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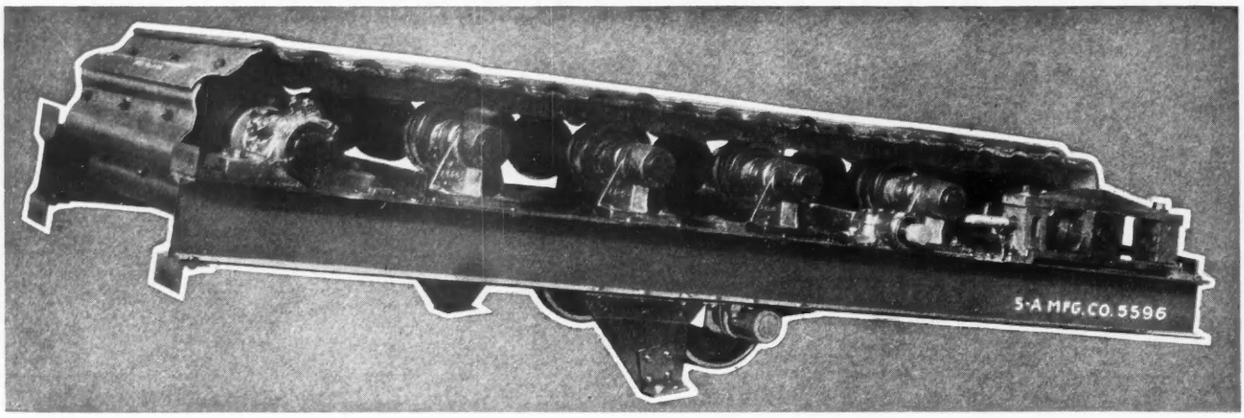
Marketing of Indiana Limestone, *by H. S. Brightly*—Use of Metals in Early Times, *by C. A. Grabill*—Continuous Electrothermic Furnaces for Complex Ores, *by T. M. Bains, Jr.*—*Biography of* Edward M. Hamilton



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ENGINEERING AND
MINING JOURNAL-PRESS

JOSIAH EDWARD SPURR, Editor

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Assisting German Copper Consumption

IN THE LAST WEEK two events occurred that might readily pass unoticed, for they reflect no outward indication of having any bearing on the mining industries, yet they deserve the close attention of anyone interested in the industrial recovery of Europe, the outlook for copper, and even business in general. These events were the floating of public bond issues in the United States by two great German electrical manufacturers—the A E G, or German General Electric Co., and the Siemens & Halske group of companies. Both corporations are prominent manufacturers of all varieties of electrical machinery and equipment. Each of them came into the bond market for $10,000,000, and each issue was underwritten by some of our best-known and highest-class banking houses.

Being electrical manufacturers, it is natural to assume that the A E G and Siemens & Halske are important consumers of copper. And so they are. In fact, the A E G is one of the best foreign customers of American copper producers. In 1924, according to its own figures, the A E G bought more than 60,000,000 lb. of copper from American sources, besides buying zinc, silver, and other raw materials here. The business of both companies is noteworthy for its proportion of export to domestic trade. Siemens & Halske export 40 per cent of their production; the A E G does approximately 32 per cent of its selling to countries outside of Germany.

Although the bond issues prepared for these two powerful companies are well protected, they carry an attractively high interest rate. The A E G debentures yield 7.70 per cent, and the S & H issues vary from 7.37 to 7.64 per cent. This is a higher rate than would be exacted from American manufacturers of similar standing, but merely reflects the element of risk which still attaches to nearly all financing abroad. The rate is a measure of the political uncertainty in Europe.

Before the war the United States did not concern itself much with foreign financing, especially foreign corporate loans. London was then the clearing house for that sort of work. The growth that has taken place in the last three or four years in the tendency of foreign countries to turn to the United States for funds is a consequence of the altered relation of London and New York in the world's money markets for both short- and long-term financing. Money is cheaper in New York than in London, and has been so for months. Last year in the New York bond market, money was subscribed for corporate issues covering such diversified developments as railway and steamship operations in France, banking in Finland, hydro-electric power-plant construction in Austria, and iron and steel production in Germany (the Krupp and August Thyssen issues). Local sources of money supply have not been available to the companies abroad seeking to finance themselves, except at extraordinarily high rates. This is particularly true of Germany, where chaotic banking conditions prior to the establishment of the Dawes plan prevailed, and where interest rates are still abnormally high. (The official rediscount rate is 10 per cent at present.) The United States has been the logical market place for anyone needing large sums of money.

The copper-mining industry should be pleased with the loans publicly made to these important German electrical manufacturers. Anything that promotes the use of copper will obviously aid the copper market, which is just what these bond issues tend to do, for they will help the German manufacturer get squarely upon his feet again. Probably there will be some misgivings from domestic manufacturers on the score of increased competition from Europe. However, that is something which will not affect the copper producer, and may prove a healthy influence in manufacturing by promoting more efficient production and lowering costs.

It is not known exactly how the German manufacturers will use the proceeds of their loans. Perhaps part of it will be withdrawn in gold, but the chances are good that most of the credit will remain in the United States. Regardless of their disposition, the loans must necessarily be a stimulus to the copper-mining industry.

Doubtless more of this foreign commercial financing in the form of bond issues will be done in the United States by other countries as well as Germany and will continue until sources closer home are available at more moderate interest rates. France would probably have been an active borrower in New York for industrial purposes had it not been for the discussion about her external obligations to this country and the threat of debt repudiation. The debt question has placed a damper upon France's present ability to borrow in the United States.

Rich and Poor Nationalities

THE OPPROBRIOUS CHARGE is currently made against the United States by Europeans that it is rich, and, therefore according to tradition, guilty. It is true that the United States has in its possession nearly half the world's gold, and this would seem to lend color to the theory of enormous wealth out of proportion to that which honest men should have come by. It is interesting therefore to look at the status of per capita of gold reserve of the United States as compared to that of other nations. For the per capita amount is the real wealth—it determines how much of the world's gold has been allotted by work and the currents of trade to the average American, compared with the average Spaniard, for example. The last figures available are for the close of 1923, and the gold distribution has not changed much since then, although during the latter part of 1924 hundreds of millions of American gold were exported.

At the close of 1923 the gold reserve of the United States per unit of population was $38. Looking over the statistics, however, we are surprised to find, in view of the common impression, that the average American has not such an unheard of share in the gold of the world as would be supposed. Uruguay had a per capita gold reserve of $37; Switzerland, of $36; Holland, of $33. Yet no foreigner complains of the opulence of the Uruguayans, the Swiss, or the Dutch. Australia, indeed, had $39, or more than the United States; and Argentina had $54, as it should blush to admit. May not some of the rancor of France and the other great nations be diverted from the United States to these substantial populations, who have been equally guilty of energy, thrift, and honest government?

To be sure, most of the European states which bore the brunt of the Great War have traded part of their gold reserves for supplies and are by far in not so favorable a position. Germany had $4 per capita. But France had $18, in comparison with which Great Britain had only $16! And Canada had $25.

Altogether, the proportion of gold held by each American is not so blatantly unbalanced. The trouble is that he has been too generous or reckless in lending it abroad. Reckless is probably the modest way to put it, for the amounts he has lost in investing in Russia, Austria, Germany, France, and other European countries are enormous. Still he comes up smiling and digs up for more and more foreign loans—yea, to Germany and to France, forsooth.

Mining Engineering Education

EXACTLY WHAT IS HAPPENING to the mining schools of the United States is not entirely clear. In the Eastern schools, connected with the great Eastern universities, the number of students has certainly fallen off sharply. Harvard has given over the pretence of maintaining a mining school at all, and it would not be surprising if some other universities did the same. Altogether, present indications are that the schools which are situated in the West near the mining centers, and which have a more practical flavor, are surviving better than the schools where the high cultural and technical education of the engineer is the aim.

Yet in the Western schools also there is evidence of unrest. Houghton has lost its president through the untimely death of Dr. F. W. McNair; Golden's presidency has been declared vacant by the board of trustees, which refused to renew Dr. V. C. Alderson's contract as head. Essays on technical education, curricula for training mining engineers, all become null and void in face of the silent failure of students to show up at many centers where the greatest thought has been put on the problem. The six-year course appears to have, temporarily at least, ruined Columbia as a mining school, for the students there are very, very few, while in the old days they were many. Now that the six-year requirement has been lifted, Columbia is on a footing of equal advantages with other Eastern colleges in the competition for students.

The problem appears to be, after all, not what universities think students should get, but what students think universities and mining schools should give them. The students have the decision; and at the present time their decision seems to favor the shorter and more practical training.

But, synchronous with this development, we note more and more men rising into high position in mining without having been trained in mining schools. Many of these have accomplished notable things for the technique of mining and ore reduction; many others have distinguished themselves in the super-necessary task of mine management, or company management. Their footing among engineers is that of peers. Therefore, many future lights in the mining world are now being trained in the great universities, but not in the mining schools. On the other hand, engineering schools train many men who take the courses as a mental discipline and who have no intention of becoming engineers. The whole problem would yield much to statistical analysis were such possible to obtain.

"Cartwheel" Versus Paper

SOME TIME AGO, in making his annual report to President Coolidge, Secretary Mellon told of the steps that were being taken to get the public to use silver dollars more freely. From 1910 to 1924, it seems, the number of "cartwheels" in circulation has dropped from 72,000,000 to 54,000,000. The Treasury wishes to increase this by 40,000,000. The idea is to save in the cost of printing and replacing paper money, for the smaller denominations of which an unprecedented demand has developed in the last three years. Various ways of feeding these extra dollars into circulation are proposed.

Unless a large part of the public can be persuaded that a silver dollar is just as convenient a form of money as a dollar bill for personal use it is likely that the hard money will flow back to the banks as soon as it is issued. In the East the occasional silver dollar has long been a curiosity to the average person, and were it not for visitors from the West the chances are that it would hardly be seen at all. The pocket will not stand the strain—not even "Scotch" pockets, as a certain comedian calls those of the one-way kind. Silver is cleaner, especially in the crowded cities where paper money often smells to heaven. But its weight gives it an unpopularity that will be hard to overcome.

The Quantity Theory of Gold

GOLD is a commodity which has for thousands of years been a standard medium of exchange for other less portable valuable and desirable commodities. As concerns the exchange between gold and wheat, for example, it would appear evident, from the law of supply and demand, that the increase in quantity of available gold, the quantity of wheat being assumed to be stationary, would cheapen gold in respect to wheat so that it would take more gold to buy a bushel of wheat, which means that the price of wheat in terms of gold (of gold dollars, for example) would rise; and so for all other commodities. This is the so-called quantity theory of money. As stated above, it is evidently true. But in actual life these simple terms never happen. If the supply of gold should remain constant, but the supply of wheat should decrease in the same proportion that the gold was supposed to increase, in the ideal case assumed above, the result would be the

same, and wheat would arrive at the identical figure in gold (dollars).

Another factor has often been well illustrated, especially since the Great War, although many times before. Paper money representing gold is more in circulation than gold itself; and since under governments having sound credit this paper money is acceptable as representing real gold in reserve and "as good as gold," governments and banks have fallen into the habit of "fudging" more or less, based upon this implicit acceptance of good paper notes, and have frankly permitted or caused a margin of excess of the paper over the gold. This has seemed to work so well that a large "gold reserve" is universally assumed to make the whole outstanding currency "as good as gold," even when the proportion of gold to outstanding paper currency becomes 50 or even 40 per cent only, the latter being the minimum basis or cover of the United States Federal Reserve notes. This phenomenon has caused nations which are poor in gold reserves to increase the margin of paper excess, sometimes with disastrous consequences. They immediately see a differential in value spontaneously originate between the outstanding notes and the real gold sold by weight; and the depreciation or differential varies roughly, at least, with the excess of paper over the value of gold reserves. Thus England, France, and Germany illustrate three stages of experiment: the diminishing ratio of gold currency in the three countries resulting in currency depreciation in England, financial danger in France, bankruptcy and the becoming worthless of the paper money issued by Germanw.

If anything is to be deduced from these lessons it is that the value of paper currency varies in direct proportion to the proportion of gold which underlies it. And if this is the case, the paper money which is represented by 100 per cent gold is the only money which retains the commodity value of gold and can be safely regarded by economists as gold money in their researches and estimates. It is difficult to see why this does not apply to the United States as well, even with its present immense gold Treasury reserves. At any rate, for England, France, and Germany and the like it is evident that the quantity relation is not between gold and wheat, since gold is not used to buy commodities; but is twofold—between gold and paper money, and, second, between paper money and wheat. And it is evident that, the quantity of gold being fixed, the more paper money there is, the less is the value or price of it in terms of gold; also, that the supply of wheat being assumed to be constant, the more paper money there is, the less wheat it will buy—the higher will rise the price of a bushel of wheat in terms of paper money

Theoretically, also, it would seem approximately true at least that if the supply of gold and of wheat remains constant, while the supply of paper money increases, the relative commodity exchange value of gold and wheat still remains the same. Actually, there are other factors, including mental and psychological ones, involved, which would and do delay the flowage of prices to the natural levels above indicated, though they probably do so flow with more or less certainty. At any rate, it is clear that the quantity theory of money (including notes and specie) is quite a different thing from the quantity theory of gold, although both are true, and represent laws which operate, even if not instantly. But we have in the problem of fluctuations in the price of wheat, certainly the price of wheat in England, France, or Germany, since the war three *always variable* factors, wheat, gold, and money; and yet the price of wheat as above indicated probably always depends mainly upon the proportionate relation of the three.

Discovery of Bauxite in Mississippi

DR. E. F. BURCHARD, of the U. S. Geological Survey, writes us apropos of our editorial of Jan. 10 on the discovery of diamonds in the Belgian Congo, and recalls to us another interesting case of the discovery of mineral deposits through the systematic notes of a geologist. The mineral deposits in question are the bauxites of the northeastern Mississippi field. The actual find was made by a prospector, but he would hardly have done so except for the careful descriptive notes of Dr. Hilgard, formerly State Geologist of Mississippi. In a bulletin on "Bauxite Associated with Siderite" which was issued by the Geological Society of America in 1924, Dr. Burchard thus describes the discovery:

"A new bauxite field in northeastern Mississippi was discovered in an interesting way by J. W. Adams, of Tuscumbia, Alabama, in 1921. In a search for bauxite, Adams began a study of the literature of the geology of Mississippi, and in a report published by State Geologist Hilgard in 1860 he found the following excellent pen picture of bauxite in a description of the 'Orange Sand.'[1]:

"'A singular rock belonging to this formation, and much resembling a true puddingstone, is found in a few localities in west Tippah and east Lafayette counties, on the territory of the Lignitic Tertiary. (For example, Section 1, Township 5, Range 2 east, Tippah County; Section 33, Township 9, Range 1 west, Lafayette County). It consists of a ferruginous and somewhat sandy cement, in which are imbedded numerous rounded concretions of a pisolithic structure, formed of concentric layers of a siliceous material, more or less ferruginous, and in some almost white, the largest being about three-fourths inch in diameter.'

"Hilgard evidently had not recognized the material as bauxite; in fact, bauxite seems not to have been known to occur in the United States until recognized in Georgia and Arkansas in 1887. Attracted by Hilgard's description, Adams at once examined the deposit in Tippah County and took samples that on analysis proved to be good bauxite. Thus encouraged and guided by the geologic relations which he had observed, Adams made a reconnaissance through northeastern Mississippi which led to finding bauxite in ten counties.

"More than sixty years elapsed between the publication of Hilgard's description and the utilization of the information. In that interval many geologists had been over the same ground in quest of underground water, clays, iron ore and petroleum, and presumably had read the report, but it fell to the lot of a non-technical but keen and persevering prospector to interpret the facts and to bring to light this interesting resource. Geologists may, however, console themselves in the fact that the note as published by Hilgard was clear and accurate, and that it eventually pointed the way to valuable discovery."

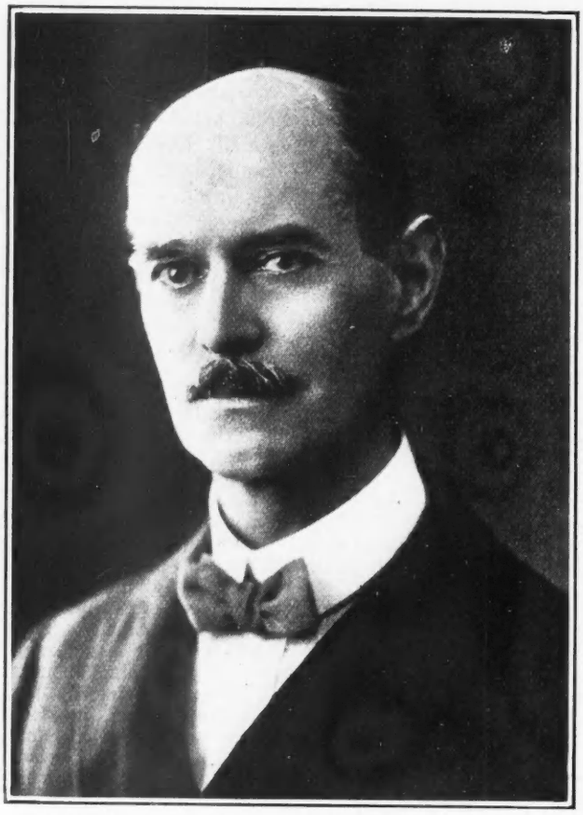
We are glad to chronicle this second case, of the careful notes of Dr. Hilgard eventually leading to the discovery of bauxite in Mississippi, as we were to call attention to the similar part played in the discovery of diamonds in the Belgian Congo by Millard K. Shaler, once a U. S. Geological Survey geologist. Without doubt these are not isolated cases, but are instances, duplicates of which could easily be unearthed by investigation and research.

[1] E. W. Hilgard: Report on the geology and agriculture of the State of Mississippi, Jackson, Mississippi, 1860, p. 14.

Metallurgists of Note

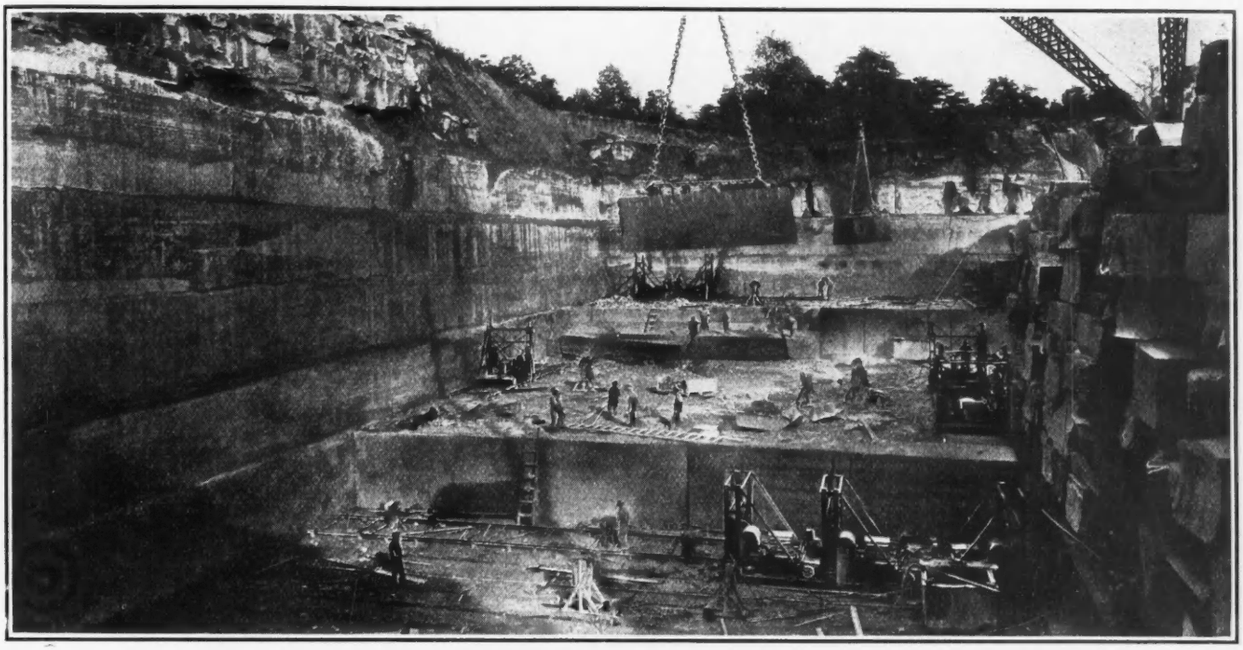
Edward Montague Hamilton

CONSULTANT cyanide-process metallurgists are few and far between. As we once pointed out editorially, the MacArthur-Forrest invention was responsible for doubling the output of the essential bulwark of currency in twenty years; significant advances in technical methods of application were made; the complexity of many gold and silver ores involved consideration of intricate problems and the selection of treatment processes the merits of which were the subject of much controversy. The need for expert advice from an impartial consultant of wide experience was obvious, if seldom realized. But the cyanide metallurgist who aspired to the position of consultant had to meet competition with industrial firms who were willing to advise and report free of charge, or for a nominal fee, but whose viewpoint and recommendations were usually warped by a desire that their clients adopt certain patented or manufactured equipment. It would have been a bad thing for the progress of technology if no exceptions could be made to this generalization, but it must be admitted that a few disinterested cyanide-process engineers have succeeded as consultants and have contributed much that is corrective and constructive to the general trend of technology. One of these is E. M. Hamilton, who was born in the Argentine, and educated in England at Truro, Chester, and Oxford University, from which he was graduated in 1893. Education of the proper kind inculcates an inquisitiveness for what may be termed occupational knowledge; it trains the mind to discriminate between the essential and the worthless; it breeds specialists in avocations that involve thought, planning, and the application of basic principles. Hamilton's university training was completed at a time when little was known of the theory of the cyanide process and next to nothing as to its application. His education in the subject began in the field, and he grew up, as it were, with the process with which he has since been conspicuously identified. From 1894 until 1898 he served an apprenticeship in several plants at Johannesburg, Transvaal, where the MacArthur-Forrest invention was first introduced on a large scale. In 1898 he became cyanide superintendent for the Van Ryn West Gold Mining Co., afterward holding the same position with the Ginsberg Gold Mining Co. Hamilton then turned his attention to Mexico, where an endeavor had been made in 1898 to apply the process to the treatment of silver ores, but without success. He was appointed metallurgist to the Minas Prietas Reduction Syndicate, operating in Sonora, in 1900, where a significant advance in technology was made by the introduction of modern methods for the treatment of the slime separated from milled ore. No real progress occurred in the treatment of silver ore, however, until 1902, when Hamilton, then on the staff of Charles Butters & Co., Ltd., was sent to Mexico to make additional tests. The result of these was the design and erection of a plant, in 1904, for the Guanajuato Consolidated Mining & Milling Co., using concentration, leaching of sand and agitation of slime. The success of this plant, which demonstrated the value of concentration in the treatment of an ore of this character, paved the way for additional research; it may be said to have been the first complete and successful plant for the treatment of silver ores in Mexico. In the winter of 1903-1904 Hamilton carried out tests on regrinding sand. Between 1910 and 1912 he was consultant to The Mines Co. of America, since when he has practiced as a consultant, latterly as a member of the firm of Hamilton, Beauchamp & Woodworth, of San Francisco.



EDWARD MONTAGUE HAMILTON

The subject of our biography has been generous in sharing his knowledge and experiences with his confrères. In addition to many contributions to the technical press, he published a "Manual of Cyanidation" in 1920. His initiative is shown by patents under his name, including one for a method of precipitating the lime from cyanide solution preparatory to the addition of aluminum powder as a precipitant of contained gold and silver—a subject in which he was prominently identified. He married, in 1908, Miss H. J. Marsh Dunn, and has three children. He is a member of the Mining and Metallurgical Society of America.



Quarry view, showing removal of earth and rock overburden

Marketing of Indiana Limestone

How a High-grade Building Material Found in One Part of the United States Is Sold

By H. S. Brightly
Technical Director Indiana Limestone Quarrymen's Association

INDIANA OÖLITIC LIMESTONE is quarried principally for building stone; by that term is meant the structural and ornamental "cut stone" for the facings of fine buildings, and the structural or ornamental trim for buildings having walls faced with brick or local stone, or of stucco applied to any form of masonry wall. This classification also includes the purely structural trim items, such as window sills and steps, in houses and in flats or apartment buildings.

To a limited though ever-increasing extent, the coarser grades of the stone are being utilized as random ashlar, or range work, in place of local ledge or field stone for the rougher types of masonry wall work, quite often for the field work of walls that are trimmed with "cut stone" of one of the finer grades of this same stone. The Indiana limestone is roughly sawed into strips of the required thickness and length for these purposes.

A limited quantity of the stone is utilized for burning into lime and a limited quantity is also ground for use as agricultural limestone and in the manufacture of glass and other products. Most of the material utilized for these purposes, lime and ground limestone, is produced from the quarry and mill waste that occurs in the production of the building stone. A quantity of this waste stone is also used as a flux by steel plants.

Building stone therefore is the principal output of the Indiana oölitic limestone quarries, all other usages of the material being byproducts.

The lime produced is very pure and high in calcium carbonate and is sold principally as a chemical or bleaching lime and for agricultural purposes, and is not used to any extent in building construction.

Apart from the building stone industry, the industries which utilize the raw material therefrom can be listed as follows: Steel manufacturing plants; glass manufacturing plants; chemical manufacturing plants; filtration and water purification plants; dye and bleaching works.

A proportionally small quantity of the byproduct is often also used by the following industries: Sugar refineries, paper mills, asphalt plants, whiting substitute manufacturers, and by alkali, magnesia, calcium carbide, carbolic, and carbonic-acid works. Though the Indiana limestone byproduct may be used for any or all these and other similar purposes at various times, this fact should not be assumed to imply that some of the output each year is supplied for all of these purposes, as, unlike the supply of stone usable for working as building stone, the supply of limestone suitable for these purposes is fairly well distributed over the country, and the supply of ground limestone for such chemical purposes is often obtained from small deposits local to the particular plant.

The geographical distribution of the material is limited, being confined to the deposit occurring principally in Lawrence and Monroe counties, in southern Indiana, but in that district the deposit is of considerable extent, extending over an area of 40 miles north and south and several miles east and west, the thickness and extent of the beds being dependent upon the extent to which the original sheet of the formation has been acted upon

and eroded away by glacial action. The deposit as laid down was originally about 80 ft. thick, and as now quarried in the hills left by glacial erosion it will vary in thickness in different quarries from 20 ft. to about 70 ft. The top, or uppermost, part of the ledge in many of the quarries, owing to this erosion, is not sufficiently solid to be utilized economically for building stone and for that reason a large percentage of the first cut in these quarries is wasted.

In some of the quarries the overburden of earth, the detrital deposit of glaciation, is removed entirely by hydraulic methods. In other quarries there is an overburden of rock of a later formation that was left by the glacial erosion, varying from a few feet to 30 ft. or 40 ft. in thickness, which must first be removed in the uncovering of the oölitic or building stone ledge. In these quarries where most of the top of the ledge was not unaffected by glacial action, it is solid and can be utilized for building stone. The so-called "oölitic" stone—that is the Indiana oölitic limestone, formerly called Bedford stone, and which is quarried and used for building stone—is a massive and homogeneous deposit, free from layering or stratification, and thus having no well-defined bedding plane or line of cleavage.

The grain is referred to as a rift of foliation, rather than as a bedding plane, and for all practical purposes this stone is treated as a free stone having equal strength in all directions. Little or no attention is paid to the direction of bedding in the production of the building stone.

The consumption of the principal product, "cut stone," for building work, is nation-wide, the stone being shipped from the quarry district in rough and semi-finished condition, as well as in the finished state, as "cut stone," to every state in the Union and to most parts of Canada.

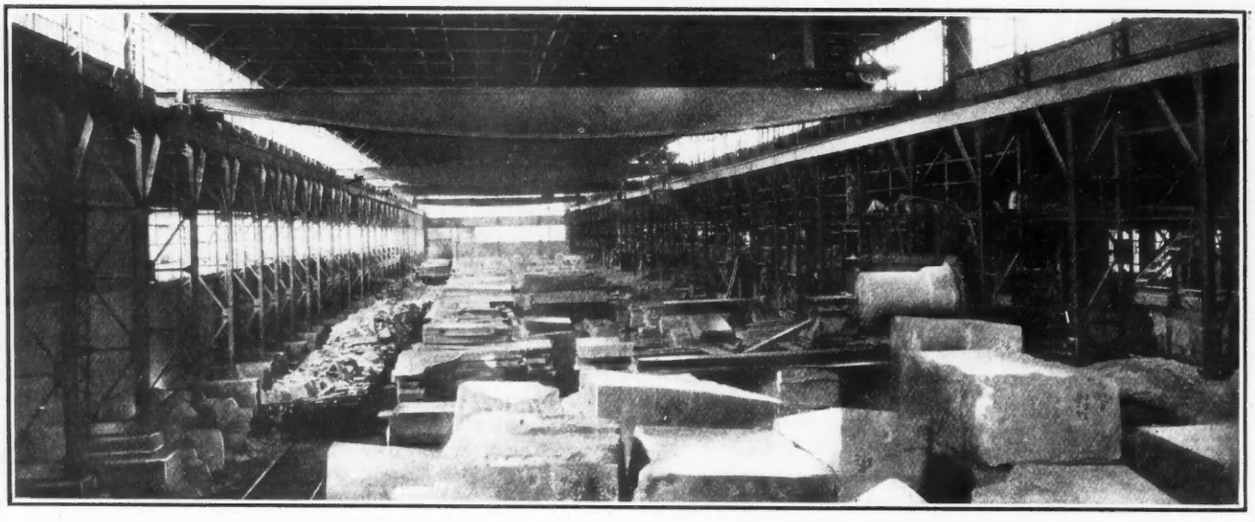
The chief marketing points are the large "cut-stone" plants, including both the large plants in the Indiana limestone district and those in the larger cities of the country. About 20 per cent of the total quarry output is cut by the aggregate of all of the cutting plants in the Indiana limestone district, at Bedford, Bloomington, and adjacent small towns in southern Indiana, and the remaining 80 per cent is shipped out in the rough as "mill block," or in the semi-finished shape as sawed slabs or strips and as molded stone, to the "cut-stone" plants situated elsewhere throughout the country. New York, Boston, Washington, D. C., Cleveland, Detroit, Chicago, and Kansas City are large marketing centers.

The annual consumption is about 35 per cent of all building stone used throughout the United States and often more, including granite, limestone, sandstone, and exterior marble. During a normal building year this will amount to upward of 10,000,000 cu.ft. In 1923 the total quarry production of the entire district amounted to more than 11,500,000 cu.ft.

The maximum demand is usually in the late summer or early fall, but of late years the demand has continued fairly heavy through the winter months. Most of the "cut-stone" plants are inclosed, making winter operation possible. Winter quarrying has never been recommended, as it is not usually considered to be safe. This makes the quarrying and storage of a winter supply of stone an essential part of the quarry operation, as the stone is not quarried to any appreciable extent in winter. Nearly all of the modern "cut-stone" plants are both inclosed and heated, which makes it possible to continue the cutting and working of the material after the quarrying is stopped, without regard to weather conditions.

The requirements of a stone for cut work—that is, for more or less ornamental stonework in buildings, apart from the necessary structural qualities such as strength, permanence and good weathering qualities—are that it can be readily worked by machinery and easily cut in any direction and without weakness along the bedding planes. Indiana limestone possesses all these qualities to a marked degree. No other light-colored ornamental building stone is so easily worked, or possesses an equivalent strength or such satisfactory weathering qualities under almost any conditions of exposure. It is these qualities, together with the abundance and availability of the material and the consequent large-scale economical production that is possible, which account for its so general—in fact almost universal—use as a building stone, in structures varying all the way from moderate-sized houses up to the finest and most elaborate of monumental buildings.

The usual requirement for building stone when applied to Indiana limestone, is briefly as follows: First, that it shall be sound stone, and, second, of the particular grade—of the color tone and texture—selected



Interior of modern "cut-stone" mill

for the particular structure. This stone occurs in both buff and gray color tones, and the quarry product is classified and segregated into several regular grades and a number of special grades by color tone and texture.

The specifying of physical requirements is quite unnecessary, and is seldom resorted to by architects and only occasionally by engineers for important engineering work. Excepting that for steps, grade courses, and other work exposed to hard wear around the base part of building, it is both customary and desirable to specify the special hard grades of either gray or buff stone. Being a natural product, the specifying of composition and related properties does not apply. Where any other physical requirement is included in the specification, it is usually only a clause providing that the stone shall have a crushing strength of at least 3,000 lb. or 4,000 lb. per square inch as the case may seem to require, according to the particular purpose for which it is to be used. The actual crushing strength of the stone is much higher than this, averaging well over 6,000 lb., and usually over 7,000 lb., per square inch, with a minimum around 4,000 lb. and a remarkable uniformity in all of the various grades. This uniformity not only applies to crushing value but also to modulus of rupture in bending. The stone has low thermal expansion and good elasticity, and the tests on fatigue that have so far been made indicate an unusually high permanent stress-resisting value.

The seasoned stone has never been known to be damaged by frost under any condition of exposure in buildings, and accelerated freezing tests, recently conducted, confirm the results of more than fifty years' experience, demonstrating its high standing in point of resistance of frost action, when employed in building construction, in comparison with other building materials. In fact, the weathering of Indiana limestone in actual practice has been found superior to many of the harder, stronger and less easily worked building stones, and of course, infinitely superior to all manufactured substitutes.

Chemical Composition Not a Vital Matter

Numerous analysis of the chemical composition of Indiana limestone show not only great purity and high percentage of calcium carbonate but remarkable uniformity in composition. The average analysis, according to recent Bureau of Standards tests, shows the composition to be as follows:

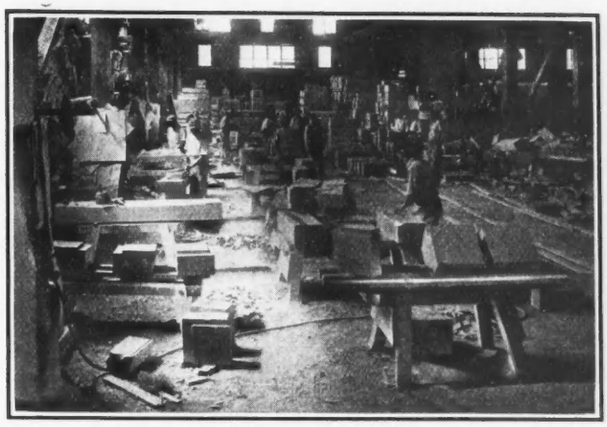
Carbonate of lime	97.3
Carbonate of magnesia	1.2
Silica	0.75
Iron and alumina	(a) 0.64
Water and loss	0.11
	100.00

(a) Iron oxide less than 0.2 per cent.

The low percentage of iron makes the ground limestone suitable for use in the manufacture of glass and for other chemical purposes for which a higher percentage of iron would be objectionable.

The building stone, as already stated, is specified by grades; these grades, however, have comparatively little significance respecting structural value and apply chiefly to the appearance of the product—that is, its color tone and textural characteristics. The grades that are lowest in cost possess strength and weathering qualities at least equal to the more costly, uniform, fine-grain and even color-tone stock, that is used principally for fine carving, sculpture, and interior work.

The grading of the product, as established by the Indiana Limestone Quarrymen's Association, is recommended by the quarry producers and is now in general use. This segregation of the product and a brief description of the various grades, together with an outline of the principal purposes for which the various grades are recommended, is here given:



Modern "cut-stone" mill interior, showing cutting department

Standard Buff—The regular buff product of the quarries with the stone of coarser and very fine textures eliminated. The standard grade, quite naturally, has the range in color tone and texture that is inherent in any natural product; the grade used for all exterior purposes.

Select Buff—The finer-textured buff stone, having a more even texture and uniform color tone than "Standard Buff"; the grade recommended for finely carved and ornamental exterior work and for interior work.

Buff Statuary Stock—Is a special grade and is simply an extremely fine-grained and uniform "Select Buff," intended for sculpture and interior work.

Rustic Buff—The coarser-textured buff, showing a distinct shelly and more open-grained formation, and containing more or less crystalline calcite intermixed. Recommended especially for sawed ashlar and the field work of walls, where the ornamental cut stone of the work is executed in one of the finer-textured grades.

Standard Gray—The regular gray product of the quarries, with the stone of coarser and very fine texture eliminated. Though this is the regular grade, it happens that the gray stone will usually run fairly fine in texture and the "Standard Gray" will, therefore, often run somewhat finer in texture than "Standard Buff"; also that a larger percentage of "Select Gray" in proportion thereto is produced by the average quarry. The variation found in "Standard Gray" is thus more likely to be variation in color tone than in texture.

Select Gray—The finer-textured gray stone having a more even texture and uniform color tone than "Standard Gray."

Variegated—The stone produced by quarry blocks that occur in the quarries at the juncture of the buff and gray stone. Such stone, in the finished work, produces cut stone of both buff and gray color tones and some blocks that have the two color tones on the one piece. The variegated variety is not segregated by texture into "Standard" and "Select" classifications.

Old Gothic—The coarser-textured variegated and other stone showing the widest range of variation in color tone and texture; a distinctive product intended especially for the field work of walls in buildings of Collegiate Gothic design, and for other informal wall-facing work, where it is used with a more or less rough sawed finish, as random ashlar or as range work, in place of rough masonry built of local ledge or field stone.

There is also the "Quarry Run," somewhat similar to "Old Gothic," produced from short-length mill blocks, which, in the aggregate, will not include quite as much of the so-called off-grade material, and, consequently, not as wide a range of variation in texture and color tone, as "Old Gothic."

There is also a special grade known as "Indiana Traver-

Standard Oil Co. Building, New York City, showing the use of Indiana limestone facing in large modern office building

tine," which has a distinctive honeycomb and shelly foundation somewhat similar to the well-known imported Travertine.

In the Special classification, there are also the Special Hard Gray and Special Hard Buff, intended for grade courses, steps, paving, and other work subjected to hard wear, and other special varieties produced under various names by the different quarry producers.

The quarry producers seldom ship in less than carload lots, and frequently mixed carloads of sawed slabs and strips, or mixed lots of sawed and molded stone, are shipped to the smaller "cut-stone" yards in various cities.

The finished "cut stone," as produced by the cutting plants both in the Indiana limestone district and elsewhere throughout the country, is shipped out to destination in any desired quantity. This will vary all the way from a single fireplace mantel facing, or piece of garden furniture requiring only a few cubic feet of stone, up to the facing for a large office building or monumental structure, involving a thousand carloads, or more, of the finished material.

The "cut-stone" facing for a small bank or store front, or the trim for a moderate-sized residence, will usually involve a sufficient quantity to make up a small carload shipment, and carlot shipments are therefore the general rule, except in making shipments of garden furniture, mantels, and other minor items. This is particularly true, as most of the smaller work is handled by the "cut-stone" yards local to the points of destination, enabling the smaller and less than carlot shipments generally to be delivered direct from cutting plant to destination, by truck.

All "cut stone" is executed to carefully prepared and accurately dimensioned "cutting and setting drawings," which are based upon the structural details, as well as on the architect's drawings and specifications. It is therefore possible to execute the "cut-stone" facing for the most elaborate structure, including all of the sculptured detail and carving, at the cutting plants and to ship this material in the finished condition ready for erection. Great accuracy in cutting is the practice, and tolerances in dimensions are not necessary as in the production of molded plastic materials. This makes possible the execution of important work involving several hundred carloads of finished stonework with little or no cutting and fitting at the building site. Fitting to structural supports can be done at the cutting plant when the shape and location of these members are properly indicated on the structural drawings, and under these conditions the only fitting that is required at the building site is such as may be found necessary to take care of irregularities in other structural work, with which the "cut stone" must conform, or to provide for any minor changes in the details that are required in course of erection.

In loading the rough stone or rough-sawed slabs for shipment, no packing is required, the blocks of stone or piles of slabs being simply blocked and wedged into place with timber, to prevent movement during transit, as minor chipping of the edges of this class of material does not constitute serious damage.

Sawed strips and molded stone or other semi-finished material is customarily loaded with thin strips of wood or lath placed between the stone to prevent abrasion, but is otherwise loaded in the same manner as rough stone.

Elaborately molded stone or stone that is more nearly finished and often material that is finished by being sawed on six sides, will be packed the same as finished "cut stone," which is loaded and securely packed into place with excelsior and stone dust. This method of packing makes possible the shipment of elaborate carved work for long distances without damage.

All classes of rough and finished stone are shipped in open-top equipment, and the finished "cut stone" shipped in both types. The shipping of stone in box cars, however, makes both the loading and unloading a more difficult operation and one that is not so practical for heavy stone, on account of difficulty of handling it without the use of a traveling crane or derrick. For that reason the use of box cars is generally confined to stone produced in comparatively small units, stone for interior work, or stone that must be shipped long distances during winter months.

When elaborately cut stone is loaded in open-top cars, it is customary to build some sort of a runway along the top of the load car to prevent damage by the train crew during transit, and in a few instances where the conditions may seem to require it, a roof of rough boards may be constructed over the entire car. Generally, a covering of waterproof paper is considered to be sufficient protection for the weather, along with the walkway for the train crew.

Large monolithic columns or column drums are often loaded on carefully constructed wood cradles built on the platform of a flat car. Though flat cars are extensively used for the shipment of all classes of rough stone, gondola cars are generally preferred for the shipment of both molded stone and the finished "cut stone."

Being a weighty material, and regardless of whether it is shipped in the rough or finished condition, a full loading of the car capacity is usually possible, even in shipping separately loaded column drums, column bases, and capitals.

Though it is customary to protect the fluting and necking of columns and other work by the strapping on of wood strip, the actual crating of Indiana limestone is a rarity, except in shipping small individual pieces, such as garden furniture and mantels, which are intended for separate shipment by regular freight, along with other commodities.

Less than carlot shipments are also in rare instances crated, but it is generally best and most economical to ship the stone in a small car as a minimum carload. The minimum carload weight, will, of course, vary somewhat with the different tariffs, but rates are usually those customary with heavy loading commodities. Maximum carloads, on the other hand, usually constitute the allowed percentage over the full marked capacity of the car; a loading of more than 100,000 lb. is quite frequent in large gondola cars.

The high average loading of both rough and sawed stone and the high comparative average loading maintained for "cut stone" shipped from the Indiana limestone district gives the industry a high tonnage loading record and consequent preferential rating basis with the railroads.

As the Indiana limestone district produces more than one-third of all the building stone used in the United States, the tonnage produced by this industry, for both long- and short-haul shipment, is no mean factor in railroad transportation, as the yearly total amounts to over 25,000 carloads of outgoing freight, with an attendant volume of incoming freight and "quarry to mill" or inter-district freight service.

Cubic Foot Used as the Unit

The value of "cut stone" is always computed on the cubic-foot basis. This applies to both the rough and finished product.

Because quarrying costs in an industry that has been so extensively standardized in operation are to a reasonable extent uniform, the cost of the rough stone and the consequent selling price of the product in the rough or rough-sawed form are also to a similar degree reasonably uniform with the various quarry producers and vary little from year to year, excepting as necessary to provide for fluctuations in the cost and efficiency of labor and in the cost of coal, equipment, supplies, and other commodities. The prices charged by one quarry producer therefore are seldom found to vary much from those of a competitor, although there are more than twenty distinctly separate and competing quarry operators that are factors in the Indiana limestone industry. Competition thus must necessarily be that of service, rather than of price, as seasonal demand has little effect on the quarry producers' prices. The quarrying of building stone is essentially an operation that follows seasonable cycles. It is, therefore, the yearly output, rather than any seasonal demand, that must regulate that part of the industry's operation. This must be planned well in advance, and consequently it does not make any great difference whether one month is light or heavy, so long as the yearly average is maintained.

The wise "cut-stone" contractor is the one who will arrange to purchase the major part of his requirements, both actual and anticipated, fairly early in the year, for continuous shipment during the season, thus enabling the quarry operator best to serve his requirements and assuring the prompt delivery of exactly the kind of stone stock that he will require for all current operations.

On the other hand, the price of "cut stone," although also computed on the cubic-foot basis, will vary greatly on account of the numerous factors that affect both the cost and selling price of the finished commodity, included in which is the element of seasonable demand. The "cut-stone" operator must keep his plant in operation at some suitable relation to capacity, during all of the months of the year, on either contract or current sales requirements; whereas, the quarry operator can quarry the stock stone for future demand later in the season or during the winter months, after actual quarrying has been stopped for the year. Thus, in addition to the range in cost by reason of the simplicity or elaborated detail that may be involved, and the consequent comparatively wide range in cost per cubic foot of "cut stone" for a simple classic treatment of a bank front or commercial structure, and that for an elaborate Gothic church or a richly ornamented monumental building, the changing costs of labor, power, and other commodities are important considerations, and, added to these, the factors of seasonal demand and plant operation, selling costs, and overhead. This accounts for the frequent varying cost of "cut stone" without relation to any changes in the cost of the rough material or in freight rates on the rough or finished commodity.

Cash and Credit Terms Common

The terms of settlement for "cut stone" are invariably fixed by contract, as most stone for building work is sold by the acceptance of uniform "contract proposal" covering the material to be supplied and all conditions relating thereto. These terms conform in a general way to the usual form of building contract and provide for the part payment on account as the material is shipped or delivered, as the case may be, with a certain percentage held back until thirty or sixty days after the completion of the entire contract.

The rough stone is sold to cutting plants by most of the larger quarry operators on thirty or sixty days'

Packard salesroom, Washington, D.C. A good example of the use of Indiana limestone for small modern commercial buildings

time, with a liberal discount for cash payment within a stated brief period after shipment. Longer terms are seldom extended. The usual terms and conditions are therefore even more uniform than in the "cut-stone" branch of the industry.

There is no direct interest on the part of the "cut-stone" trade that tends to control or affect the marketing condition or prices for the rough quarry product, although naturally the general trend of business in the "cut-stone" trade will, in like manner, affect the quarry operators. Prices on the rough product, however, do not so readily respond to trade conditions, and there may be quite a marked change, up or down, in the current price of "cut stone" without corresponding changes in the price asked by the leading quarry operators for the rough quarry blocks.

There has thus been a great deal of stabilization of prices in the quarrying branch of the industry, based upon current wage rates, supply and equipment costs, and freight rates, rather than upon seasonal market conditions. This, of course, is a distinct advantage to the buyer, as well as to the seller, as except when facing wage or freight rate advances, the buyer or "cut-stone" contractor is thus usually quite safe, in so far as the cost of stone stock is concerned, in figuring and bidding on future building operations.

In view of the fact that Indiana limestone is such a well-known and universally used building stone for the facing and trim of all types of buildings, no introduction of the material is necessary to the architectural and building professions, which continue to specify and use it on the basis of merit, embracing structural value, permanence, pleasing appearance, and moderate cost.

Quality of Stone Helps to Widen Market

Extending the market for this product is therefore largely one of convincing the prospective building owner of its merit, and the advantage and ultimate economy of following this architect's or builder's advice to pay the little additional cost of this fine natural stone over that of manufactured substitutes. This additional cost, though usually slight, may sometimes be considerable, dependent upon the elaboration of the particular work and the consequent amount of hand cutting that is involved, and, of course, the character of substitute that is under consideration. Therefore, apart from the introducing of the material into new fields of usage and the extending of the existing markets in a manner usual to any progressive industry, with well-organized promotional, publicity, and technical service departments, the principal marketing problem of the quarry producers is the balancing, so far as possible, of the demand for the various grades of stone that are necessarily produced by any quarry operation, so as not to have an overabundance of any one grade and a shortage of another, as a result of any one year's operation. Actually, this condition does usually exist to a greater or lesser extent at the end of each building season, owing to the current heavy demand for certain of the grades produced. The result of this condition is that though a stock of the other grades may be carried through the winter season when quarrying operations are at a standstill, there will often be a shortage in these certain grades before the spring quarrying season opens. This condition, however, is being gradually dispersed by the more intensive promotion of those grades of which there may be proportionally a surplus produced. This condition varies, of course, with all of the quarries, as they not only differ in the percentages of the various grades produced, but also are not likely to produce the same percentages of these grades during any two successive quarrying seasons.

The balancing of the demand by well-directed promotional effort, will, it is hoped, in time enable the quarry producers to market a full percentage of their output during any building season. And, furthermore, this will result in salvaging to use certain of the sound but off-grade stone that up to now has to some extent been wasted through insufficient demand for certain classifications in which it would fall, combined with a lack of storage space in the stacking yards.

The domestic market is not appreciably affected by imports of foreign stones, although a substantial but comparatively small quantity is imported each year for use principally in the larger cities along the Atlantic seaboard.

It is not possible to give any comparison of the domestic and foreign markets, excepting to state that there is little waste abroad, where the building stone quarrying operations are usually carried on in a very primitive manner compared with the practice in American quarries. Substantially all of the stone quarried abroad is utilized in some way, and this careful conservation of all waste as a byproduct, to some sort of usage, the American quarry operator must learn. In this problem, the high domestic freight rates are an important and serious factor.

Conservation of the material itself in the course of production is largely a problem of educating the building profession, together with gradually increasing the price to an extent that will make it possible profitably to work up and market a greater percentage of the short length and irregular-shaped blocks that are always produced, yet, which, at the existing low prices, cannot be worked up into sawed stone to advantage by the quarry mills.

It is not possible to make direct comparison of the structural merit of Indiana limestone with any imported stone, because the former is vastly superior to any of the foreign limestones that might be considered as falling in the same class. It weathers better and is in every way superior to the French or English limestones. In fact, most of the foreign stone imported is not in this class at all, but is so-called fancy semi-crystalline limestone that is used principally for decorative interior work, and is treated and finished the same as marble.

The prices, as previously stated, are always computed on the cubic foot basis. That applies both to the rough quarry block, to sawed and semi-finished stone, and to the finished "cut stone." Only in rare instances where it is used in comparatively thin slabs, more as a decorative stone, for interior work and for flooring, is it figured on the square-foot basis.

The quarry operators make no difference in the price on the rough quarry block, according to quantity; the price on one carload would be the same as on fifty. Naturally, small lots requiring a less than carload shipment would take a higher rate, although the price on the stone itself would probably be the same.

The price on sawed stone similarly would not vary with the quantity above a carload shipment. The price for molded stone, on the other hand, might vary considerably with the quantity of each mold required. As this is always produced as required for each order, and in that respect is special work, a pattern and tool or

set of tools must be made for each mold. It thus makes considerable difference in the production cost whether 10 linear feet or 100 linear feet or more of a given mold is required, and similarly whether a carload is made up of a lot of short runs of various molded sections or of a quantity of, say, two or three molded members.

In that department of the quarry production of stone known as the "Milling for the 'Cut-stone' Trade," the work of the quarry operators' mills approaches nearest to that of the "cut-stone" operator, the cost and prices being similarly varied with the quantity and character of the work, more than by the difference in value of the particular grades of stone that may be used.

Prices on the rough blocks and sawed stone are not based in relation to quality—that is, in so far as structural properties, permanence, and weathering qualities are concerned—as the various grades are about equal in these respects, but are in a general way (after the elimination of specialties) based upon the fineness and uniformity of texture and color tone. The most uniform and finest in grain, called "Statuary Stock," is the highest in price, and from that the material is graded down to the coarser-textured "Rustic," which, although a specialty, is usually about the same as "Old Gothic," the lowest in cost, excepting the "Quarry Run," which is produced from short lengths and irregular shaped or so-called "cull" quarry blocks.

Seasonal demand does not affect the quarrying cost, which is based upon a year's cycle of quarrying operations, and the prices are therefore usually the same at all seasons of the year.

The average values for the "rough quarry blocks," "sawed" and "dressed stone" for the four-year period 1920 to 1923 inclusive, taken from the figures prepared for the U. S. Geological Survey, are shown by the following table. It is not feasible to go beyond this four-year period in preparing these figures, as the conditions in the industry in the immediate post-war period were not such that would furnish information of much general value; also, prior to 1920 the production figures of the Indiana limestone district were not so well segregated. (Note that in 1920 the "rough blocks" and "sawed stone" are included under the one heading.)

Though the average values for "rough blocks" and "sawed stone" are considered to be substantially correct as a criterion of average cost, the figures given for "cut stone" are considered to be rather low, and in that respect decidedly misleading as a criterion of average cost for cut or dressed stone. This is explained by the great volume of semi-finished or machined stone

Limestone Prices, 1920 to 1923 Inclusive

	1920	1921	1922	1923	Average Value Four-year Period
Rough blocks	....	$0.61	$0.58	$0.62	$0.61 7/10 (c)
Sawed stone	$0.72	1.05	0.94	1.01	0.99 5/10 (c)
Dressed stone....	2.53	2.76	3.02	2.17 (b) / 3.29	2.88
Average value all stone (a) sold for building work	$1.15	$1.29	$1.17	$1.30	$1.24

The above figures are all f.o.b. quarry district and do not include freight, cartage and handling or other delivery charges.

(a) This average value is the average value of the rough, sawed and dressed or "cut stone," as sold by the quarries and mills in the Indiana limestone district.

(b) In 1923 a further segregation was made by dividing the so-called "dressed stone" into two classes as "semi-finished" or molded and machined stone, and completely finished or "cut stone"; hence the two unit figures given for this year, the first for "semi-finished" and the second for "cut stone."

(c) These averages are for the three year period 1921 to 1923 as the values for "rough blocks" and "sawed stone" were not segregated in the 1920 or previous reports.

(that is, stone milled for the "cut-stone" trade by the quarry producer) that is included in the "dressed stone" figures, onto which the further cost of the finishing, hand cutting, and carving, drafting, detailing, and models must be added to give a true average value for finished "cut stone."

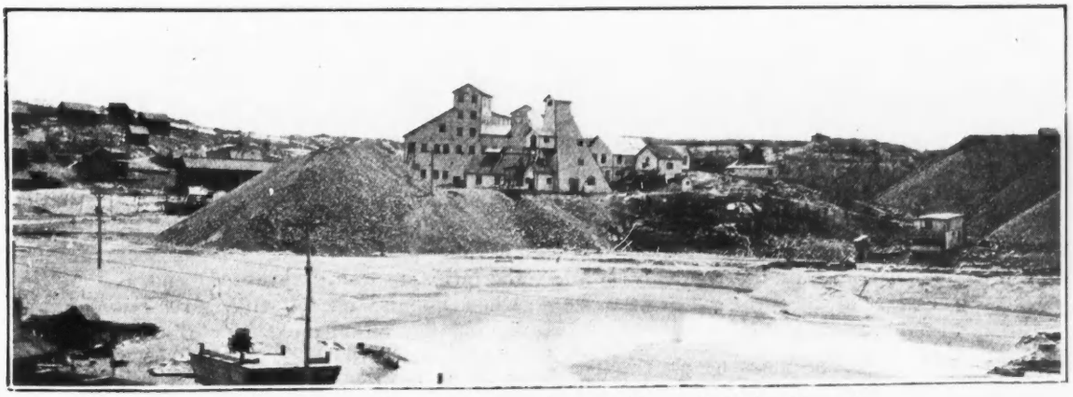
Another factor that should also be kept in mind is the volume, large in the aggregate, of the roughly finished machine stone, sills, copings, and molded courses, that is sold as "cut stone" for use as structural trim in commercial and industrial buildings, small houses, and apartment buildings. This more than offsets the higher cost of elaborate cut and carved Gothic work, which may run from $6 to $10, or even more, per cubic foot, giving what is probably a considerably lower figure than the true average value for "cut stone."

The regular gradings, as established by the Indiana Limestone Quarrymen's Association and now in general use by all of the leading quarry operators, are as follows:

Select Gray	Standard Buff
Standard Gray	Variegated
Select Buff	Old Gothic

"Rustic," "Travertine" and all other gradings or specialties of the various quarry producers are not considered as regular grades, though in some instances the regular grade product of a particular quarry is given a trade name by its producer.

The range above and below the average values for rough blocks as given in the table, for blocks of the various grades, is from about 75 per cent above these average values for the finest Select or Statuary Stock, to about 30 per cent below for the lower cost Variegated, Old Gothic, and Rustic grades.



Mill of Mining Corporation of Canada at Cobalt, Ontario

Continuous Electrothermic Furnaces for Complex Ores

By T. M. Bains, Jr.
Assistant Professor of Mining, University of Illinois

THE PUBLICATIONS of B. M. O'Harra, of the U. S. Bureau of Mines,[1] on the electrothermic treatment of complex ores of zinc-lead-iron, have brought out the advantages and some of the disadvantages of the briquet method of electric smelting. Two types of continuous furnaces have been designed and tested at the University of Illinois, which do not use briquets. The first type, described below, is the "inclosed arc" furnace, using a bath of ferro-alloy of relatively low melting point, to obtain a uniform temperature for distillation of the charge, which is fed directly on top of the bath. The zinc is vaporized and passes into the condenser, while the lead sinks by gravity to the bottom of the bath. Any iron, silicon, manganese, or copper present will alloy with the bath, though only a certain amount of the copper will alloy, the remainder separating out similarly to the lead.

The second type is a continuous-resistor furnace, in which the unbriquetted charge, in cylinders, passes through the retort, which is heated by graphite or carbon resistances. The reducing atmosphere always present prevents oxidation of the graphite or carbon. The zinc is volatilized and passes into the condensers, and any of the other metals and slag are retained in the cylinders.

The inclosed-arc furnace is shown in Figs. 1 and 2. The design is similar to the Girod arc furnace, save that the current returns up the inclosing wall of the arc. The electrodes are shown clearly in the figures. The current enters through the arc carbon, passing thence through the bath to the conducting wall inclosing the arc, and up this wall to the other electrode. In a large furnace, the standard Girod or Heroult type of electrodes would be used, and the inclosing wall would be made of graphite where the temperature is excessive. The basic point is to prevent the carbon monoxide and zinc vapors becoming highly heated, thus forming large quantities of blue powder.

In the furnace shown in Fig. 1, the arc is inclosed in a graphite tube, the lower end of which is submerged beneath the surface of the ferro-alloy bath. The calcined or roasted ore charge is fed through an annular space about the inclosing wall of the arc. This charge rests upon the bath, and the temperature cannot exceed the temperature of the bath. As the alloy melts at 1,250 deg. C., the temperature for the best distillation of zinc may be secured. The heat of the inclosing wall preheats the charge. As the lead and other metals, except zinc, are reduced and become liquid, they either sink below the ferro-alloy by gravity or alloy with the bath alloy. The hearth is tapped at the bottom and a lead alloy is drawn off. Any gangue will form a slag and float on the bath, overflowing into

Two Types of Electric Furnace for Zinc-Lead-Iron Ores

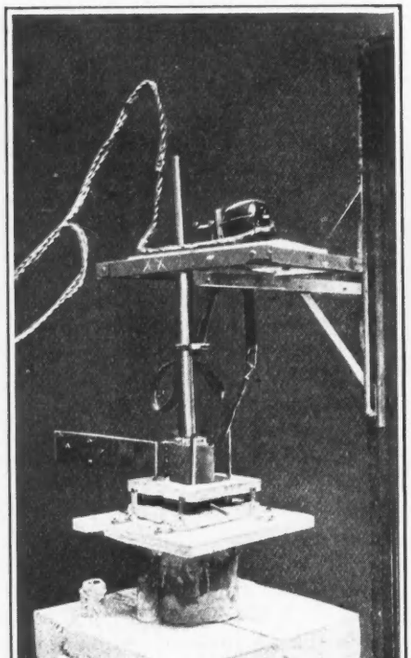
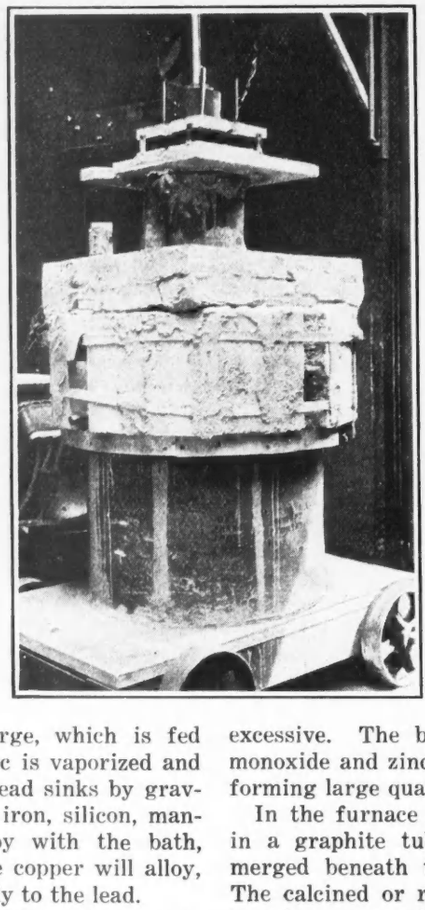


Fig. 1—Continuous "inclosed arc" zinc furnace developed at the University of Illinois. Laboratory model, showing detail of top

Fig. 2—This shows the lower part of the laboratory furnace of Fig. 1. The design is similar to that of the Girod



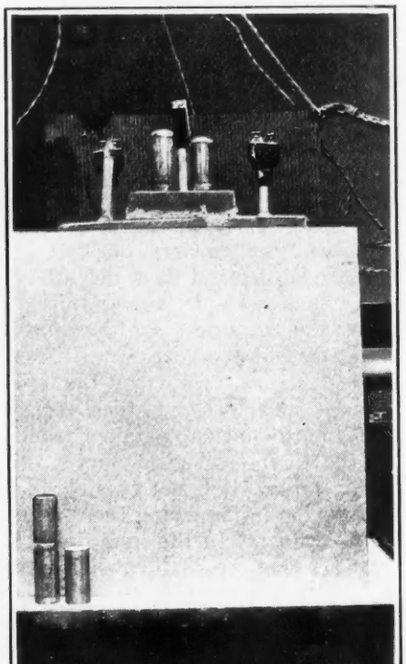


Fig. 3—A zinc furnace of the continuous resistor type, that has exhibited no mechanical difficulties in service

[1]Bulletin No. 208, U. S. Bureau of Mines, by B. M. O'Harra. "Experiments on the Distillation of Zinc From Complex Zinc-Lead-Silver Ores." B. M. O'Harra and E. S. Wheeler. Technical Series, August, 1923, School of Mines and Metallurgy, Rolla, Mo.

a "gutter," which carries it to another tap. The zinc vapor passes over into a condenser, with the carbon monoxide and other gases.

The advantage of this type of arc furnace is that at no time are the charge or vapors or gases subjected to the intense heat of the arc. Also, the lead is not volatilized any more than in the regular forms of retorts now in use at zinc smelters. Four products were formed—namely, (a) zinc; (b) lead alloy; (3) excess ferro-alloy, and (4) slag. This excess ferro-alloy would have to be treated either directly in a lead or copper furnace or it could be granulated and used for the precipitation of "sponge copper" from copper sulphate solutions.

The furnace shown in Fig. 1 developed no electrical or metallurgical troubles, except in the feeding device. The inclosing wall of the arc heated the incoming charge to a "sintering" temperature and interfered with regular feeding. This is a minor detail and can be corrected.

The second type of furnace, which is shown in Fig. 3, gave no mechanical trouble. It is the only zinc furnace that I have seen of which this can be said. After a run, the furnace can be cooled and another run started without repair or difficulty. Also, no leakage of vapor or gas occurs, the only places that the carbon monoxide and zinc appear at all externally are at the gas exits and the zinc taps, and only at the latter when tapping is in progress.

The retort chamber and the two adjacent condenser chambers are shown in Fig. 4. The two columns of cylinders holding the charges also are shown in this figure. The retort chamber is heated by means of helical carbon resistors, made by sawing a helical path in a tubular carbon. This has a path of 160 in., with a cross-section of $\frac{3}{8}$ of a square inch. At 55 volts, a.c., 60 cycles, a current of 150 amperes flowed through the resistors, giving 7.9 kw. at 96 per cent power factor.

Through this tubing graphite cylinders were pushed from the bottom upward. The cylinders were separated by graphite disks, as shown in Fig. 4. At the upper end of each cylinder, slits were sawed for exits for the gas and zinc vapor. The zinc vapor and carbon monoxide passed then to the condensers, downward, and up the condensers, the carbon monoxide passing out of the exits shown at the top of the furnace in Fig. 3. Pyrometer tubes in the condensers and retort allowed of temperature readings. The zinc was tapped from the bottom of the condensers.

The cylinders containing the non-volatile material of the charges pass through the top of the graphite cross-connector of the helices, then through the top of the retort cover, then through two inches or so of granular graphite, contained in a compartment over the top of the retort and the condensers, and thence through another cover to the atmosphere. To conserve heat, the cylinders pass through the material to be charged into the cylinders, preheating the charges and cooling the graphite cylinders below the oxidation point of graphite. This is shown in Fig. 3, the rectangular box between the pyrometer tubes holding the ore charge next to be fed to the cylinders.

In the cylinders, after leaving the retort, are the lead alloy and any slag from the gangue. It is possible if the ore contains much copper to separate the lead and copper, so that a copper alloy with 8.5 per cent lead will be separated from an alloy of lead, with a little copper. The gold and silver in the test run seemed to divide about equally between the lead and copper alloys. The separation is made by placing cylinders instead of solid disks between the cylinders holding the charges. These "copper cylinders" are also of graphite, but have a solid bottom and a cover with an extremely small slit in it. The copper alloy is liquid and will run through this slit, but the lead alloy always contains a trace of zinc, which makes it more viscous, and it will not pass after the copper alloy, but remains in the charge cylinders. This makes a very interesting separation of a zinc-lead-copper ore, the products being zinc, lead alloy, and copper alloy. Some of the zinc made by this means contained less than 1.5 per cent lead—Prime Western grade. There seems to be a discrepancy between these results and those obtained by O'Harra, of the Bureau of Mines at Rolla.

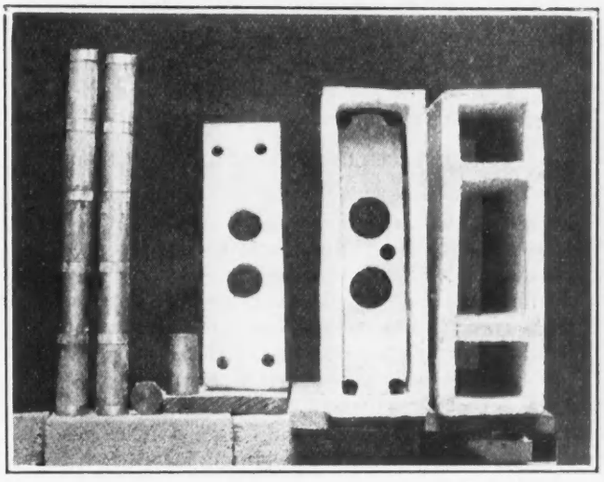


Fig. 4—Resistor furnace retort and condenser parts

To protect the helical resistors from oxidation on cooling and also to prevent the entrance of oxygen or carbon dioxide into the condensers, the entire retort and condenser tiling were inclosed in another tile, having a 1-in. spacing on the four sides. This space was filled with granular resistor carbon and heated electrically. To start a run, this granular resistor was heated to a red heat by passing a separate current through it; then the helical resistors were heated by passing the current through them.

A charge of the complex ore, calcined or roasted, and the necessary carbon for reduction of the oxides, was placed in each 3-in. graphite cylinder and fed to the bottom of the furnace. The cylinders had a small clearance within the interior of the helical resistors, but as the resistors had a thin alundum coating on the inside, no short circuits could occur if a cylinder touched the inside wall of the resistor. No dusting of the charge occurred, even when zinc dust, mostly minus 200 mesh, was distilled. No electrical or mechanical trouble occurred during any of the runs.

For distillation of blue powder and zinc scrap, where the temperature need not exceed 1,100 deg. C., iron cylinders and disks may be used. Calite, a specially prepared iron, is non-rusting and would give better results. The use of disks between cylinders, instead of a cylinder with a fixed bottom, is advantageous if slag or sinter should stick to the wall of the cylinder. Also, the lead slug is more readily removed if movable disks are used.

Large furnaces of this second type could be accurately designed. Instead of the helical resistors, 2- or 3-in. cylindrical or tubular rods of standard lengths might be secured from the Acheson Graphite Co. The resistance of this material is practically uniform at all temperatures. Graphite connectors could be used to make the necessary connections between rods. For the treatment of blue powder, from the present retort furnaces, calorized iron cylinders will stand 1,150 deg. C. For complex ores, carborundum or graphite cylinders would have to be used.

The feeding device at the bottom of the furnace could be made one of a continuous or intermittent type, the column of cylinders moving steadily or only when a new cylinder is introduced into the column.

In the type of furnace described the heat loss is negligible. The cylinders are cooled as they emerge from the top of the furnace by the ore mixture to be charged later. The cylinders in the furnace shown in Fig. 3 were below 150 deg. C., when exposed first to air. These are immediately recharged, and the heat is to a great extent conserved.

Advantages Over "Briquet" Process Are Noteworthy

I believe that such a process as the second one mentioned above is more simple and will produce the products at less cost than is possible by the use of the "briquet" process. A briquet process appears to be simple from the electrical standpoint, but it has various disadvantages—namely: (1) Briquets cannot be made commercially so uniformly that some "hot spots" do not exist in distillation, which increases the volatilization of such metals as lead. (2) Briquet resistance varies greatly from cold to white heat. (3) Briquet resistance varies with different ores. (4) Variable voltage equipment is required by (2) and (3). (5) Briquetting is expensive, if uniform large briquets are to be produced. (6) Baking of briquets, to eliminate the hydrocarbons, to harden the briquet so as to stand the pressure of the "set-up," and to make the briquets conductors of electricity, requires expensive equipment for large-scale work.

The above-noted defects are inherent, whereas those that may occur because of poor manipulation and carelessness, such as making of poor contacts in assembling, are many and costly.

A furnace of the second type described above can be designed as accurately as a steam engine. The various co-efficients are well known. This is not true of the briquet process.

The Torpedo Copper Mine, in New Mexico

The Torpedo mine is situated near Organ, Dona Ana County, N. M., 15 miles from the railroad. The mine makes considerable water, which must be pumped, and the price of coal delivered at the mine is $15 per ton. Hauling, freight and smelting charges on the ore amount to about $20 per ton, and no ore running less than 6 per cent copper can be shipped to the El Paso smelter and pay a profit. Notwithstanding these adverse conditions, the smelter returns show a gross production of more than $800,000, although the property is at present not producing. According to L. B. Bentley, the manager, ore has been mined to a depth of 300 ft. only, and all shipments have come from the oxidized zone. The deposit so far explored is 250 ft. wide and 800 ft. long, but the surface outcrop indicates the extension of the orebody for more than 3,000 ft.

From the 300 level five winzes, in depth from 30 to 65 ft., have been sunk, all in ore, the 65-ft. winze encountering chalcocite mixed with quartz. A 50-ft. crosscut from the bottom of the 65-ft. winze is in ore the entire distance, and no walls had been found when the water compelled cessation of work. The ore averages 8 per cent, and picked specimens 70 per cent, copper. The other winzes are in chrysocolla, malachite, and red and black oxides.

The ore contains some gold and silver, the silver increasing with the sulphur at the rate of about one ounce silver to 1 per cent sulphur, and the gold varying from 25c. to $2 per ton.

The property consists of two patented claims and one unpatented claim, covering in all 54¾ acres.

It is hoped at some future time to obtain electric power from the Elephant Butte Dam, which will eliminate the high fuel expense; and a leaching plant on the ground capable of handling the low-grade ore would save the high transportation and smelting costs which now hamper operations.

Austrian Magnesite Industry Now Active

The Austrian magnesite industry covers the greater part of the world's requirements of calcined (roasted) magnesite for refractory purposes, such as for furnace linings and crucibles where high temperatures are required. Production is estimated at 170,000 tons in 1922 and 150,000 tons in 1923, according to Elbert Baldwin, U. S. Assistant Trade Commissioner at Vienna. Ninety per cent of the production is usually exported. Exports in the first nine months of 1924 were lower than those of 1923 and materially behind pre-war shipments. An improvement is expected to follow the greater activity reported in the American and Continental iron and steel industries. The largest Austrian producer, the Veitscher Magnesite Co., announces a net profit for the business year ended June 30, 1924, of 5,500,000,000 Austrian crowns, or $80,000, and a dividend of $1.20 per share—the same as last year—plus a bonus of four English shillings earned by the associate Eglinton Magnesite Brick Co. for the year ended March 31, 1924.

Foreign capital is being sought for the development of hitherto unexploited Austrian deposits of magnesite. Several deposits, said to be of higher quality and more readily exploitable than deposits now in operation, have been discovered since the war. Development of hydroelectric power is a factor which may eventually revolutionize the Austrian industry, in view of the high temperatures required for calcining the ore and the fact that the available domestic fuel supply consists only of lignite.

Calcined magnesite rather than raw forms the bulk of foreign shipments, totaling 85,000 tons in 1923, valued at $1,650,000, and 53,000 tons, valued at $1,000,000, in the first nine months of 1924. In both years approximately one-half of total shipments were to the United States. Shipments to Great Britain declined from 13,000 tons in 1923 to less than 1,000 tons in the first half of 1924. Exports to other countries, chiefly to France, Germany, and Czechoslovakia, have not varied greatly.

Uses of Metals in Early Times

A Study of Ancient Conditions and the Results Achieved With Scant Resources

By C. A. Grabill
Metallurgical Engineer, Washington, D. C.

C. A. Grabill

AS A metallurgist I have always wanted to know what results were obtained by the ancient Greek and Roman engineers with the presumably scanty resources at their command, with their ignorance of chemistry and physics, and lack of steam and electricity and other modern industrial aids. The results which they achieved were much better than is generally appreciated, and the beauty and workmanship of their bronzes, and the free use of metal in war and in construction, bear testimony not only to their skill but also to their ability to produce cheaply and in quantity. Iron reinforcing in masonry, though unquestionably increasing stability, is but little used even today. Unfortunately, ancient literature is remarkable for its lack of information touching the mining and metallurgical industries and their importance in the social life of the time, a fact especially strange because Pliny, who gives us much of the data to be found in ancient writings, though not an engineer himself, was, while a colonial governor, at every opportunity writing to the imperial headquarters in Rome "Send me an engineer," until the exasperated emperor replied, "Can't you get along with the engineers you have? Good ones are scarce around here, and we need all we have."

That the early engineers were men of ability is shown by the fact that Frontinus, superintendent of the Water Department of Rome, soon after the beginning of the Christian era, wrote a treatise on surveying (now lost) that served as a textbook for fifteen hundred years. Nor were the mining engineers behind, as the tunnels, shafts, and slag heaps of Cyprus, Laurium, and Rio Tinto testify. The statuary, tools, instruments, and ornaments still in existence prove that the metal, once won, was worked by men of intelligence and knowledge, but they do not tell us anything as to the availability of the metals to the man in the corner house. Could he go out and buy a knife or sword when he wanted one or get a hammer and chisel and some nails at the shop in the next block or send the boy for a lock for the door or a new faucet for the bath tub? He certainly could in Roman times, and apparently had not much difficulty doing so as far back as the time of Alexander, although the prices were relatively high. That we have so few remains of these articles is due partly to the oxidation of iron, copper, lead, and tin, but more to the ease with which scrap metal may be re-worked.

The metals seem to have been more common in Greece and Rome than they were in this country prior to the introduction of the railroad and about as much so as they were in Mexico fifty years ago. Fortunately for our knowledge of ancient economic conditions, the priests at a number of the important Greek temples recorded their accounts in stone for the benefit of the temple accountants and the knowledge of posterity. These included itemized lists of inventories, expenses, and receipts. Some of them have been copied and published, but apparently they are not available in this country. Prof. Gustav Glotz has, however, published a short study of the expense account at the Temple of Delos, that, though far from complete, enables one to obtain a pretty fair picture of the economic conditions in Greece at the time.

Delos was an island about three miles long near Athens, and the temple, though small, was popular, in the track of the principal commercial routes, and occupied an important place in the political and commercial life of the country. The original list is an itemized statement of the expenses of the temple for several hundred years, but more complete for the years between 350 B.C. and 250 B.C. It covers practically everything, including such items as payrolls, purchases of food and supplies, marble, metals, charcoal, clothing, tools, brick, sand, lime, contracts for services, freighting, and the thousand and one things required by a temple staff of a dozen or so living on a small island which supplied but few of their requirements.

The main point of interest to us is the place in the economic structure occupied by the metals, but to understand it one has also to study the general condition of the workman of the time, and the result is a picture of a society much resembling that existing in Mexico prior to the building of the railroads, say 1875. It is unquestionably difficult to make a direct comparison between conditions then and now, because the expenses are all set down in a silver currency which is relatively much depreciated today and which fluctuated then as now. Furthermore, the silver currency, though not a token currency, had back of it a gold currency which fluctuated in value, owing to the wars of Alexander. Wars then had no less influence on commerce and exchange than they do now. Theoretically, there seems to have been a double or triple currency of gold and silver or of gold, silver, and copper. The predominant currency appears to have been the gold one, as usually happens in such cases; at least, that is the inference from the writings of some of the statesmen of the time; but the usual method of payment was by silver. The system was rather that of barter in which one of the articles exchanged was known weights of metal of known purity rather than money as we know it today. The weights of the coins were actually the basis of their system of weights. This condition of affairs leaves us without a stable standard of comparison. The only thing available for comparative purposes that is stable from man's standpoint is his own labor. Its re-

sults may vary, but in the main its mechanical equivalent per hour and its importance to the individual is a fairly constant quantity.

A Sounder Base for Professor Fisher

If Professor Fisher had based his India-rubber dollar on an hour's labor as a unit instead of on a commodity unit, he would have, both theoretically and practically, a much sounder base. Though I realize that such a proposition would meet the opposition of the labor unions because it would call attention to and tend to prevent any profiteering on their part, nevertheless I believe that such a basis for money is the only sound and logical one, just as I believe gold and silver to be the most convenient and accurate means for measuring it.

The thing to do, then, is to see what the workman could obtain for his labor, first in money and then in what the money would buy in commodities common to that time and this, particularly metals and foods. The monetary unit of the accounts was the drachma, a silver coin weighing about two-thirds as much as our quarter. From 500 to 400 B.C. Greece seems to have been genuinely democratic, and every one received the same wage, one drachma per day, without distinction between slave and freeman or roustabout and architect, but by 328 B.C. distinctions had become marked and the daily payroll schedule at Delos was:

	Drachmas
Errand and water boys	1
Roustabouts and helpers	1½
Experienced labor	2
Skilled labor, masons, carpenters, and other artisans	2½

In 319 B.C. skilled labor was paid 2 drachmas per day and helpers were paid 1½ drachmas.

In 279 B.C. a gang was sent to erect a fallen column. The gang consisted of a carpenter "to erect a machine for raising the column" (probably shear-legs and winch or gin-pole with block and tackle), two masons to set the column, and a "machine tender." The carpenter and masons received 2 drachmas each per day and the hoist man ⅝ drachma for the job. The masons also received 2½ drachmas for the job, for helping to hoist the column into place. Were labor union rules in force then, too? Most of the work was done by the job (the contract or tarea system of Mexico).

Engineers' Pay Meager

The engineers were certainly not a pampered class. Theodorus, the architect of one of the great temples, received 1½ drachmas per day. In 329 B.C. the architect at Eleusis received 2 drachmas and a few years later 4 drachmas per day. In 282 B.C. the architect at Delos received only 2 drachmas per day, though a few years later he received a raise of 50 per cent. In 309 B.C. a consulting engineer of note was called in for a fee of 3½ drachmas per day, with an allowance for expenses that brought his total up to 4½ drachmas per day. These were the men who built the temples that still serve as models for present-day architects.

There is a big discrepancy between the wages of those employed by the day and those employed by the year. When the wages of masons employed by the day was 2½ drachmas the men on the yearly salary list received only ⅔ drachma. Professor Glotz explains this by assuming that the difference was due to lost time, but it is more likely due to the fact that the day man had to feed and house himself, whereas the temple staff were housed in the temple and its environs and probably obtained most of their food from the temple offerings. Probably, also, they received small sums on holidays as tips for acting as guides to strangers, as do the guides in the Washington Capitol. During the first part of the period covered by these accounts the temple slaves received 10 drachmas per month "for their needs," and employees of the better grade received 13 drachmas plus an allowance of 2 drachmas per month for clothing. Later all salaries were raised to the latter rate. In 269 B.C. two musicians were hired for an annual salary of 180 drachmas for a year of twelve months (some years had thirteen months). At Eleusis all except one of a temple staff of eighteen received 180 drachmas per annum, plus an allowance of 44 drachmas per annum for clothing and a few odds and ends extra, making a total of 230 drachmas per annum (twelve months). The chief priest received the same salary as the others, but had an additional 100 drachmas a year from a special endowment fund.

Average Workman Received Two Drachmas Daily

The theoretical basis for these annual salaries is worth noting. About 280 B.C. two new stone workers from the mainland were employed for a year. The salary was 1½ measures of wheat (or three of barley—worker's option) per day for cereal food, 120 drachmas per annum for other food and extras, and 15½ drachmas per annum for clothing. No allowance was made for housing, so presumably it was furnished by the temple authorities. The following year the grain allowance was changed to a cash payment of 120 drachmas per annum, making the annual salary 255½ drachmas. At the same time the men of this class on the daily payroll received 2 or 2½ drachmas per day. Allowing for sixty holidays in the year and twenty-five days lost from sickness and other causes, the earning power for 275 days would have been at least 550 drachmas, so the perquisites of the temple employees must have been at least as much as their regular salary. For comparative purposes the wage of the average man may be taken therefore at 2 drachmas per day. Favored ones such as foremen and superintendents received 25 per cent more and unskilled labor 25 per cent less.

The drachma was a silver coin weighing at the place and period mentioned from 64 to 67.3 grains, approximately 59/60 fine silver, the alloy being two parts gold per mil and the remainder principally copper. The difference in weight was due to early changes in the mint standard to facilitate handling foreign exchange, and during the period covered by the accounts the drachma may be considered as 66 grains of fine silver without material error. The purity and regularity of the coins is in itself a guarantee of the skill of the mint assayers and metallurgists, as is also the cutting of the dies. Sixty-six grains of silver at 69c. per oz. are worth 9½c. in United States currency, but 9½c. no more represents the value of the drachma to the ancient workman than 25c. represents the intrinsic value of the United States silver quarter. On the silver basis, however, the ancient Greek workman received 132 grains of silver per day, worth 19c. today, as against 3,480 grains receivable by the modern American workman who is paid $5 per day, a ratio of 1 to 26.3. The American can get more than twenty-six times as much silver for a day's work as could the ancient Greek.

It is well to state that, of all the articles listed, silver was the most valuable compared with modern prices. In spite of the quantity produced at Laurium, it was relatively scarce, although actually there was more in circulation than today, per capita. The demand was due to the fact that practically all commercial transactions were completed by the actual exchange of silver coin, their being no paper currency and but little use of checks. It should be borne in mind that there was also a gold currency and the gold-silver ratio varied from 16 to 1 to 10 to 1, being at this time not far from 10 to 1, at which point silver is worth $2.06 per ounce. If the gold-silver ratio be taken at 10 to 1, which was not far from the truth in 280 B.C., then the drachma was worth 28.4c. United States currency, and the gold wage per day was 13.2 grains of gold, which would be 57c. United States currency, against 116.1 grains receivable by the American on a $5 per day wage. Obviously, the old-timer received only one-ninth as much gold as his modern successor. But at that I can remember times and places when the Mexican peon received less than 19c. United States currency, and any engineer who has worked south of the Rio Grande y Bravo knows that 57c. United States currency was not far from the customary pre-war rate for Mexican workmen.

The question is, are these high ratios exceptional or do they apply to all commodities. I think they are somewhat exceptional, not only because of the greater demand for coinage purposes but because of the locking up of truly enormous quantities of the precious metals in the temples as offerings. The inventories of the temple treasuries are huge, and as offerings they were removed from circulation and hence unavailable for commercial purposes.

Lead Comparatively Cheap

As proof of the foregoing statement take the data for lead, which are surprisingly different. The price ranged from 2 drachmas per avoirdupois talent (the ancients had an avoirdupois and a troy talent, even as we have avoirdupois and troy pounds) in the fourth century to 7 drachmas per talent in 250 B.C. In 279 B.C. the price was 5 drachmas per talent of 82¼ lb.—that is, 0.58c. per pound, silver basis, or 1.7c. per pound, gold basis. The workman would have reecived 33 lb. of lead as a day's pay. It should be noted that this price included the cost of the lead at the Laurium smelter, freight to Athens, transshipment at the Piræus, freight by water to Delos, and retailer's profit, and, for part of the time at least, war risk. The price, therefore, should not be compared with the present wholesale price quoted in the market report, but with the price charged in the town hardware store—say 10c. per pound, at least—probably more. Furthermore, a few years before it had sold as low as ¼c. per pound silver, or ¾c. gold, and the daily 2 drachmas would have purchased 82 lb., more by 30 lb. than the American's $5 will buy today. This comparative cheapness of lead is due to silver's being the metal sought, with lead a byproduct, just as copper is the metal sought today and silver is the byproduct. The overproduction of lead was so great that at times the litharge from the cupeling furnaces was dumped in the sea, the smelters preferring to lose it entirely rather than to reduce it and throw an additional burden on an already glutted market. The cheapest price (¼c. per pound) therefore probably represents merely the cost of reduction, freight, and retailer's profit. This fact also explains the unusually high percentage of lead in ancient slags and the liberality with which lead was used for water pipe, setting foundations, filling sockets, for reinforcing bars, and for other like purposes. The high price of silver should be balanced against the low price of lead.

Copper was used by the ancients as currency, as well as for statues, arms, and kitchen utensils, and the currency was not token money, as in our day, but coins were exchanged for their intrinsic value, being definite weights of convenient size for exchange as a commodity. The silver-copper ratio was from 500 to 1 to 120 to 1, rather a wide variation, but not more so than it has had during the last fifty years. In 420 B.C. a lot cost the Delos temple 26 drachmas per talent (82¼ lb.), which is 3c. per pound on the silver basis, and 9c. on the gold. In 375 B.C. a lot sold for 69 drachmas per talent (8 and 24c. respectively). At the cheaper of these prices the workman would have received 6⅛ lb. a day and at the higher only 2⅜ lb. These were retail prices. At present he would get in this country 20 or 25 lb. as a day's equivalent—say five times as much. Because the lots mentioned are small is no reason for concluding that all transactions were at retail. An ancient Assyrian inscription mentions the capture of 150 tons of copper in one Greek temple, and the statement was not exaggerated, because some of the actual articles itemized have been found in modern times.

Ancients Used Iron Freely

Iron forms the basis of our modern construction chiefly because of the use of steam and electricity; nevertheless, it entered into the ancient economic structure rather more than is generally understood to be the fact. One Assyrian warehouse has been uncovered that still contained 200 tons of iron and steel, mainly as ploughshares, picks, mattocks, hammers, chains, and similar articles. In 282 B.C. the purchasing agent at Delos bought 45 minæ of ingot iron for 18 drachmas. The mina was 1⅜ lb.; so the daily 2 drachmas were worth 6⅞ lb. of iron. The price of the iron was 2⅞c. in silver and 8.3c. in gold per pound. This iron was not pig iron, but was either wrought iron or mild steel, and was, of course, sold at retail, the price including original cost, land and water freight, and jobber's and retailer's profits.

A Giant's Sledge

There were giants in those days. At least one of the temple workmen used a sledge hammer weighing 33 lb., for which the purchasing agent paid 24 drachmas (one man's labor for twelve days). In 280 B.C. a miscellaneous lot of locks, bolts, and hinges cost 1½ drachmas per mina. Bar iron cost 1⅛ drachma per mina in 298 B.C. "Pins and hooks," probably reinforcements for masonry, cost 1⅞ drachmas per mina, and a chisel weighing 4½ minæ, probably a stone cutter's tool, cost 6 drachmas 4½ obols. Iron, therefore, was a little more expensive than copper then, and was worth about the same amount of gold that it is now.

If we consider the ancient wage as being paid in a composite of the five metals, the Greek workman of 280 B.C. received only one-tenth as much as the American on a $5 per day basis. On the other hand, if we compare the wage with that in the principal mining camps of Mexico before the war, it will be found to be much the

same. This resemblance goes much farther in other commodities.

To get an adequate picture of the situation it is necessary to include the prices of the principal foodstuffs. Just as wheat and corn are the basis of the country's commerce today, so were wheat and barley in ancient days. Greece did not produce sufficient grain for its own needs. It was not a wheat-growing country and the yield was low, about nine or ten bushels per acre. The deficit was made up by importations from Africa and elsewhere, so the price paid represents not only the cost of production but also the risk and expense of transportation from the Nile Valley to Athens, and should be compared not with the price of wheat in Chicago but rather with the retail price in England. The price of barley was artificially held at half of that of wheat by the type of contract referred to in the foregoing, by which the workman could draw part of his pay in wheat or double the amount in barley. This ratio, by the way, is about the same as it is now.

Commodity Prices Fluctuated Widely

There is a long list of purchases of wheat, and the price varied as it does now. In 282 B.C. the price started the year at 7 drachmas per medimnus, dropped to 4½, recovered, and rose to 10, almost as great a variation as we had in war time. The usual rate seems to have been from 7 to 10, but in 268 B.C. the two stone workers mentioned in a preceding paragraph converted their grain allowance into cash at a rate of 10.5, which seems to have been the average of the price for the preceding three years. The medimnus was 1.56 bushel. At 10 drachmas per medimnus, the workman received an equivalent of 0.31 bushel of wheat per day, against 3.0 bushels now: the ratio of 1 to 10 still holds (assuming $5 per day and $1.67 per bushel for present rates). The wheat was worth 66 grains of gold per medimnus, or 42.3 per bushel, making the Delos price $1.80 per bushel United States currency equivalent, gold basis. The bushel of wheat would have purchased from 8 to 20 lb. of copper at Delos, and at present wholesale prices it would purchase 10. At Delos it would have purchased 22 lb. of iron. Now it would purchase 30 lb. Last spring it would have purchased 22 lb. only, so the relationship is fairly close. At Delos the bushel of wheat would have purchased from 75 to 260 lb. of lead. At present wholesale prices it would purchase 18 lb. only.

Meat was cheap in the olden days. Between 377 and 374 B.C., 109 bulls were purchased for sacrificial purposes. Presumably these were large, fully developed, and especially fine animals, because the temple was wealthy and internationally famous. The representations on coins and in sculptures show particularly fine beasts. They cost 77½ drachmas each—that is, $22, gold, or 12 bushels of wheat—say 2¼c. per lb. Pigs cost from 1½ to 8 drachmas each—that is, from 42c. to $2.27, gold, each. They are represented as varying from young animals to fat full-grown ones. One can only guess in this case, but it is easy to see that pork chops did not cost 45c. per lb.; 4c. would be a closer guess. As another fair guess it would seem that the daily 2 drachmas would purchase more meat then than the $5 does today.

Olive oil cost from 15 to 45 drachmas per metretes, depending on the time and quality. Presumably the average price of 26 drachmas per metretes paid in 279 B.C. is a fair one for medium-grade oil, second running. The metretes was 10.6 gal., so the workman could get 0.86 gal. per day. The price was 70c. per gallon, gold. Though the price is four times as high today, the workman can get more now than he could then, thanks to the cottonseed, which was not available for the ancient olive grower.

Wine cost from 4 drachmas to 22 drachmas per metretes—10c. to 60c. a gallon, gold, and a workman could buy from one to five gallons a day; and a quart of bootleg costs two days' pay here and now! A bushel of wheat was good for 18 gal. of the common grade and 3 gal. of the best!

Clothing Prices High

But—and here is why ancient statues represent nearly every one, including the gods, as unclothed—a coarse chiton cost 10 drachmas; a himation, 20, and a ceremonial costume of white linen 25 to 40 drachmas. Five days' pay for a shirt, ten for a cloak, and a month's work for a Ku Klux kostume! The stone cutters mentioned before were allowed 15½ drachmas for clothing. If this was the genuine allowance out of their wages for that purpose, either clothes were not considered necessary or the men were expected to have their clothes woven and made at home. Consider the plight of the temple engineer with a wife and three small children to support and an allowance of $12 per year for clothes for the family! Still it takes the $80 per month clerk two weeks to pay for a $40 suit, seven days to pay for his wife's $20 summer dress, and no Ku Klux kostume allowed for.

Professor Glotz does not give much insight as to the prices of vegetables and fruit, but judging from the figures in the Decree of Diocletian they were much cheaper than now: that is, a workman could obtain considerably more fruit and vegetables for a day's labor than one can now.

The final conclusion is that the introduction of steam power has increased the output per unit of man's labor approximately ten times in the mining industry and also in weaving, and materially more in transportation, and consequently has raised the average wage payable in the product of these industries by a corresponding amount. On the other hand, the things in which power does not enter, such as farm products, required about the same or even more labor to pay for than today. It all comes back to the simple principle that to obtain high wages the workman must produce a corresponding output, whether by his own ability or by external aid does not matter.

Income Taxes Paid by Mining Companies

Statistics just compiled by the Bureau of Internal Revenue covering tax returns for 1922 show that 152 metal mining companies reported a net taxable income of $34,871,917; 343 oil and gas companies had a net taxable income of $38,929,696; 218 companies mining salt and other related materials show a similar total of $23,960,986; 272 concerns engaged in other forms of non-metal mining had a net income of $12,055,121; 466 concerns engaged in quarrying, including clay, sand and gravel, had a net taxable income aggregating the sum of $22,433,807.

Useful Operating Ideas

Method of Aligning Raises

By Fernando Montijo
Engineer, Moctezuma Copper Co.,
Pilares de Nacozari, Sonora, Mexico

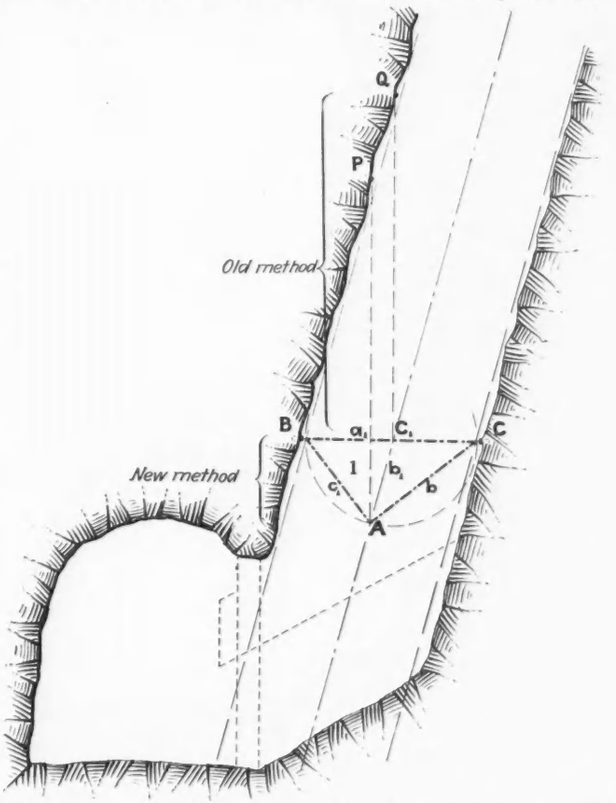
In placing direction lines, including bearing and inclination angles, in inclined raises for connections, a common method is to hang from plugs on the hanging wall of the raise two strings on the line of the bearing, of such length each that the line of sight will pass through their lower extremities, for a given inclination. In steep raises this method has not been found satisfactory, because, to have the lower ends of the strings in the center of the raise and at a convenient distance from the floor, it is necessary to place the plugs at a considerable distance above. (Points P and Q in the accompanying figure.) The raise must be extended this added distance by means of approximate lines. The plugs must also be close together or the vertical distance from the floor will be necessarily greater. The steeper the raise, the greater will be this additional height. Therefore small errors in lengths or bearing will vitiate the alignment. Under these conditions it is difficult to find a convenient spot in the wall of the raise, even at the required vertical distance, to place

Angle of	$a=4$ 4-ft. Raise c_1	b	$a=5$ 5-ft. Raise c_1	b
60	2.00	3.47	2.50	4.33
61	2.03	3.45	2.54	4.31
62	2.06	3.43	2.58	4.29
63	2.09	3.41	2.62	4.27
64	2.12	3.39	2.65	4.25
65	2.15	3.38	2.68	4.22
66	2.18	3.36	2.72	4.20
67	2.21	3.34	2.76	4.18
68	2.24	3.32	2.80	4.15
69	2.27	3.30	2.84	4.12
70	2.29	3.28	2.87	4.09
71	2.32	3.26	2.91	4.07
72	2.35	3.24	2.95	4.05
73	2.38	3.22	2.98	4.03
74	2.41	3.20	3.01	4.00
75	2.44	3.17	3.04	3.97
76	2.47	3.15	3.08	3.94
77	2.49	3.13	3.12	3.91
78	2.52	3.11	3.15	3.88
79	2.55	3.09	3.18	3.85
80	2.57	3.06	3.21	3.83
81	2.60	3.04	3.25	3.80
82	2.62	3.02	3.29	3.77
83	2.65	3.00	3.32	3.74
84	2.67	2.98	3.35	3.71
85	2.70	2.95	3.38	3.68
86	2.73	2.92	3.42	3.65
87	2.76	2.90	3.45	3.62
88	2.78	2.88	3.48	3.59
89	2.80	2.86	3.51	3.56
90	2.83	2.83	3.54	3.54

the plugs, so that the long strings will hang free from interfering stulls, ladders, and other obstructions. The position is often inaccessible to the driller without constructing a staging of some kind.

The following plan is now being used at the Pilares mine with good results: Referring to the figure, plugs B and C are placed on a horizontal line of the calculated bearing, about eight feet from the floor. A string is stretched tightly across, and its mid point, C, marked by inserting some object, such as a small washer. From C a definite distance is measured each way along the string to points as close as desired to B and C. This distance may be two feet for a four-foot raise or two and a half feet for a five-foot raise. In individual cases these dimensions may be exceeded. To the last-named points near the plugs the ends of a second string are attached.

A small weight, such as a nut, is inserted in the string so that, in hanging freely, a triangle will be formed, the hypotenuse being the horizontal string and the weight the vertex of a right angle, A. The lengths of the two sides for various angles of inclination may be found from the formula. The values have been tabulated for four-foot and five-foot raises, the distances, BC_1, C_1C, and C_1A equaling 2 ft. in the first case and 2½ ft. in the second.



Sketch showing the method of aligning a raise now used in the Pilares mine of the Moctezuma Copper Co.

The weight A and the washer C_1 are thus on the line of sight of the center line of the raise, and from them the center at the back is located at P and Q. Referring again to the figure: In triangle 1, a_1 and b_1 are identical (radii of the same arc); BC_1A the angle of inclination.

$$c_1 = \sqrt{a_1^2 + b_1^2 - 2a_1b_1 \cos BC_1A}$$
$$= \sqrt{2a_1^2 - 2a_1^2 \cos BC_1A}$$
$$= \sqrt{2a_1^2 (1 - \cos BC_1A)}$$

In triangle ABC, $b = \sqrt{(2a_1)^2 - c_1^2}$

For convenience in taking off and replacing the string triangle two wire hooks may be placed at B and C to hook on the spads on the plugs.

Treatment of Refinery Slag at Rosario

By Samuel G. Lasky*

The New York & Honduras Rosario Mining Co., at San Juancito, Honduras, uses the Crowe vacuum process of cyanide precipitation and refines the precipitate in Case oil-fired tilting furnaces. The slag produced is remelted to recover the major part of its included silver. Although developed at Rosario from a different standpoint, this remelting of the slag may suggest to operators the possibility of using less flux in refining their precipitates. The flux used at Rosario is a mixture of soda and borax in the proportion of two parts of soda to one part of borax. It is added to the charge in the ratio of six parts of flux to one hundred parts of dried precipitate. The slime filters allow enough silica to pass through to make unnecessary its addition to the flux.

The ore sent to the mill in previous years was mined chiefly from one main vein and has been fairly uniform. During the last few years, through the discovery of a number of new veins, ore has been mined from different sources. Since this change, efforts have been made to keep the ore sent to the mill up to a certain standard, but, although this standard can be maintained as an average over a period of time, temporary variations necessarily occur, even during a single shift, which introduce complications throughout the circuit. The variation in the base-metal content, especially lead, in the precipitate with a change in ore, and the variation in the silver and gold content of the pregnant solution, are the two important factors to consider. It sometimes happens that the precious-metal content decreases after the zinc addition order, based on the assayer's report, has been issued for the day. In other words, an excess of zinc will be added during the succeeding twenty-four hours or until the next assay has been obtained. The excess zinc must be considered in fluxing the precipitate.

When the plant is running at full capacity the precipitates are already fluxed and in the furnaces before the changes are detected by the assayer. Under the circumstances a correct flux cannot be made and high-silver slags became the general rule rather than the exception. Even after subsequent concentration and cyanidation the value in the slag is excessive. Experimental tests to determine the correct treatment of the high-silver slag were made.

The tests were made on Wilfley table tailings that were crushed to pass a 150-mesh screen. The first or preliminary test resulted as follows: Dilution, 10 to 1; agitation, 72 hours; solution, 0.615 per cent free cyanide; lime, to saturation; consumption of potassium cyanide, 120 lb. per ton of slag; heads, 618 oz. silver; tailings, 389.5 oz., and extraction, 37 per cent. In washing the tailings, free silver could be observed. Insufficient cyanide was present, although some of the silver was much too coarse for cyanidation.

In tests Nos. 2, 3, and 4, agitation was continued for seventy hours. The solution titrated 2.05 per cent free potassium cyanide and the dilution was eight to one. In test No. 3 the cyanide tailings were amalgamated. In test No. 4 the sample was melted down without flux, and the resulting silver button was removed before cyanidation. The results were as follows:

*Formerly refinery foreman with the New York & Honduras Rosario Mining Co.

Test	Free Potassium Cyanide Before, Per Cent	Free Potassium Cyanide After, Per Cent	Consumption of Potassium Cyanide per Ton of Slag Pounds	Silver Heads, Ounces	Silver Tails, Ounces
2 and 3	2.055	.258	287.5	470.60	151.63
3				478.60	57.77
4	2.055	.403	264.3	26.90(a)	23.48

(a) After remelting.

The extractions by cyanidation were as follows: No. 2, 68.5 per cent; No. 3, 68.5 per cent; No. 4, 75.8 per cent. The total extractions were respectively as follows: 68.5, 87.9, and 95.1 per cent.

It is evident that if the slag is remelted before cyanidation, an additional saving of 128 oz. of silver per ton of slag and a decrease in consumption of cyanide amounting to 23.2 lb. per ton will result. The saving amounts to about $76, United States currency, for the silver and $4 for the cyanide, a total of $80. From this must be subtracted about $23 to meet charges for fuel, flux, and crucible consumption. The net saving, therefore, becomes approximately $57 per ton of slag produced. As a result of these tests it was decided to remelt all refinery slag before concentration. The results have been satisfactory since the change.

Computing Assays on Total Tonnages

By Montgomery Drunzer

Chief Metallurgical Accountant, Ray Consolidated Copper Co., Hurley, New Mexico

A simple method of computing the assays of a mixture of two lots of ore of known content is as follows: Assume as the known tonnages and assays:

	Weight, Tons	Copper, Per Cent	Zinc, Per Cent	Iron, Per Cent	Magnetic Iron, Per Cent
Lot A	5,900	1.44	0.08	2.00	1.10
Lot B	1,100	1.63	0.10	2.75	0.20

The total tonnage is 7,000. First calculate the percentage that Lot B is of the total tonnage for which the assays are required. This equals 15.71 per cent. By subtraction, the difference in the assays between lots B and A is as follows:

Lot B assays exceed Lot A by per cent	0.19	0.02	0.75	....
Lot A	1.44	0.08	2.00	1.10
Lot B	1.63	0.10	2.75	0.20
Lot A assays exceed Lot B by per cent	....	....	0.90	....

If Lot B assays are higher, the assays of the mixture are obtained by adding to Lot A assays the product of 15.71, the difference in assay and $\frac{1}{100}$. If Lot B assays are lower, the assay of the mixture is obtained by subtracting from Lot A assay the product of the difference in assays, 15.71 and $\frac{1}{100}$. Thus by the difference in assays and the addition or subtraction of the products as indicated the following results are obtained:

	Copper	Zinc	Iron	Magnetic Iron
Total tonnage 7,000 per cent	1.47	0.08	2.12	0.96

To reverse the calculation and to determine the assays for a part of the total tonnage of the two lots in question, find what percentage Lot B is of the tonnage for which the assays are required, as, for example: 1,100 tons is 18.64 per cent of 5,900 tons. The differences in assays between the total tonnage and Lot B are then noted and the calculation is made as follows: If Lot B assays are higher, then subtract from the total tonnage assays the product of 18.64, the difference in assays and $\frac{1}{100}$. If Lot B assays are lower, then add to the total tonnage assays the product of 18.64, the difference in assays and $\frac{1}{100}$. By using the foregoing weights and assays the results will revert to the original assays. The method is apparently not in general use, but those to whom the problem has been submitted have adopted it because of its rapidity.

Discussion

Meteor Mountain Crater, Arizona

Caused by Shower of Meteorites and Accompanying Gases and Steam, According to Best Opinion—Exploration Work Fails to Find Deposit

THE EDITOR:

Sir—Owing to my former connection as superintendent with the United States Smelting, Refining & Mining Co.'s drilling operations at the Meteor Mountain crater, near Canyon Diablo, Arizona, I have received from various parts of the United States newspaper clippings giving information similar to that in the issue of *Mining Journal-Press* of Dec. 6. This information is misleading in several particulars, and as the crater is one of the natural wonders of the world, it seems to be a duty to correct the information at least for fellow engineers and other readers of the *Mining Journal-Press*. The removal of the drilling equipment appears to be the occasion for recent publicity, as the United States company's work there actually ceased many months ago.

The crater is three-quarters of a mile in diameter, and, after partial filling, from five to six hundred feet deep. It happens that in and around the locality of the crater more iron meteorites have been found than in all the rest of the world put together. Those that I have seen vary from 1,800 lb. in weight down to the size of a pinhead. It is not merely popular belief, as mentioned in the *Mining Journal-Press*, but many actual analyses show that these iron meteorites invariably contain about 8 per cent nickel and about two-tenths of an ounce of platinum to the ton. This material is harder than any armor plate. A peculiar curved variety, perhaps an alteration product, contains about 6 per cent nickel and a proportionately smaller percentage of platinum. D. M. Barringer, of Philadelphia, who did the pioneer prospecting work many years ago, and whose writings are the best authority on the crater, has called this curved variety "shale ball." Unlike the iron meteorites, the shale ball contains an appreciable amount of chlorine; it splits up after considerable exposure to the atmosphere; and under the microscope exhibits a wonderful display of metallic colors.

As stated by *Mining Journal-Press*, much has been written about the crater. The Hearst papers a few months ago, in a characteristic Sunday supplement article, showed an alleged photograph of one of these meteorites with an imbedded diamond proportionately about the size of a decanter stopper. ("Decanter" is now perhaps an obsolete word with mining engineers, but in the days when they could afford "the little miracle of liquid flame that evens man with God," the word and article were in commoner use.) It is true that these meteorites contain diamonds, but a good microscope is needed to bead them.

Mining Journal-Press states that scientists are not agreed about the origin of the crater. Now there are scientists and scientists. Such accepted scientists as Professor Elihu Thompson, President W. W. Campbell of the University of California, and Dean W. F. Magie of Princeton University are of the opinion that the crater was formed by a shower of meteorites and the accompanying gases and steam which would accumulate during the shower's passage through the earth's atmosphere. It has been pointed out to me by Dean Magie that the probabilities against a mere coincidence of the occurrence of the meteorites at the exact location of the crater make an enormously large figure.

On the other hand, a gentleman who has written a book on oil geology and may possibly be regarded as a scientist expressed the firm opinion that the crater was formed by the collapse of a salt dome. The two hundred million tons or so of rocks, some as big as a church, and millions of tons of flour sand, piled around the rim of the crater, as much as a hundred feet in height above the plain, are unexplained by the salt dome theory, but are presumably regarded as another coincidence.

When the grand old man of Arizona, Dr. L. D. Ricketts, was offered the crater for exploration, he instructed a firm of drilling experts to make an examination. Their representative, perhaps a Christian Scientist, in his efforts to prove that the crater was not formed by meteorites, dragged in what he calls an anticline near by. The most cursory examination of this "anticline" shows that the sandstone strata are absolutely horizontal, and that erosion has made an elliptical shaped hill.

One naturally turns to the publications of the U. S. Geological Survey for information on the crater. Many years ago, after a probably hurried examination of much territory, Gilbert reported the occurrence as a "volcanic crater." The only other reference found in the Survey's publication is a non-committal footnote in the guide book of the Santa Fe route. Gilbert afterward corrected his first verdict, but not in the Survey's publications. There are no exposures of volcanic rocks within nine miles of the crater, and Mr. Barringer states that some of his drill holes inside the crater demonstrated conclusively that the strata are unbroken and undisturbed at a depth of 1,000 ft. or less. The latter fact is, of course, entirely inconsistent with a volcanic origin, and also with "a blow-out of steam or gas" suggested by *Mining Journal-Press*.

Mr. Barringer's explorations by shaft sinking and drilling inside the crater were based on the theory that the meteoric shower had become imbedded more or less straight down below the floor of the crater, but his work disposed of that theory. In agreement with Mr. Barringer's later theory, the United States company's explorations on the rim of the crater were on the assumption that the main body of the meteoric shower had become imbedded at an angle with the surface of the plain. My understanding is that not enough work was done to prove or disprove this latter theory, but presumably the United States company decided to give

up the attempt at what was necessarily a pretty long and expensive shot. More dirt was somehow thrown out of the crater than was dug in the Panama Canal, but how much of this was done directly by meteorites and how much by the accompanying gases and steam cannot even be guessed at, as nearly all the factors except the hole and the rock piled around the rim are unknown.

L. F. S. HOLLAND.

Inspiration, Ariz.

Prospecting by Radio

THE EDITOR:

Sir—The article by Wilbur C. Riley entitled "Prospecting by Radio," which appeared in the *Mining Journal-Press* of Nov. 8, contains many statements which it is of interest to analyze. The article comprises a brief description of the methods of electrical prospecting in general and an inadequate report on a method invented by David G. Chilson, which method is claimed to be superior to every other method. Mr. Riley claims, with regard to the well-known *potential methods*, that in "measuring or plotting of equal potential lines . . .

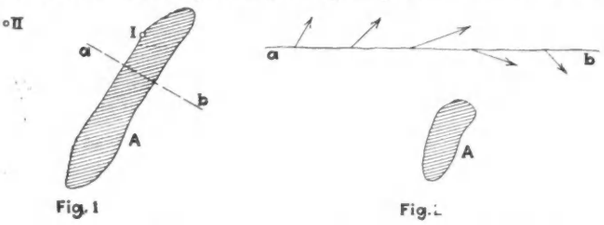


Diagram showing the position of the electrodes and the magnetic field developed

uneven moisture areas and other substances in the soil give indications which could be misconstrued as indicating the presence of an orebody." By means of equipotential investigations,[1] orebodies which were previously quite unknown have, however, been discovered where lakes and swamps occur alternately with dry, sandy moors. Fig. 3 gives an example in Osterbacken (Skelleftea district, Sweden), in which wet swamps and dry, sandy moors and dunes have not perceptibly influenced the distribution of the equipotential lines.

Mr. Riley further states that "considerable time has been spent upon another method in which an intense magnetic field is created without the use of any electrical contact on ore or earth. This method is said to be limited only by the short distance in which the intensity of the magnetic field is effective. This statement in regard to the *electromagnetic methods* is of doubtful accuracy. One electromagnetic method has been developed in America by H. R. Conklin, of Joplin, where several investigations have been carried out successfully. During the last few years I have been studying the various electromagnetic methods and have observed the operations in both Sweden and America. In Sweden and Norway several new orebodies (some of them at a great depth) have been detected by means of those methods. A description of the methods that have been used in Sweden and a number of the practical results hitherto obtained will be published soon. May it suffice only to mention here the discovery of a copper orebody about 300 ft. long and about 20 ft. wide, situated beneath 40 ft. of water in the middle of a lake six miles long and one mile wide. Mr. Riley is probably

[1] *Mining Journal-Press*, April 5, 1924, pp. 584, 585.

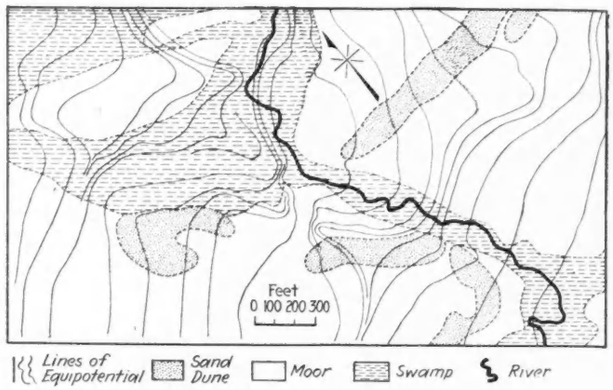


Fig. 3—Part of the terrain at Osterbacken, in the Skelleftea district in Sweden

not informed of the newer developments of the methods, and he has most probably based his statement regarding the restricted practicability of the electromagnetic methods on tests which have not been carried on correctly.

It is impossible to get a proper conception, from Mr. Riley's article, of how Mr. Chilson goes about his work. This much is clear, however, from the article and from Chilson's patent (No. 1,491,900): one electrode from a source of current ("radio transmitter") is brought into contact with an exposed orebody. It is here stated that "all connecting ores will act in unison with the transmitter and as a part of the transmitter." According to the letters patent the second electrode of the source of current is connected with the earth. Whether this always applies in the field, is not clear from Mr. Riley's article, but this would appear to me to be necessary, if there is, on the whole, to be any result at all. If this interpretation of mine is correct, Chilson's method of procedure can be illustrated in the following manner: I and II, Fig. 1, are the points between which the current flows. It is connected with an orebody, *A*, which thus constitutes one of the electrodes. It is therefore clear that the density is greatest—that is, the most current flows—in *A*. The electromagnetic field along the line *a-b* must consequently be directed as outlined in Fig. 2—namely, the direction of electromagnetic field at a certain point is approximately at right angles to a line drawn from the point in question to the orebody. It should therefore be possible to determine the position of the orebody by investigating the direction of the field. So far as can be judged, this is just what Chilson is trying to do.

The claims as to the use of "radio" and "electromagnetic waves" in these investigations do not convey any meaning to me. The method adopted is, in my opinion, only an inadequate attempt in carrying out the electromagnetic methods.

Mr. Chilson's method seems to have limited application, since electrical contact must be established; in other words, the orebody must be exposed at some point. Mr. Riley states that comparative conductivity tests on sulphides and soils proved the electrical continuity of sulphide orebodies, contrary to the general contention of geologists that orebodies at depth are not connected, but this statement is contradicted by so many facts known to mining engineers and geologists that it is superfluous to answer it here.

KARL SUNDBERG.

Stockholm, Sweden.

Continuous Filters

THE EDITOR:

Sir—I have noted Mr. Kelly's discussion on "Continuous Vacuum Filters" in your issue of Dec. 27, in answer to certain points brought out on the same subject by L. B. Eames and myself in your issue of Nov. 1. When I first commented on this subject, it was with a hope that it might elicit an expression from the operating staffs of the producing companies of northern Ontario, which, by reason of their connection, would lend weight to any such discussion.

Mr. Eames, in his discussion, takes a broad view and has a good word to say for the counter-current decantation alone without being dogmatic. Mr. Kelly champions the filtration in series method without thickeners; my own viewpoint being that between these extremes, or the middle-of-the-road course. I hesitate to discuss the subject further, as I doubt whether much is to be gained by argument. There are, however, three points that Mr. Kelly brings up that I feel should be answered.

First, both Mr. Eames and I brought to Mr. Kelly's attention the fact that there was dissolution of values in the thickeners. This Mr. Kelly admits, but he dismisses the matter by a statement that no consideration was given to this, and he says "it was done to simplify the figures." As I know that the dissolution of values in the thickeners at one of the Porcupine plants sometimes runs into dollars, and as I considered that point of greater weight than any other, it seems to me that it should not be dismissed with a gesture as irrelevant or immaterial. I admit that these high undissolved values, going to the thickeners, may be due to insufficient agitator capacity, or the improper working of the agitators, but even under favorable conditions there is certain to be a noticeable extraction during the process of passing through the thickeners.

In his discussion, Mr. Kelly claims that he will do the same thing as is accomplished in the thickeners by introducing agitators between the filters. This, no doubt, can be done if he provides sufficient storage and agitating capacity to give the necessary contact; no mention was made of agitation in the original article, merely a statement of repulping before the second filtration.

Secondly, I made the statement that, in some ores, a more rapid dissolution of values was effected by using a pulp having a greater dilution than 1 to 1; this Mr. Kelly dismisses by saying that it applies only to refractory ore, and does not apply to Porcupine ores. In 1913, I carried on a series of laboratory tests on a Porcupine ore properly ground and well mixed, using a thousand grams of ore in a 2½-liter bottle, making up three charges in each series of tests, adding to the first 1,000 c.c. of solution; to the second 1,500 c.c., and to the third 2,000 c.c., giving to each series the same unit of time for agitation, using six, twelve, eighteen, and twenty-four hours of agitation to the three series of tests. On that particular ore there was a more rapid dissolution of values in the more dilute pulps. This was especially noticeable in those where the shorter unit of time was used. I merely mention this to show that my statement was based on personal experience.

In northern Ontario, where the major part of the extraction is effected before the pulp reaches the agitators, I assume that no advantage would accrue by maintaining a pulp in the agitators more dilute than 1 to 1, or at least not sufficient to compensate for difficulties that inevitably would be encountered as a result of such a practice.

Third, Mr. Kelly objects to my statement of greater elasticity in the combined system. The object of the counter-current system is primarily that of dilution of solution values, but it is also obvious that the thickeners serve as a storage for peak loads and as a factor of safety for fluctuating values in pulps going to the agitators, and it must be apparent to any practical millman that even though ample agitator capacity is provided for normal mill feeds, there are times, owing to abnormal conditions, when the thickeners become a source of important economic value, even in mills designed on a sound basis; for these reasons I am still of the opinion that the system embracing both counter-current decantation and filtration gives a more elastic unit, and offers greater protection against loss, than either of the other systems in their present state of development. The trend of late has been toward partial counter-current decantation followed by filtration, as evidenced by filter installations at the Hollinger and the Wright-Hargreaves.

Lastly, Mr. Kelly spends a great deal of time in discussing high pressure sprays. High-pressure sprays have been used for many years on continuous filters in various parts of the world. Personally, I have found that high-pressure sprays require a good deal of attention, for they have the unhappy faculty of choking up, and it is difficult to get a uniform distribution over the whole area of the filter surface. There is a limit in practice to which these refinements can be carried, and millmen as a whole prefer simplicity in mill operation rather than simplicity in figures.

I, however, wish to maintain an open mind, and I am willing to admit that there may be conditions when the filters in series should be given serious consideration, and if sufficient agitation and storage capacity is introduced between the filters in series to insure the same protection against loss that is given by counter-current decantation, the process is feasible. This involves experimentation and accurate estimates as to initial and operating costs.

HENRY HANSON.

Toronto, Ont.

The "Blue-sky" Laws

THE EDITOR:

Sir—On page 5 of the Jan. 3, 1925, issue of *Mining Journal-Press* the question is asked "What is the matter with the mining industry?" Every one who is *au fait* on the matter, *knows* that the *whole trouble* is the "blue-sky" legislation. Repeal all the "blue-sky" laws and the hills will soon be swarming with prospectors and operators.

It is a disgrace to our country to have our vast undeveloped mineral resources lie stagnant, and the banks overflowing with money that cannot be loaned even at 2 per cent.

The investment bankers, better business bureaus, the horde of detectives that swarm the country and the unjust arrests and convictions have caused such unfair public sentiment that it is absolutely impossible to get any prominent newspaper to accept at any price an advertisement asking for financial help to develop a prospect, and yet such a state of affairs actually exists in this year of our Lord 1925, and the "goose that lays the golden egg has been killed."

New York C. W. GAMMON.

News of the Week

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Summary

AN INCREASE of wages amounting to 50c. per shift has been granted employees by the principal mining companies in the Coeur d'Alene region in Idaho. This follows a recent 10 per cent increase in the Southeast Missouri lead district.

Officials of Dunwell Mines, Ltd., of British Columbia, have decided to offer the company's property for sale.

The Childress Lead & Zinc Co. has increased its holdings in the Joplin-Miami zinc-lead district.

Milling operations have been started by the Cynide Gold Mining Co. in the Buckhorn district, in Idaho.

Copper prospects in Northern Rhodesia are attracting attention of British investors.

The Utah-Apex mine, in Bingham, Utah, now producing 1,000 tons of excellent lead ore daily, may be purchased by the American Smelting & Refining Co.

Purchase of the "3-R" mine, in Arizona, by the Magma Copper Co., will be followed by increased activity.

The Yukon-Treadwell Mining Co. has started its 100-ton mill to treat Keno Hill ores.

Joseph Myers, managing director of the Bingo Mines Co., of Manitoba, has been arrested in London, charged with fraud.

Calumet & Hecla Consolidated will begin operations at the new Tamarack reclamation plant on March 1.

Childress Lead & Zinc Co. Buys Auburn Mine and Mill

Increased Holdings in Joplin-Miami District—Will Install Large Central Pumping Plant

The Childress Lead & Zinc Co., of which Frank Childress, of Joplin, is president, continues to increase its holdings in the Joplin-Miami district.

For a consideration not officially announced, but reputedly approximating $100,000, the Childress company has taken over the Auburn mine and mill, situated on a 160-acre lease in the south part of the Oklahoma section of the field. The transaction was the culmination of a drilling option taken on the property some months ago. The company also has taken a drilling option on the Franks and Danglade leases in the Waco section. It has moved six drills upon the tract and will increase the number to ten immediately. The leases comprise 480 acres in all and there are four mills upon them, including the Pyramid, Blue Rock, Freehold, and Allegheny Western. These mines were closed early in 1924 when ore prices were discouraging. They also had a heavy pumping problem to overcome. It is the intention of the Childress company to install a large central pumping unit, either at the Pyramid or Allegheny Western, provided the drilling indicates such an investment justified.

The Childress interests already own the Wade, Fort Worth, and Lucky Jenny properties, in the Oklahoma section of the field. They also have a lease on the Midas, and are using that mill for ore from the Fort Worth mine, which lost its mill by fire on Jan. 20. Oddly enough, the company had planned to work Midas ore at the Fort Worth mill. After the fire the Midas mill was repaired. With the Auburn mine and the several properties in the Waco camp, the Childress company should assume an important place among the district's producers.

Coeur d'Alene Companies Raise Wages 50c. Per Shift

MINE WORKERS in the Coeur d'Alene region of Idaho have been given a 50c. increase in wages. This adds about $500,000 to the annual payroll, bringing it to about $6,000,000. The increase affects about 3,000 men and became effective on Feb. 1.

It was made by the large producers of lead, silver and zinc ores, including the Hecla, the Federal, Tamarack & Custer, Callahan Zinc-Lead, Gold Hunter, Bunker Hill & Sullivan and other companies. The new scale will be $5.50 a day for muckers, $6 for miners, and $6.75 for timbermen.

Build Feldspar Plant in Maine

The Oxford Mining & Milling Co., of Portland, Me., has work under way on the construction of a feldspar grinding mill at West Paris, Me. With equipment, the cost will be about $100,000. Operation will be almost entirely automatic, requiring only a small crew.

Dunwell Property, in British Columbia, Is for Sale

Mine Situated in Portland Canal District—Hitherto Overtures for Purchase Have Been Ignored

At a special meeting of Dunwell Mines, Led., held at Victoria, B. C., on Jan. 26, the directors of the company were given power to enter into negotiations for the sale of the mine on a basis of a substantial amount of cash —which shall be sufficient to repay the shareholders their capital and a good interest on their investment—and a substantial share interest in any company organized to take over, equip, and operate the mine. The property is situated in the Portland Canal district and some rich oreshoots have been opened. R. F. Elliott, a Victoria attorney who has had considerable success in company promotion, was appointed to conduct negotiations for the directors. Ratification of any sale is to be made by the shareholders at a special meeting to be called for that purpose.

Overtures for the purchase of the property have been made, from time to time, by financial concerns in Canada, the United States, and Great Britain, but the directors considered it to be better policy to develop the orebody to a stage at which a more intelligent appraisal of the value of the property can be made. This, they believe, has now been accomplished.

The orebody has been opened on four levels, giving a vertical depth of about 700 ft., and considerable driving has been done along the wall of the vein, with frequent crosscuts through it, on levels 2 and 3.

Contract Let for Eight-Mile Tram from Afterthought Mine

A contract for an eight-mile wire-rope tram connecting the Afterthought mine, in Shasta County, Calif., with the Bully Hill zinc and copper plant has just been let, according to local reports. Construction will be started soon. When accommodations can be provided at the Afterthought, a mine crew will be put to work and the ore sent to the smelter at Winthrop.

Production of zinc oxide from Bully Hill ore is proceeding at the rate of about 30 tons per day. This resumption of mining at the Afterthought follows a prolonged shutdown and increases the mining activity in northern California to something like its old-time scale.

Rich Ore Opened in Undeveloped Area at Tonopah

The Tonopah silver district, in Nevada, is the scene of a new discovery in the Rescue Eula mine, in the southeast part of the district.

The new find was made on the 1,100 level, in a south crosscut, in undeveloped territory. It may prove to be the westerly continuation of the vein which the Tonopah Belmont developed on the lower levels of the Buckeye Belmont, to the east of the Rescue property, when it held an option on that property. The vein in the Rescue has an east-west strike with a steep north dip, and is in trachyte.

The crosscut has passed through 7 ft. of vein material, which is reported by the management to average more than $30 per ton, with some very high-grade streaks not included. The crosscut is still showing streaks of ore, some of commercial size and grade, and will be continued until a definite footwall is reached, after which drifting will be started. Developments are of course too meager as yet to indicate the value of the strike, but to date it looks good.

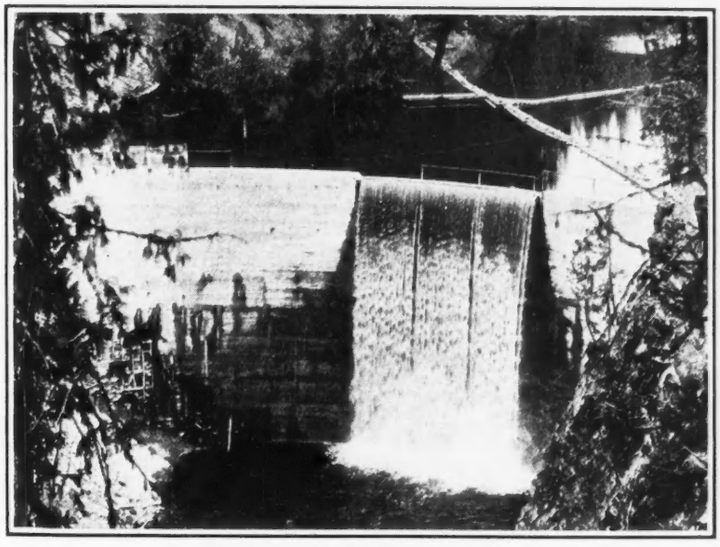
Mill of the Cynide Gold Mining Co. in the Buckhorn district, in Idaho

Cynide Gold Mining Co. Starts Plant in Northern Idaho

Good Reserve of $10 Ore Said To Be Available—Power Plant Supplies Electricity

After two years of development and preparatory work the Cynide Gold Mining Co. has started its mill and cyanide plant in the Buckhorn mining district, 22 miles northeast of Bonners Ferry, Idaho. J. E. Ellis is president and general manager of the company. The property was operated about twenty years ago, but the recovery by amalgamation was very low. Much better results are expected from the new plant, which has a rated capacity of 200 tons of ore per day. The machinery at the mine and mill is operated by electric current, generated at the mining company's new power plant on the Moie River near Eileen. A transmission line 6½ miles long has been constructed. The ore crushed so far has averaged about $10 per ton in gold, and a recovery of more than 90 per cent is indicated.

Underground workings are said to total 4,000 ft., the vein being tapped by three tunnels. Ore sufficient to run the mill for more than a year is said to be blocked out. A tramway connects the portal of the producing tunnel with the mill, which is several thousand feet lower down. The mill equipment includes a crusher, rolls, a ball mill and the necessary tanks, pumps, and auxiliary equipment for cyanidation.



Dam built by the Cynide Gold Mining Co. to supply hydro-electric power

Good Hydraulic Season in Prospect at Round Mountain

Reports from officials of the Round Mountain Mining Co., which owns and operates placer and lode mines at Round Mountain, Nev., indicate more than the usual downfall of snow in the drainage areas from which the Round Mountain company derives its water for placer operations. Conditions are regarded as favorable for a successful hydraulic season.

It is reported that Thomas "Dry Wash" Wilson has been promised a sufficient water supply by the Round Mountain Mining Co. to wash the dump gravel on hand from his prospect shaft. This shaft is on ground adjoining the Round Mountain property and results of the trial run will be valuable to all concerned, as the tests will give some definite data as to the importance of the Wilson discovery. Wilson discovered this gravel more than a year ago, and sunk a 150 ft. shaft, passing through 50 ft. or more of gravel which contained gold. He has previously been unable to do any sluicing, on account of the absolute lack of water, the entire supply of the district being owned or controlled by the Round Mountain company.

Copper Situation in the Belgian Congo and Northern Rhodesia

Union Minière, Only Producer, Adds to Its Plants—Bwana M'Kubwa Will Build Roasting and Leaching Units—N'Kana—N'Changa

By A. B. Parsons
Assistant Editor

WHAT will the Union Minière, Belgian Congo copper giant, produce in 1925? What in 1930? Why, after making 20,405,000 lb. of copper in August, 1924, has production been cut to about 17,200,000 lb. per month since? What is the situation with Bwana M'Kubwa and the Perkins process plant? What are the potentialities in the matter of size and date of initial production—if any—of N'Kana and N'Changa and the other copper properties and prospects in Northern Rhodesia concerning which so much gossip reaches the United States by way of London? These are some of the questions being asked around New York. Without attempting to give specific answers I will outline the situation as it appears from the latest authentic information.

First, the Union Minière. It of course stands alone as an actual producing enterprise. The following figures of production are pertinent:

Period		Pounds
1911		2,195,000
1915		30,900,000
1921		61,535,000
1922		95,400,000
1923		127,350,000
1924	First half	81,208,000
1924	Second half	107,645,000
1924	July	18,850,000
	August	20,405,000
	September	17,255,000
	October	16,620,000
	November	17,355,000
	December	17,160,000

There are two possible explanations of the decrease since August. The Katanga rainy season begins in September and lasts for five or six months. Production is impeded in various ways. The labor is not so efficient; wet ore is more difficult to handle, and the presence of water in the ore cuts the capacity of trains, concentrators, and smelter furnaces. On the other hand, the company recently issued 100,000 new preference shares of 1,000 francs each to supply 100,000,000 francs, or about $5,000,000, new capital for plant expansion. I understand that these have all been subscribed by old shareholders; yet it is not improbable that the officials wanted to make a concrete demonstration of the ability of the property to do big things, and accordingly treated higher-grade ore during July and August than has been handled since.

As to future production, with an ore reserve of at least 75,000,000 tons averaging 6 per cent copper, the rate clearly depends on the equipment and plant provided. In this connection the following may be mentioned:

(a) At the Ruashi mine, one of the new producers, a large screening and washing plant has lately been put in operation. The coarse material goes to the blast furnaces at the Lubumbashi smelter, and the fines are placed in stockpiles at the mine, pending the completion of a large leaching plant. Huge quantities of such material are in storage at the various mines, much of it averaging 6 or 8 per cent copper.

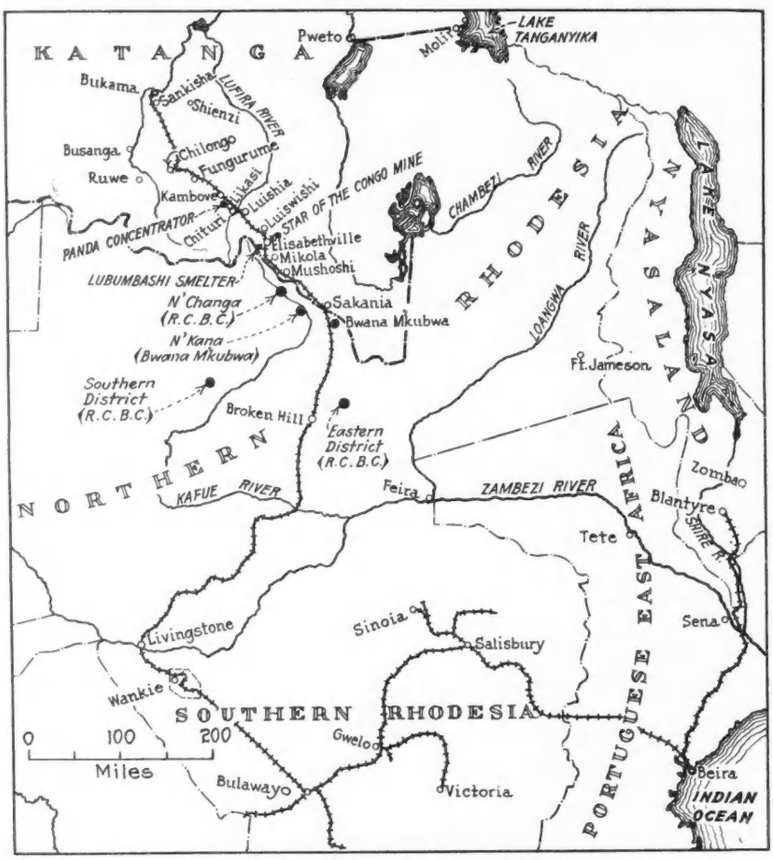
(b) A 500-ton flotation plant has just been completed to treat tailing from the Panda concentrator, shown in the accompanying illustration. The latter, incidentally, was designed by the engineers on the staff of Archer E. Wheeler, consulting engineer for the company in New York, and is doing excellent work on about 4,000 tons of ore per day. Nearly all of the machinery in the mill and concentrator was supplied by manufacturers in the United States. The flotation adjunct was built by Minerals Separation, and is said to be making a good recovery. The oxidized copper minerals are floated by virtue of the proper selection of reagents.

(c) One of the blast furnaces at the Lubumbashi smelter has been enlarged and the capacity of some of the others probably will be increased.

(d) The pilot leaching and electrolytic plant is operating regularly, producing 100 tons of cathode copper per month. Recently a deposit of pyrite, advantageously situated, has been opened, thereby assuring a source of leaching acid at reasonable cost. Although the final appropriation has not been made, it is virtually certain that an initial leaching unit with a capacity of about 6,000,000 lb. of finished copper shapes per month will be erected soon. Detailed plans are nearing completion in Mr. Wheeler's office. Incidentally, several innovations are to be included in the design. The process is to be continuous, rather than batch; leaching will be accomplished by agitation instead of by percolation; and 50-ft. electrolytic vats with very slow circulation will be installed.

There seems to be nothing to prevent the company from producing 240,000,000 lb. of copper in 1925, if the policy is to aim at that figure. And continued expansion of its plants indicates a progressive increase in output to a point well above that, in the next few years.

The next property in point of development is that of the Bwana M'Kubwa Copper Mining Co., Ltd. This venture has enlisted financial support from a large number of London houses, including the Anglo-American Corporation of South Africa, Minerals Separation, Selection Trust, Ltd., Union Corporation, Gold Fields Rhodesian Development Co., and others. The enterprise, of course, has been subjected to the closest scrutiny by the engineers of these companies, including A. Chester Beatty and J. C. Moulden. The ore reserves are estimated at 4,592,000 tons



Parts of the Belgian Congo and Rhodesia

The black dots show the location of the more important copper prospects. Beira, via Bulawayo, is the principal port for Katanga copper shipments.

assaying 3.63 per cent copper above the 350 level. The distance explored along the strike is 1,240 ft. on the hanging wall orebody, and 1,420 on the footwall. Mining will be by underground methods.

Walter Perkins has developed a process for treating the carbonate ores by subjecting them first to a reducing roast to produce, as I understand it, a "sponge" copper, followed by ammonia leaching. A small test plant has been in operation for some time with entire success. A recovery of 92 per cent of the contained copper is reported. Preliminary work is under way for the erection of an initial unit with a capacity of 1,000 tons per day.

At the recent annual meeting the chairman estimated on a basis of 1,000 tons of ore treated per day, and a metal production of 22,500,000 lb. of refined copper per year, profits of £175,000. Costs including depreciation are estimated at £45 per ton of metal, and the market for standard copper is figured at £60. Metal produced in the test plant has been classified by London dealers as "excellent best select" grade, which seems to establish its quality.

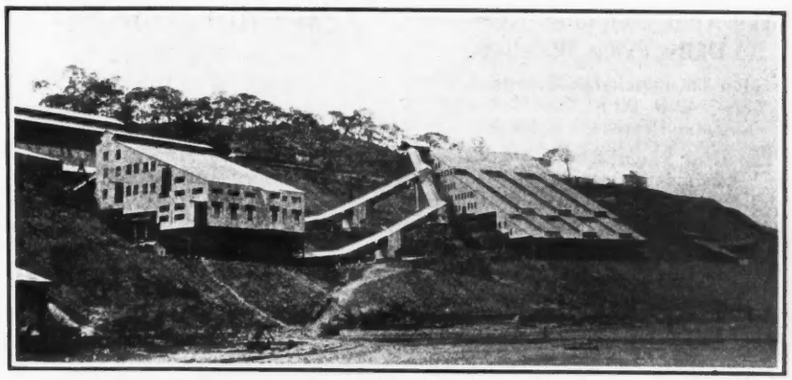
The company is amply financed and is already provided with railway connections; but, even if construction is hastened as much as possible, it is doubtful if production can be expected until well into 1926. Even then the output, comparatively speaking, will not be large.

Another asset of the Bwana M'Kubwa company is the N'Kana mine, situated 30 or 35 miles northwesterly from the M'Kubwa property. Here 954,938 tons of ore averaging 3.48 per cent copper has been proved. Development has been suspended, however, as there is no necessity for opening more ore. In the meantime work is directed to exploring other parts of the concession.

N'Changa is one of three districts in Northern Rhodesia where the Rhodesian Congo Border Concessions has found good prospects on its concession of 52,000 square miles, a territory somewhat larger than the State of New York. A report by P. K. Horner has just been issued in which the results of exploration on the N'Changa, Southern, and Eastern Areas, shown on the accompanying map, are described briefly.

N'Changa is the nearest to the railroad—about 15 miles. One significant fact in connection with the exploration and development of this entire region is the use of motor cars and trucks for passenger and freight transportation. The Border Concession interests have constructed about 250 miles of motor road. It is not too much to say that the automobile and the highway have revolutionized methods of prospecting in a territory like this. Economy of time is the big feature. In eighteen months forty-seven distinct discoveries have been made.

The N'Changa main-lode deposit has been proved over an area 800 ft. long and from 120 to 140 ft. wide. A depth of 200 ft. has been proved by diamond drilling. Four shafts are now being sunk for further development. Assays given show from 2.7 to 5.5 per cent copper over distances from 90 to 200 ft. A probable average grade of 4.5 per cent is indicated. Though it is impossible to give any definite estimates as to ore reserves, enough has been done to establish definitely the existence of a workable orebody.



Union Minière concentrator at Panda

Virtually all of the machinery in this plant was supplied by manufacturers in the United States

The deposit is described as a "crush zone mineralized by ascending solutions, and oxidized near the surface." The copper-bearing formation is generally a shale. Sulphides are expected at greater depth. Four other deposits are being developed in the immediate vicinity.

The Eastern Area is designated as "porphyry," primary sulphide-copper ores being found at intervals over a distance of about 15 miles. Underground mining of relatively high-grade sulphide ore, easy to concentrate, is indicated. A compressor plant and a diamond drill are now at work.

The Southern Area is not a new discovery, but as the former prospectors did not consider oxidized ore containing 3 to 5 per cent of copper to be of value, exploitation was not attempted. Five properties of promise are receiving attention. The distance from the railway, more than 125 miles, is a handicap, of course. The construction of a railroad to the district would depend upon the extent of the ore deposits opened.

Another company that has a large area to prospect is the Rhodesia Minerals Concession, Ltd. It is said that several good prospects have been found in an area of 7,000 square miles lying just north of the Zambezi and Kafue rivers, shown on the map.

Obviously, it will be several years at best before any of these properties except Bwana M'Kubwa will be in position to produce any considerable amount of copper—if they ever do. However, as I pointed out, motor cars for passengers and freight are going to play a big part in reducing the time necessary to convert a prospect into a mine.

Northern Rhodesia and the Belgian Congo undoubtedly contain vast quantities of copper that some day will be mined. But any deluge of the metal in the next few years is not to be anticipated—either with pleasure or without.

Utah Copper Sues To Recover Metal in Old "Waste"

The Utah Copper Co., operating at Bingham, Utah, has brought suit against the Montana-Bingham Mining Co., seeking to establish its right to recover copper taken up by water that percolates through "refuse" copper-bearing rock dumped by the Utah Copper Co. on ground leased from Montana-Bingham. It also seeks the right to have certain ground owned by Montana-Bingham condemned for the purpose of erecting vats on it, to recover the copper contained in the impregnated waters. Utah Copper claims a perpetual easement granted years ago, to dump certain refuse ores into what is known as the Winnemucca Gulch.

It has been found that the water which has percolated through the dump can be made to yield by certain precipitation processes about 14 lb. of copper per 1,000 gal. of water. Utah Copper claims the right to collect the water and to recover the copper contained. To do this it will be necessary to drive a tunnel into the dump, and to construct a pipe line across Montana-Bingham ground to carry the water to precipitating vats. The rights to do this work are also claimed by the Utah Copper. Montana-Bingham contends that the water and all its contents belong to it, and denies the right of the Utah Copper to drive the tunnel and construct the pipe line. It is estimated that 100,000,000 lb. of copper is contained in the dump, a good proportion of which can be recovered.

North Butte Surrenders Daggs Option at Superior, Ariz.

The bond and lease on the Daggs property, near Superior, Ariz., has been surrendered by the North Butte Mining Co. after about $200,000 has been spent on development work. The options were taken over by a syndicate known as the South Syndicate, which is pushing the work started by the North Butte company. Chester Hoatson, who was managing the work for the North Butte, is connected with the new organization and is continuing as manager. About thirty men are employed at the property.

Utah-Apex Shipping 1,000-Tons Daily From Bingham

Develop Through Utah-Delaware Workings—A. S. & R. Co. May Purchase Property, Is Report

The Utah-Apex Mining Co., of Bingham, Utah, is reflecting both the good price of lead and the satisfactory physical condition of its property. At present it is shipping at the rate of 1,000 tons of ore daily, carrying 15 to 20 per cent lead. January earnings are placed at from $150,000 to $175,000; and February earnings, before depletion and depreciation, are expected to reach $200,000.

A new strike on the 1,800 level has been followed over 65 ft., with all sides in ore averaging over 15 to 20 per cent lead. This is regarded as the most important single strike ever made on the property. The 2,400 level of the mine—through agreement with the adjoining Utah-Delaware — is being developed from it neighbor's workings, and in this way the expense and loss of time of shaft sinking are obviated. Informal discussions are reported to have taken place between the owners of the Utah-Apex and American Smelting & Refining Co. officials, in regard to the possible purchase of Utah-Apex by the latter. This company's engineers are said to be making an examination of the property.

Oliver Iron Mining Co. Employees Get Steel Company Bonus

More than $1,000 in bonus money was distributed during the week beginning Jan. 26, to employees of the U. S. Steel Corporation on the Mesabi range in Minnesota. The Oliver Iron Mining Co. is a subsidiary of the Steel Corporation. Each employee holding his original certificate of stock for five years receives a bonus of $5 a share. This year a special additional bonus of $8.87 is being paid on 1920 stock, representing a distribution covering unpaid amounts on account of sale of that year's stock of employees. The U. S. Steel Corporation is the one company on the range that encourages its employees to invest their savings in the company for which they work. This year the company is offering common stock to its employees at $125 a share.

Work Old "Shallow" Lead Diggings

An interesting development resulting from the high price of lead ore in the Joplin-Miami district has been the recent revival of shallow lead mining in the Kansas City bottoms, in the northeastern portion of Joplin, where mining was first started in the early 70's.

The property is owned by Howard Murphy, of Joplin, and associates, and is leased by them to the Main Street Mining Co. This company, in turn, is subleasing the land to small operators, just as in the old days, and at this writing there are eighteen of these small companies more or less successfully attempting to harvest lead that was missed in the shallow ground fifty years ago.

Washington News

By Paul Wooton

Special Correspondent

Exhaustion of Oil Supply Not Matter of Immediate Worry

Oil-shale Exploitation in the Background—One Company Sees Early Profit From Shale "Mine"

It has been taken for granted by the public for many years that our oil resources are very limited. Now it develops that no one is worrying much as to the adequacy of supplies for an indefinite number of years to come, but the fact that reserve supplies cannot be estimated accurately in advance, as can be done, for instance, when ores are blocked out, gives rise to enough uncertainty to make for a very general desire that oil be confined as much as is possible to its higher uses.

A spokesman for the oil producers predicts that the extent of our domestic resources will be surprising. Long before they are exhausted, however, he expects to see large foreign pools brought in, the oil from which can be laid down here cheaper than we will be able to produce it from our own operations. Finally, he expects the cost of flowing oil to reach a point where oil from shale will be on a competitive basis. That will be at a distant day, he believes, but, like all oil men, he scrupulously avoids expressing his guesses in terms of years.

There is strong support, and some of it is from official quarters, for the belief that oil shale may become an early source of supply. Nearly anyone familiar with the progress being made in treatment processes admits that the day when oil shale can compete has been brought much nearer by these improvements. Recent tests are said to have been so successful that some officials believe the time is at hand when actual production in considerable volume from this source may be expected. Others not so optimistic say that the low quality of shale oil and the costs of mining and treating will preclude extensive use of products from that source until flowing oil in pools has been depleted greatly.

One company preparing to undertake the recovery of oil from shale has a large property where a minimum of difficulties seem to exist. The shale is in outcrops which lend themselves to steam-shovel operations, and the topography is such that loaded cars of the material can be delivered by gravity to the retorts where internal combustion reduces forty-ton charges. The recovery is high and the terrain is suitable for the cheap disposal of spent shale. That this enterprise is taken seriously is indicated by the interest manifested in it by large oil companies.

Another indication that oil shale holds early promise is the action of the Japanese in preparing to attempt commercial production of oil from Manchurian shale.

Yukon-Treadwell Starts "Farthest North" Concentrator

THE concentrating mill constructed by the Yukon-Treadwell Mining Co. at Wernecke, Y. T., was put in operation on Jan. 6. The company is operating mines in the Keno Hill district. The mill treats 100 tons of ore per day by flotation. The ore averages 50 oz. silver and 8 per cent lead, the concentration ratio thereof being 10 to 1. The concentrate is transported overland by tractor to White Horse, a distance of 400 miles. The mill is the farthest north on the American continent.

Californians Want Original Sutter Creek Nugget

The Pioneer Society of California is making an effort to secure the original nugget found in Sutter Creek, which caused the gold rush of 1849. The society has been under the impression that the nugget is held by the Smithsonian Institution. Senator Shortridge recently was importuned by the society to secure the return of this nugget to California. He took the matter up with the Institution and found that it has a flake of gold, the size of a dime, which came from the early findings in Sutter Creek, but it is not purported to be the first gold taken from the stream.

Through the Institution, Senator Shortridge learned that W. C. Wyman, of New York, claims to be in possession of the first nugget. Mr. Wyman brought the nugget to Washington last week, along with papers intended to substantiate his claim. Though there can be no doubt as to the fact that this nugget was one of the very first found in Sutter Creek, Senator Shortridge is attempting to obtain further evidence to satisfy himself that it is the original Wyman nugget. Mr. Wyman is asking $5,000 for the nugget, which is about half the size of a pipe bowl.

Magma Copper Company Takes Over "3-R" Properties

The filing of a deed recently in the office of the County Recorder of Nogales, Ariz., conveyed the first definite information that the Magma Copper Co. had taken over the well known "3-R" mining property in the Patagonia district in Santa Cruz County.

With the acquiring of the "3-R" property, long considered a promising copper property, the Magma company, it is expected, will start a big program of operations.

The deed to the "3-R" is signed by the Patagonia Superior Copper Co., a Magma subsidiary. The property formerly belonged to the late Colonel R. R. Richardson, after whom it was named.

The deed covers the sale of twenty-one patented claims in the Harshaw district of Patagonia, and numerous unpatented claims, buildings on the "3-R" ground, as well as other structures, improvements, and machinery, together with the Bloxton pumping station, near Patagonia.

London Letter

By W. A. Doman
Special Correspondent

Shareholders Object to Burma Mines Control in London

Reassured by Officials — Prospects Appear Good—Dome Dredge Arrives in Spain

London, Jan. 20—A full report of the proceedings at the meeting of the Burma Corporation in Rangoon has now reached London. It is of a most interesting character, and, given good metal prices, shows that it will remain a mining investment for years to come. Labor is on a better footing, the railway conditions have improved, extraction is good, and ore reserves can be easily maintained. Vigorous efforts are being made to clear the balance sheet of obligations so as to free the profits for the shareholders. One shareholder, while congratulating the directors and his fellow shareholders upon the remarkable condition of affairs, was rather critical in regard to the enlargement of the board from five to twelve. He pointed out that it was impossible for all the members to attend the meetings in the East, and described it as a mistake for affairs to be controlled from London. It was thought necessary, he said, during less fortunate times, to transfer the management to Burma, and he could not see why it should revert to London, where it would be mainly in the hands of financiers. Though it was made pretty clear by the resolution that was passed that the control would be in London, Sir Robert Horne, representing the National Smelting Co., remarked that the shareholders' fears were groundless, and the company's large liquid funds would not be diverted from the purpose for which they had been allocated.

After some delays, the dredge of the Dome Mining Corporation (Spain) has been delivered in that country, and should by now be well on its way to the property, where everything is reported to be complete for its erection. Certain people seem to have a good deal of faith in the future of this property, and are said to be buying shares.

H. F. Marriott has resigned from his position as consulting engineer to the Sabie (Transvaal) Gold Mining Co. One of the directors has recently returned from a visit to the property, and it is proposed to raise the capital of the company from £70.000 to £125,000. Mr. Marriott has not made public his reason for resigning; presumably it is not unconnected with the increase of capital, part of which will be applied toward the purchase of the Heather mine, adjoining.

Interest in Rhodesian copper ventures and Transvaal platinum farms has to a great extent cooled down. A. Chester Beatty is on his way to Egypt; other people are making for the Riviera, and the dry work of development is now proceeding on platinum deposits. Nothing exciting is expected for a time in either of these departments, and even tin is considerably less active.

Toronto Letter

By Our Special Correspondent for Northern Ontario

Toronto Stock Exchange Suspends Kirkland-Rand

Shares Being "Marked Up" Without Apparent Reason—Lake Shore Does Well

Toronto, Jan. 31—The election held by the Standard Stock and Mining Exchange of Toronto, which handles much the largest proportion of mining stocks sold in this country, resulted in the election of a new board. This new board has shown a desire to adopt a new policy, in an endeavor to offset the serious criticism to which the exchange has been subjected for several years. As an evidence of the desire of the board to afford better service and better protection to the public, the first step was to suspend from trading the stock of the Kirkland-Rand. The shares of this company, which is not now operating, were being "marked up" to a remarkable price, presumably with a view to distribution, and the directors of the exchange, feeling that this was entirely unjustified, suspended trading in the stock. It is understood that the Kirkland-Rand has threatened to take action for damages.

At the Lake Shore mine, in Kirkland Lake, the mill is treating 300 to 325 tons a day, with a recovery of approximately $175,000 a month, which it is hoped to maintain during the present year. This should represent a profit of at least $1,000,000 a year, or 50 per cent of the capital. The company is now paying dividends at the rate of 5 per cent a quarter, but at the end of the year an extra bonus of 5 per cent was paid, and it is presumed that during the present year the dividend will either be increased or distribution augmented by bonus payments.

Underground development continues to be satisfactory, particularly on the 1,000 and 800 levels, and the ore reserves are substantial. It is proposed to run a crosscut underneath Kirkland Lake and raise to the surface on the north side of the lake. This raise will come out near the railroad track, and will enable supplies to be hauled to the mine through the underground workings and thus eliminate an expensive team haul from the railway station.

Recent discoveries on the Violet property of the La Rose mine, of Cobalt, appear to be of considerable importance. At a depth of 830 ft. high-grade ore has been encountered, and in the 30 ft. drift which has been run, the last three rounds have shown about 3 ft. of 3,000 oz. ore, in addition to several feet of high-grade mill rock. Though underground work has been continuously carried on, no shipments have been made until the recent discovery, which is the first for considerable time. This discovery has proved the existence of high-grade ore at this depth on the lower diabase Keewatin contact, and will encourage development by other companies in similar formation. The La Rose was the first company in the Cobalt Camp to sink a shaft through to the lower contact without having any indication of ore on which to start.

Myers, Bingo Mines Official, Charged With Fraud in London

JOSEPH MYERS, of Winnipeg, managing director of the Bingo Mines Co., recently was arrested in London, on a provisional warrant issued under the Fugitive Offenders Act, charged with fraud and with circulating, as a director, false statements relating to the mine, which is in northern Manitoba. It is understood that this warrant was issued at the instance of a Winnipeg firm, one of the members of which is a director and a very large shareholder in the company.

The magistrate has ordered a remand in the case and has refused an application for bail, on behalf of the accused, who was supposed to be returning to Canada. In view of this arrest, the complete story of this company, which has excited so much comment, will now be made public.

Following the annual meeting of the company held in London a few days ago, it was reported that the recent sampling of the property by J. A. Reid and J. A. Dresser did not confirm the report of values on the property. In spite of this, however, the shareholders are stated to have passed a vote of confidence in the directors. It does not appear that the complete findings of these engineers were made public, the reason given, which is a very poor one, being that the reports were too technical for general distribution; and it is contended by some of the shareholders that the directors of the company are desirous of concealing as far as possible the true condition of affairs. The issuance of the warrant for the arrest of Myers followed the meeting.

Increased Copper Output in Michigan

Estimated refined copper production in the Michigan district in January was 11,200,000 lb., a small increase over the output for December. Calumet & Hecla Consolidated produced 6,000,000 lb., made up of 2,700,000 from Ahmeek, 1,500,000 from the Calumet reclamation plant, and 1,800,000 from the conglomerate department. Mohawk produced 1,600,000 lb.; Quincy, 1,000,000; Isle Royale, 750,000; and Copper Range, 1,850,000.

Australian Letter

By Our Special Correspondent for Queensland

Galena Found in Mount Isa Ore at Depth of 170 Ft.

Primary Ore at Shallow Depth Is Significant—Arsenic Mining Slackens —Tin Active

Brisbane, Dec. 10, 1924.—According to reports from the mine superintendent of the Mount Isa Mines, Ltd., developments on the main lode veins on their Black Star, Rio Grande, and Mount Isa leases continue to be satisfactory. The deepest level reached last month was 200 ft., in the Black Star, where the water was encountered. At 170 ft. splashes of galena occurred in the ore, a sample of which yielded 60 per cent of lead and 300 oz. of silver per ton. At 186 ft. the ore was averaging 20 per cent of lead, with good material in the bottom of the shaft. With the static water reached, the striking of primary ore at so shallow a depth is considered to have an important bearing on future operations and the prospective erection of a treatment plant.

The Black Rock shoot has entered the main lode, and the face, at 41 ft., shows high-grade ore across the full width of 42 in., the average values being 36 per cent of lead and 21 oz. of silver per ton. The present known length of this high-grade ore is 500 ft., with a width of 30 ft. of highly payable and 15 ft. of low-grade material. The Rio Grande orebody has been proved up to the present to be of high grade for a distance of 500 ft., with a width of 30 ft. In this mine there are now four shafts spaced along the line of lode, and in each highly payable ore is reported to have been proved.

The production of arsenic in Queensland has, through a drop in the market value of the commodity, received a check. At one time it was expected that a good market would be found in America, but little real business has been done. The main center in this state where arsenic is mined is the Stanthorpe district, near the southern border, and the chief producer is the state mine. In the third quarter of the year this mine had an output of 104 tons, obtained from 1,046 tons of ore. This is sold at a cheap rate for the destruction of prickly pear, a pest which is spreading at an alarming rate in Queensland as well as in the southern states. A privately owned mine in the same district produced for the quarter 70 tons of arsenic, but so far has not been able to sell any of it. The market for arsenic is reported as being very unsatisfactory.

In the Kangaroo Hills tin field, North Queensland, there is a fair amount of production from the older mines, and much prospecting is being done. The Sardine, which has produced so well in the past, is still turning out a fair quantity of ore, but has not been able to declare any dividend for some time. On this field a big project has lately been initiated for the recovery of alluvial tin by hydraulic sluicing. The company having the undertaking in hand holds an area of 1,000 acres, which contains in places very heavy deposits of tin. Prospecting by means of bores has proved that the area has excellent prospects.

The proposed seasonal working of the Chillagoe state smelters is to begin in January, and continue as long as ore supplies are available. Referring to the heavy loss incurred by these smelters and the state mines connected therewith, the Minister of Mines attempted to justify the position by saying that the mines produced a very useful commodity, that they gave employment to about 1,000 men, and that it is better to create work, even at a loss, than to have a form of relief to the unemployed that is humiliating. He also stressed the advantage which the government railways received from the traffic created by this state undertaking.

C. F. & I. Has One Way To Deal With Bootleggers

THE Colorado Fuel & Iron Co. has posted the following notice at all of its mines and also at the steel plant at Pueblo:

"This company is going to get along in the future without the services of bootleggers and their customers. We class as bootleggers all those who manufacture, sell, or distribute intoxicants, either personally or through agents or members of their families. Such persons will be discharged on evidence satisfactory to the management without waiting for conviction in the courts."

Will Start Tamarack Reclamation Plant in Michigan

Calumet & Hecla Consolidated's new reclamation plant on the Tamarack conglomerate sands, in the Michigan copper district, will be "turned over" on March 1 for adjustments. After a thorough testing, the plant will go into operation, probably on April 1 or May 1. It will produce about 700,000 lb. of refined copper per month at an estimated cost of 9c. per lb.

The capacity of the plant is approximately three-eighths that of the Calumet plant. Tamarack sands are not as rich as those of the Calumet & Hecla, and consequently recovery of refined copper will be less and cost per lb. higher. It is estimated there are 12,000,000 tons of sand in the Tamarack deposit, from which 120,000,000 lb. of copper should be recovered. On this basis, it will require about fourteen years to treat the entire supply.

Fremont Mine Will Be Reopened

A new company, the Black Hills-Fremont Mines Co., has taken over the former holdings in the Fremont mine, near Sutter Creek, Calif., and has completed arrangements with the owners, Arthur Goodale and his associates, to operate the property. B. I. Hoxie has been appointed superintendent. The first operations of the company will be concentrated on orebodies near the surface north of the Gover shaft in the North Gover claim.

Mexico City Letter

By W. L. Vail

Special Correspondent

Secretary of Labor Will Enforce Safety Laws

Fine in Prospect for Violators—Guanajuato Labor Statutes Held Impracticable

Mexico City, Jan. 28—In view of an unusual number of accidents in mines recently, the Mexican Secretary of Labor and Commerce has issued a circular letter to all operating mine superintendents, insisting upon compliance with the laws guaranteeing a maximum precaution against accidents. Following the circular special inspectors will be sent out, and failure to comply with the instructions of the government will result in fines.

Where accidents of serious nature are proved to be the fault of mine owners heavy fines will be assessed in addition to the indemnity to injured workmen or their families in case of death. The department also has sent out circulars reminding mine operators of their obligation to send in monthly statements of operations of all classes, so that the government may keep in closer touch with the industry. Failure to comply with this latter circular also calls for a fine.

The new labor law, which has caused considerable friction in the State of Guanajuato, calls for a minimum wage of 1.25 pesos per day outside city limits and 1.50 within the city; also indemnification for injuries and sickness in the same manner as is set forth in United States labor laws, although not so drastic. A 7 per cent profit for the workers on the value of silver produced above 60c. per ounce, and 7 per cent of a specified excess on gold bullion is provided for by statute. These percentages must be paid before bullion can be shipped out of the state. A committee consisting of two workmen and the mine manager supervises working conditions, subject to approval by the committee to the State Department of labor.

The law is claimed by many mine operators to be radical, cumbersome, and entirely impracticable on many points, and it is expected to be considerably modified through a joint action of the state and federal authorities. In the meantime the larger companies are complying, as far as possible, with the new law, and are making monthly deposits of so-called surplus profits with the indicated authorities.

Asuncion & Co., owners of the important mines at La Luz, adjacent to the city of Guanajuato, have optioned them to George W. Bryant, and Mr. Bryant has extended options to associates in California. Work here calls for the construction of a mill, with extensive mine development.

The Consocio Co., of Guanajuato, has a 350-ton mill ready to operate with three miles of tramway connecting with the mines, which are equipped and ready to produce. The plan of operation is being worked out by W. J. Loring, mining engineer, from San Francisco.

Men You Should Know About

James S. Douglas, of Douglas, Ariz., spent a few days at Los Angeles recently.

L. F. Strobel, mining engineer of New York, has gone to Cripple Creek, Colo., for a month.

James L. Bruce, consulting engineer of Salt Lake City, has been in New York and Boston recently.

Charles Bocking, general manager for the Butte & Superior Mining Co., was a recent visitor in New York.

David R. Thomas, mining engineer, has been appointed manager of the Argonaut Gold, Ltd., at Dane, Ontario.

Home Smith, of Toronto, has been elected president of the McKinley-Darragh-Savage Mines, of Cobalt, Ont.

Harry C. Dudley, mining engineer, of Duluth, has gone to Pasadena, Calif., where he will reside for the next four months.

George R. McLaren has resigned from the management of the Argonaut Gold property, in the Larder Lake district of Ontario.

H. A. Kee, of the McIntyre Porcupine Mines, Ltd., has been appointed consulting engineer of the Porcupine Davidson Gold Mines.

H. R. Plate, consulting and mining engineer, announces the removal of his office headquarters to the Halbrook Building, San Francisco.

H. F. Marriott, of London, has gone to Paris in connection with the nickel property in Greece of which he is consulting engineer.

J. Gordon Osler, of Toronto, has been elected a director of the Consolidated Mining & Smelting Co. of Canada, Ltd., in succession to his father the late **Sir Edmund Osler.**

Cyril Parsons, mining engineer of London, is now on the Akim property (West Africa) making an investigation preliminary to a report.

William J. Loring recently announced that he is no longer connected with the management of the Carson Hill mine, near Angels Camp, Calif.

S. H. Brady has resigned as superintendent of the Rescue Eula mine, at Tonopah, Nev., and the mine has been shut down pending the selection of his successor.

Charles E. Knox, president of the Montana Tonopah Reorganized, has been in Tonopah to observe the new work being started by this company from the Gipsy Queen shaft.

Otto Wartenweiler, consulting engineer of Los Angeles, is now associated with the Smith-Emery Co. of Los Angeles and is in charge of physical testing and mechanical engineering.

J. T. Terry, metallurgical engineer, of Los Angeles, Calif., is conducting roasting and acid leaching tests on copper ores at the Cucharas property, 30 miles from Acaponeta, Nayaret, Mexico.

L. D. Gordon, president and general manager for the Round Mountain Mining Co. and the New Candelaria Mines Co., in Nevada, has returned to the mines from a business trip to San Francisco.

Gerald M. Ponton has returned to Canada from the Southern States, where he had been engaged for some years in oil and gas enterprises, and will practice as consulting engineer at Haileybury, Ont.

Dr. T. C. Chamberlin, emeritus professor of geology at the University of Chicago, has been awarded a gold medal by the Society of Economic Geologists, in recognition of his contributions to geology.

Walter A. Rukeyser

Walter A. Rukeyser, mining engineer of New York City, recently completed a mine examination in the Sudbury district of Ontario, and sailed on Jan. 29 for South America to examine several properties for a New York syndicate. He will return the latter part of March.

B. J. Roberts, recently in charge of the reconstruction and operation of the coal preparation and coking plant of the St. Bernard Mining Co., at Earlington, Ky., has joined the Deister Machine Co., as sales manager.

Sidney H. Ball, mining engineer of New York, is in Butte, Mont., on a business trip in the interest of the Jib Consolidated Mining Co., of Basin, Mont. It is understood that he will spend about a week in examining the property.

Jules Labarthe, metallurgical and construction engineer, has opened engineering offices at 85 Second St., San Francisco. **Herman A. Ruth,** formerly with Bradley, Bruff & Labarthe, will continue with Mr. Labarthe as chief engineer.

John J. Barry, Jr., mining engineer, a graduate of the Montana State School of Mines, and mine foreman for several years in the Butte district, has been assigned to the California properties of the Anaconda Copper Mining Co., by which he has been employed.

Charles L. Bradbury, mining engineer, has resigned his position with the **Cia. de Real del Monte, at Pachuca,** Hidalgo, Mexico, to accept the superintendency of the Cabrestante group of mines of the Mazapil Copper Co., Ltd., at Concepcion del Oro, Zacatecas, Mexico.

J. Edgar Pew, of Dallas, Tex., vice-president of the Sun Oil Co., and president of the American Petroleum Institute, conferred with Secretary Work at Washington, D. C., recently, in regard to the proposed inquiry into petroleum conditions by the federal oil conservation board.

Professors **Theodore J. Hoover** and **W. F. Dietrich,** of the Stanford University mining and metallurgy department, have selected the Mammoth mine, at Jackson, Amador County, Calif., as the best site for the mine surveying and sampling course that is to be given during the spring vacation.

Charles Butters and **R. S. Botsford,** mining engineers, recently returned to the United States from Canada, and left on Feb. 4 for Vallecitos mine, Anori, Colombia, South America. After spending about two months in Colombia, they will proceed to Nicaragua, returning therefrom to New York City.

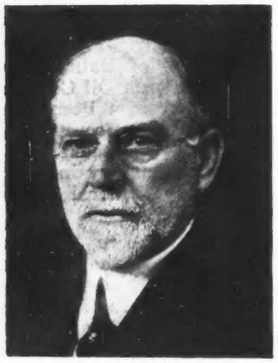
John M. Sully, mining engineer, was married recently to Miss Marjorie Louise Bloom, of Los Angeles. Mr. Sully has been the general manager of the Chino mines since the company was organized, and is a member of the board of directors of the Ray Consolidated Copper Co., which company now owns the Chino holdings in New Mexico.

Alva H. Gunnell has resigned his position as resident engineer for the Morrison Syndicate, of Los Angeles, operating the Atwood mine, at Lordsburg, N. M., and has removed to Vanadium, N. M., to give attention to his personal interests in the operation of the Ground Hog mine, near Santa Rita, being associated in this project with **Fred W. Richard,** mining engineer, formerly of Courtland, Ariz.

Harold G. Moses, former shovel repair foreman, has been appointed general foreman at the Chino mines of the Ray Consolidated Copper Co. in Santa Rita. He succeeds **William Mudge,** who has resigned the position because of ill health. **Harvey A. Forsyth,** who enjoys the distinction of being the oldest steam-shovel engineer at the mines, in point of seniority, succeeds Mr. Moses.

John W. Newton, superintendent of the Commerce Mining & Royalty Co. for Oklahoma, was elected governor of the Tri-state chapter of the American Mining Congress for 1925, at a recent meeting held in Picher, Okla. He succeeds **T. E. Coyne,** of Webb City, Mo. **P. B. Butler,** manager for the Barnsdall Zinc Co., was elected vice-governor for Missouri; **J. H. Trewartha,** superintendent of the Vinegar Hill Zinc Co., vice-governor for Kansas; and **W. T. Landrum,** manager for the Cortez Mining Co., vice-governor for Oklahoma. **C. F. Dike, P. W. George, Cham Rice** and Messrs. **Newton** and **Landrum** were re-elected as directors for a term of three years.

Societies, Addresses, and Reports



James H. McGraw

Hoover Praises Business Press

Growth of Industry and Opportunities Offered Described by Speakers at Banquet

SPEECHES by noted business men marked a banquet given at the Hotel Pennsylvania, New York City, on Jan. 30, by the McGraw-Hill Co., at the close of a three-day convention to which its staff representatives from all part of the country had been summoned. In the absence of James H. McGraw, president of the company, E. J. Mehren, a vice-president, acted as toastmaster. The speakers who had been invited to address the gathering were Julius H. Barnes, past president of the Chamber of Commerce of the United States; Fred I. Kent, vice-president of the Bankers Trust Co.; David Sarnoff, vice-president and general manager of the Radio Corporation of America; and Fred M. Feiker, vice-president of the Society for Electrical Development.

During the convention the discussion had revolved around the general topic of economic marketing in industry, with emphasis on the help that business papers may give in cutting down waste in sales and distribution. The dinner came as a fitting close. Results of the convention were summed up briefly by Malcolm Muir, a vice-president.

The Secretary of Commerce, Mr. Hoover, who found himself unable to be present, expressed his regret in a letter that was read by Mr. Feiker.

"I wanted to attend your convention to say a personal word of appreciation for the fine service which you, your company, and your publications are rendering to American industry," wrote Mr. Hoover.

"A big change has come in the spirit of American business, and for this change you are in part responsible. I mean the change from rule of thumb and *laissez-faire* to scientific determination of facts and program of action based on facts. The business press is probably the greatest force in making industrial opinion. The schools and colleges have an important place, the trade associations can do much in the fields of production and distribution, the government bureaus which keep in contract with business can help to promote sound leadership in industrial and economic thinking. All have an important place, but the business press and technical journals are in a unique position and have a unique opportunity. I believe that no organization of technical publications has come nearer to living up to this opportunity than the McGraw-Hill publications under the leadership of Mr. James H. McGraw.

"The thought that I have in mind is that your great group of journals can not only recognize and support sound industrial leadership; you can also initiate it. The field of your opportunity is practically limitless."

The day had gone forever, Mr. Barnes said, when the simple needs of a neighborhood were supplied by the village artisan with his market within an arm's length. Today industry was developed on a worldwide scale.

In the 140 years since the Republic was founded, the world's wealth had increased from 100 billion dollars—accumulated since the beginning of time—to ten times that today, said the speaker. The secret of this accelerated

Underwood & Underwood
Fred I. Kent

progress, he said, lay in the harnessing of power to man's service. Fifty years ago one-half horsepower per worker was used in the manufacturing field; today 4 hp. per worker. Fifty years ago the national wealth was 30 billion; today 320 billion. The speaker then pointed out to his audience what it meant to modern industry to have this power service. In the last analysis, he said, the earnings of commerce are the basis for all things that make life worth living.

"If this expanding production is human service visualized to us, we have a right to see what this accelerated progress presents to us in new and complex problems," said the speaker. "The chief problem is the growing complexity of the relation between government of established authority and the private processes of industry and private lives. . . . The intense individualism of America cannot be restored in its old shape, but it is possible to so align the relationship of government and the private lives of our people that we can preserve that individual impulse, the resourcefulness, the initiative on which the whole progress of America has clearly been based."

Underwood & Underwood
Julius H. Barnes

It rested upon such organizations as theirs, Mr. Barnes told the audience, and on Chambers of Commerce and all those agencies which crystallize and express through resolution and declaration the opinion of their organization, to find some way to guide government in the growing complexity of these questions which government touches more intimately than ever before and must touch always.

Mr. Sarnoff, who came to this country at nine years of age and who now at thirty-four has been vice-president and general manager of the Radio Corporation of America for two years, chose "Opportunity" as the topic for his speech. He attempted to illustrate the difference between looking at an opportunity and seeing it. Hertz looked at the opportunity for transmitting electromagnetic waves from one place to another without the aid of physical agencies, he said. He had in his grasp the fundamentals of radio, and he looked at it. But Marconi saw that opportunity and took advantage of what he saw, and that resulted in the application of wireless telegraphy to the needs of mankind. These opportunities are around us every day, said Mr. Sarnoff.

In Europe, he had noticed, important positions were almost without exception filled with very much older men than those who fill similar positions on this side. Not only was the United States a young nation, said the speaker, but it was a nation of young men—a wonderful asset for the boys of America. In concluding he said "I cannot sum up the word 'opportunity' in any better way than to say, 'Opportunity! America is thy name'."

Underwood & Underwood
David Sarnoff

New Machinery and Inventions

Rock Drilling Equipment in New Lines Announced by Boston Manufacturer

Two lines of rock drills have just been introduced by a new entrant in the machinery manufacturing field—namely, the Gilman Manufacturing Co., of East Boston, Mass. One of these comprises the following six drills—all of the hand-held hammer type:

AF211 plug-hole hammer rock drill.
AR211 foot-hole hammer rock drill.
AR231 Type A light sinker hammer rock drill.
AR231 Type B light sinker hammer rock drill.
AR221 Type A heavy sinker hammer rock drill.
AR221 Type B heavy sinker hammer rock drill.

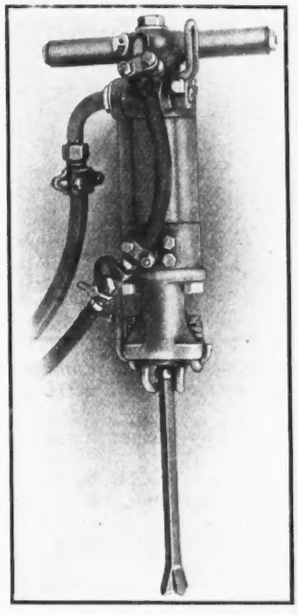
The AF211, for dry holes, is intended primarily for drilling plug holes in quarries and stone sheds, but, being light and small, can be used for other kinds of light drilling. It has a push-handle throttle, and the steel can be oscillated by means of a loose-fitting solid-end hand wrench. Exhaust air from the throttle block, conducted by a short length of hose to a rider encircling the steel, blows the cuttings out of the hole. The piston hammer motion is of the valveless type. Live air cushions the piston at both ends of the stroke, thus quieting the action. The drill is easily good for holes up to 1 in. in diameter and 6 in. long.

AR211, also for dry holes, likewise has a push-handle throttle, valveless piston motion and air cushioning. A wide range of adaptability is claimed for it. The drill is equipped with a combined rotation lever and drill steel retainer which permits the use of standard ⅞-in. hexagon collared shank steel.

The AR231 Type A light sinker has a water supply attachment which makes it useful for sinking in dry places, stoping, and block-holing wherever dust is objectionable. Valveless piston motion and air cushioning are features also of this model. A slip-joint connection between the hammer piston and chuck combines with a novel ratchet mechanism to give a powerful torque to the steel. The throttle valve controls the hammer action, rotation and hole blowing. Lubrication is automatic. Removal of the chuck bushing is made easy by a jaw clutch joint between bushing and chuck sleeve. All parts are easily cleaned.

Created to meet the demand for a dry machine of the same general character as Type A, the AR231 Type B sinker is said to have a perfect balance, valveless piston action, strong torque, and absence of vibration. The Type A and the Type B machines are readily converted from dry to water machines or vice versa. Holes of 12 ft. in length and up to 2 in. in diameter are easily drilled.

Both the AR221 Type A and the Type B heavy sinker hammer rock drills, intended for wet and dry work respectively, weigh 65 lb. and can drill holes 14 ft. long and up to 2¼ in. in diameter. The use of air and water under pressure for ejecting the rock cuttings makes the Type A machine excellent, it is claimed, for heavy down-hole drilling underground and where dust is objectionable. The principal uses of the Type B machine are in quarrying and for open-air work in general where heavy blasting with deep holes is required. Features claimed for both machines are the power and flexibility of the hammer engine, and simplicity of construction. The steel is rotated by a simple type of balanced, rotary piston motor mounted coaxially with and surrounding the piston of the machine, by two shafts, extending the length of the cylinder, and establishing a connection between the motor gear and the chuck through a series of gyrating yokes. This means that the required speed reduction from the motor piston to the drill steel chuck is secured without complicated gearing or protrusions from the drill casing.



A light sinker hammer rock drill for drilling with water under pressure—the AR231 Type A

The line of mounted hammer rock drills embraces machines for all the work of light and heavy drifters. These are:

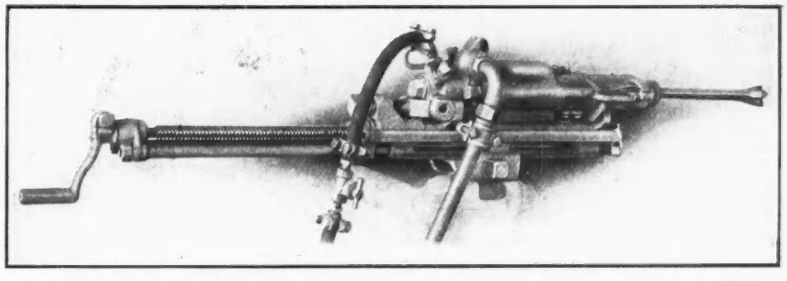
AR431 Type A "Bantam" drifter.
AR431 Type B "Bantam" drifter.
AR421 Type A light drifter.
AR421 Type B light drifter.
AR521 Type A pneumatic feed drifter.
AR521 Type B pneumatic feed drifter.
AX321 Type A heavy drifter.
AX321 Type B heavy drifter.
AX521 Type A pneumatic feed heavy drifter.
AX521 Type B pneumatic feed heavy drifter.

In all sizes they are furnished with guide shell and screw-feeding mechanism and in some of the large sizes they may also be had with a pneumatic feed. They are made in both dry and wet patterns.

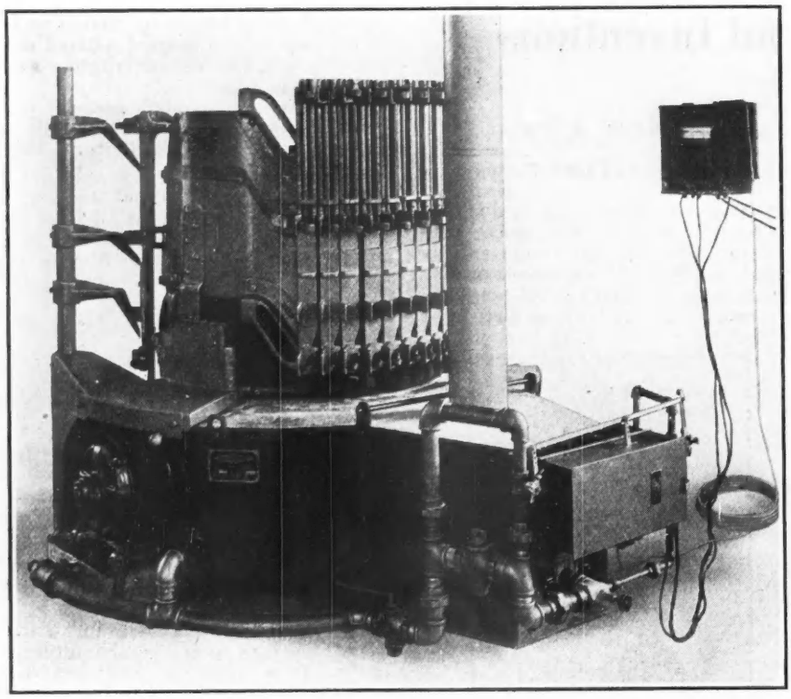
The AR431 Type A "Bantam" drifter is designed to perform the alternate duties of a mounted and hand-held machine. The light weight which is a necessary feature is obtained, it is claimed, without sacrificing those qualities which make for long and satisfactory service. The machine is intended to meet the demand for liberal drilling capacity from a mounting in light blast hole work in drifts, crosscuts, and stopes underground. When occasion requires its use as a hand-held machine, the hammer engine proper may be easily detached from the feeding means, whereupon the drill is ready for all but the heaviest kind of down-hole drilling. The design of the feed slide contributes materially to the machine's adaptability for such purposes.

The feeding means consists of a shell with sliding trunnion and feed screw, equipped with feed slide, to which the drilling engine proper, which is detachable, is secured by a vise and tongue-with-socket connection. The hammer engine is therefore always in direct alignment with the feeding means, even after replacement. There are no bolts or nuts to become misplaced.

The hammer piston motion is of the valveless type with which all the company's mounted hammer rock drills are equipped. This is said to insure exact balance and uniform weight distribution of reciprocating and rotating parts, affording freedom from vibration. Air



A light machine for drilling with water under pressure—the AR431 Type A "Bantam" drifter hammer rock drill. It can be used as a mounted or as a hand-held machine



New heat-treating machine showing furnace and drive. It automatically heats, hardens and tempers the cutting end of rock drill steel

cushions are provided at each end of the stroke, protecting the rigid parts against hammering. The machine will drill holes easily up to 12 ft. in length and to 2 in. in diameter.

The AR431 type B drifter differs from the type A, just described, essentially in that air only passes through the steel to the bottom of the hole, cleaning it of dirt and cuttings.

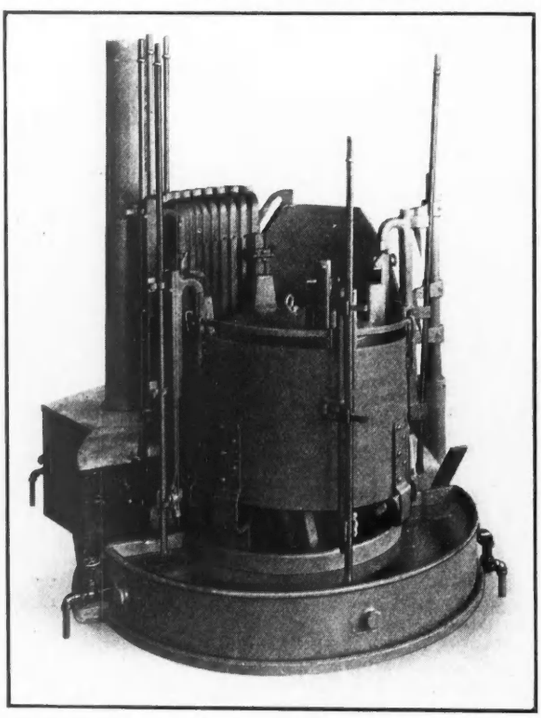
The company has exerted its best effort to produce a line of mounted hammer rock drills that will meet most advantageously the many existing conditions attending the breaking of rock.

A Machine for Heat-treating Rock Drill Bits Automatically

Included in the line of rock drilling machinery that has just been introduced by the Gilman Manufacturing Co., of East Boston, Mass., is a new heat-treating machine, two views of which are shown in the accompanying cuts. It consists of a heating furnace which may be equipped with an automatic pyrometer control, and a quenching tank, in combination with drill steel carriers that are actuated by a driving arrangement upon a stationary circular cam track.

In operation, the drill steel, after being forged to the required shape, is placed on one of these carriers, which automatically conveys it to the heating furnace. Here the end of the steel is subjected to a heat to raise it uniformly to the correct hardening temperature. The bit is then automatically transferred to the quenching tank, where its edges are rapidly and uniformly cooled by a jet of cold water, after which the bit, while still in the machine, is tempered and finally automatically ejected. The entire operation of heat treatment is performed by the machine, automatically.

It first heats the bit to the critical temperature and then, before the temperature can change, quenches it. Each steel is treated exactly the same as any other. It is claimed that it is impossible with this machine to heat the steel to the proper temperature and quench it at an improper temperature.



This view shows the quenching tank of the heat-treating machine. The bits cannot touch the bottom of the tank

The quenching occurs immediately upon removal of the steel from the furnace. After the edges are cooled by the jet of cold water, the remainder of the heated portion of the bit is gradually immersed in still water, to form a backing for the cutting and reaming edges, which backing gradually decreases in hardness and increases in toughness to a point where the material of the bar in its original state is reached. The machine is said to prevent any contact whatever of the cutting and reaming portions of the bit with the bottom of the tank during quenching.

Westinghouse Achievements in 1924

The engineering achievements of the Westinghouse Electric & Manufacturing Co. for the year 1924 are set forth in an exceedingly attractive pamphlet that has been prepared by H. W. Cope, assistant director of engineering. About eighty subjects are covered. The pamphlet is dedicated to the memory of Benjamin Garver Lamme, "whose brilliant mind and breadth of vision," it is stated, were responsible for many past achievements of the company.

Trade Catalogs

Electric Portable Hoists — Bulletin 76-E, dated January, 1925, issued by the Sullivan Machinery Co., Chicago, Ill., covers the single-drum hoists (type HE) and the double-drum hoists (type HDE), which were introduced during the last year. These were designed to furnish an electric portable hoist of the type and utility of the Sullivan Turbinair hoists, to be used when electric wires are strung to the work to be done, or when air power is not available.

Circuit Breakers—A 32-page bulletin, bearing the number 47495.1, has been issued by the General Electric Co. describing four improved types of oil circuit breakers. These types bear the designation FH-103, FH-203, FH-206, and FH-209, and all are for controlling and protecting circuits of large capacity.

Heating Systems — A folder issued by the American Blower Co., Detroit, Mich., describes the company's direct-fired heater, which is designed for heating such buildings as garages, foundries, warehouses, machine shops, and similar structures.

Compressed Air Equipment — "You can do it quicker with air" is the title of a 16-page pamphlet issued by the Sullivan Machinery Co., Chicago, Ill., in which the numerous ways in which compressed air can be put to work are shown by means of illustrations.

The Market Report

Daily Prices of Metals

Jan. Feb.	Copper N. Y. net refinery*	Tin		Lead		Zinc
	Electrolytic	99 Per Cent	Straits	N. Y.	St. L.	St. L.
29	14.625	57.50	58.00	9.95	9.65	7.55@7.60
30	14 50@14.625	56.875	57.375	9.75	9.40	7.50@7.55
31	14 50	56.50	57.00	9.75	9.40	7.50
2	14 50	56 25	56.75	9 75	9.40	7.35@7.40
3	14.25@14.375	56.125	56.625	9.45@9.75	9.40	7.25@7.35
4	14.375	56.50	57 00	9.45@9.75	9.40	7.35@7 375
Av.	14.479	56.625	57.125	9 733	9.442	7.440

*These prices correspond to the following quotations for copper delivered: Jan. 29th, 14.875c.; 30th, 14.75@14.875c.; 31st and Feb. 2d, 14.75c.; 3d, 14.50@14.625c.; 4th, 14.625c.

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. Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

The quotations are arrived at by a committee consisting of the market editors of *Mining Journal-Press* and a special representative of the Bureau of Mines and the Bureau of Foreign and Domestic Commerce.

London

Jan.	Copper			Tin		Lead		Zinc	
	Standard		Electro-lytic						
	Spot	3M		Spot	3M	Spot	3M	Spot	3M
29	65	66	69½	265¼	268¼	39	37½	37 5/16	36½
30	64¾	65¾	69½	262¾	265¼	37⅜	36⅛	36¾	35⅞
Feb. 2	64⅜	65⅜	68¾	259½	262½	37¼	36	35⅞	35¼
3	63⅝	64⅝	68½	260	262⅞	37⅛	35½	35⅜	35
4	64	65	68½	260¼	263¼	37	35⅝	35¾	35 3/16

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

Silver, Gold, and Sterling Exchange

Jan.	Sterling Exchange "Checks"	Silver		Gold London	Feb.	Sterling Exchange "Checks"	Silver		Gold London
		New York	London				New York	London	
29	4 79⅛	69	32 7/16	87s 0d	2	4.79½	68⅞	32 5/16	86s11d
30	4. 78¾	68⅞	32 7/16	87s 1d	3	4.78¾	68¾	32¼	87s 0d
31	4 79¼	69¼	32½	.....	4	4.78⅜	68⅝	32¼	87s 1d

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

Metal Prices Recede Further in Inactive Market

New York, Feb. 4, 1925—Led by further declines in the London cables, prices of the important non-ferrous metals declined further during the week ending today, most consumers, as usual, not being keenly interested in buying in a declining market.

Copper Dropped to 14½c. Delivered

Most of the larger copper producers have been content to remain out of the market during the week, as their order books were in good shape, and they felt that the present recession in price was likely to be only temporary.

Copper was freely offered in the Valley yesterday for 14⅝c., and some sellers for prompt shipment booked small tonnages at 14½c. Today, a more bullish feeling is evident, inquiries being somewhat better, though there cannot yet be said to be much buying interest except at cut prices. Numerous resale lots have been unearthed at the lower prices prevailing recently. Forward copper is somewhat more difficult to obtain in the open market than prompt.

Average Metal Prices for January

Copper:	
New York Electrolytic	14.709
London Standard	66.065
London Electrolytic	70.607
Lead:	
New York	10.169
St. Louis	9.953
London	41.443
Silver:	
New York	68.447
London	32.197
Sterling Exchange	477.702
Zinc:	
St. Louis	7.738
London	37.917
Tin:	
99 per cent	57.692
Straits	58.250
London	265.560
Quicksilver	81.596
Antimony	17.428
Platinum:	
Refined	117.000
Crude	111.663

Lead Below 9½c.

The contract price for New York lead, set by the American Smelting & Refining Co., was reduced from 10 to 9.75c. on Friday, Jan. 30. Not a great deal of business has been done during the week, and rumors of cut prices have referred more to quotations than sales. An important tonnage was sold yesterday, however, at 9.45c., New York. In St. Louis, one producer has sold well at 9.40c. during most of the week.

Spot Zinc at Premium

Only a moderate tonnage of zinc has been sold during the week to galvanizers, and export business has been non-existent. Premiums of 5 to 10 points have been realized on zinc for prompt shipment compared with that for April and May. New York prices continue 35c. per 100 lb. above St. Louis. High-grade remains at 8¾c. delivered.

Silver Market Quiet

The silver market has been very quiet of late and a slight reaction in price has resulted from the lessened demand. The House Banking and Currency Committee has reported favorably on the bill authorizing the purchase of an additional 14,500,000 oz. under the Pittman Act, and should this bill become law, it should have a stimulating effect on the price of silver, for a time at least.

Mexican Dollars: Jan. 29th, 53½c.; 30th, 53c.; 31st, 53⅜c.; Feb. 2d and 3d, 53c.; 4th, 52⅞c.

Only Mild Interest in Tin

Tin buying has been on only a small scale, though some interest was taken on declines, which carried the price below 57c. for spot Straits. A slight

premium was asked for forward. Arrivals of tin in January, according to the New York Metal Exchange, were 7,155 long tons.

Foreign Exchange

On Tuesday, Feb. 3, closing cable quotations on francs were 5.41c.; lire, 4.155c.; and marks, 23.81c. Canadian dollars, $\frac{1}{16}$ per cent discount.

Other Metals

Quotations cover large wholesale lots, f.o.b. New York, unless otherwise specified.

Aluminum—99 per cent, 28c. per lb.; 98 per cent, 27c. London, 98 per cent, £125 long ton.

Antimony—Per lb.:
Chinese brands, 18@18.50c.
Cookson's "C" grade, 20c.
Chinese needle, lump, nominal, 10c.
Standard powdered needle, 200 mesh, 11½@13c.
White oxide, Chinese, 99 per cent Sb_2O_3, 16@16½c.

Bismuth—$1.30@$1.35 per lb. in ton lots. London, 5s.

Cadmium — 60c. per lb. London, 2s. 2d.@2s. 6d.

Cobalt—$2.50@$3 per lb. Discounts on contracts. Oxide, $2.10@$2.25. London, 10s. for metal; 9s. for black oxide.

Germanium Oxide—25 to 50 gm. lots, $10 per gm.

Iridium—$325 per oz. Nominal.

Lithium[1]—95@96 per cent grade in 1 to 5 lb. lots, $75 per lb.

Magnesium—Sticks, 1¼ in., 99.9 per cent, 90c.@$1 per lb. London quotes 4s. for 99 per cent.

[1]**Molybdenum**—99 per cent, $12 per lb.

Monel Metal—32c. per lb.

Nickel—Ingot 31c.; shot, 32c.; electrolytic, 38c. (99.75 per cent grade). London, £162½.

Osmiridium—Crude. $58.50 per oz.

Osmium—$100@$104 per oz.

Palladium—$79@$83 per oz. Crude, $60 per oz. London, £19.

Platinum—Refined, $117 per oz.
Crude, $113@$114.50.

Quicksilver—$81@$82 per 75-lb. flask. San Francisco wires $81.65. Quiet. London, £13¼.

Radium—$70 per mg. radium content.

Rhodium—$85@$90 per oz.

Ruthenium—$40@$45 per oz.

Selenium — Black powdered, amorphous, 99.5 per cent pure, $2.20 per lb.

Tantalum—Metal, $350 per kg.

Tellurium—$2 per lb.

[1]**Thallium Metal**—Ingot, 99 per cent pure, $5 per lb.

Tungsten Metal—Powder, 97 to 98 per cent, 95c.@$1 per lb. contained tungsten.

[1]**Zirconium Metal**—98 per cent grade, per lb., $30.

Metallic Ores

Chrome Ore—Per ton, c.i.f. Atlantic ports:
Indian, $20.
Rhodesian, $22.
New Caledonian, $24.
Market nominal.

[1]**Galena Radio Crystals**—Best quality (50 per cent of sized fragments good) 50c. per lb. in 500-lb. lots, f.o.b. Philadelphia.

Iron Ore—Prices for iron ore and magnetite for 1924 season were published Aug. 9.

Manganese Ore—42c. per long ton unit, seaport, plus duty. Market steady. Chemical grades[2], powdered, coarse or fine, 82@87 per cent MnO_2, Brazilian, and Cuban, $70@$80 per ton in carloads.

Molybdenum Ore—60@70c. per lb. of MoS_2 for 85 per cent MoS_2 concentrates. Nominal.

Tantalum Ore—Foreign, 30@50c. per lb. of Ta_2O_5 contained, c.i.f. New York, according to quality.

Tungsten Ore—Per unit, N. Y.:
High-grade wolframite, $9@$9.25.
High-grade scheelite, $9.50@$9.75.

Vanadium — Minimum 18 per cent V_2O_5, $1@$1.25 per lb. Nominal.

Lower Prices for Zinc and Lead Ores

Joplin, Mo., Jan. 31, 1925

Zinc Blende	Per Ton
High	$59.05
Premium, basis 60 per cent zinc	$52.00@ 53.00
Prime Western, 60 per cent zinc	50.00
Fines and slimes	49.00@ 46.00
Average settling price, all	56.04

Lead Ore	
High	$148.35
Basis 80 per cent lead	125.00
Average settling price, all	139.59

Shipments for the week: Blende, 13,468; calamine, 84; lead, 3,777 tons. Value, all ores the week, $1,285,440.

Shipments for the month: Blende, 70,824; calamine, 204; lead, 14,126 tons. Value, all ores the month, $5,788,970.

Zinc blende is still being settled for that was bought on a basis of $60 and lead that was bought on a basis of $140, which brings the settlement average above the basis prices of the week.

A shipment of 84 tons of calamine this week was settled for on a basis price of $30 per ton of 40 per cent zinc.

No restriction of output is noticeable, though there is insistent assurance that production will be lowered soon. It is now about 17,000 tons per week. Total zinc production for the month was 77,300 tons and total shipments were 70,780 tons, indicating an increase of 6,520 tons reserve stock.

Platteville, Wis., Jan. 31, 1925

Zinc	Per Ton
Blende, basis 60 per cent zinc	$55.00

Lead	
Lead, basis 80 per cent lead	$130.00

Shipments for the week: Blende, 751 tons; lead, none. Shipments for the year: Blende, 2,937; lead 160 tons. Shipments for the week to separating plants, 1,420 tons blende.

Non-Metallic Minerals

Prices received for non-metallic minerals vary widely and depend upon the physical and chemical characteristics of the commodity. Hence the following quotations can only serve as a general guide as to the prices obtained by producers and dealers in different parts of the United States for their own product. In the last analysis the value of a particular non-metallic mineral can only be ascertained by direct negotiation between buyer and seller.

[1]**Amblygonite**—8@9 per cent lithium oxide, $50@$60 per ton, f.o.b. mines.

Asbestos:
Crude No. 1—$325@$400.
Crude No. 2—$200@$250.
Spinning fibers—$100@$150.
Magnesia and compressed sheet fibers—$65@$100.
Shingle stock—$45@$55.
Paper stock—$35@$40.
Cement stock—$15@$25.
Floats—$9@$12.
Sand—$6@$8.
All per short ton, f.o.b. mine, Quebec, tax and bags included.
No. 1 Rhodesian crude, $280; No. 2, $200 per short ton c.i.f. New York.
Prices of crudes show advance. Business has been good. Rumors of merger have caused strengthening of market, Production is moderate.

Barytes—f.o.b. Kings Creek, S. C.:
Crude, $7@$8 per gross ton.
Ground, off color, $14 per ton.
White, bleached, $17 per ton.
Waterground, 300 mesh, bags included, $22 per ton, Charlotte, N. C.
Crude, $8.50, f.o.b. Ga.
Crude, $8.50, f.o.b. Mo.
Water ground and floated, bleached, $23@$24, f.o.b. St. Louis.
In Canada, 94@96 per cent $BaSO_4$, $8 per net ton, f.o.b. mine.
Demand steady. Market good.

Bauxite — American, f.o.b. shipping point per gross ton:
Crushed and dried, $5.50@$8.50.
Pulverized and dried, $14.
Calcined, crushed, $19@$20.
Foreign, per metric ton, c.i.f.:
French red, 5 per cent SiO_2, $5@$7.
Adriatic, low SiO_2, $4@$6.50.

Beryl—$65@$80 per ton, hand-sorted crystals, f.o.b. Vermont. Nominal.

Borax—Granulated and refined, crystals or powdered, in bags, carloads, 4¾c. per lb.; in bbls., 5c. Boric acid, 10½c.

[1]**Celestite**—90 per cent $SrSO_4$, finely powdered, $40 per ton in carload lots.

Chalk—F.o.b. New York, per lb.:
English, extra light, 5c.
Domestic, light, 4¼@4½c.
Domestic, heavy, 3½@3¾c.
In bulk, $5@$5.50 per ton.

China Clay (Kaolin)—F.o.b. Virginia mines, per short ton:
Crude No. 1, $7.
Crude No. 2, $5.50.
Washed, $8.
Powdered, $10@$20.
Powdered (Blue Ridge), $12@$15.
Imported English, f.o.b. American ports:
Lump, $12@$20.
Powdered, $45@$50.
1A grades, domestic, $16@$17, f.o.b. mines.

Corundum — South African, $65 per ton, New York.

Diatomaceous Earth—Per short ton, f.o.b. plant, California:
Kiln-fired brick, $65.
Kiln-fired aggregate, ¼ in., $45.
Insulating powder, $30.
Natural aggregate, ¼ in., $20.
Air-floated powder, $40.
Business reported satisfactory.

Emery—Per lb., f.o.b. plant:
Greek Naxos, 6½c.
Turkish, 6½c.
Khasia, 5½c.
American, 3½@6½c.
Market fair.

Feldspar—Per long ton, f.o.b. cars,

[1]Price furnished by Foote Mineral Co., Philadelphia.

North Carolina:
No. 1 pottery grade, $6.50@$7.50, depending upon quality.
No. 2 pottery grade, $4.50@$5, depending upon quality.
No. 1 soap grade, $6.75@$7.25.

In *Connecticut*, per net ton, f.o.b. mines:
40 to 200 mesh, $16@$30.
Market better than in December.

In *New Hampshire*, per net ton, f.o.b. mines:
No. 1, not over 10 per cent SiO_2, $7.70.
No. 2 pottery grade, $7.
Ground, $17@$20, f.o.b. mill.
Market fair.

In *New York*, per ton, f.o.b. cars:
No. 1, $8. Market still dull.

In *Maine:*
No. 1 ground, $19. Market good.
No. 1 Porcelain grade (Virginia) 140 mesh, $22; No. 1 Body spar (Maryland) 120 mesh, $17; Enamelers' grade (Maryland) 80-100 mesh, $13.50@$16; Enamelers' grade (Virginia) 100 mesh, $20; Glassmakers' grade (Virginia) 30-100 mesh, $19; Glassmakers' grade (Maryland) 30-100 mesh, $13@$15.

In *Tennessee:*
Pottery grades, $16@$21.
Tile grades, $14@$16.
Enameling grades, $11@$16.
Crude, $7 for ordinary grades. As high as $7.25 offered for exceptional quality.
Market improving.

In *Canada*, f.o.b. mine:
Crude, No. 1, over 12½ per cent potash, less than 5 per cent SiO_2, $7.50 per net ton.
Crude, No. 2, 20 to 25 per cent SiO_2, $5.50 per net ton.
Ground, No. 1, 180 mesh, $21 per net ton, bags included.
Ground, No. 2, 180 mesh, $16 per net ton, bags included.

Fluorspar — F.o.b. Middle Western mines, per net ton:
Gravel, not less than 80 per cent CaF_2, and not over 5 per cent SiO_2, $20.
Lump, No. 2, not less than 85 per cent CaF_2 and not over 5 per cent SiO_2, $20.
Lump, No. 1, 95@98 per cent CaF_2, not over 2½ per cent SiO_2, $30.
Ground, 93 to 98.5 per cent CaF_2 and not over 3 per cent SiO_2, $30@$35 in bulk, $39 in bags or barrels.
Acid, ground, not less than 98½ per cent CaF_2 and not over 1 per cent SiO_2, $40@$45 in bulk, $49 in packages.
In Canada, 84@86 per cent CaF_2, less than 5 per cent silica, $17 per net ton, f.o.b. mine.

Fuller's Earth—Per ton, f.o.b. Midway, Fla.:
16 to 30 mesh, $16.50.
16 to 60 mesh, $18.
30 to 60 mesh, $18.
60 to 100 mesh, $14.
Plus 100 mesh, $7.50.
Powdered, imported, duty paid, $23 @$25 per ton.

Garnet—Per short ton:
Spanish grades, $60, c.i.f. port of entry.
Domestic Adirondack, $85, f.o.b. shipping point.
Market firm.
Canadian, $70@$80, f.o.b. mines.

Gilsonite—Per ton, f.o.b. Colorado:
Jet asphaltum, $36.
Selects, $33.
Seconds (ordinary grades), $25.50.

Graphite—First quality, per lb.:
Ceylon lump, 6½@7c.
Ceylon chip, 5@5½c.
Ceylon dust, 2½@4c.
Crude amorphous, $15@$35 per ton.
Flake, No. 1 and No. 2 from New York, 12@30c.
Manufactured grades:
No. 1 Flake, lubricating, 10@30c.
No. 2 Flake, lubricating, 10@30c.
Extra fine ground, 12@30c.
Medium fine ground, 6@14c.
Facings, 4@8c.
Market improving. Foreign markets higher in price on account of depleted stocks.

Gypsum—Per ton, depending upon source:
Crushed rock, $2.75@$3.
Ground, $4@$6.
Agricultural, $6@$7.
Calcined, $8@$16.

Ilmenite—Concentrates, 52 per cent TiO_2, 1½c. per lb., f.o.b. Virginia points. $60 per short ton, Florida mines.

Iron Oxide (See Ocher) — Ground, 95 per cent through 200 mesh, Standard Spanish red, $40 per ton.

Kaolin—See China Clay.

Lepidolite—$20@$30 per ton for ordinary grades. Nominal.

Limestone—Depending upon source, f.o.b. shipping points; per ton:
Crushed, ½ in. and less, $1.10@$1.70.
Crushed, 3 in. and larger, 90c.@$1.50.
Agricultural, $1.50@$5.

Magnesite—Per ton, f.o.b. California mines:
Calcined lump, 85 per cent MgO, $35.
Calcined ground, 200 mesh, $42.50.
Dead burned, $29@$31, Washington.
Dead burned, $40@$42, Chester, Pa.
Caustic calcined, Grecian, $50@$51, c.i.f., New York.

Manjak—Barbados, in 1 to 5 ton lots:
Grade "A," 6c. per lb.
Grade "AC," 7c. per lb.
Grade "AA," fine, 8c. per lb.
Grade "C," fine and lump, 9c.
Grade "C," lump, 12c.

Mica—
North Carolina prices:
Scrap, $17@$20 per ton.
Sheet, per lb., No. 1 quality, clear:
Punch, 1½ in., 7c.

1½ x 2 in., 16c.	3 x 4 in., $1.75.
2 x 2 in., 30c.	3 x 5 in., $2.35.
2 x 3 in., 75c.	4 x 6 in., $3.
3 x 3 in., $1.25.	6 x 8 in., $4.50.

Ground, 60 mesh, $65 per ton.
Ground, 80 mesh, $70.
Ground, 120 mesh, $120.
Ground, 140 mesh, $125.
Dry ground, roofing, $30.
Dry ground, 80 mesh, $35.
Dry ground, 100 mesh, $67.50.
Dry ground, 160 mesh, $70.00.
In *New Hampshire:*
Washer and disk, $320 per ton.
Scrap, $24 per ton.
Madagascar, amber, dark, free from iron, per lb., f.o.b. New York:

No. 1.....	$2.75	No. 4.....	$0.75
No. 2.....	2.25	No. 5.....	.50
No. 3.....	1.35	No. 6.....	.30

[1]Price furnished by Foote Mineral Co., Philadelphia.

[1]**Monazite**—Minimum 6 per cent ThO_2, 6@8c. per lb.

Ocher—"Yellow Peruvian," $25@$30 per ton, Georgia mines. Market good.

Ozocerite—Per lb. in bags, New York:
Black, 160 deg. melting point, 24@25c.
Green, 170 deg. melting point, 26@30c.

Phosphate — Per long ton, f.o.b., *Florida* export prices:
76@77 per cent, pebble, $5.50.
75 per cent, $5.25.
74@75 per cent, $5.
70 per cent, $3.35.
68 per cent, $3.
In *Tennessee*, per long ton:
78 per cent lump, $8.
75 per cent hand-mined lump, $6.75 @$7.
75 per cent washed lump, $7.
72 per cent washed run of mine, $5 @$5.50.
65 per cent ground 95 per cent through 100 mesh, $7 per short ton.
Not much change in prices. Exports fair.

Potash—	Bags	Bulk
Muriate of potash 80@85 per cent, basis 80 per cent.....	$34.55	$33.30
Sulphate of potash 90@95 per cent, basis 90 per cent....	45.85	44.60
Sulphate of potash-magnesia 48@53 per cent, basis 48 per cent	26.35	25.10
Manure salt 30 per cent.....	19.03	17.33
Manure salt 20 per cent.....	12.55	10.55
Kainit 14 per cent	10.25	8.25
Kainit 12.4 per cent.....	9.75	7.75

Two thousand pounds net weight, c.i.f. Atlantic and Gulf ports. German weights, tares and analyses.

For prompt shipment:
5 per cent on minimum quantity of 50 short tons K_2O
6 per cent on minimum quantity of 100 short tons K_2O
7 per cent on minimum quantity of 300 short tons K_2O
10 per cent on minimum quantity of 500 short tons K_2O

The calculations are on total quantity of foreign potash salts imported during the present fertilizer year ending on April 30, 1925.

Pumice Stone—Imported lump, 3@40c. per lb.
Powdered, in bbl., 3@5c.
Lumps, in bbl., 6@8c.

Pyrites—Tharsis, per long ton unit, c.i.f. U. S. ports:
Furnace size, 12c.
Lump, 11c.
Fines, through ½ in., 11½c.
Cinder from ore to remain property of buyers.

Quartz Rock Crystals — Colorless, clear and flawed, pieces ¼ to ½ lb. in weight, 30c. per lb. in ton lots.
For optical purposes, double above prices.

Rutile—F.o.b. Virginia points, per lb.:
Granular, 94@96 per cent TiO_2, 12@15c.
Pulverized, 100 mesh, 94@96 per cent, 17@30c.
93 per cent TiO_2, $200 per ton, Florida.

Silica—Water ground and floated, per ton, f.o.b. Illinois:
450 mesh, $31.

350 mesh, $26.
250 mesh, $22.
200 mesh, $20.
100 mesh, $8.

Glass sand, $2@$2.25 per ton; brick and molding sand, $2@$2.25.

Spodumene — $20@$30 per ton, depending upon lithium content. Nominal.

Sulphur—$16@$18 per ton for domestic, f.o.b. Texas and Louisiana mines; $18@$20 for export, f.a.s New York.

Talc—Per ton, in 50-lb. paper bags, *Vermont* mills, carloads:
Ground, 200 mesh, extra white, $11@$12.
Ground, 180 mesh, medium white, $10.50@$11.50.
Ground, 160 mesh, medium white, $10@$11.
Demand good. Market firm.

In *New York*, double air-floated, including containers:
200 mesh, $13.75.
325 mesh, $14.75.
100 mesh, $11, not air-floated.
Demand fair.

In *California*, $20@$30 per ton, ground.

In *Georgia*, powdered, per ton:
Gray or yellow, $7.50@$10.
Red or white, $10@$14.
Market good for powders.
White, $12@$15.
Grayish white, $8@$10.
Red, $12@$14.
Yellow, $8@$12.
Roofing, $7.50@$8.

Tripoli—Per short ton, burlap bags, paper liners, per minimum carload 30 tons, f.o.b. Missouri:
Once ground:
Rose and cream colored, $16@$25.
White, $18@$27.
Double ground:
Rose and cream, $17@$25.
White, $19@$30.
Air-float:
Rose and cream, $25@$30.
White, $35.

Zircon—Freight allowed east of Mississippi River:
99 per cent, 6c. per lb., f.o.b. Florida.
Powdered, 7c. per lb., f.o.b. Florida.

Mineral Products

Arsenious Oxide (white arsenic)—5⅝c. per lb. delivered. Sales confined to occasional carloads.

Copper Sulphate—4⅜c. per lb.

Sodium Nitrate—$2.65 per 100 lb., ex vessel Atlantic ports.

Sodium Sulphate—$17@$19 per ton, New York.

Zinc Oxide—Per lb. in bags:
Lead free, 7⅝c.
5 per cent lead sulphate, 6⅝c.
10 to 35 per cent lead sulphate, 6⅜c.
French, red seal, 9⅝c.
French, green seal, 10⅝c.
French, white seal, 11⅝c.

Ferro-Alloys

[1]Ferrocerium—$7 per lb.

Ferrochrome—1 to 2 per cent carbon, 23c. per lb.; 4 to 6 per cent carbon, 11½c. per lb.

Ferromanganese—Domestic and foreign, 78@82 per cent, $115 per gross ton. Spiegeleisen, 19@21 per cent, $33 f.o.b. furnace; 16@19 per cent, $32.

Ferromolybdenum—$1.80 per lb. of contained molybdenum for 50 to 55 per cent grades.

Ferrosilicon—10 to 12 per cent, $39.50 @$44.50 per gross ton, f.o.b. works; 50 per cent, $85 delivered.

Ferrotitanium—For 15 to 18 per cent material, $200 per ton, f.o.b. Niagara Falls, N. Y.

Ferrotungsten—90c. per lb. of contained W, f.o.b. works. Quiet.

[1]Ferro-uranium—35 to 40 per cent U, $4.50 per lb. of U contained, f.o.b. works.

Ferrovanadium—$3.25@$4 per lb. of V contained, f.o.b. works.

Metal Products

Rolled Copper—Sheets, 23c.; wire, 17c.

Lead Sheets—Full lead sheets, 13⅜c. per lb.; cut lead sheets, 14c. in quantity, mill lots.

Nickel Silver—29½c. per lb. for 18 per cent nickel Grade A sheets.

Yellow Metal — Dimension sheets, 20⅝c. per lb.; rods, 17⅝c. per lb.

Zinc Sheets — 11c. per lb., f.o.b. works.

[1]Price furnished by Foote Mineral Co., Philadelphia.

Refractories

Bauxite Brick—$140@$145 per M., Pittsburgh, Pa.

Chrome Brick—$48@$50 per net ton, f.o.b. shipping point.

Firebrick—First quality, $43@$46 per M., Ohio, Kentucky, Central Pennsylvania; second quality, $36@$40.

Magnesite Brick — 9-in. straights, $65@$68 per net ton, f.o.b. works.

Magnesite Cement—$47@$50 per net ton, f.o.b. Chester, Pa.

Silica Brick—$40@$42 per M. Pennsylvania; $45@$47 Alabama.

Zirkite—Powdered, 80 per cent ZrO_2, 3c. per lb.; 70 per cent, 2½c. per lb. Brick, straights, 80c.@$1 each.

Steel Prices Advancing—Pig Iron Dull

Pittsburgh, Feb. 3, 1925

The steel industry is operating at nearly if not quite 90 per cent of capacity. In bars, shapes and plates an advance of $2 a ton became effective in the West a week ago and in the last week a 2.20c. price for the three products seems to have become established in the Pittsburgh market, representing $2 a ton advance on bars and shapes and $4 on plates.

About half the independent sheet mills have advanced prices $2 a ton, except on automobile sheets. The leading interest announced the advance on Jan. 30, but applying only to second quarter. A general advance of $2 a ton in wire products is practically completed, putting nails at $2.95. Contracts were previously made for the usual sixty-day period.

Pig Iron — The market is dull but moderately firm. Bessemer, $23; basic, $22; foundry, $22@$23, f.o.b. Valley furnaces.

Connellsville Coke — Spot furnace, $3.65@$3.75 on the basis of recent sales, with $4 in prospect. Spot foundry remains at $4.75@$5.25. As operators in the medium sulphur district did not follow in the recent wage advance, heating coke and smelter coke is likely to range at considerably below $4, with an unusual differential below standard blast furnace grade.

Katanga Copper Shares Attract Investors

The following article from the *Boston News Bureau* will interest many American investors in copper shares:

"Some significant buying of the shares of the Union Minière du Haut-Katanga Co., owning large mining interests in Africa, has recently taken place on the Brussels Stock Exchange. This buying has advanced the 260,000 capital shares to 5,355 francs each; the so-called dividend shares, of which 260,000 are issued, have advanced to 5,200 francs, and the "privilege" or preference shares, of which 100,000 are issued, have risen to 2,707 francs. With francs quoted at five cents, this gives an equivalent quotation of $265 for the capital shares, $260 for the dividend shares, and $135 for the preference shares.

The two largest owners in the Union Minière company are the Belgian Government and the Tanganyika Concessions, Ltd., of London. The Belgian Government owns 51,906 capital shares and 181,000 dividend shares. This probably represents practical control of the company. The Tanganyika Concessions owns 103,048 capital shares and 78,000 dividend shares.

"There are evidences that Americans have sought an interest in this great African copper enterprise, which is today producing at the rate of about 175,000,000 lb. of copper annually.

"The *Boston News Bureau's* Brussels correspondent recently stated: 'Your countrymen and other foreigners continue to purchase the shares of the Union Minière company and they are doing this on such a scale that the Belgian Government as well as the Belgian public view these heavy purchases with some anxiety.

" 'The Union Minière company has just started the working of its Kipushi mine, the ores of which run very high in copper values and also 2 kilograms of silver per ton. The Kipushi mine is situated 11 kilometers from the Lubumbashi smelters of the Union Minière company. It is very near the Congo Rhodesia border.

" 'The number of shares will soon be increased moderately. I hear the company is to issue 100,000 new preference shares and 4,000 each of new capital and new dividend shares. This matter will be determined shortly'."

Metal Statistics

Monthly Average Prices of Metals

Silver

	New York		London		Sterling Exchange	
	1924	1925	1924	1925	1924	1925
January	63.447	68.447	33.549	32.197	425.524	477.702
February	64.359	.....	33.565	.....	430.457	.....
March	63.957	.....	33.483	.....	428.769	.....
April	64.139	.....	33.065	.....	434.788	.....
May	65.524	.....	33.870	.....	435.716	.....
June	66.690	.....	34.758	.....	431.675	.....
July	67.159	.....	34.509	.....	436.649	.....
August	68.519	.....	34.213	.....	449.510	.....
September	69.350	.....	34.832	.....	445.740	.....
October	70.827	.....	35.387	.....	448.274	.....
November	69.299	.....	33.775	.....	460.543	.....
December	68.096	.....	32.620	.....	469.115	.....
Year	66.781	.....	33.969	.....	441.397	.....

New York quotations, cents per ounce troy, 999 fine, foreign silver. London, pence per ounce, sterling silver, 925 fine.

Copper

	New York		London			
	Electrolytic		Standard		Electrolytic	
	1924	1925	1924	1925	1924	1925
January	12.401	14.709	61.273	66.065	67.193	70.607
February	12.708	.....	63.113	.....	68.167	.....
March	13.515	.....	66.137	.....	72.087	.....
April	13.206	.....	64.338	.....	70.150	.....
May	12.772	.....	62.006	.....	67.648	.....
June	12.327	.....	61.375	.....	66.313	.....
July	12.390	.....	61.652	.....	65.815	.....
August	13.221	.....	63.481	.....	67.800	.....
September	12.917	.....	62.750	.....	67.125	.....
October	12.933	.....	62.641	.....	66.620	.....
November	13.635	.....	63.731	.....	68.063	.....
December	14.260	.....	65.295	.....	69.762	.....
Year	13.024	.....	63.149	.....	68.062	.....

New York quotations, cents per lb. London, pounds sterling per long ton.

Lead

	New York		St. Louis		London	
	1924	1925	1924	1925	1924	1925
January	7.972	10.169	8.002	9.953	31.528	41.443
February	8.554	.....	8.643	.....	34.589	.....
March	9.013	.....	8.891	.....	37.161	.....
April	8.263	.....	7.932	.....	32.819	.....
May	7.269	.....	6.973	.....	29.426	.....
June	7.020	.....	6.848	.....	32.138	.....
July	7.117	.....	6.886	.....	32.916	.....
August	7.827	.....	7.764	.....	32.728	.....
September	8.00	.....	7.876	.....	33.023	.....
October	8.235	.....	8.118	.....	35.715	.....
November	8.689	.....	8.590	.....	39.425	.....
December	9.207	.....	9.106	.....	41.583	.....
	8.097	.....	7.969	.....	34.421	.....

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

Tin

	New York				London	
	99%		Straits			
	1924	1925	1924	1925	1924	1925
January	48.250	57.692	48.750	58.250	246.790	265.560
February	52.772	.....	53.272	.....	272.399	.....
March	54.370	.....	54.870	.....	277.429	.....
April	49.457	.....	49.957	.....	250.863	.....
May	43.611	.....	44.111	.....	218.511	.....
June	42.265	.....	42.765	.....	219.219	.....
July	45.750	.....	46.250	.....	233.332	.....
August	51.409	.....	51.909	.....	254.638	.....
September	48.595	.....	49.095	.....	243.511	.....
October	50.038	.....	50.538	.....	248.543	.....
November	53.848	.....	54.348	.....	257.738	.....
December	55.721	.....	56.245	.....	261.875	.....
Year	49.674	.....	50.176	.....	248.737	.....

New York quotations, cents per lb. London, pounds sterling per long ton.

Zinc

	St. Louis		London	
	1924	1925	1924	1925
January	6.426	7.738	34.761	37.917
February	6.756	.....	36.518	.....
March	6.488	.....	35.298	.....
April	6.121	.....	32.588	.....
May	5.793	.....	30.648	.....
June	5.792	.....	31.788	.....
July	5.898	.....	32.193	.....
August	6.175	.....	32.544	.....
September	6.181	.....	32.926	.....
October	6.324	.....	33.514	.....
November	6.796	.....	35.022	.....
December	7.374	.....	36.932	.....
Year	6.344	.....	33.728	.....

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

Antimony, Quicksilver and Platinum

	Antimony (a) New York		Quicksilver (b) New York		Platinum (c) Refined New York		Platinum (c) Crude New York	
	1924	1925	1924	1925	1924	1925	1924	1925
January	10.279	17.428	59.500	81.596	122.115	117.00	111.663	
February	10.935	.....	59.565	.....	124.739	.....	.....	
March	11.442	.....	64.269	.....	121.692	.....	.....	
April	9.952	.....	74.308	.....	115.577	.....	.....	
May	8.755	.....	76.962	.....	115.731	.....	.....	
June	8.403	.....	73.720	.....	116.000	.....	.....	
July	8.477	.....	72.173	.....	118.231	.....	.....	
August	9.839	.....	72.096	.....	120.000	.....	.....	
September	11.022	.....	72.423	.....	118.923	.....	.....	
October	11.519	.....	70.654	.....	118.000	.....	.....	
November	14.385	.....	68.708	.....	117.792	.....	.....	
December	15.024	.....	72.750	.....	117.000	.....	.....	
Year	10.836	.....	69.761	.....	118.817	.....	.....	

(a) Antimony quotations in cents per lb. for ordinary brands. (b) Quicksilver in dollars per flask. (c) Platinum in dollars per ounce.

Pig Iron, Pittsburgh

	Bessemer		Basic		No. 2 Foundry	
	1924	1925	1924	1925	1924	1925
January	24.76	24.66	23.76	23.76	23.88	23.76
February	25.26	.....	23.76	.....	25.06	.....
March	25.14	.....	23.76	.....	24.76	.....
April	24.56	.....	23.26	.....	23.80	.....
May	23.89	.....	22.08	.....	22.91	.....
June	22.90	.....	21.49	.....	21.48	.....
July	21.90	.....	20.76	.....	20.76	.....
August	21.76	.....	20.76	.....	20.99	.....
September	21.76	.....	20.76	.....	21.68	.....
October	21.76	.....	20.26	.....	21.26	.....
November	22.08	.....	21.44	.....	21.17	.....
December	23.65	.....	22.04	.....	22.86	.....
Year	23.28	.....	22.01	.....	22.55	.....

In dollars per long ton.

Monthly Crude Copper Production

Domestic

	1924			
	September	October	November	December
Alaska shipments	3,602,468	11,651,471	8,902,042	6,633,986
Calumet & Arizona	3,448,000	4,444,000	4,028,000	3,650,000
Miami	4,099,000	4,895,000	4,732,000	4,699,547
New Cornelia	5,096,158	5,069,899	5,703,506	6,713,520
Old Dominion	2,495,000	3,004,000	2,937,000	2,956,000
Phelps Dodge	11,958,000	13,156,156	12,260,000	12,242,000
United Verde Extension	5,268,896	3,539,538	3,136,660	3,687,440
A.S. & R. & Tenn. Copper	14,750,000	13,500,000	11,750,000	15,500,000
Imports: Ore and concentrates, matte	11,759,019	4,127,986	19,703,976	15,080,051
Partly from				
Chile	5,939,411	.....	.....	.....
Cuba	2,560,000	.....	.....	.....
Canada	319,724	.....	.....	.....
Mexico	1,800,113	.....	.....	.....
Imports of black and blister, unrefined	27,024,684	33,852,068	48,686,075	37,707,825
Partly from				
Chile	8,022,886	.....	.....	.....
Peru	3,824,548	.....	.....	.....
Africa	6,141,793	.....	.....	.....
Mexico	4,512,257	.....	.....	.....
Imports of refined and old	15,216,096	7,055,806	17,030,588	9,905,642

Foreign

Boleo, Mexico	1,433,148	1,572,165	1,552,320	1,551,769
Falcon Mines, Rhodesia	479,200	.....	419,400	425,200
Furukawa, Japan	3,936,792	3,494,394	2,446,745	.....
Cons. M & S., Canada	270,380	.....	.....	.....
Granby Cons., Canada	1,508,786	2,312,348	3,006,550	.....
Katanga, Africa	17,293,815	16,638,930	17,386,152	17,221,050
Mount Morgan, Aust	904,000	.....	498,000	544,000
Mount Lyell, Aust	786,000	1,066,000	.....	.....
Phelps Dodge, Mexican	3,792,000	3,487,000	3,712,000	3,226,000
Sumitomo, Japan	3,350,001	2,997,801	2,911,254	2,274,146

Comparative U. S. Copper Mine Production

	1921	1922	1923	1924
January	90,596,597	32,010,292	112,267,000	133,356,000
February	86,682,941	45,957,530	102,725,000	128,260,000
March	91,046,345	55,705,760	121,562,000	129,816,000
April	46,946,523	76,601,000	118,157,000	131,928,000
May	25,310,511	88,714,000	125,438,000	130,644,000
June	24,623,693	93,740,000	125,479,000	127,506,000
July	22,033,739	91,000,000	125,249,000	129,574,000
August	23,248,398	101,188,000	131,088,000	133,512,000
September	23,855,316	96,408,000	124,523,000	126,346,000
October	23,231,572	103,273,000	132,481,000	137,924,000
November	28,341,442	102,845,000	127,963,000	136,626,000
December	26,629,137	103,003,000	129,354,000	136,244,000

Mining Stocks

Week Ended January 31, 1925

Stock	Exch.	High	Low	Last		Last Div.
COPPER						
Alaska-Br. Col.	N. Y. Curb			*6		
Anaconda	New York	45½	43½	44¼	Ja.17, Fe.16,	0.75
Arcadian Consol.	Boston	2⅜	2⅛	2⅛		
Ariz. Com'l.	Boston	13⅛	12⅛	13⅛	Ja. 19, Ja. 31	0.50
Calaveras	N. Y. Curb	1⅜	1⅛	1⅛		
Calumet & Arizona	New York	56¼	54½	56⅜	De.5, De.22 Q	0.50
Calumet & Hecla	Boston	17⅜	17	17⅛	Ja.30, Mh.4	0.50
Canario Copper	N. Y. Curb	4⅞	3⅜	4		
Cerro de Pasco	New York	54¼	52½	53⅞	Ja. 22, Fe. 2, Q	1.00
Chile Copper	New York	37	35¼	37	Mh.3,Mh.20, Q	0.62½
Chino	New York	25½	24½	25½	Sept., 1920	0.37½
Con. Coppermines	N. Y. Curb	3¼	3 1/16	3⅛		
Copper Range	Boston	30	27	30	May, 1924	1.00
Crystal Copper	Boston Curb	*72	*60	*70		
Davis-Daly	Boston	*65	*65	*65	Mar., 1920	0.25
East Butte	Boston	5	4⅜	4⅜	Dec., 1919	0.50
First National	Boston Curb	*30	*26	*28	Feb., 1919	0.15
Franklin	Boston	1⅛	1	1		
Gadsden Copper	Boston Curb	*80	*76	*76		
Granby Consol.	New York	20	18	20	May, 1919	1.25
Greene-Cananea	New York	18⅛	17	18⅛	Nov., 1920	0.50
Hancock	Boston	†1⅛				
Howe Sound	N. Y. Curb	3⅛	3⅛	3⅛	April 1924	0.05
Inspiration Consl.	New York	30⅜	28⅛	30⅛	De.20, Ja.7, Q	0.50
Iron Cap	Boston Curb	2⅛	1⅞	1⅞	May, 1923	0.15
Isle Royale	Boston	18	17	18	Sept. 1923	0.50
Jerome Verde Dev.	N. Y. Curb	1⅛	1	1⅛		
Kennecott	New York	55⅝	53⅜	55⅜	De.2, Ja.2, Q	0.75
Keweenaw	Boston			*99		
Lake Copper	Boston	2⅜	2⅛	2⅛		
Magma Copper	New York	42½	40½	42	Jan., 1919	0.50
Mason Valley	N. Y. Curb	2⅜	2⅛	2⅛		
Mass Consolidated	Boston	1	*90	*90	Nov., 1917	1.00
Miami Copper	New York	23⅜	23	23⅜	Fe.2 Fe.16 Q	0.50
Mohawk	Boston	38	36⅛	38	Ja. 13, Mh. 2	1.00
Mother Lode Coa.	New York	8⅜	8⅛	8⅛	De. 12, De. 31	0.37½
Nevada Consol.	New York	15⅜	14½	15½	Sept., 1920	0.25
New Cornelia	Boston	23	22⅛	22½	Fe. 6, Fe. 23	0.25
New Dominion	N. Y. Curb			2⅜		
North Butte	Boston	3	2⅜	3	Oct., 1918	0.25
Ohio Copper	N. Y. Curb	1⅛	1 1/16	1⅛	No.14, De.2	0.05
Old Dominion	Boston	25	24	25	Dec., 1918	1.00
Phelps Dodge	Open Mar.	†130	†123		De.2, Ja.2 Q	1.00
Quincy	Boston	34	30½	33½	Mar., 1920	1.00
Ray Consolidated	New York	15⅛	14⅛	15⅛	Dec., 1920	0.25
Ray Hercules	N. Y. Curb	*11	*10	*11		
St. Mary's Min. Ld.	Boston	45⅛	40½	45⅛	May 1924	3.00
Seneca Copper	New York	1	*25	*25		
Shannon	Boston	1⅛	1 1/16	1 1/16	Nov., 1917	0.25
Shattuck Arizona	New York	7	6⅛	6⅛	Jan., 1920	0.25
Superior & Boston	Boston	1⅛	1⅛	1⅛		
Tenn. C. & C.	New York	9⅛	8⅝	9⅛	De.31, Ja.15,Q	0.25
United Verde Ex.	N. Y. Curb	27⅛	27	27⅛	Ja. 2, Fe. 2	0.50
Utah Copper	New York	90	89	90	De.12, De.31,Q	1.00
Utah Metal & T.	Boston	*96	*69	*88	Dec., 1917	0.30
Victoria	Boston	1	*90	1		
Walker Mining	N. Y. Curb	3 1/16	3 1/16	3 1/16		
Winona	Boston	*26	*15	*20		
NICKEL-COPPER						
Internat. Nickel	New York	28⅛	25⅛	28	March, 1919	0.50
Internat. Nickel pfd.	New York	97⅛	97⅛	97⅛	Ja. 15, Fe. 2, Q	1.50
LEAD						
Carnegie Lead & Zinc	Pittsburgh	7	6	6⅛		
National Lead	New York	159⅞	156	158⅛	De.12, De.31, Q	2.00
National Lead pfd.	New York	117⅛	116⅜	117⅛	Fe.2, Mh.14, Q	1.75
St. Joseph Lead	New York	44⅛	42⅛	43⅜	De. 9, De. 20	0.50
ZINC						
Am. Z. L. & S.	New York	10⅛	10⅛	10⅛	May, 1920	1.00
Am. Z. L. & S. pfd.	New York	35	32⅛	34	Nov., 1920	1.50
Butte C. & Z.	New York	8⅛	7	8⅛	De.10, De.24	0.50
Butte & Superior	New York	21⅛	18⅛	20⅞	June, 1923	0.50
Callahan Zn-Ld	New York	4	3⅛	3⅞	Dec., 1920	0.50
New Jersey Zn.	N. Y. Curb	193⅛	190⅛	193	Ja.20, Fe.10	2.00
United Zinc	N. Y. Curb			*15		
Yellow Pine	Los Angeles	*75	*68	*68	De.10,De.15 Q	0.04
SILVER						
Alvarado	Boston Curb			1⅛	Oct. 1920	0.50
Beaver Consol.	Toronto	*31⅛	*30	*31⅛	May, 1920	0.03
Castle-Trethewey	Toronto	*74	*72	*72⅛		
Coniagas	Toronto	2.28	2.17	2.27	May, 1924	0.12½
Keeley	Toronto	2.16	2.13	2.14	Fe.28, Mh.15	0.08
Kerr Lake	N. Y. Curb	1⅛	1⅛	1⅛	Oc. 1, Oc. 15,	0.12½
La Rose	Toronto	*31½	*26½	*28½	Apr., 1922	0.10½
Lorrain Trout Lake	Toronto	1.30	1.28	1.29		
McKinley-Dar.-Sav.	Toronto	*18	*17	*17½	Oct., 1920	0.03
Mining Corp. Can.	Toronto	2.80	2.60	2.70	Sept., 1919	0.12½
Nipissing	N. Y. Curb	6⅜	6⅛	6⅛	Ja.18,Ja.20,QX	0.30
Ontario Silver	New York			5⅜	Jan., 1919	0.50
Temiskaming	Toronto	*24	*24	*24	Jan., 1920	0.40
GOLD						
Alaska Gold	New York			*25		
Alaska Juneau	New York	1	1	1		
Argonaut	Toronto	*35½	*33⅛	*35		
Carson Hill	Boston	*50	*50	*50		
Consol. W. Dome L.	Toronto	*17⅛	*16⅛	*17⅛		
Cresson Consol. G.	N. Y. Curb	3⅛	3⅛	3 1/16	De.31, Ja.10 Q	0.10
Crown Reserve	Toronto	*51⅛	*49⅛	*50	Jan. 1917	0.05
Dome Mines	New York	15⅞	15⅛	15½	De.31, Ja.20, Q	0.50
Golden Cycle	Colo. Springs	1.40	1.40	1.40	Dec.11, 1924	0.03
Hollinger Consol.	Toronto	14.65	14.45	14.60	Fe.9, Fe.26, M	0.05
Homestake Mining	New York	46⅛	44⅞	45	Ja.20,Ja.25,MX	1.50
Jib. Consol.	N.Y. Curb	*45	*35	*40		
Kirkland Lake	Toronto	*42	*40	*41⅛		
Lake Shore	Toronto	4.90	4.80	4.85	De.1, De.15,XQ,	0.10
McIntyre-Porcupine	New York	17	16⅜	17	Fe.2, Mh.2,	0.25
Newray	Toronto	*26	*25	*25⅛		
Night Hawk Pen.	Toronto	*29½	*28	*28		
Portland	Colo. Springs	*44	*44	*44	Oct., 1920	0.01
Rand Mines	New York			35⅜	Aug. 1924	1.71
Teck-Hughes	Toronto	1.33	1.28	1.31		
Tom Reed	Los Angeles	*57½	*43	*57½	Dec., 1919	0.02
Tough-Oakes	Toronto	*38½	*36	*38		
United Eastern	N. Y. Curb	*60	*50	*53	July, 1924	0.05
Vipond Cons.	Toronto	1.33	1.30	1.31		
Wright-Hargreaves	Toronto	4.28	4.20	4.25	De.15, Ja.2,QX	0.05
GOLD AND SILVER						
Black Oak	N. Y. Curb			*81		
Con. Cortez	N. Y. Curb	*10	*10	*10		
Con. Virginia	San Francisco	7	5½	6		
Continental Mines	N. Y. Curb			1¼		
Dolores Esperanza	N. Y. Curb	*50	*35	*35	July, 1923	0.05
Premier Gold	N. Y. Curb	2½	2	2⅛	De.22, Ja.5,QX	0.10
Tonopah Belmont	N. Y. Curb	*59	*58	*58	Apr., 1923	0.05
Tonopah Divide	N. Y. Curb	*39	*35	*38	Se. 22, Oc. 10	0.10
Tonopah Extension	N. Y. Curb	3	2 1/16	3	De.11, Ja.1	0.05
Tonopah Mining	N. Y. Curb	1⅞	1⅞	1⅞	Fe., Mh., '24	0.57½
Unity Gold	N. Y. Curb	*75	*70	*70		
West End Consol.	N. Y. Curb			*46	Mar., 1923	0.05
Yukon Gold	N. Y. Curb			*45	June, 1918	0.02
SILVER-LEAD						
Ahumada	Boston Curb	11	9	10½	De.15, Ja.2, X	0.15
Bingham Mines	Boston	33½	32⅛	32⅞	De.20, Ja.2	0.50
Cardiff M. & M.	Salt Lake			1.15	De.16, No.18	0.10
Chief Consol.	Boston Curb	3⅜	2⅜	2⅜	May, 1924	0.10
Columbus Rexall	Salt Lake	*25	*24½	*25	Aug., 1923	0.05
Daly Mining	Salt Lake			1.50	July, 1920	0.10
Erupcion	Boston Curb	3	2⅞	3	De.15, Ja.2, X	0.15
Federal M. & S.	New York	23	20⅛	23	Jan., 1909	1.50
Federal M. & S. pfd.	New York	62	60⅛	60⅛	No.25, De.15,	1.75
Florence Silver	Spokane	*3⅜	*3⅛	*3⅛	Apr., 1919, QX	0.01
Hecla Mining	N. Y. Curb	14⅛	13⅞	14	No.15, De.15	0.25
Iron Blossom Con.	N. Y. Curb			*29	Oc.25, 1924	0.02½
Marsh Mines	N. Y. Curb			*6	June, 1921	0.02½
Park City	Salt Lake	4.95	4.90	4.95	De. 15, Ja. 2	0.15
Park Utah	Salt Lake			3½	April, 1924	0.15
Prince Consol.	Salt Lake	*34	*29½	*33½		
Silver King Coal	Salt Lake	5.75	5.75	5.75	De.20, Ja 2, Q	0.20
Silversmith	Spokane	*32	*30	*30	Ja. 1, Ja. 10	0.02
Tamarack-Custer	Spokane	*88	*80	*80	Se. 22, Se. 29	0.25
Tintic Standard	Salt Lake	9.40	9.25	9.25	Ja.2, QX	0.50
Utah-Apex	Boston	8	5⅛	6⅜	Ja.10, Ja.15,	0.25
IRON						
Bethlehem Steel	New York	52	50½	51	Jn.1, Jy.1, Q	1.25
Char. Iron	Detroit			*20		
Char. Iron pfd	Detroit			*74		
Colorado Fuel & Iron	New York	46⅞	42⅜	45⅛	May, 1921	0.75
Gt. North'n Iron Ore	New York	40⅜	38⅛	38⅞	De.10, De.27	2.00
Inland Steel	New York	45⅞	46	48⅛	Fe.14, Mh.20 Q	0.625
Mesabi Iron	N. Y. Curb	4⅛	4	4		
Replogle Steel	New York	20⅜	19⅛	19⅜		
Republic I. & S.	New York	59⅞	57⅛	57⅛	May, 1921	1.50
Republic I. & S. pfd.	New York	93⅞	93	93⅞	Mh.8, Ap.1, Q	1.75
Sloss-Sheffield S. & I.	New York	86⅜	85	86⅛	Mh.10, Mh.20	Q1.50
Sloss-Shef. S.&I. pfd.	New York	96⅛	96⅛	96⅛	Mh.20, Ap.2, Q	1.75
U. S. Steel	New York	128⅜	125⅞	126⅛	Fe.28,Mh.30,QX	1.75
U. S. Steel pfd.	New York	126⅜	124	124	Fe.1, Fe.27, Q	1.75
Virginia I. C. & C.	New York	40⅞	40⅛	40⅛	De.15, Ja.2	1.50
Virginia I.C.&C.pfd.	New York	79	79	79	De. 13, Ja. 2, Q	2.50
VANADIUM						
Vanadium Corp.	New York	29⅛	27⅛	28⅛	Jan., 1921	1.00
ARSENIC						
Western Utah Copper	N. Y. Curb	*20	*20	*20		
ASBESTOS						
Asbestos Corp.	Montreal	47⅛	40⅞	41	Fe.1, Fe.15 Q	2.00
Asbestos Corp. pfd.	Montreal	80	75⅛	80	Ja.2, Ja.15, Q	1.50
SULPHUR						
Freeport Texas	New York	11	9⅞	10⅞	Nov., 1919	1.00
Texas Gulf	New York	107⅞	103½	104⅛	De.1,De.15, QX	2.25
DIAMONDS						
De Beers Consol.	New York	24⅛	23	24⅛	Ja.6, Fe.2	0.95
PLATINUM						
So. Am. Gold & P.	N. Y. Curb	3⅛	3	3⅛		
MINING, SMELTING AND REFINING						
Amer. Metal	New York	51⅛	49⅜	50¼	Fe.18, Mh.2 Q	0.75
Amer. Metal pfd.	New York	115	115	115	Fe.19, Mh.2, Q	1.75
Amer. Sm. & Ref.	New York	100⅜	96⅞	100	Ja.16, Fe.2, Q	1.50
Amer.Sm.&Ref.pfd.	New York	110⅜	109½	109½	Fe.6, Mh.2 Q	1.75
Consol. M. & S.	Montreal	68	63⅜	64	De.11, Ja.15 SA	0.75
Federated Metals	N. Y. Curb			37½		
Southwest Metals	N. Y. Curb			2		
U. S. Sm. R. & M.	New York	36⅜	34⅛	36⅛	Jan., 1921	0.50
U.S. Sm. R.&M.pfd.	New York	46	45½	45⅛	Ja.8, Ja.15	0.87½

* Cents per share. † Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. K, Irregular. I, Initial. X, Includes extra. The first date given is that of the closing of the books; the second that of the payment of the dividend.

Boston quotations courtesy Boston Stock Exchange; Toronto quotations those of the Standard Stock Exchange of Toronto, by courtesy of Arthur E. Moysey & Co.; Spokane, Pohlman Investment Co.; Salt Lake, Stock and Mining Exchange; Colorado Springs, Colorado Springs Stock Exchange.