any bullion. This output is considerably in excess of the best month for this year and exceeds the corresponding month last year. It is no doubt due to the Sixty-four vein, which in one place

showed 26 in. of 2,600 oz. ore. During the month the low-grade mill treated 6,756 tons and the high-grade mill 176 tons.

The fiscal year of the Coniagas ended Oct. 31, and it is understood that the output was approximately 1,200,000 oz. which is the best record for several years. No estimate is yet available of the costs or profit but costs per ounce were considerably less than for the previous year. Ore reserves will not be estimated but conditions remain about the same as at the end of last year. The average grade of the ore was under 10 ounces per ton.

Kirkland Lake—The Wright Hargraves which started milling only last May has already entered the lists of the dividend payers by the declaration of a 5 per cent dividend payable Jan. 1. The company has an issued capital of \$2,750,000.

The shaft being sunk by the Associated Goldfields, of Larder Lake, on the recently acquired Costello claims will shortly reach 110 ft. when cross-cutting will be started. Work has been stopped on other parts of the company's ground on which so much money has been raised and spent and it is understood that the management has practically abandoned all hope of finding anything of value on this portion. The company has been through a number of reorganizations, the last one being for a capitalization of \$30,000,000.

The directors of the Bourkes mine have passed a by-law raising the capital from \$2,500,000 to \$5,000,000 and will offer \$1,700,000 of the new stock to shareholders in proportion to their holdings. A shareholders' meeting will be called for Nov. 19 to consider and ratify the by-law.

A new gold discovery has been made near the Argonaut mine in Gauthier township. The vein has been stripped for a considerable distance and shows a width of 3 ft., and carries considerable iron and copper sulphides in addition to gold values.

Porcupine—The new shaft planned by the Hollinger Consolidated Gold Mines will probably be sunk near the south side of the property and comparatively close to the boundary of the Vipond-North Thompson. The fact that the greenstone schist, in which the greatest of the Hollinger orebodies occur, is dipping sharply toward the south, is considered highly important as affecting the position of the V. N. T.

MEXICO

Chihuahua

Ahumada Stockholders To Meet at Juarez

Chihuahua—The Ahumada Mining Co., with headquarters in Ciudad Juarez and mines in various parts of the state, has issued a call for a general meeting of stockholders to take place at the offices of the company in Juarez on Dec. 5. The meeting has been called by the secretary, H. B. Harding, for the purpose of hearing the annual report of the directors for the last year and discussing plans for future operations. Some changes will probably be made on the board of directors.

The Cia. Minera Carmelita and the Laura mining company will hold a joint stockholders' meeting in Chihuahua City on Nov. 24 for the purpose of electing new officers and transacting business. R. E. White is president of both of these companies.

Sinaloa and Durango

Rise in Silver Causes Increase in Activity in Culiacan

Culiacan—In the Badiraguato district the old Guajolote mine is being worked by Messrs. Cochran and Coffee. The deposit is a free milling gold ore running about 0.7 oz. in gold and well in silver. A mill has been built and recent development work has opened up large ore reserves.

The Los Cuates mine in the same district, belonging to the Piero family, of Pericos, and under lease and bond to J. Q. Kiler and associates, is being opened up, and it is reported that they have struck good ore.

The San Luis Gonzaga mine, being worked by F. E. Avery and associates, from Columbus, Ohio, is being developed as fast as is possible with hand drills. The operators have an abundance of water power developed and will soon install a compressor with air drills.

The Rosendeña mine, belonging to J. Q. Kiler, is under option to Arizona capitalists, who will soon begin unwatering, with the purpose of installing a concentrator.

In the Sinaloa district, the Bacubarito Placer Mining Co. has shipped in twelve carloads of dredge machinery, which is being hauled from the station of Casal to Bacubarito, where the company possesses placer deposits. This is a Mexican company composed of prominent capitalists in Mexico City.

In the Mocorito district, the property being worked by Gaston Schwod and Zerapio Lopez and Ernesto Espinosa is said to be giving good results. They have installed a small stamp mill and are treating a free-milling gold ore with amalgamation.

The Potero, also in the Mocorito district, is again working to full capacity after a short shutdown due to an accident to some of the machinery.

At the mine of the Palmarito Company in the Mocorito district, the development work is progressing in the three-compartment shaft. Good ore is said to have been encountered on the 100 level.

In the Santa Cruz district, the cyanide plant being operated by J. R. Rogers is making regular shipments of silver bullion. Old dumps left by the old West Coast Mining Co. are being treated.

In the Tamazula district of western Durango, the Zalate mine, being worked by Ramon Espinosa, has encountered rich ore as the old workings are being cleaned out and unwatered.

The Providencia property, belonging to Primitivo Zazueta, in Tamazula, has been purchased by a London syndicate, which will install a reduction plant to treat the gold ores of this mine.

In the Tamazula district Messrs. Foreman and Pike are developing their gold property on the Sianori Creek. A mill to treat these ores will soon be installed.

The rise in the price of silver has caused considerable activity in mining circles, as with silver around 70c. there are a number of properties which can work at a profit. New denouncements continue to be registered in the mining agency, and mining properties are changing hands which have been abandoned since the beginning of the revolution in 1910. The country is absolutely peaceful, and at present it is perfectly safe to go anywhere without fear of molestation.

ARIZONA

Smith-Hovland Case Before U. S. District Court—Magma Chief Investigation Dropped—Jerome Verde Property Formally Transferred—Dundee-Arizona To Sell Stock

By JAMES H. McCLINTOCK

Phoenix—The long-continued case in chancery of Hoyal A. Smith, against Henry B. Hovland has at last reached the United States Court for the District of Arizona, following the report of Edwin F. Jones of Tucson, who has acted as master in chancery. Briefly, the report is that the two litigants entered into a verbal agreement of partnership, of date of Jan. 1, 1905; that the partnership has been dissolved; that the debts of the partnership, with a single exception, have been paid from a sale of partnership assets, and that no accounting between the partners has been made. On this foundation and upon the basis of evidence that came mainly from the parties at interest, the master has decided that Hovland owes the partnership more than \$1,000,000 and that Smith is entitled to credits aggregating \$187,460.76.

The men were close friends when they joined in investments in mines, work for which they had been prepared in the same school, and they deemed the signing of a partnership agreement unnecessary. They had dealings involving the handling of millions of dollars, in connection with the purchase and sale of large properties in the Bisbee and Miami districts. Following a disagreement, this in the language of the master's report, "they met as enemies. They both sat here (in Tucson) during the whole of this trial, for more than a year, without in any manner acknowledging the presence of the other. Their testimony is colored by their animosity and hatred of each other." The trial began in February, 1920, and has occupied most of the intervening time, with massing of infinite detail concerning the joint and separate operations of the principals.

The Arizona Corporation Commission has dropped its investigation into the affairs of the Magma Chief Copper Co., a corporation which started operations in the Superior district and which later purchased the Sombrero Butte property, near Mammoth, Pinal County. Statement was made by the commission that the evidence submitted did not substantiate the charges of mismanagement.

At Miami, much work is to be done on the reverberatory furnaces of the International smelter before one of them can begin handling the 40,000 tons of concentrates now crowding the bins of the Miami Copper Co. Masons must be secured for repairing the furnace brickwork and for completing the connections with the new stack and converter flues. L. O. Howard, superintendent, says that all will be in readiness by Nov. 20. Work is to be started in the Sulphide tunnel, to secure silicious ores for fluxing the concentrates and for feeding the Inspiration experimental leaching plant, in which work is also to be resumed at an early date.

The property of the Jerome Verde Copper Co. at Jerome, inclusive of 27 full claims and several fractions, has been formally transferred to the Jerome Verde Development Co., for

an announced consideration of \$420,000, subject to a mortgage lien held by the Registrar & Transfer Co., of New York. The transaction is one in which the United Verde Extension Co. practically takes over the Jerome Verde, thus materially increasing its available acreage. The property acquired is one of the largest in the Verde district, with central and advantageous position, adjoining both United Verde and Extension, available for development from either. Despite its situation, only one lens of really good copper ore ever has been developed in Jerome Verde, though the formation at several points is declared to be favorable.

Dundee-Arizona Copper Co. has secured permission from the Arizona Corporation Commission to sell 61,120 shares of stock at \$1 a share. Though Dundee is active on the curb, very little of its stock is in other than a few hands. The new money is needed for deep exploration. The mine is one of the smallest in the Jerome section, having only two full claims, centrally located, next to the U. V. Extension ground and a short distance from the Extension service tunnel. It has a large deposit of surface carbonates and is said to have good indications of worth-while sulphides in the lower levels.

Globe—Superior & Boston is doing extensive development work in silver-bearing ground, north of the main shaft, drifting east and west from a new shaft at 55-ft. depth. Concentrates shipped have returned about \$200 a ton.

Oatman—Tom Reed has dropped about 100 men during the last month, which is said to be due to the cost of handling ore that might be profitable under better conditions. It is reported that only the higher grade will be handled. Much of the ore being milled is coming from the Aztec section of the mine.

NEW MEXICO

Question of Reduction in Freight Rates Receiving Attention of Traffic Men

By JAMES P. PORTEUS

Lordsburg—The most encouraging event for mining in this section is the effort now being made by railroad traffic men in the direction of a reduction in freight rates on mine necessities, timber, fuel, and steel. The new rates will be effective as soon as the formalities can be completed. These rates cover shipments into the mining centers and are intended directly to assist the industry. A reduction on coal rates from Gallup, Dawson, and southern Colorado points has already gone into effect in southwestern New Mexico. The saving over the old rate will be from 50c. to \$1.04 per ton.

Railroad freight men have not hesitated to admit that the present local ore rates were practically prohibitive. One of the executives remarked soon after the last blanket raise in rates, which so effectively stopped ore shipments, "It is evident that freight rates on ores are too high. There are millions of tons of low-grade ore in this territory [Arizona and New Mexico] that could be moved at lower rates. It would seem to be better to reduce the rates and move the tonnage at a small profit than to let the cars lie idle."

COLORADO

Commerce Commission Asked To Reconsider Gold Hunter Freight Rate Decision

Denver—Colorado ore shippers are advised that the Interstate Commerce Commission has been requested to reconsider its decision in the case of the Gold Hunter Mining & Smelting Co., in which the commission found that freight rates on ore or concentrates based upon gross values were unreasonable.

To this decision Commissioner Daniels and Hall both dissent, in that they believe that for general application the gross-value method for rate making is preferable to a net value.

This decision was discussed at some length in *Engineering and Mining Journal* of Sept. 24, 1921, p. 508.

The Colorado mining organization has asked the American Mining Congress at Washington to oppose vigorously any action by the Interstate Commerce Commission that would revoke decision or have a tendency to sustain rates based upon gross valuation.

UTAH

Chief Consolidated Gets Control of Eureka Lily

Salt Lake City—Mine operators and railroad traffic officials of Utah, Nevada, and California have been invited to attend a conference to be held under the direction of the Public Service Commission in Nevada at Carson City. The meeting has been called for the purpose of discussing the possibility of reducing freight rates to the smelters from mining districts in the three states.

Eureka—Ore shipments from the Tintic district for the week ended Nov. 5 amounted to 168 cars, as compared with 191 cars the week preceding. Shippers were: Tintic Standard, 81 cars; Chief Consolidated, 39; Eagle & Blue Bell, 12; Iron Blossom, 11; Colorado, 6; Swansea, 7; Empire Mines, 3; Gemini, 1; and Sunbeam, 1.

The Chief Consolidated has gained control of the Eureka Lily, which adjoins the Tintic Standard. The Water Lily shaft in the Chief's most easterly holdings, which was sunk by Walter Fitch, Jr. Co. under contract, has been deepened 1,106.8 ft. in the three months ended Oct. 18. This makes an average of 368.9 ft. per month, maintained in spite of the fact that during the last ten days of the record the presence of gas in the bottom of the shaft made it possible to work only one shift a day. This record includes the present world's record for shaft sinking of 427.5 ft. in thirty-one days. The shaft is now down 1,250 ft.

The Chief Consolidated is opening up its newly acquired limestone quarry, and has so far proved a deposit of limestone of good grade over 125 ft. thick, 200 ft. along the strike of the beds, with an average depth of 70 ft. This block of ground is estimated to contain about 175,000 tons of marketable limestone.

Ore running well in silver has been struck by lessees in the Butcher Boy mine, formerly the Showers Consolidated, in South Tintic. The ore is in a winze 50 ft. below the tunnel level.

Park City—Shipments for the week ended Nov. 5 were 1,979 tons. Shippers were: Judge allied companies, 923

tons; Silver King Coalition, 568 tons; Ontario, 428 tons; and New Quincy, 50 tons.

At the Silver King Consolidated pyrite is increasing in the breast of the Spiro tunnel, which is being driven under the Thaynes canyon section, and quartz and other vein material is beginning to appear. The D. & M. fissure is expected to be cut soon. The ground is somewhat fractured and there is a large flow of water. The contact raise has reached black limestone, and drifting is to be started. On the 275 level a flat vein of galena is reported to be getting stronger and improving with every round. There is a heavy flow of water in the Iron drift.

Salt Lake City—The Alta Tunnel & Transportation Co. has received a settlement for the fourth lot of ore shipped since Oct. 1. This ore averages 46 oz. in silver. Difficulty is being experienced in securing enough teams to move the ore from the bins to the main canyon, where the ore is transferred to trucks. The ore is making out on the limestone bedding from the fissure, and on the south side of the stope bedded ore is 6 ft. thick, and it is stated will run 50 oz. This face is 30 ft. from the mineralizing fissure. Good progress is being made in advancing the east drift on the tunnel level.

The Big Cottonwood Coalition Mines Co. has completed arrangements for continuing development during the winter. The property consists of seventy-two claims in the Big Cottonwood mining district, a quarter of a mile from the Brighton road. An electrically driven compressor, transformers and other equipment have been purchased. The tunnel, which is in 3,388 ft., is being driven under contract.

Milford—A tunnel is being driven on the Galena Mining Co.'s property in the Beaver Lake mining district. This tunnel is following a fissure toward an old shaft from which ore was mined in the early days.

IDAHO

Cyanide Gold Mining Co. Buys Equipment—United Metals Lets Drifting Contract.

Seafoam—A contract has been let by the United Metals Co. for 150 to 500 ft. of drifting, with a view to placing the property on a producing basis by spring. Directors of the company have also provided funds for building a stamp mill early next season.

Lakeview—Development of the Moonlight group, adjoining the Weber property, has opened up a 2-ft. vein of high-grade silver ore carrying gold.

Bonnors Ferry—A three-drill compressor and complete equipment has been purchased by the Cyanide Gold Mining Co., operating the old Buckhorn mine, in the northeastern corner of Boundary County.

WASHINGTON

Old Dominion Exploring Recent High-Grade Discovery

Colville—Following the completion of installation of ventilating equipment and some necessary timbering, drifting on the showing of extremely high-grade dry silver ore found in the Old Dominion mine in September is being continued, and with encouraging results.

Kettle Falls—The long tunnel of the Silver Queen Mining Co. has cut the vein at a distance of 1,100 ft. from the portal.

OREGON

Good Ore Being Taken from Bay Horse Mine.

Huntington—The Bay Horse mine, which resumed developments early this season, following several years of inactivity, continues to improve to such an extent as to lead to the belief that it may rank among the important mineral producing properties of the state. The general average of the ore is high through the mineralized zone that traverses the company's property for the length of three claims. The value is in silver. About five tons of high-grade ore is stoped per day.

MONTANA

Black Rock and Emma Mines May Resume Production Soon—Tarbox Levies Assessment

By A. B. KEITH

Butte—It would occasion no surprise were the development force increased at the Black Rock mine of the Butte & Superior Mining Co. In fact, there has been much talk that production might be resumed soon. The ores of the Black Rock mine run well in silver, in addition to their zinc content. Development of the body of copper ore discovered some time ago is proceeding satisfactorily. The drift on the 2,200 level continues in copper ore averaging 4 per cent or over, and this has served to encourage the belief that the 2,600 level will show not only as good ore but also a larger tonnage of it, in view of the history of other "northwest" veins.

The management of the Anaconda Copper Mining Co. is said to be thinking of resuming production at the Emma mine, the silver ores of which are sufficiently rich to warrant their extraction with the smelters of the company in operation. The Emma mine, which is owned by the Butte Copper & Zinc Co., has been kept clear of water during the suspension of operations.

The Tuolumne company in a crosscut from the main drift on the 1,600 level of the Main Range mine cut through a number of streaks of gray copper ore running well in silver. Though the showing disclosed no particular tonnage, it appeared to indicate a more mineralized area in the vein, in which section further development work will be done. This is in a portion of the vein to the west of the crosscut through which the vein was first opened. Drifting easterly has been resumed.

The Elm Orlu Mining Co.'s operations on its upper levels have disclosed indications of a considerable tonnage of silver ores, upon which the Timber Butte mill is operating to advantage. It has been necessary to work out milling problems in effecting a proper saving of the silver, as gray copper appears. Satisfactory results are said to have been obtained. Milling operations for some time have been claimed to be a model for efficiency, both as to the recovery of zinc as well as that of silver and copper.

North Butte's development work on the 3,600 level of the Edith May vein is reported to be progressing satisfactorily. Opening of the fissure at this depth is expected to put into sight a considerable tonnage of high-grade copper ore.

Saltese—The Tarbox Mining Co. has levied an assessment of 5 mills per share, payable Nov. 11 and delinquent Dec. 30.

NEVADA

Rochester Silver Corporation May Finance New Candelaria Mill—New Camp at Royston Active

Rochester—The Rochester Silver Corporation shipped bullion valued at \$40,407 early in November. This represents the clean-up for the last half of October and is larger than for any equal operating period during the last two years. It is rumored that the company is prepared to finance the building of a mill at Candelaria for the Candelaria Mines Co. This latter company has developed over \$2,000,000 worth of ore in its property at Candelaria and considers the property ready for a mill, but construction has been delayed for financial reasons.

Eureka—In the Eureka Croesus the Catlin shaft has reached a depth of 650 ft. and will be continued to the 1,000 level. In the Bullwhacker favorable developments are reported in a drift on the 430 level. The Eureka Holly is crosscutting on the 500 level and the crosscut has about reached the projected position of an important orebody.

Hornsilver—The south crosscut from the shaft on the 700 level of the Orleans Hornsilver entered ore at 35 ft. The grade is not reported to be very high as yet, but there is still time for improvement, as no hanging wall has been reached. The shaft is to be sunk to the 800 level.

Tonopah—Bullion shipments since Nov. 1, and representing clean-up of operations for the last fifteen days of October, are as follows: Tonopah Extension, \$43,600; Tonopah Mining, \$45,600, and West End, \$62,600. The Belmont and MacNamara shipments have not been reported. The West End is mining from 6,500 to 7,000 tons of ore per month, which is the largest tonnage in its history. The best ore is being mined from the Ohio vein, but the West End vein continues to produce nearly half the total tonnage, and some ore of milling grade is being mined from the Fraction and Footwall veins. In the Midway, operations of leasers in the old workings are proving profitable. From the new shaft, on the 1,530 level, the north and south crosscuts are now out about 700 ft. from the shaft.

Royston—In this new camp, which has been rejuvenated, and which is situated about twenty-eight miles north of Tonopah, in the San Antone mining district, considerable surface work is being done, and several shafts have been started. Thus far most of the operators are lessees, although new companies are being organized and preparing to begin work. On the Betts, or original lease, the deepest hole is down about 25 ft. The vein was 10 in. wide at surface and has widened to 2 ft., and is rich, assaying several hundred ounces of silver per ton. It is claimed that the vein outcrop has been traced for over 1,000 ft., but the meager work done to date, in addition to the fact that vein is narrow and outcrop hard to follow, leaves some doubt as to its proven continuity.

Ely—The Nevada Consolidated Copper Co. is still engaged in the development of the Ruth mine, and the high-grade copper orebody discovered about ten months ago has been proved to persist in depth, with an average value of 12 per cent copper. This is direct-smelting ore.

MICHIGAN
The Copper Country
Copper Range Increasing Force Slowly
—Quincy Starts Logging—C. & H.
To Continue To Explore Kearsarge Amygdaloid Vein
 BY M. W. YOUNGS

Houghton—The Copper Range mines continued to show a small increase in man-power in October, and refined copper production increased about 10 per cent. Both Champion and Trimountain increased their rock shipments somewhat, and Baltic maintained its September average. Champion sent 44,000 tons of rock to the mill, Baltic 19,000, and Trimountain, 12,000. Champion's yield per ton of rock was a little better than usual, and Trimountain's recovery also was above average. Baltic's yield fell off slightly, owing to a run of ground not quite up to the usual standard for the mine. An extensive program of drifting is under way in Champion and Trimountain, particularly in the latter mine. Emphasis is being placed on opening work rather than on production.

Logging operations have been started by the Quincy Mining Co. near Hancock, in a tract of timber land which it has held in reserve for many years. Labor conditions are now such that they warrant the building of roads and the cutting of this timber, which will be used entirely for underground purposes. It is in a sense a relief measure, inasmuch as it will give employment to a crew of men for several months.

A great deal of timber is still used in the mines, although some companies have been able to effect economies by the use of waste rock in abandoned stopes. This saves timber and the expense of hoisting the poor rock to surface as well. Although all round or stull timber remains in place in old workings, flat or sawed timber is recovered and used again in newer portions of the mine.

Though Calumet & Hecla has reduced its metal surplus considerably, there is still an abundance of copper in the Lake district, which accounts largely for the fact there will be no resumption of operations by the Calumet & Hecla mines this winter. The estimated production of Copper Range, Quincy, Mohawk and Wolverine, and the Calumet & Hecla refinery during the seven-months' period from April 1, the date of the Calumet & Hecla shutdown, to Nov. 1, was 45,000,000 lb. This is small in comparison with the normal output for the district, which, had all the mines been operating, would have reached 157,000,000 lb. Sales during the period, including both Lake and rail shipments, were 51,000,000 lb. Copper has been moving more freely out of the district for the last two months, and it is believed the surplus will have been reduced sufficiently by spring to warrant the resumption of mining by the Calumet & Hecla and subsidiaries at that time.

Calumet & Hecla will give attention to a continuation of exploratory work in the Kearsarge amygdaloid vein, which was cut at depth by a crosscut from the 81st level of the Red Jacket shaft, soon after general mining operations are resumed, probably in the spring. Though results of the drifting already done in this lode are only mediocre, the showing warrants further investigation. The work was stopped only because it can be prosecuted with greater facility and at less

cost while mining operations are under way in the shaft. The drifts will be extended both north and south a reasonable distance to determine whether or not the vein will become better defined and more uniformly mineralized.

Not more than 1,000 ft. of drifting remains to be done before the 81st level haulageway, which will serve Calumet & Hecla's conglomerate shafts, will be completed. No. 12 shaft, its southern terminal, will be used as a supply shaft and for the use of the miners, and the Red Jacket shaft, the northern terminal, will become exclusively a hoisting shaft. The intervening shafts will be abandoned, eliminating the cost of maintaining expensive surface plants, and the mining of the lode will be done from the haulageway. This drift will, in large part, solve the problem of deep mining costs.

H. F. Fay, president of the Mayflower-Old Colony, has arrived in the district. Work will be resumed soon at the 1,400 level of the Mayflower, where drifts will be run both north and south. Exploratory work on the 1,700 level will continue. The main drift south will be pushed. A fault recently was encountered in this opening, after passing through 300 ft. of well-mineralized ground, and a crosscut east has been started to pick up the vein again.

Extensive repairs are under way in No. 2 shaft, Ahmeek, where the concrete skipway, which has crumbled in places, will be replaced with timber. This work will keep a force of timbermen busy for several months.

JOPLIN-MIAMI DISTRICT

Southern Lead & Zinc Co.'s Property Sold—3,000 Miners Working Steadily in Picher District—Producers More Optimistic.

BY P. R. COLDREN

Joplin—F. W. Evans, president and manager of the Keltner Mining Co., which has a mine and mill at Picher, Okla., has purchased the mill and mine of the Southern Lead & Zinc Co., situated in Kansas, two miles north and one mile west of Picher, and has started it in operation.

The Southern mine was developed about four years ago, Fred C. Clark, former playing manager of the Pittsburgh National League baseball team, having been one of the principal owners. For many months it was a steady and large producer, having one of the good concentrators of the field. For some months it has been idle, owing to the low price of ore. The Keltner mine, which Evans has been managing and of which he is one of the principal owners, has been a steady producer and is still being operated. The consideration in the deal is said to have been on the basis of \$150,000.

The Euterpe Mining Co. is changing from electrical to oil engine power at its mine, in Kansas, just north of Hockerville, Okla. It has so far installed one 185- and one 125-hp. engine, and two more of similar size are to be installed and in operation by Dec. 15. The sinking of a third shaft at the mine is to be started at once. The company is operating two shifts in the ground and one with the mill.

Ed. Boyle, chief mining inspector for the State of Oklahoma, has visited the Oklahoma section of the field and reports increased activity, with prospects for further increase. Last week the Mahutska and White mines, at Picher,

resumed operation, and it is stated the Piokee and the Victory Metal will be started up in the immediate future. The Blue Ribbon mine, at Hockerville, is also operating again, after a shutdown of several months, and the Haines mine, at Commerce, has also resumed. Mr. Boyle states that about 3,000 miners are now being given steady employment in and around Picher.

At the meeting of the Tri-State branch of the American Zinc Institute at Picher on Nov. 9, several members of the Ottawa County Medical Society reported that there is little unemployment in the district and very few cases of poverty-stricken people unable to feed and cloth themselves. They expressed the opinion that the mines now operating in the field will be able to give work to all reliable miners wanting work this winter, provided no more miners are encouraged to return to the field. Many who left early last spring or in midsummer have not returned.

There is a general feeling of optimism throughout this field that seems to be growing despite the slow rise in ore prices. Producers are talking and believing that zinc ore will be selling for at least \$30 before spring. If it is, renewed activity at probably twenty-five mines that are now idle may confidently be predicted.

WISCONSIN

State Industrial Commission Holds Hearing on Proposed Safety Regulations—Vinegar Hill Opens New Ore at North Unity

BY J. E. KENNEDY

Platteville—The Wisconsin State Industrial Commission held a public hearing in Platteville on Nov. 4 on proposed general safety orders for mines, recommended for adoption by an advisory committee appointed last winter by the commission to draft more comprehensive and better safety orders for all mining operations in the state. The state commission has had general safety orders on lead and zinc mines since February, 1916, but they are recognized to be too general to be satisfactory. There have been no orders heretofore relating to safety in iron mining. The committee at a later date will conduct a hearing at Hurley or Rhinelander upon the proposed orders for iron mines.

The advisory committee is composed of the following members: E. R. Shorey, University of Wisconsin, Madison; H. B. Morrow, School of Mines, Platteville; J. J. Handley, Wisconsin Federation of Labor, Milwaukee; James Billingsley, Frontier Mining Co., Galena, Ill.; John J. MacCullough, Vinegar Hill Zinc Co., Platteville; T. H. Garnett, Mineral Point Zinc Co., Galena, Ill.; A. M. Plumb, Wisconsin Zinc Co., Platteville; A. A. Bawdon, Odanah Mining Co., Hurley; Dr. J. J. Rutledge, U. S. Bureau of Mines, St. Louis; and A. D. Findeisen and R. McA. Keown, Industrial Commission, Madison.

The Vinegar Hill Zinc Co. has opened up a new run at the North Unity mine, making forty tons of lead concentrates per week, in addition to an increased output of blende. This company is now operating the Dale, a new property at Livingston.

Local prospectors have struck a good deposit of lead in a shaft on the Cook ground, east of the old Dall mine. The Blockhouse company has its No. 2 mill inclosed.

THE MARKET REPORT

Daily Prices of Metals

Nov.	Copper, N. Y., net refinery*	Tin		Lead		Zinc
	Electrolytic	99 Per Cent	Straits	N. Y.	St. L.	St. L.
10	12.875@13.00	28.125	28.375	4.65@4.70	4.35	4.70@4.75
11	.....	.....	.....	.....	.....	.....
12	12.875@13.00	28.125	28.50	4.65@4.70	4.35	4.70
14	13.00	28.375	28.625	4.65@4.70	4.35	4.70
15	13.00	28.375	28.625	4.65@4.70	4.35	4.70
16	13.00	28.625	28.875	4.65@4.70	4.35	4.70

*These prices correspond to the following quotations for copper delivered: Nov. 10 and 12, 13.125@13.25c.; 14, 15, and 16, 13.25c.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York, cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Tin is quoted on the basis of spot American tin, 99 per cent grade, and spot Straits tin.

we have heard of no sales made for near-by deliveries at 13 3/4c., but it seems likely that this price may be established in the next two or three days.

Export demand from Germany, France, and England has been satisfactory and Japan also has again participated in the market. The price of electrolytic copper in London is now higher than Continental parity, though this condition is no doubt a temporary one. The Copper Export Association has raised the Hamburg price to 13.50c., coincident with the increased firmness in the domestic market.

Lead

The official contract price of the American Smelting & Refining Co. continues at 4.70c. Several producers have done a quiet business during the week at this level. At least one outside interest, however, is offering ordinary lead at 4.65c., and corroding lead, which ordinarily commands a premium, is obtainable at 4.70c. The St. Louis market continues weak, with free offerings at 4.35c., a price which has been shaded in some instances. Desilverized could probably not be obtained in St. Louis for less than 4.40c., however. Desilverized lead in Chicago has sold for 4.50@4.55c. during the week.

Zinc

The week has been quiet, and only small sales are reported. The slowing down of business has had a slight effect upon prices, zinc being obtainable practically the entire week for 4.70c. No sales are reported below this level, though there are rumors that 4.675c. might have been done yesterday. Zinc is gradually but surely improving in statistical position. Stocks of zinc were reduced over 10,000 tons during October, according to figures of the American Zinc Institute. On Oct. 1 they were 81,135 tons; on Oct. 31, 70,824. Zinc production during the month was 14,538 tons; whereas shipments totaled 24,849 tons, which accounts for the decrease. The average number of retorts in operation was 26,859. At the end of the month, 27,949 were being used. Total retort capacity of the country is 155,656. The figures explain why the zinc market improved during the last few weeks. The base price of sheet zinc has been reduced from \$10 to \$9 per 100 lb., f.o.b. works, with discounts allowed up to 8 per cent.

Tin

Tin continues to exhibit a stronger tendency, and the feeling that the advance was to be only a temporary spurt has been largely dissipated. The statistical position of the metal is none too good, as large stocks are still available. However, production has been somewhat curtailed, and in fact it is doubtful if American producers can continue to keep their plants in operation much after the first of the year, as South American producers are not sufficiently well pleased with present prices to be willing to ship any concentrates.

London

Nov.	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic	Spot	3 M	Spot	3 M	Spot	3 M
	Spot	3 M							
10	66 1/2	67	74	156 3/8	158 3/8	24	23 3/8	25 3/8	26 1/2
11	66 1/2	67 1/2	74	158	160	24 1/2	23 3/8	25 3/8	26 1/2
12	...	...	...	...	...	...	...	...	...
14	67	67 3/8	75	157 3/8	159 3/8	24 1/2	23 3/8	25 3/8	26
15	66 3/8	67 3/8	75	157 3/8	159 3/8	24 1/2	23 3/8	25 3/8	26
16	66 3/8	67 3/8	75	157 3/8	159 3/8	24 1/2	23 3/8	25 3/8	26

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver and Sterling Exchange

Nov.	Sterling Exchange "Checks"	Silver			Nov.	Sterling Exchange "Checks"	Silver		
		New York Domestic Origin	New York Foreign Origin	London			New York Domestic Origin	New York Foreign Origin	London
10	39 1/4	99 1/4	68 1/8	39	14	395	99 1/4	67	38 3/8
11	39 3/8	99 1/4	68 1/8	38 3/8	15	396 1/2	99 1/4	67 1/2	38 3/8
12	39 3/8	99 1/4	66 3/8	38 1/2	16	397	99 1/4	67 1/2	38 3/8

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command one-half cent premium.

Metal Markets

New York, Nov. 16, 1921

Copper has been in good demand during the last week at increasing prices; the remaining non-ferrous metals have been quiet and steady, with no unusual demand expected during the rest of the year. Inventories are customarily made during December, and consumers do not care to carry unduly large stocks at that time. The marked progress made at Washington toward the limitation of armaments is unlikely to have any effect on the metal industry, with the possible exception of decreasing the normal demand for nickel, for the amount of any of the other metals used in armament is an insignificant proportion of the average peace-time demand.

Nov. 11 was Armistice Day, a holiday throughout the country. The next holiday will be Thanksgiving Day, Nov. 24.

Copper

On Thursday and Saturday a few producers were still quoting 13 1/4c. delivered for small amounts of spot metal, with 13.25c. being generally asked for November-December. The demand exhausted the supply, and by Monday 13.25c. was the best that could be done for any near-by delivery, with 13 3/4c. asked for January. Sales were in fairly large volume on Monday and Tuesday at these prices. Today some producers are entirely sold out of copper available for November shipment and are quoting 13 3/4@13.50c. for December-January, delivered. So far

The tinplate business is also improving, both here and in England. The recent reduction in the price of tinplate to 4.75c. has stimulated sales, and also the chief interest has allowed customers to book orders and specifications for delivery early in the new year, the finished material being held in stock until the consumer is ready for it. This is expected to result in tin-platers operating at 75 to 85 per cent capacity during the remainder of the year, instead of 50 to 60 per cent, as has been the case recently.

Tin for February delivery: Nov. 10th, 28.625c.; 12th, 28.75c.; 14th, 29c.; 15th, 28.875c.; 16th, 29.375c.

Arrivals of tin, in long tons: Nov. 7, London, 25; 12th, Liverpool, 25; Straits, 75; 14th, Straits, 775; Australia, 100.

Gold

Gold in London: Nov. 10th, 104s. 2d.; 11th, 104s. 6d.; 14th, 104s. 5d.; 15th, 103s. 9d.; 16th, 103s. 6d.

General stock of money in the United States Nov. 1, 1921: Gold coin, \$3,504,677,154; standard silver dollars, \$341,923,378; subsidiary silver, \$272,861,577; United States notes, \$346,681,016; Federal Reserve notes, \$2,713,214,310; Federal Reserve Bank notes, \$124,763,400; National Bank notes, \$743,288,847; total, \$8,047,409,682. Circulation per capita, \$52.71.

Foreign Exchange

Today sterling sold at the highest figure since last May. The rise is in part attributed to short covering. Other exchanges have been generally quiet. On Tuesday, Nov. 15, francs were 7.255c., lire, 4.1625c.; and marks, 0.385c. New York funds in Montreal, 9 $\frac{1}{8}$ per cent premium.

Silver

China exchanges have improved again, with the result that China has bought considerable silver during the last week. The Indian bazaars, on the other hand, continue to keep out of the market. The market closes quiet, with tendency uncertain.

Mexican Dollars—Nov. 10th, 52 $\frac{1}{2}$; 12th, 51; 14th, 51 $\frac{1}{2}$; 15th, 51 $\frac{1}{2}$; 16th, 51 $\frac{1}{2}$.

Other Metals

Quotations cover wholesale lots unless otherwise specified.

Aluminum—List prices of 24.5@25c. are nominal. Outside market, 17.50@18c., with practically no sales.

Antimony—Chinese and Japanese brands, 4.70c.; W. C. C. brand, 5.25@5.75c. per lb. Cookson's "C" grade, spot, 9c. per lb. Chinese needle antimony, lump, nominal at 4c. per lb. Standard powdered needle antimony (200 mesh), nominal at 5.25c. per lb.

White antimony oxide, Chinese, guaranteed 99 per cent Sb₂O₃, wholesale lots, 6 $\frac{1}{2}$ @7c.

Bismuth—\$1.50@1.55 per lb.

Cadmium—Range \$1@1.10 per lb., in 1,000-lb. lots. Smaller quantities, \$1.10@1.25 per lb.

Cobalt—Metal, \$3@3.25 per lb.; black oxide, \$2@2.10 per lb. in bbls.

Iridium—Nominal, \$150@170 per oz.

Molybdenum Metal—In rod or wire form, 99.9 per cent pure, \$32@40 per lb., according to gage.

Nickel—Standard market, ingot, 41c.; shot, 41c.; electrolytic, 44c. Small ton-nages, spot, 35@38c. Market dead.

Monel Metal—Shot, 35c.; blocks, 35c., and ingots, 38c. per lb., f.o.b. Bayonne. Osmium—\$70 per troy oz. Nominal. \$70, Los Angeles, Cal.

Palladium—Nominal, \$55@60 per oz. Platinum—\$85 per oz. The market is weaker. Practically no sales have been made.

Quicksilver—\$39@41 per flask. San Francisco wires \$41. Market dull.

The prices of the following metals remain unchanged from the figures published in these columns on Nov. 5: Rhodium, Selenium, Thallium, and Tungsten.

Metallic Ores

Manganese Ore—\$23@24 per unit, seaport; chemical ore, \$55@60 per gross ton, lump; \$75 per net ton, powdered. Nominal.

The market is generally exceedingly quiet, and prices on the following ores remain unchanged from the figures published in the Market Report in the Nov. 5 issue: Chrome, Iron, Magnetite, Molybdenum, Tantalum, Titanium, Tungsten, Uranium, Vanadium, Zircon, and Zirkite ores.

Zinc and Lead Ore Markets

Joplin, Mo., Nov. 12.—Zinc blende, per ton, high, \$27.75; basis 60 per cent zinc, premium and Prime Western, \$25; fines and slimes, \$23@22; average settling price, all grades of zinc, \$24.09.

Lead, high, \$63.90; basis 80 per cent lead, \$55; average settling price, all grades of lead, \$55.57 per ton.

Shipments for the week: Blende, 8,774; lead, 911 tons. Value, all ores the week, \$262,050.

Purchases of blende were 4,400 tons this week, against 12,850 last week. Buyers were willing to take more ore on a \$25 basis, but sellers of reserve stock firmly asked \$26 to \$27.50, and consequently purchases were little more than the week's production. Shipments were almost 4,000 tons in excess of purchases, and mark a further decrease of reserve stock of over 3,200 tons.

Production, which was on a high level all summer, has dwindled to less than 5,500 tons per week, according to recent surveys made by purchasing agents. Each week's shipment is now making inroads on the reserve stock, much of which is held for \$30 basis, with some holding for \$40 basis.

Platteville, Wis., Nov. 12—Blende, basis 60 per cent zinc, \$30. Lead ore, basis 80 per cent lead, \$60 per ton. Shipments for the week: Blende, 512; lead ore, 78 tons. Shipments for the year: Blende, 10,184; lead ore, 1,683 tons. Shipped during the week to separating plants, 602 tons blende.

Non-Metallic Minerals

Asbestos—Crude No. 1, \$1,000@1,500; No. 2, \$600@850; spinning fibres, \$225@400; magnesia and compressed sheet fibres, \$150@250; shingle stock, \$80@150; paper stock, \$45@65; cement stock, \$15@25; floats, \$7@10, all per short ton, f.o.b. Thetford, Broughton and Black Lake mines, Quebec, Canada.

Generally dull markets also exist for the non-metallic minerals, and there is no quotable change in the following from the prices published in our Nov. 5 issue: Barytes, Bauxite, Borax, Chalk, China Clay, Emery, Fluorspar, Fuller's Earth, Graphite, Gypsum, Kaolin, Lime-

stone, Magnesite, Mica, Monazite, Phosphate Rock, Pumice Stone, Pyrites, Silica, Sulphur, Feldspar, and Talc.

Mineral Products

Arsenic—6 $\frac{1}{2}$ c. per lb., f.o.b. New York. Price has become firmer.

Potassium Sulphate—Powder, domestic, \$1@1.10 per unit, basis 90 per cent, f.o.b. New York.

The prices of Sodium Nitrate and Sodium Sulphate are unchanged from the quotations published in these columns Nov. 5.

Ferro-Alloys

No quotable changes have taken place in the following ferro-alloys from the prices quoted in the Nov. 5 issue: Ferrotitanium, Ferrocerium, Ferrochrome, Ferromanganese, Ferromolybdenum, Ferrosilicon, Ferrotungsten, Ferro-Uranium, and Ferrovanadium.

Metal Products

Zinc Sheets—\$9 per 100 lb., less 8 per cent on carload lots, f.o.b. works.

Copper Sheets and Wire, Lead Sheets, Nickel Silver and Yellow Metal are unchanged from the quotations given in the Nov. 5 issue.

Refractories

Prices on the following are unchanged from the figures published in the Nov. 5 issue: Bauxite Brick, Chrome Cement, Chrome Brick, Fire Brick, Magnesite Brick, and Silica Brick.

The Iron Trade

Pittsburgh, Nov. 15, 1921

The dullness in the steel market has become more pronounced, and affects all lines more or less, with the exception of tinplate, which, since the establishment of a \$4.75 price a fortnight ago for the first half of 1922, has shown activity in mills obtaining specifications for immediate rolling, shipments to be made after Jan. 1.

In production, sheets and wire products show the most activity, production being at 60 to 70 per cent of capacity. Tubular goods come next, bar production is fair, and plate, shape, and rail production is light.

There are hints that the railroads are now more actively engaged in buying rolling stock and rails than is generally assumed. Few contracts have thus far been announced.

Fundamental conditions affecting the steel trade are as good as formerly, but the usual year-end dullness is appearing somewhat ahead of time. Resumption of the forward movement is to be expected by about Feb. 1. Meanwhile, steel production may taper off a trifle. October showed a rate in ingot output of 44 per cent of capacity, the best rate since February, and comparing with a 21 per cent rate last July.

Steel prices generally exhibit a slight softening tendency from week to week, but there are no clear-cut declines. With a full operation present prices would, in the main, be found profitable.

Pig Iron—The market is absolutely stagnant. Prices are unchanged at \$20 for bessemer, \$19 for basic, and \$21 for foundry, f.o.b. Valley furnaces, but there is little doubt there would be some yielding if competitive business of importance were offered.

Coke

Connellsville—Furnace, \$3.35@3.50; foundry, \$4.25@4.75 per ton.

Risks and Security in Mining Investments

BY POPE YEATMAN AND E. S. BERRY*

BEFORE CONSIDERING in detail the question of risk and security in mining investments, it might be well to give in brief a typical financial history of a successful mining proposition:

The first step is the financing of the prospector who makes the discovery by those who "grubstake" him. The number of mines which pay from the beginning are few indeed, so that, after discovery, funds beyond the means of the prospector and of his partners must be supplied, usually by disposing of an interest in the property. Later, as development continues, still larger sums are necessary in order to install machinery and perhaps a treatment plant. If the sum required is large, the aid of bankers may sometimes, after consolidating several other properties, be called in, a stock company formed, and securities issued. Before this, in most instances, the original discoverer has dropped out, and unless the partners themselves arrange for the financing, the promoter or middleman comes into the venture, and plays his often very important part.

After successful operation for a number of years, with perhaps consolidation with other properties, profits begin to ease off and production lessen. It is at this period that, especially in the case of precious-metal mines in which the ore has been erratic or pockety, the "tributor" or leaser appears, who searches for and mines ore in the old workings, paying the company a royalty on the ore he extracts. When the mine no longer attracts the leaser, the end has come and operations cease.

Small investors are not justified in going to the expense of having exhaustive examinations made and are forced in the main to rely, first, on their own studies of the problem; second, the reliability and reputation of the engineer reporting on the property; third, the standing of the banking house that issues the stocks or bonds; fourth, on the board of directors of the company or controlling organization; and fifth, on the management.

The investor's own study or diagnosis of the problem may be based on too incomplete data, on lack of technical knowledge on his own part, and on too little published information due to (a) youth; this latter may be due to the fact that the company has not been in existence long enough to publish annual reports; (b) that it is desirous of picking up adjoining properties and is therefore unwilling to spread broadcast its reports in detail.

The reliability and reputation of the engineer on whose report the advisability of making the venture is based are, naturally, a matter of first consideration, for on his experience, technical and commercial knowledge, and honesty everything depends. The experience and past record of the engineer should count for much with the investor in determining the reliance to be placed on the report.

The reputation of the bond or brokerage house of issue is of the highest importance. Some excellent firms have made a specialty of bringing out mining securities, and have carefully guarded the interests of their clients in making sure that the venture was a worthy one and an attractive one for the investor. Their main purpose has been to do well for their clients and by so doing place themselves in a position of high honor and make it possible for the firm to build up a large and stable business.

The importance of a good directorate goes without saying, and in its appointment the small investor may have something to say later, but in the beginning the bankers and the mining group bringing out the securities will control.

During the constructive period of the enterprise, it is most important to have in charge of the design, planning and carrying out of the work men of the highest caliber. The business, when well established, systematized, and reduced to a routine, can be conducted by an organization whose qualities are mainly honesty and plain common sense. The gold mines of the Rand have experienced these conditions, at first employing men of great experience and ability as advisers and managers, and later, when operations were more or less standardized, men of a routine type of mind were put in charge, and so with many other gold mines. The low-grade porphyry coppers in this country, however, are still in the first-named class.

Questions which a careful investor should go into are:

1. What is nominal capital?
2. What proportion issued?
3. What proportion of working capital is already expended and what remaining on hand?
4. What further amount may be needed?
5. Financial condition of company as to debts and similar information?
6. Annual income?
7. Dividends?
8. Application of profits?
9. Yield of ore?
10. Working costs?
11. Nature of equipment?
12. Tonnage mined and treated monthly?
13. Ore reserves?
14. Life of mine?
15. Validity of title?
16. Location of property; whether in foreign country or United States?
17. Safety of investment under law of and difficulties of operating in a foreign country?
18. Does chemical combination of ore present any extraordinary difficulties?

As in all business ventures, there are risks of all degrees in mining. As the risks are great, so should the returns be proportionately high. The following gives some idea of the relative chances in investment:

It has been stated that 95 per cent of the commercial and industrial enterprises which are started every year ultimately prove impracticable or unsuccessful. In mining the proportion of failure is also high. Such failures include those of ventures poorly conceived, organized and financed, as for example, small retail stores, concerns organized to introduce impracticable patents or processes; or in the case of mining, they include companies which were poorly managed or financed, which should never have been undertaken and whose securities should not have been placed on stock exchanges without careful investigation.

The reduction in the proportion of failures is considerable in the case of mining companies whose securities have been floated by financial houses of high repute. After favorable reports by engineers of experience and standing, the failures are reduced to a minimum.

Other ventures, more or less of a gambling nature, are the formation of exploration companies, without real values in hand, whose aim is to seek out mines and prospects, purchase and develop already existing mines which need funds for further development or for the building of treatment plants, but which at the time of the formation of the development company are not contemplated. Such enterprises are presented with no fraudulent purposes in view, it being recognized by the investors that the business is more or less of a gamble.

As showing the large amount of work which such exploration companies often have to do in their search for properties, the following table illustrates what a great mass of properties have to be looked into, and the proportion of propositions rejected as unattractive:

	—Number of Properties—		
	1913	1914	1915
Presented for consideration.....	614	639	786
Rejected after office examination.....	490	538	655
Subjected to preliminary field examination.....	100	82	118
Accorded complete examination.....	24	19	13
Properties acquired.....	3	2	3
Properties taken under option.....	3	1	3

A speculative venture of another kind would be the unwatering and reopening of mining properties which had not been operated for years, and the records of which had either been incomplete or lost entirely, or were not considered trustworthy. It may be that maps, assay plans, and records of production and sales were entirely missing, and that the only inducement to go into the proposition was hearsay evidence, and indications of considerable old work as shown by shafts, tunnels, and dumps. Many old mines in Mexico and even in the United States were purchased, opened up, and operated on knowledge based on little more than hearsay evidence. Such mines are always supposed

*Excerpt from a booklet "Mining Securities," issued and copyrighted by the American Institute of Finance, Boston, 1921.

to contain great speculative features, but they are real gambles.

Again, metallurgical conditions may have changed since the mines were originally abandoned, and to such a degree as to make it seem possible to operate mines that had ceased to work on account of not having been able to make a profit formerly.

Other ventures of a speculative nature, but with greater chances of success, are represented by certain vein mines only partly prospected, but with evidences very greatly in favor of the continuance of the ore shoots in length and depth, it not having been feasible previously to thoroughly prove the ground by thorough development. Past records of production, costs, and other data have much weight in determining the desirability of such investments, but care should be taken to discover if possible whether the ore-bodies were reaching their limit, or whether the ore was becoming impoverished in depth to such an extent as to be unprofitable.

A true investment proposition would be one in which the orebody was thoroughly determined as to tonnage, length of life, with treatment plant employed or promised; assurance of favorable costs of production and reasonable prices for the product, and grounds for belief in the honest and efficient conduct of its operations by the directors and management. Many iron, coal, and low-grade copper properties, and to some extent lead mines, may be included in the true investment type.

The most desirable type of all, however, is that giving a combination of the investment and the speculative features as illustrated in the early days, and at the present time by the low-grade copper mines of Utah, Nevada, Arizona, New Mexico, and Chile. When many of these properties were first put on the market, they were what might be considered truly speculative, because, though the officials and engineers believed that there was a large tonnage of ore and that it could be treated at a very handsome profit, the operations had not been carried out on a sufficiently large scale to prove this.

However, after success began to be assured and the proposition became worthy of being placed in the investment class, there was still a considerable speculative value on account of all profitable ore not yet having been fully developed throughout the company's property, and until after this feature has been thoroughly proved it is not possible to leave out the speculative element and look on the proposition as one truly in the investment class alone.

Of course, with most raw metals, as is the case also with manufactured products, there are always the questions of price, cost, and demand and supply, and these should be recognized when the investment is under consideration.

Thirty or forty years ago, practically all mining propositions, with the possible exception of some of coal and iron,

were considered as absolute gambles, and anyone investing in them was thought to be a speculator of the wildest type. It was not considered right for anyone to go into such propositions unless he could stand the loss of what he invested; in other words, he should be ready to "kiss his money good-bye" when he made his purchase.

Today, however, because of the greater knowledge of ore deposits, more men skilled in the business of mining, and a greater trust in those engaged in such pursuits, mining has come to be considered a legitimate business in which investments can be made with safety and with as much certainty as in many manufacturing or commercial enterprises; but the investor should go into the business, not in the old-fashioned, happy-go-lucky spirit, but after thoroughly considering the value of the property and the ability and integrity of the officials who are to be responsible for the conduct of the business.

On account of risk inherent in mining, the dividend rate should be higher than is usual for railway or high-class utilities and industrials. Some companies have accumulated amortization funds, and diverted these funds for the purchase of other mining properties, thus continuing the functions of the organization beyond the life contemplated for the original orebodies, but the investor of the mining type prefers to do his own investing of funds.

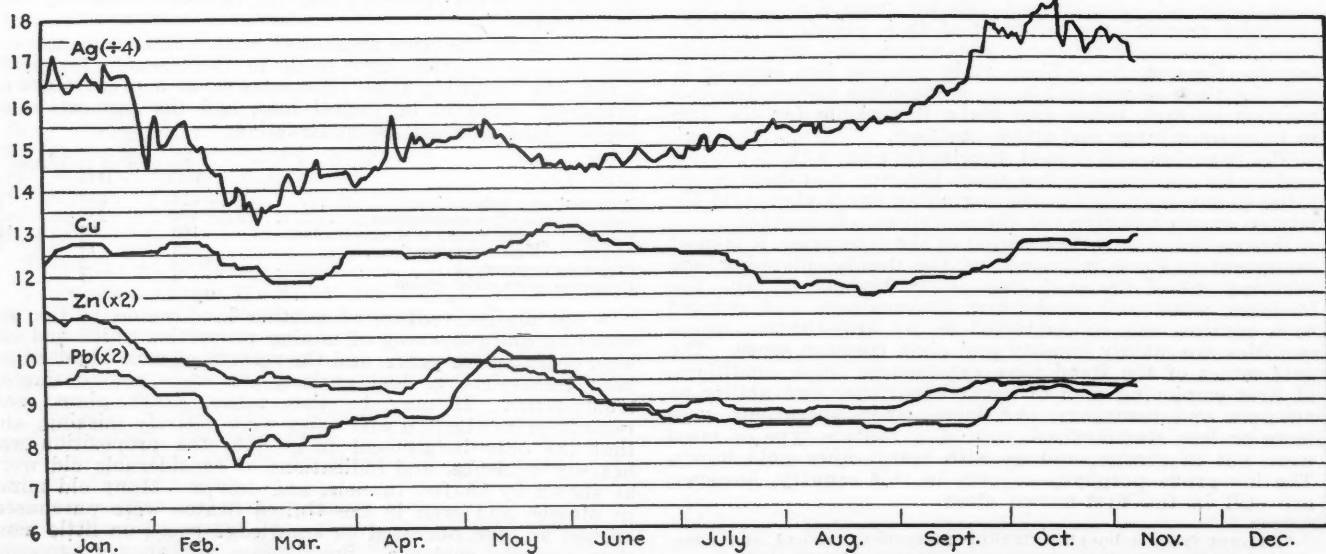
Other things being equal, of securities of two properties with equal amounts of ore and of the same grade, the one having speculative chances of still further ore being developed should sell for a higher price than the other, the orebodies of which were completely developed.

It must be realized that, unlike railway, manufacturing, or agricultural enterprises, the assets of a mining company are what are known as "wasting assets." As the ore is extracted, the reserves are depleted and there is nothing to replace such loss. In other words, the capital is drawn upon, and the dividends should be great enough not only to pay a good rate of interest, but also to provide for the return of the principal.

There are a few companies, however, whose prospective life is so great that for all practical purposes depletion need not be considered. Illustrative of this point may be mentioned Chile Copper, and Braden Copper, whose ore reserves, on the basis of the capacity of the treatment plants contemplated, have very long lives.

The old-time fable that mining ventures are inherently gambles, and therefore dangerous, still holds in the minds of many, but our increased knowledge of orebodies, improved methods of mining and metallurgical treatment, good and honest management, has of late years placed mining in the list of safe and attractive business enterprises, which, of course, require proper care and study of the proposition before entering into the venture, such as any business should demand.

1921 Prices of New York Copper, Silver, Lead and St. Louis Zinc



Gold Imports Make Record Stocks

Maximum Accumulation Is Registered—Gold Backing of Federal Reserve Notes Greatly Increased—Nations Are Still Maintaining Embargoes on Gold Shipments, but Are Trying To Reach Sound Currency Basis

EDITORIAL MARKET STUDY

THAT THE MERE POSSESSION of gold does not bring prosperity to the holder is well illustrated by the present position of the United States. More gold lies in the vaults of the Federal Reserve Banks of the United States and the Treasury than has ever been accumulated in one country—over 40 per cent, it has been estimated, of the total stocks in the world. The annual domestic production of gold, which at the present time lies between \$40,000,000 and \$50,000,000, is only about one seventieth of the gold coin and bullion in the Republic, \$3,504,677,154 on Nov. 1. Economists and bankers are puzzled over the benefit to be derived from the possession of so much precious metal, and it is held to be a foregone conclusion that a good measure of this accumulation ultimately will be and can be released without harm to the country's financial structure.

RECORD STOCKS OF GOLD IN UNITED STATES

The stock of gold in the United States is at a record high, although not much higher than in June, 1919, the month in which the embargo on the export of gold was lifted. Stocks then stood at \$3,092,038,000, dropped to \$2,646,616,000 in May, 1920, and on Nov. 1, 1921, were \$3,504,677,154, a new record. The imports of gold which have been responsible for this swelling of stocks and which average \$70,400,000 monthly, have practically all found their way into the vaults of the Federal Reserve Banks—the natural reservoirs for the gold of the country. Gold does not remain long in the possession of the individual members of the Federal Reserve system, as they are required by law to keep all their reserve with the Federal Reserve Bank of their district. Hence any importation of gold under the auspices of a member bank will find its way to a central reservoir, where it can perform the important function of acting as a gold reserve behind paper currency.

The Federal Reserve system is admirably adapted to provide the necessary elasticity to prevent undue fluctuations of currency and credit whenever a large amount of gold enters or leaves the country. The medium through which this elasticity is obtained is the issuance of Federal Reserve notes, which are backed by gold and redeemable in it. During the war and for a time thereafter the amount of gold behind the Federal Reserve notes was considerably below 100 per cent, and the ratio varied greatly. Now, however, the gold backing to the Federal Reserve notes is above 100 per cent, an unusual situation. The change is well illustrated by figures taken from the circulation statement of the Treasury Department as of Nov. 1, 1921, which among other tabular matter gives the following comparative statistics:

	Nov. 1, 1921	Nov. 1, 1920
Gold coin (including bullion in Treasury)	\$3,504,677,154	\$2,739,043,566
Federal Reserve notes.....	2,713,214,310	3,663,517,685
Ratio gold to notes.....	129.2	77.4

In the short space of one year the net improvement in the ratio is 51.8 per cent; it is even greater in the first ten months of 1921, as on Jan. 7, 1921, the ratio was 63.6 per cent. The 100 per cent line was crossed early in August, veritably a milestone in the position of the Federal Reserve system, and further gains have been made. The notable transformation in the relation of gold to notes is due to heavy importations of gold from foreign countries, coupled with a sharp contraction in note circulation—de-

flation of the currency as it has been called. Before the introduction of the Federal Reserve system an influx or efflux of gold greatly affected the credit structure of the country, credit curtailing on an outflow and increasing on an inflow. The Federal Reserve system has minimized this effect.

NATIONS STILL HAVE GOLD EMBARGOES

The gold entering this country is being sent to reduce foreign indebtedness to the United States. Its source is largely private and newly mined metal, as the gold holdings of the large central banks of Europe such as the Bank of England and the Bank of France hold more gold than they did before the war. Even the German Reichsbank shows but a small loss of gold. Owing to the great inflation of European paper currencies, the magnitude of the gold reserves has been largely overshadowed.

It will be recalled that practically the entire world insists on maintaining an embargo upon gold for fear of undermining the slim reserves beneath mountains of paper. The United States is the outstanding exception. Many nations, particularly in South America, are in an excellent position as regards gold reserves, but, due to the fact that the export of gold has been forbidden for a long time, the governments of these countries are reluctant to lift the bars and fear a general rush on the part of the populace to procure gold regardless of the strong position of the banks. A bill has recently been introduced into the Argentine Congress to permit the export of gold to within 50 per cent of circulation, as Argentina now has a reserve of 81 per cent. Permitting a freer movement of gold would improve foreign exchange rates, which would in turn aid our exporters in disposing of products that are now tied up in South American ports because of adversely fluctuating exchange rates.

Although many commissions, international conferences, and individuals have investigated the world's currency problems, and many practical recommendations have been made and offered as solutions, these recommendations have not been translated into action and have not had the backing necessary to enforce their introduction. The apostles of the printing press, Russia, Poland, Germany, Austria, and other countries, are pursuing their way unchecked, and utterly disorganizing their financial systems.

EFFORTS TO RETURN TO GOLD STANDARD

The states set up by the peace settlement are having difficulties in organizing and developing a satisfactory currency. They all seem to realize the necessity of linking their systems to gold, but are finding it a hard task to carry out such a program. The advantage of using a gold standard is clearly established and requires no further evidence in its support than the sorry example of the present state of disorganized European finance.

The Czecho-Slovakian republic has created a reserve fund of gold, silver, and jewels, raised through voluntary subscription, which it intends to use in its currency arrangements. One of the great impediments to the introduction in the Central European states of sound currency is the unbalanced condition of exports and imports. Until some balance is established in foreign trade, the gold reserve will be threatened. The chaotic state of the world's business is attributed largely to disturbed foreign exchange. The effort of any nation to return to a gold standard is worthy of encouragement, as it will hasten the day when conditions return to normal.

MINING STOCKS
Week Ended November 12, 1921

Table with columns: Stock, Exch., High, Low, Last, Last Div. Section: COPPER. Lists various copper stocks like Ahmeek, Alaska-Br. Col., Allouez, etc.

Table with columns: Stock, Exch., High, Low, Last, Last Div. Section: NICKEL-COPPER. Lists Internat. Nickel, Internat. Nickel, pf., etc.

Table with columns: Stock, Exch., High, Low, Last, Last Div. Section: LEAD. Lists National Lead, National Lead, pf., St. Joseph Lead, etc.

Table with columns: Stock, Exch., High, Low, Last, Last Div. Section: QUICKSILVER and ZINC. Lists New Idria, Am. Z. L. & S., Am. Z. L. & S. pf., etc.

Table with columns: Stock, Exch., High, Low, Last, Last Div. Section: GOLD. Lists Alaska Gold, Alaska Juneau, Carson Hill, Cresson Consol. G., etc.

Table with columns: Stock, Exch., High, Low, Last, Last Div. Section: SILVER. Lists Arizona Silver, Batopilas Mining, Beaver Consol., etc.

Table with columns: Stock, Exch., High, Low, Last, Last Div. Section: GOLD AND SILVER. Lists Boston & Montana, Cash Boy, Consol. Virginia, etc.

Table with columns: Stock, Exch., High, Low, Last, Last Div. Section: SILVER-LEAD. Lists Caledonia, Cardiff M. & M., Chief Consol., etc.

Table with columns: Stock, Exch., High, Low, Last, Last Div. Section: VANADIUM. Lists Vanadium Corp., New York, etc.

Table with columns: Stock, Exch., High, Low, Last, Last Div. Section: ASBESTOS. Lists Asbestos Corp., Montreal, Asbestos Corp., pf., etc.

Table with columns: Stock, Exch., High, Low, Last, Last Div. Section: MINING, SMELTING AND REFINING. Lists Amer. Sm. & Ref., Amer. Sm. & Ref. pf., Am. Sm. pf. A., etc.

*Cents per share. †Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. K, Irregular. I, Initial. X, Includes extra. Toronto quotations courtesy Hamilton B. Wills; Spokane, Pohlman Investment Co.; Salt Lake, Stock and Mining Exchange; Los Angeles, Chamber of Commerce and Oil; Colorado Springs, The Financial Press, N. Y.

