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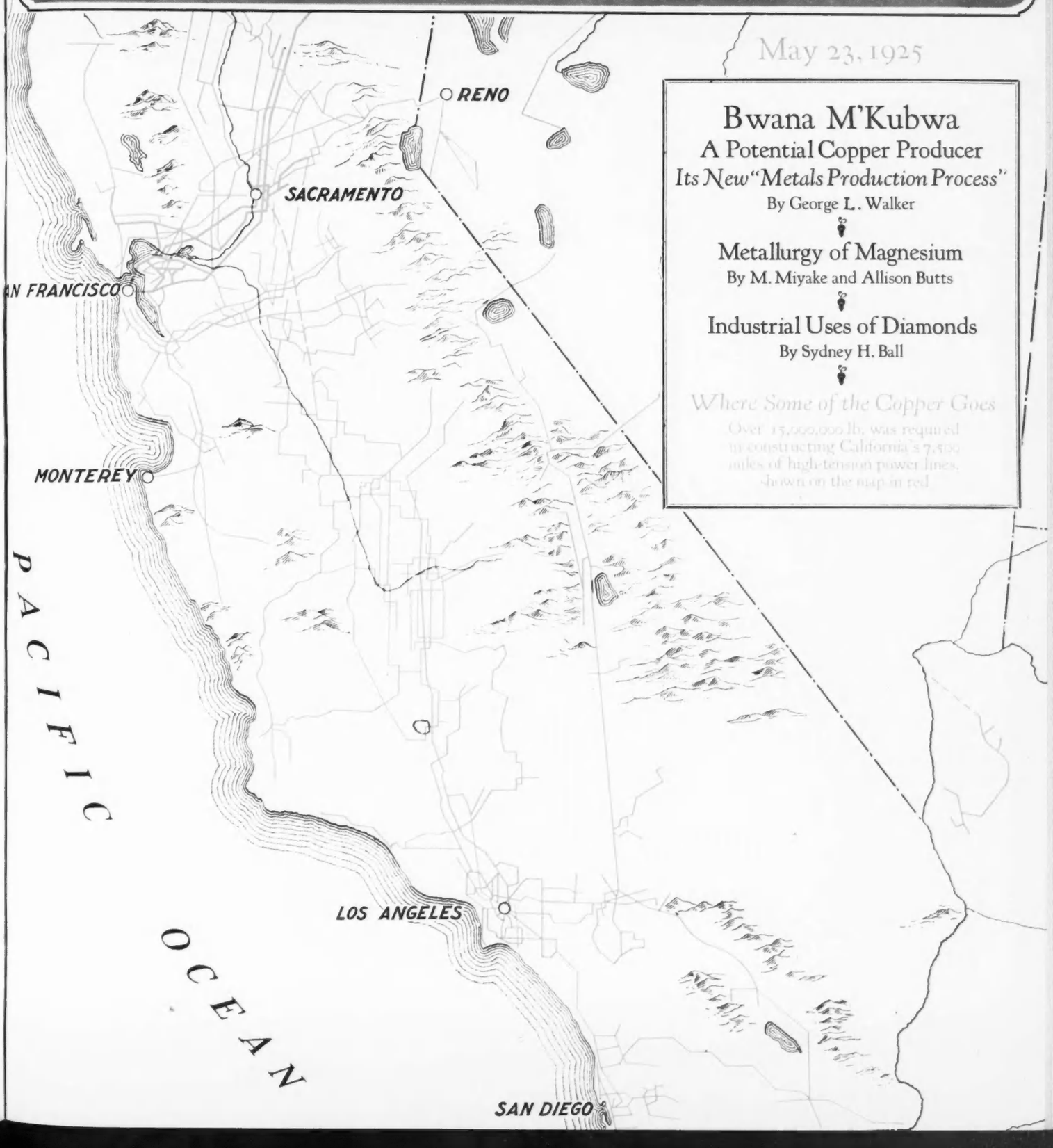
ENGINEERING AND MINING JOURNAL-PRESS

A CONSOLIDATION OF ENGINEERING AND MINING JOURNAL AND MINING AND SCIENTIFIC PRESS

May 23, 1925



Bwana M'Kubwa

A Potential Copper Producer

Its New "Metals Production Process"

By George L. Walker

Metallurgy of Magnesium

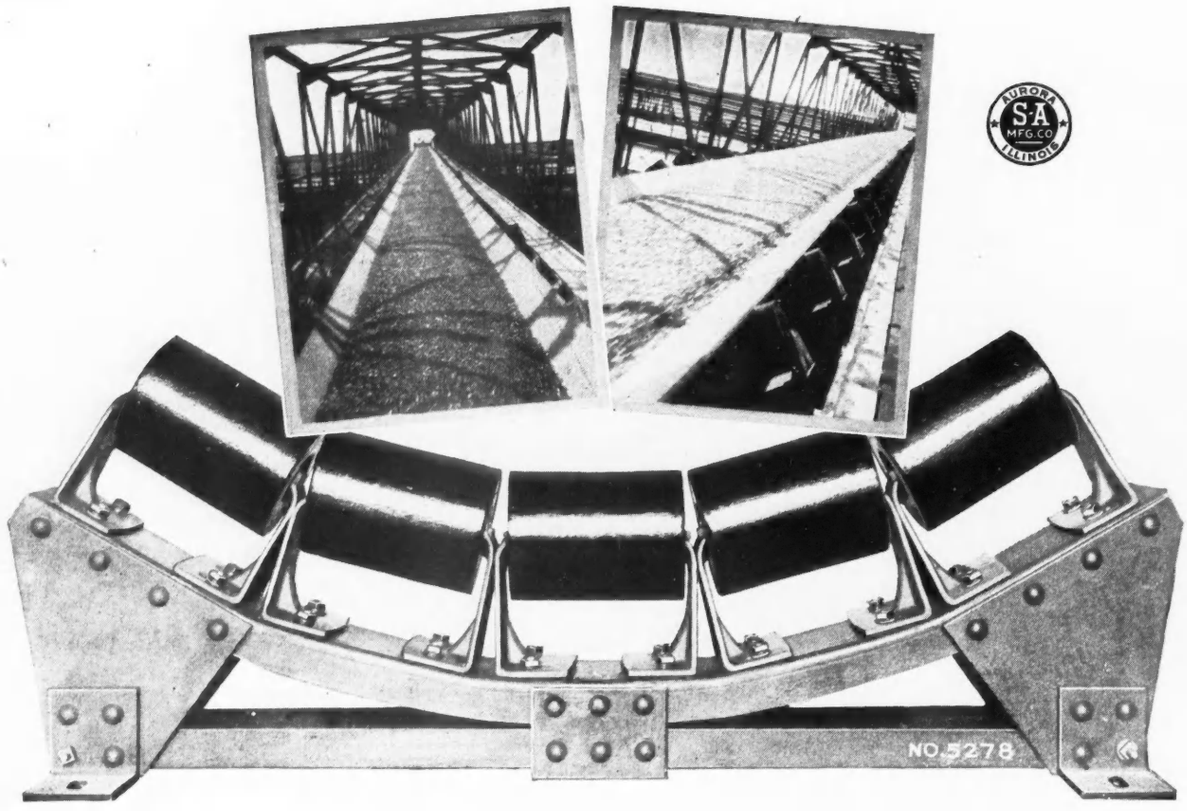
By M. Miyake and Allison Butts

Industrial Uses of Diamonds

By Sydney H. Ball

Where Some of the Copper Goes

Over 15,000,000 lb. was required in constructing California's 7,500 miles of high-tension power lines, shown on the map in red



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ENGINEERING AND
MINING JOURNAL-PRESS

JOSIAH EDWARD SPURR, Editor

Volume 119 | New York, May 23, 1925 | *Number* 21

Concentration of American Industry

STATISTICS compiled by the staff of *Engineering and Mining Journal-Press* have divided mining enterprises in the United States into four groups: (a) those producing metals or minerals to the value of over $1,000,000 annually; (b) those producing between $100,000 and $1,000,000; (c) those producing between $20,000 and $100,000; (d) those producing less than $20,000. The figures of the 1920 census were used as a basis. Numerically, Group (a) comprises 2.2 per cent of the whole; Group (b) 17.3 per cent; Group (c) 23.5 per cent, and Group (d) 56.9 per cent. As to the total volue of production, Group (a), however, produces 53.5 per cent; Group (b) 36.6 per cent; Group (c) 7.5 per cent; and Group (d) 2.4 per cent. These figures present a striking picture, showing that the lion's share of mining production is borne by a relatively small number of large producers. The actual number in Class (a), for example, shown by our compilations, is the astonishingly small figure of 193.

Is this tendency peculiar to mining, or is it characteristic of other industries? It is wholesome and necessary continually to compare our own industries with others which are representative, to ascertain if mining is out of line, or if it is being borne on as part of a larger movement. If the former, we are justified in attempting to adjust it by special efforts and devices; if the latter, it means that we are involved in a tidal flow which it is impossible for us to buck alone. In this connection a statistical study recently made by the National Industrial Conference Board is of interest. The study concerns the manufacturing establishments of the United States as enumerated in the 1920 census. Of the total number of plants covered by the census, 3.7 per cent turned out 59 per cent of all the manufactured goods, totaling over $43,000,000,000 in value. Comparing, now, the basis of employees, and not of product, it is found that 32 per cent of all industrial workers (manufacturing workers) are employed by 1 per cent of the plants, this 1 per cent constituting the group each unit of which has over 500 wage earners on the payroll; and it is even true that the 0.3 per cent ($\frac{3}{10}$ of 1 per cent) of all manufacturing plants which employ more than 1,000 each have working for them nearly one-fifth (19.7 per cent) of all wage earners in these industries. On the other hand, the great numerical majority—93.2 per cent—of all manufacturing plants, employ 100 or less workers each.

The figures above cited for the manufacturing industries also show that corporate management is on the increase. In 1919, 86.5 per cent of all wage earners in factories were working under corporate management, as against 70.6 per cent in 1904; and the value of manufactured products turned out by corporations was 87.7 per cent in 1919, as compared with 73.7 per cent in 1904.

The situation and tendencies both for mining and for manufacturing are even more pronounced than the figures indicate, for, in the census figures, each plant having an individual manager is usually counted as a separate unit, whether owned jointly with some other plant or not.

It therefore appears that the grouping tendencies in mining are part of a larger trend which affects all American business. This tendency will be regarded with different feelings by different parties. On the one hand, the advocate of individualism, of unlimited competition and opportunity, will regret the tendency; on the other hand, the advocates of efficiency, of "elimination of waste," of being geared to compete in foreign markets with foreign industries, will point out the economic advantages of consolidation and organization.

Distribution of *Mining Journal-Press* Circulation

IN THE PRECEDING EDITORIAL is was pointed out that a relatively small number of mining enterprises in the United States turns out the great bulk of production; and the producing units were divided into four groups, in accordance with the production of each. The consolidation of many small operating units in one operation undoubtedly means, in most cases, more efficient and more economical operation; and this is the underlying, governing motive in this development. The tendency is one which is naturally deplored by the majority of mining engineers, for in the consolidation of units and the replacement of many small operating organizations by larger ones, one of the features of "elimination of waste" is the elimination of many experienced and capable engineers and operators, who find themselves out of a job. Moreover, there is no haven for them in consulting, for the field of the independent consulting engineer has been correspondingly shrunk.

The manufacturer of mining machinery, on the other hand, finds the situation convenient, for, withal, the tonnage of ore and metal produced is constantly rising, and the concentration of large producing units renders his marketing problem simpler. The mining journal, from a selfish standpoint does not view this trend with enthusiasm, for the apparent result is to limit the practicable circulation and circumscribe its growth. Nevertheless, one interesting fact concerning the circulation of the *Mining Journal-Press* comes out of the statistics. A test survey was made in a typical mining region to show the distribution of circulation. In Group (a), the group having the largest production, it was estimated that *Mining Journal-Press* has several subscribers to each unit; while in Group (d), the group representing the smallest units, there is only one subscriber for each two or three operations. It would be easy to take this fact as a text for an admonishment for small operators to subscribe to the *Mining Journal-Press*, if they would have their hearts' desire and step into the larger producing group. There must be, in-

deed, some connection between men who are not interested or who are not sufficiently intelligent to be alive to the technique, news, and economics of their industry, and the fact that the properties which they are conducting are small and struggling. Economy alone does not account for it. The program of the "elimination of waste" by the larger producers includes additional subscriptions to *Mining Journal-Press*.

Zinc Miners and Smelters Air Their Views

MEMBERS of the American Zinc Institute had a splendid opportunity to discuss the divergent viewpoints of miners and smelters at the recent annual meeting in St. Louis. As our readers know, considerable friction exists between these two important groups of the zinc industry in the Middle West, owing principally to the manner in which the zinc is produced and sold. The Joplin zinc market is the only one in the world, so far as we know, that has a separate and distinct market for concentrates and a market which fluctuates weekly in sympathy with the price of the virgin metal. Platteville is closely allied with Joplin, and for all practical purposes may be considered as part of the great Middle Western zinc market. Mutual distrust of the two groups was much more intensified in the past, but the good work of the American Zinc Institute has done much to calm this spirit. Not satisfied with the progress made, the Institute is bending further efforts to iron out the differences of miner and smelter.

We have long felt that part of the miner's suspicion of the smelter lay in the latter's superior knowledge of the zinc market—its machinery and the forces that drive it. The smelter in selling its product deals with a huge market, with a world commodity that is sold in every civilized country. The Joplin miner deals with a commodity that is chiefly sold locally. His concentrates command a price dependent mainly upon the price of slab zinc. Naturally, the miner cannot be so closely in touch with business conditions affecting the slab zinc market as is the smelter. This may lead the miner to feel that he is somewhat at the mercy of the smelter, in that the smelter can play a greater rôle than he, in deciding what prices shall be. This is true, however, to only a very small extent. The smelters do not make the market alone. Galvanizers, brokers and dealers, brass manufacturers, and others also have a most important part to play, equally as important as the producers.

Ordinarily there is keen competition in the slab-zinc market—keener than the average miner realizes, and keener than producers often care to have it. Moreover, the market constantly receives the attention of speculators both in the United States and Europe—especially in Europe. The speculative element is present in all raw-material markets, from wheat to copper, and it cannot be eliminated. Most authorities agree that intelligent speculation has a useful function to perform and that it tends to narrow the fluctuations in the price of a raw material. The slab-zinc market is uncontrolled by any company, and anyone trying to manipulate prices in disregard of fundamental conditions would be foolhardy. It would help the miner greatly in obtaining a better picture of the zinc market were he to engage in the selling of the metal and to take the risks that are associated with that task.

In the present controversy between miner and smelter one often hears the complaint that at a certain price for ore the miners cannot make both ends meet—the price being below the cost of production. Smelters have often made the same complaint, and it is a common grievance of all industries. Wouldn't it be wonderful if any producer of the metals could regulate the price he was to receive for his product by his cost of production? But our present economic structure is not based upon this principle and very wisely. Once a commodity is produced, cost of production is not the governing factor in its sales price. Cost of production is a subordinate item to the amount of product for sale, and the demand for the product. Our old friends supply and demand are the ones who determine market prices. No matter what the slab zinc price is, there are always a few producers who complain that the price of the metal is below the cost of production. This is true of a 5c. as well as a 10c. zinc market.

A cure for the present reciprocal unrest of miners and smelters might lie in the greater participation of these groups in each other's field. We know of at least one great smelting company that had a costly experience in mining zinc ores in the last few years. Such might also be the outcome of a joint venture on the part of the miners in the smelting business. One thing is sure: each group will have a greater respect for the position of the other after these experiences.

Probably the distrust between the two parties cannot be entirely removed, no more so than it can between the buyer and seller of any metal product. Lead producers are at the moment under surveillance because one consumer felt the price of lead was unjustifiably high.

The American Zinc Institute is courageous in trying to clear up the atmosphere from the inside and trying to soften the intensity of the feeling. Deliberations of the committee appointed by the Institute will help. So will the dissemination of accurate information about the economics of the zinc market and the economic laws that govern prices in all markets.

Curtailing Copper Production

AS HAS BEEN so often the case since the resumption of copper mining in 1922, a spasm of talking curtailment is agitating the industry. We say "talking," because experience has frequently been that the procedure of cutting production progressed little farther than that stage. Anaconda, through a "spokesman" at 25 Broadway, has "let it be known" that its production in the United States will be cut by 5,000,000 lb. and in Chile by 2,500,000. No formal announcement to this effect has been made, but when the vice-president in charge of operations at Butte contradicted published reports, reaffirmation came from the spokesman. The assumption is that a material cut will be made at Butte, at Inspiration, and at Chuquicamata.

One feature of the report that surprised many was the statement that Anaconda recently has been producing 25,000,000 lb. per month in Montana. Even though this was smelter production, and included metal from Butte & Superior and other small shippers, the Anaconda mines have been operated at much nearer maximum capacity than are those of various other producers, notably the Jackling porphyry properties. Utah Copper, for example, has produced about 18,000,000 monthly during the past year including the first quarter of 1925, although 22,500,000 or more doubtless could be made. When the report of the contemplated curtailment was

broadcast in Wall Street the financial papers hailed Anaconda as again showing its dominant position as leader of the industry. Apparently, however, if Anaconda's lead had been followed in the first quarter of 1925 the March production for the United States would have exceeded the 150,766,000 lb. that it actually reached.

Rumors have it that Phelps Dodge, Calumet & Arizona, Calumet & Hecla and others may curtail; but no one in authority seems ready to say that production will be cut materially.

The Soviet Seeks an Education

LACK OF CONTINUOUS CONTACT between scientists, scientific institutions, and cultural organizations of the United States and the Union of Soviet Republics has been felt for many years in both countries, says a recent press bulletin of the so-called Russian Information Bureau, of Washington, D. C. Since the war, it says, there has been practically no mutual exchange of scientific publications, with the result that the institutions and organizations concerned have been unable to form any comprehensive idea of their mutual activities and achievements.

This statement is only partly true. There has indeed been lack of contact for a number of years, but that it has been felt save by Russians is rather doubtful. Whether right or wrong, the opinion has prevailed, in the United States at least, that the Russians have had little to offer of an intellectual nature since their affairs became disordered and intellect unfashionable. It is unfortunate that so few Americans, even among university graduates, can read the Russian tongue; else they might judge for themselves the value of what the occasional publications that reach this side contain. In the absence of first-hand information, the statements of Soviet agencies, here and elsewhere, have gone discredited and ignored.

In the present case, the Joint Information Bureau in Moscow, for which the Washington bureau speaks, seeks to promote the exchange of scientific and other publications. It is a good sign that the Soviet feels that Russians should inform themselves on scientific and technical progress made abroad. Other evidence of a thirst for information has lately come to hand. Soviet agents who were concerned with the recent purchase of supplies in this country for reorganizing the platinum mining industry of the Urals did not neglect to buy a large number of technical books on various phases of the work. They also sought to secure, on a rather generous scale, photostat copies of all articles that the *Mining Journal-Press* had ever published on the subject.

Overfeeding may lead to indigestion, and now that the Soviet sits down to an intellectual repast that once it scorned, may it carefully restrain itself!

Nickel in Ocean Cables

NOTWITHSTANDING the great strides of the radio, the metal cable still holds first place in intercontinental communication, as it does in communication between individuals on land. A great stride in the design of an ocean cable has been made with the development of permalloy, containing about 79 per cent nickel and 20 per cent iron, which is used as a wrapping for a copper-stranded core. Because of the great magnetic permeability of the new alloy, signals can be transmitted much more rapidly than on the older type of cable. Whereas 300 signals per minute was the maximum before, 1,500 now can travel over one conductor without overlapping and blurring.

In the construction of the new cable recently laid between New York and Rome, the core of the 2,400-mile conductor consists of a round copper wire 146/1,000 in. in diameter, around which are wound spirally six copper tapes. A thin film of a special "lubricating" compound surrounds the copper, and in it "floats" a single very thin spirally wound tape of permalloy. Research showed that the magnetic properties of the alloy were affected by differences in pressure to which it would be subjected if wound on the bare copper. Hence this feature of the construction. The metal portion of the cable is 195/1,000 in. in diameter. The insulation of gutta-percha and jute, and the protecting armor of steel and tarred hemp, are essentially the same as provided for the old type of cable.

The significance of the quintupling of the capacity of an ocean cable, so far as the use of metals is concerned, is problematical. A large quantity of nickel is used in this cable, and nickel producers may benefit somewhat from a new market, even though ocean cables are not being laid every day or even every month. As one cable will do the work of five cables, only one-fifth as much copper will be needed to provide for a given amount of communication. So, it might be argued, one of the copper miners' markets will be decreased. Looked at from another angle, copper producers may be heartened by observing that the time has not yet come when waves of ether are to be the conductors of electricity to the exclusion of their product.

African Oddities

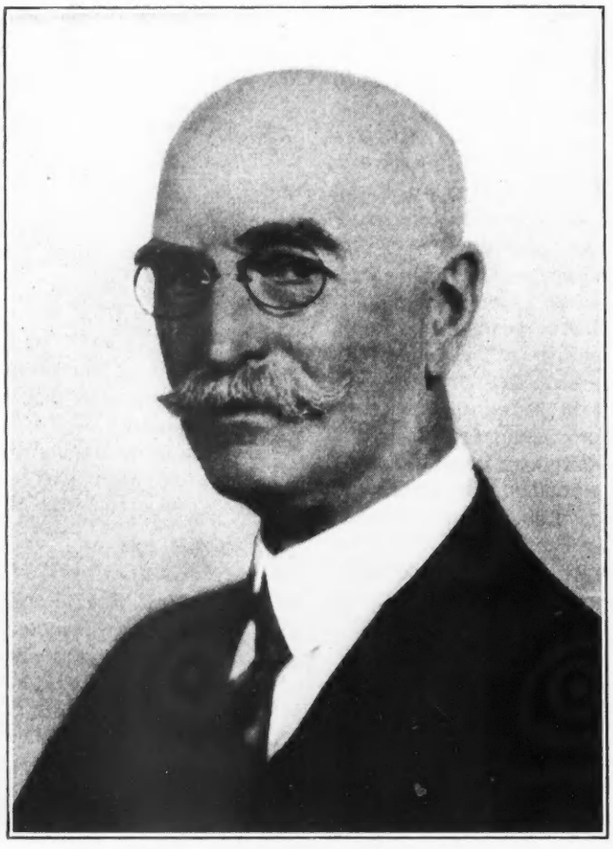
MARK R. LAMB tells a story of an Englishman in Argentina who complained that he had been eighteen years on the pampas and the natives had not learned English yet—obviously, a backward people. Strange things were found by Marco Polo in his long sojourn in Asia, so strange that he was frequently looked upon as an Ananias by contemporaries after his return. Nothing so strange, however, as the existence of a people who hastened to learn his European tongue to spare him the trouble of acquiring theirs is chronicled in his book. Mining engineers travel widely, at times beneath strange skies, and generally they find it quicker to pick up a smattering at least of the tongue of those with whom they have to deal.

As Africa's mineral wonders draw attention to that continent, new names, strange words, catch the eye and ear. A new vocabulary attracts the student or perhaps repels him. Katanga, as a name, has been long familiar. Now comes N'Changa, N'Kana, Mpata, Bwana M'Kubwa and others that have a similar look—these, we are told, are words of the Swahili tongue. A learned interpreter in New York tells us that Bwana M'Kubwa means "big chief." "Bwana" itself means "Sir" and is used in addressing one respectfully. Bwana Tumbo is an old familiar, recalling Roosevelt in Africa. Our interpreter tells us that "tumbo" means "stomach"; as everyone can see, its derivation from "tummy" being obvious. Our typists at the outset concluded that M'Kubwa was Irish, whatever nationality Bwana might be, and were consistent in spelling it "McKubwa" whenever occasion arose. Africa probably has many other things of interest for the philologist and geologist alike.

Mining Engineers of Note

James Wilson Neill

JAMES WILSON NEILL reached young manhood at a time when ambitious Americans desirous of embarking upon a mining career sought the classic mining schools of Germany. Neill was graduated from Clausthal, where he specialized in mining and metallurgy and acquired a useful knowledge of the German language. Returning to America, he promptly went West, and soon took an active part in the mining activities of the Western states. At Mine La Motte, in 1883, he constructed the first sintering roaster for lead ores. This consisted of an old Scotch hearth, a blast pipe being placed beneath the grate. Two other sintering plants of similar type were constructed at Bingham, Utah, one of which was afterward sold to the Boston & Montana. These early sintering furnaces were the inspiration for the later development of the Dwight-Lloyd sintering furnace, which has since become standard roasting equipment with the lead smelters. In 1887, Neill went to El Paso and constructed a lead smelter consisting of four small blast furnaces. In addition, he erected a wooden smelter stack, 7 ft. square and 110 ft. high. This smelter was in operation within ninety days from the time the ground was broken for foundations. It was erected for the Mexican Ore Purchasing Co., and was used for the smelting of oxidized lead ores which were shipped from Mexico to El Paso. Leadville, Colo., next attracted Neill, and while he was in that region he invented and worked out many of the details of the magnetic separation of pyrite from blende by lightly roasting the pyrite. Basic patents were obtained upon the idea, but no financial return was ever derived by Neill from his invention. He was superintendent of the Philadelphia smelter at Pueblo for six months and then went to Salt Lake, remaining there until 1904 and engaging in consulting and professional work. He reported upon the Bingham mines for the U. S. Smelting, Mining & Refining Co. and made an extensive examination of the Centennial Eureka mine. He was the first general superintendent for the U. S. Smelting in Utah and was of considerable assistance to the company at a time of great financial difficulty in 1899 when the Globe Bank failed. In 1904 he went to Butte, Mont., and affiliated with the F. Augustus Heinze interests, holding the position of chief of staff for two years. He then went to California and became interested in gold dredging and placer operations. Recognizing the inherent difficulties in saving fine gold by the ordinary riffles and sluices, he tested out several types of jigs and finally invented a new type, the Neill jig. This has been installed upon a number of gold dredges and has proved efficacious in saving both fine gold and accessory minerals. The Neill jig is operating on several dredges of the Natomas Company of California. It removes black sand and accessory minerals, which are ground in a conical mill and then run over riffles. Neill also invented the Neill leaching process, which made use of sulphur dioxide as the active agent for the solution of copper from ores, but this brought little financial return. He has always been partial to the gold dredges and placer-mining interests and has assisted in developing methods and appliances for the operation of various mines. For a time he investigated the black sands along the Pacific Coast, but did not succeed in establishing any large-scale operation. The important work upon which Neill is now engaged is in the direction, as consulting engineer, of the operations of the Matsukata interests in opening up a large iron-ore deposit at the north end of the main island of Japan. Recently, Neill left Seattle for Japan, and his friends wish him success in this new undertaking. The company which he represents has erected a fifty-ton blast furnace, with accessory equipment for initial experiments. On a previous trip Neill drilled and sank test pits in the ore deposit and succeeded in establishing the principal dimensions of the orebody which was described in our May 16 issue News Section.



James Wilson Neill

Of an alert mind and sunny disposition, and carrying his years lightly, Neill has made many friends in a long life of useful work which has meshed in with an era of great mining history.

Bwana M'Kubwa—A Potential Copper Producer

Its Plant and New "Metals Production Process"

By George L. Walker
London, England

IMMEDIATELY southeast of the holdings of Union Minière du Haut-Katanga, in Africa, but across the line in Northern Rhodesia, the Bwana M'Kubwa Copper Mining Co. is erecting a plant of 1,000 tons' daily capacity to reduce copper ores to the metal by an entirely new process. All of the machinery and equipment for this plant has been purchased and is either on the ground or in transit. The plant will, it is planned, be completed next December and will produce 10,000 long tons of copper next year.

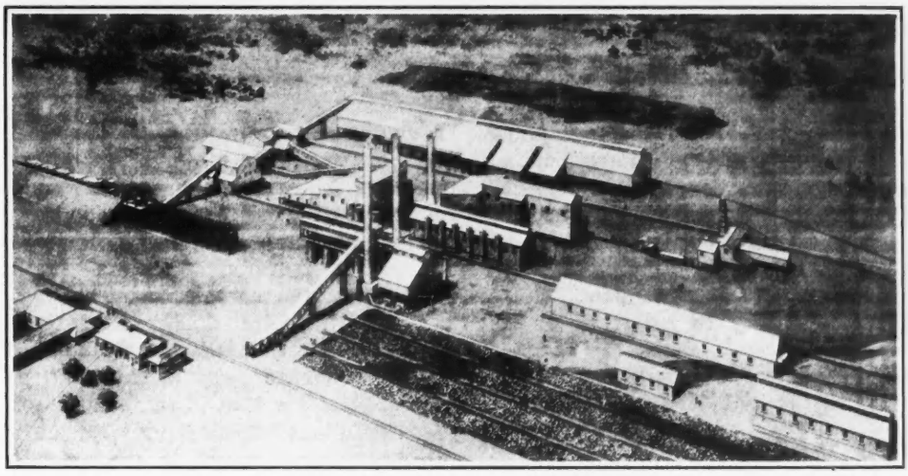
The new reduction process has been developed by Minerals Separation, Ltd., and is covered by patents. "It has been found that," reads an official statement,[1] "by employing a heat treatment involving regulation of temperature, atmosphere, and time, all minerals of copper can be transformed into a common product that is soluble in cupric ammonium carbonate."

"Atmosphere" and "all" are the important words in the statement quoted. After the ore has been heated to the proper temperature it passes into a specially designed reducing furnace, where the final reaction, which reduces the copper to soluble oxides, takes place in an atmosphere of producer gas, air being excluded. The process, it is claimed, opens up a wide field, as it reduces all minerals of copper in the same ore at the same time.

Ores to be treated are chiefly malachite near the surface, with appreciable quantities of all of the oxides and silicates. Some sulphides appear at the 250 level. At the 450 level these are reported only partly oxidized. Somewhere below this level massive sulphide ore, it is expected, may be encountered.

Above a depth of 500 ft., 7,568,365 tons is developed averaging 3.9 per cent Cu. The deposit consists of mineralized beds having a dip varying from 90 to 60 deg. For a length of 2,400 ft. they outcrop and rise 50 to 70 ft. above the surrounding plain. The Footwall orebody, 50 to 100 ft. wide, is proved to a depth of 450 ft. The Central Lode was a secondary deposit and very rich, but the greater part of it was extracted by ancient miners. At depth it changes to dolomite. The Hanging Wall orebody, 25 to 50 ft. wide, is also proved to a depth of 450 ft., but is of less length than the Footwall orebody. Hanging Wall orebodies Nos. 2 and 3, 15 to 25 ft. wide, are partly developed on three levels, and are of about the same length as the main Hanging Wall orebody.

The company proposes to mine the upper or oxidized zone by open-cut methods, using steam shovels. The proposals for open-cut mining cover the entire orebody over the proved length of the deposit and down to the 270 level (4,130 ft. above the sea). It is thought possible that the open-cut work may be carried below that depth. No unusual difficulties are expected to present themselves to mining by steam shovel. On the south side of the pit allowance has been made for the entire removal of the barren sandstone lying between the ore and the footwall quartzite, which will stand vertically without lateral support, but which is to be given a slope of 10 in 1. Standard-gage track will be used.

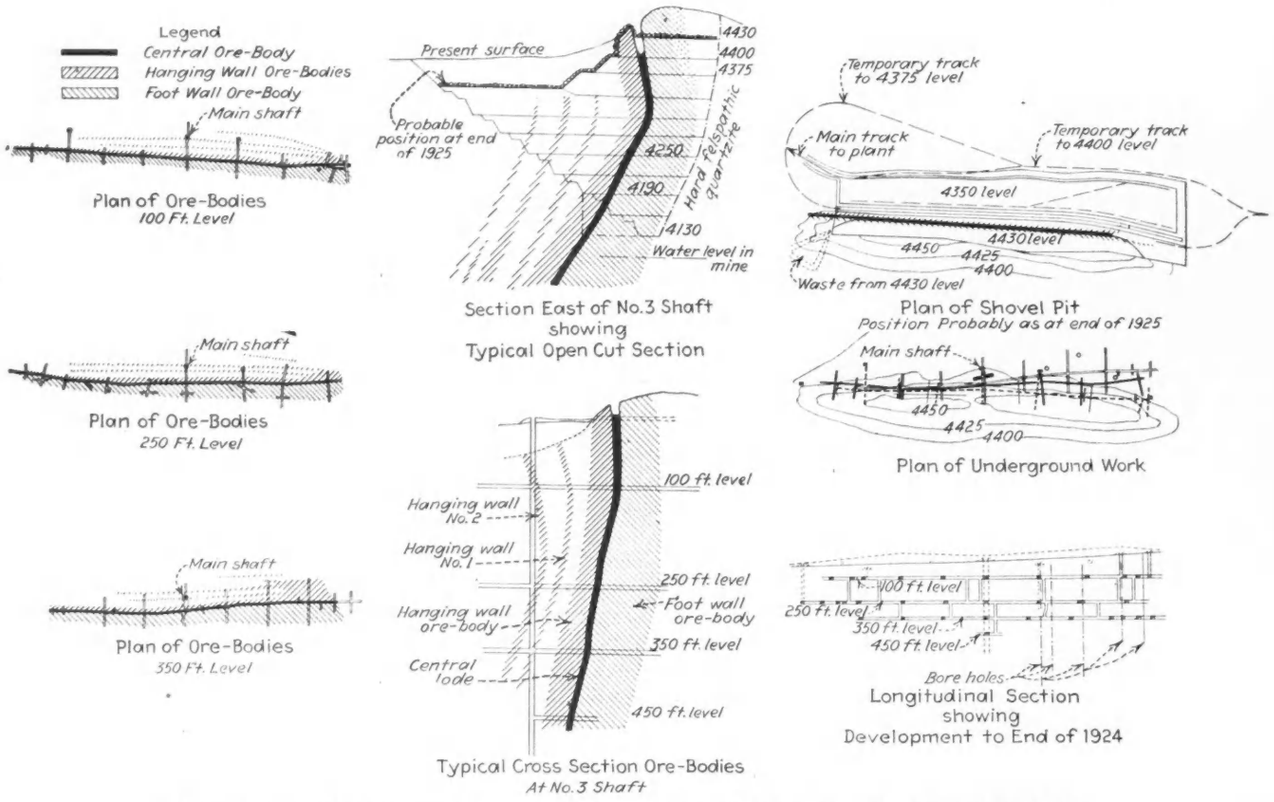


Perspective drawing, showing view of first 1,000-ton unit of Bwana M'Kubwa plant now under construction

Facilities for dumping waste and ore are ample. As the greatest tonnage represents waste, the waste dumps have been placed immediately adjoining the mine. Beyond these the ore dumps have been located, one for ore which it is not advisable to treat at present—that is ore containing less than 2 per cent copper—and another for ore that may be produced before the plant is ready.

It is proposed during 1925 to strip the top of the mine kopje to the 4,430 level, storing the ore which may be produced from this work, and dumping the waste. The 4,400 level has already been established.

[1]This article is prepared largely from a special report recently issued by the company.



Mine plans and sections, Bwana M'Kubwa Copper Mining Co., Northern Rhodesia

These stripping operations during the year will place the mine work three or four years in advance of plant requirements. After 1925, the amount of stripping removed annually will depend largely on the amount of capital the company wishes to lock up in such work.

Excavation of 5,750,000 cu.yd. of material is involved in the proposed open-cut operations. This includes 3,500,000 to 4,000,000 tons of oxidized, enough for more than ten years' operations of the present plant. After that period it will be necessary to resort to underground mining methods.

It is estimated in the company's report that the ore delivered at the plant will cost under 3s. 6d. per ton, including stripping.

The mine equipment, which is either on the spot or in transit, includes two 78-C Bucyrus shovels, three 40-ton locomotives, 8 miles of standard railway track, fifteen 16-cu.yd. automatic dump cars, electrically-driven compressors, and drills and sundry tools.

As to underground mining, the mine plans, shown on this page, include a typical cross-section taken at the main shaft; plans of the orebodies on the 100 level (4,300 ft. elevation), 250 level (4,150 ft.) and 350 level (4,050 ft.); also a longitudinal section and plan. In all, more than 23,500 ft. of underground development has been done and 4,000 ft. of drilling.

By several years of laboratory work and by operating a 10-ton pilot mill at Bwana M'Kubwa, Minerals Separation has evolved and demonstrated what it calls the "Metals Production Process." Previously established processes, like producer-gas manufacture, ammonia leaching and the poling of molten copper to remove oxygen, are included, with some improvements, discoveries, and adaptations.

The vital feature of the process is that of reducing all forms of copper in mixed ores to a uniform solubility. This is accomplished by crushing the ore to ½-1 in. and submitting it to a heat treatment involving regulation of temperature, atmosphere, and time. It is first passed slowly through a preheating furnace of the rotary-kiln type (a modified rotary drier), in which its temperature is raised to 400 to 450 deg. C. in about half an hour, producer gas providing the heat. The ore is thus hydrated and heated to the reaction temperature in the most economical way, it is claimed; colloids are dehydrated at the same time.

After preheating, the ore is fed through a gas lock into a cylindrical reducing furnace, fitted with an internal spiral for control of the time of contact. Here the atmosphere consists of a stream of producer gas running countercurrent to the ore. The heat of the reaction will keep the temperature somewhere near that at which it enters the furnace. The reduction reaction is rapid, being twenty minutes at most. Where the reaction takes place the furnace is brick-lined; the lower end is water-cooled to reduce the temperature of the ore to approximately that of the air outside before it is discharged through a gas lock.

Further crushing in rolls to about ⅛ in. is accomplished in two stages, preparatory to leaching.

Copper Content Now Readily Soluble in Ammonium Carbonate

In the condition in which the ore now is, its copper content is readily soluble in a solution of ammonium carbonate in the presence of oxygen. The solution of copper in ammonium carbonate (cupric ammonium carbonate) acts as a carrier of oxygen, the oxygen required being supplied in an aërating tower outside of the leaching tank, or by using air lifts.

The primary leaching solution contains about 5 per cent of ammonia and 4 per cent of carbon dioxide, and

will dissolve about 5 per cent of copper. This is followed by other leaches and washes, the solutions being passed forward in the usual way so as eventually to become the primary solution for a fresh charge. The final stage consists of a steam wash to remove the last remaining portion of copper-bearing solution and ammonia. Most of the metals which usually are dissolved, when leaching with acid, will remain in solution. Iron and the alkaline earths will be almost entirely absent from the final leaching solution.

The time devoted to leaching, including washing, etc., depends mainly on mechanical factors. Ordinarily it will vary from three to seven days. From 70 to 80 per cent of the copper is extractable in the first few hours; eventually over 90 per cent of it is extracted.

The strong solution from leaching, containing 5 per cent ammonia, 4 per cent carbon dioxide, and 5 per cent copper, is distilled by means of injected steam to remove ammonia and carbon dioxide, which are condensed and returned to the circuit for further use. Removal of the ammonia and carbon dioxide causes precipitation of the copper from the solution as copper oxide. On filtering, a cake is obtained which, when dry, contains 75 to 80 per cent copper. The effluent, which is practically barren, is run to waste, or may be returned to the circuit as required. Thus the possibility that the impurities will build up in the solutions is avoided.

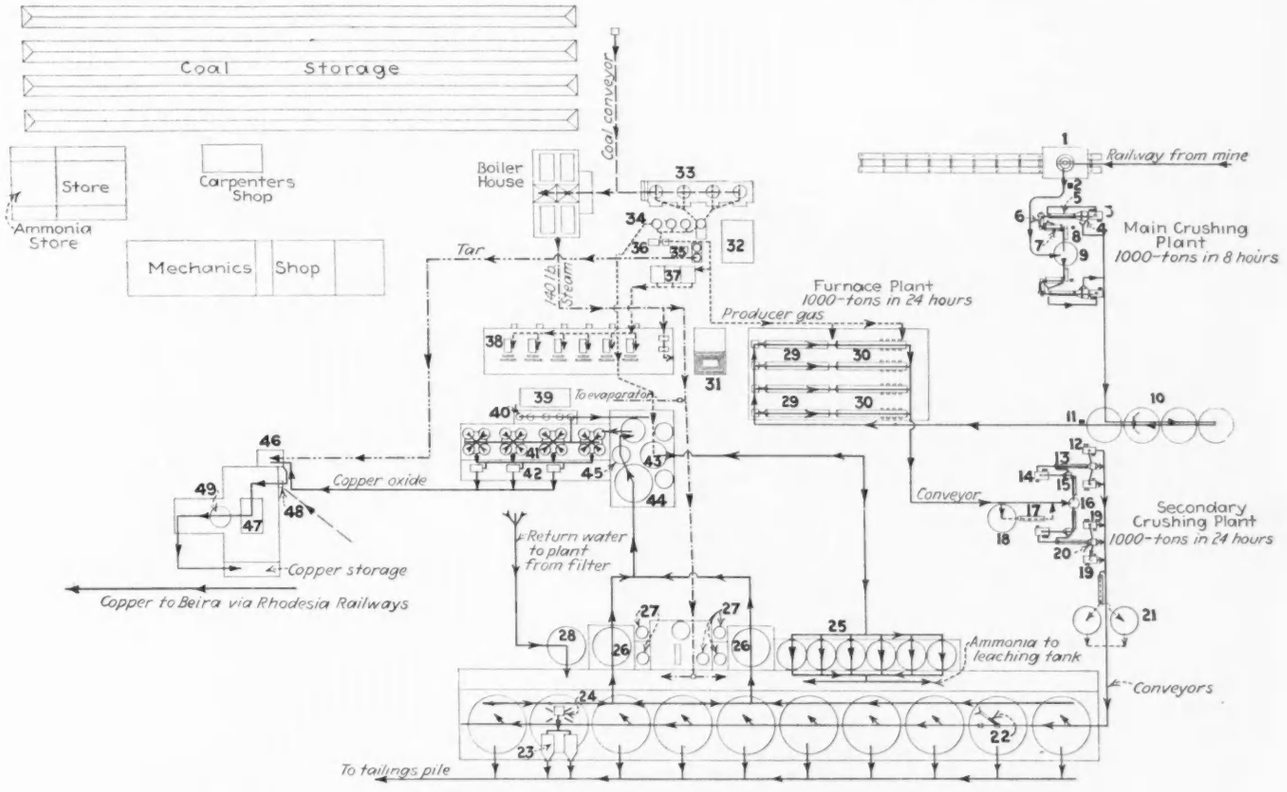
Reduction of copper oxide to metallic copper can be done, the company's report states, by mixing it with tar and smelting to metal, being poled up to pitch. Refining can be done in the usual way. The copper obtained is very pure. Copper bars obtained in the pilot plant gave the following analysis:

Copper, per cent	99.85	Lead	Trace
Arsenic, per cent	0.01	Nickel	None
Antimony	Trace	Oxygen, per cent	0.123
Bismuth	None	Sulphur, per cent	0.002

Salient features of the process are the ease with which it deals with silicates, and the fact that one type of operation suffices for all copper minerals.

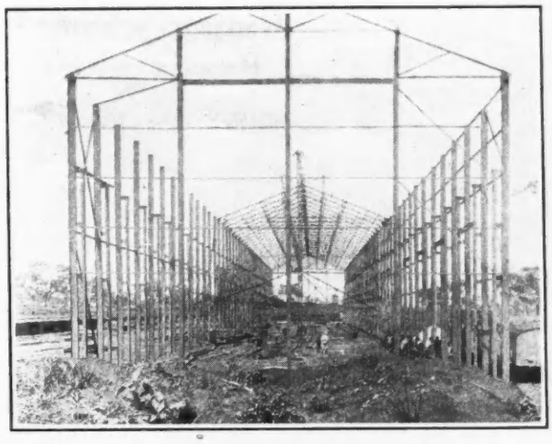
It is interesting to note, the company's report states, that the two most important byproducts of producer-gas manufacture are reagents used in the complete process. The amounts of ammonia and tar obtained as byproducts in the production of the reducing gas required for heat treatment are more than sufficient for leaching the ore and refining the copper oxide.

There were no preliminary trials of the pilot plant. In the first twelve runs 103 tons of 3.78 per cent ore were treated and 88.4 per cent of the contained copper recovered. The copper was chiefly in the form of silicate, some malachite, considerable graphite, and a trace of sulphide. The next six runs were on 2.88 per cent ore from another orebody, and recovery was 90.3 per cent. Here the copper was mostly in the form of



Flow sheet of first 1,000-ton unit of Bwana M'Kubwa's proposed 3,000-ton plant

1. 30-in. gyratory.
2. Magnet.
3. 54x24-in. rolls.
4. Hum-mer screen.
5. Elevator.
6. 48-in. disk crusher.
7. 2-in. screen.
8. 36-in. feeder.
9. 200-ton surge bin.
10. Main storage, 3,000 tons ½-in. ore.
11. Magnetic pulley.
12. 36x16-in. rolls.
13. Elevator.
14. 36x16-in. rolls.
15. Hum-mer screen.
16. Bin.
17. Elevator.
18. By-pass bin (500 tons).
19. 36x16-in. rolls.
20. Hum-mer screen.
21. Storage bins 1,000 tons ½-in. reduced ore.
22. Conveyor tripper and chute.
23. Removable chute.
24. 3-ton grab.
25. Solution storage tanks.
26. Circulating tank.
27. Sump tank.
28. Return water tank.
29. Pre-heating furnace.
30. Reducing furnace.
31. Water cooling tower for gas engines.
32. Gas-plant machinery house.
33. Gas producer plant.
34. Wet scrubbers.
35. Tar plant.
36. Fans.
37. Sawdust scrubbers.
38. Power house.
39. Water-cooling tower for condensers.
40. Condensers.
41. 12-ft. diameter evaporators with 20-ft. diameter sumps.
42. Filter.
43. Ammonia storage.
44. Rich solution storage.
45. Sand filter.
46. Oxide tar mixing plant.
47. 20x10-ft. refining furnace.
48. Coal hoist.
49. 12-ft. Walker casting machine.



Leaching-tank building at Bwana M'Kubwa in process of construction

The leaching solution is handled between storage and leaching tanks chiefly by air-lift pumps, which are assumed to aid the solutions to absorb a large quantity of oxygen. A washing tower will be provided to dissolve out the ammonia taken up by this air. If further aëration is found desirable, special aërating towers will be erected. Pumping which involves a lift higher than 30 ft. is done by means of centrifugal pumps.

After leaching and washing is complete, the ore is steamed to remove the last traces of ammonia. High-pressure steam from the boiler plant, reduced to a pressure of 1½ oz., is introduced into the top of a tank and sucked through the ore by a vacuum pump.

From the leaching tanks the copper-bearing solution goes to a storage tank, passes thence through a sand filter to remove suspended solids, to another storage tank, from which it is fed into the evaporators as required. There are sixteen evaporators, each 12 ft. in diameter by 24 ft. 6 in. high—vertical cylinders with conical bottoms so arranged that steam can be blown through two or more in series. Fresh steam always is introduced into the weakest solutions, passing on into the stronger ones.

Condensers of 1,000 sq.ft. area, five in number, each with a cooling coil, receive the vapors containing ammonia and carbon dioxide, from the evaporators and recover the ammonia as a condensate, which is sent to a storage tank. The evaporators, arranged in groups of four, discharge into a 20-ft. diameter sump tank, which has a conical bottom. After the ammonia is boiled off and the copper precipitated as oxide, the entire contents of the evaporator pass to the sump, from which they are discharged into a Sweetland filter, which reduces the moisture content of the oxide to about 15 per cent to 20 per cent. The oxide cakes go to the refining plant, where they are mixed with about 10 per cent of gas-producer tar. This reduces the moisture content materially. The mixture is smelted to metal in a coal-fired refining furnace, and the refined metal is cast with a Walker machine.

High-class materials and equipment are employed throughout in the construction of the plant. Extensive shop facilities are being provided for light and heavy repairs. The steam-power plant, gas-producer plant, electric plant, and mine equipment are all of excellent design.

The gas required for the gas engines and furnaces is provided by four producers, of 10 ft. inside diameter, and of the semi-low-temperature type, which are rated to gasify 72 tons of coal per day. The semi-low producer has a high shaft, which renders ammonia recovery possible without the excessive use of steam.

Cleaning of the gas is effected in the usual way by wet scrubbing towers, centrifugal cleaners, and sawdust scrubbers. Differing from ordinary ammonia recovery plants, the primary wet scrubbing tower is followed by three others, which recover the ammonia as an aqueous solution instead of by the use of sulphuric acid. The company's report states that this gives a poorer recovery of ammonia, but makes it possible to get ammonia at a cheap rate. It is expected that about 800 lb. of ammonia will be recovered daily as an 0.8 per cent solution, providing for the replacement of ammonia lost in operation.

The main power plant is equipped with six 300-kw. alternators driven by Premier horizontal gas engines, one being a spare. The current generated is 600 volt, 3 phase, 50 period. Two 180-kw. d.c. Belliss & Morcom engine generator sets are used for exciters (one of these also being a spare). The current generated is 440 volt direct. The boiler equipment includes four Babcock & Wilcox water-tube boilers, with a total capacity of 68,000 lb. of steam per hour at 140-lb. pressure. These are equipped with automatic stokers. Their main load consists of supplying steam for the evaporators.

Cost of Producing Copper Estimated

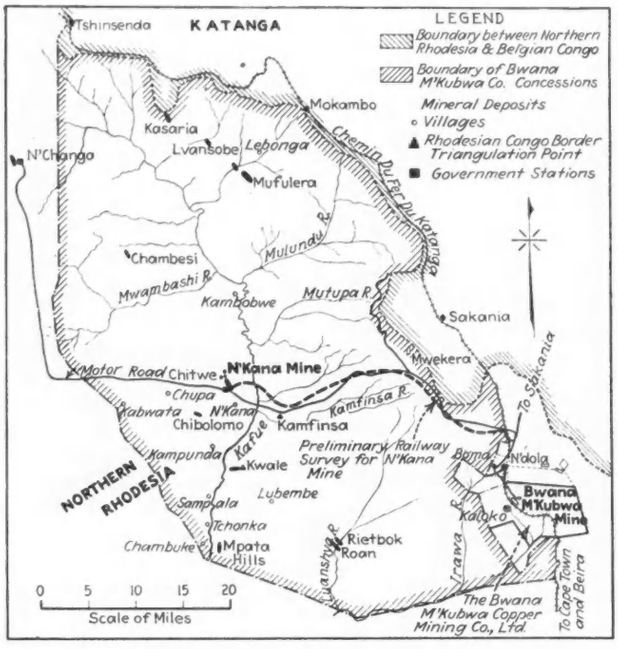
The management estimates that the cost of producing copper, including ocean freights to Europe and selling commissions, but not including London office expenses or depreciation, will work out as follows:

	Cost per Long Ton Copper			Cost per Shor Ton Ore		
	£	s.	d.	£	s.	d.
Mining	5	18	8	..	3	6
Treatment	22	19	5	..	13	7
Realization	11	13	5	..	6	10
	£40	11	6	1	3	11

Computing on the basis of a production of 10,266 long tons of copper annually sold at £65 per ton, an estimated yearly operating profit of £250,722 8s. is arrived at by the management.

Last year, when Bwana M'Kubwa's plant construction was decided upon, 1,204,000 shares of treasury stock were sold at par, 5s., which was rather better than the market price at that time. At the annual meeting, held soon after, Edmund Davis, chairman of the board, named the following corporations as among the large subscribers to that issue: Anglo-American

View from waste dump showing Bwana M'Kubwa orebody (at left) rising boldly from the plain



Map of Bwana M'Kubwa Copper Mining Co.'s mineral concession

silicate, with some malachite, and less than 0.1 per cent of sulphide. Then followed seven runs on 3.998 per cent ore, chiefly silicate with 0.15 per cent of sulphide, with the following results: Highest recovery, 96 per cent; lowest, 92; average, 93.4. The company expects that the product from the large plant will run 99.93 to 99.95 per cent copper.

Tests showed an average ammonia loss of 0.51 lb. per ton of ore. It is considered that under working conditions the total loss will be 0.3 lb. ammonia, and that ammonia, made at the plant, will cost under 3d. per pound.

Coal from the Wankie colliery is brought in over the Rhodesia Katanga Junction Railway (operated by the Rhodesian Railways) which serves Bwana M'Kubwa. From this coal the gas used in reduction is produced in four semi-low-temperature type producers. A high shaft recovers the ammonia with economy in the use of steam. The primary wet scrubbing tower is followed by three others, which recover the ammonia as an aqueous solution, instead of by the use of sulphuric acid. It is declared that the amounts of ammonia and tar obtained as byproducts will be more than sufficient for leaching the ore and refining the copper oxide.

A Modern Plant

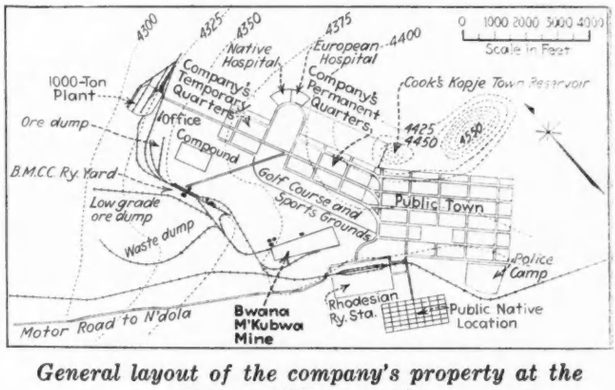
Ore is brought from the shovel pit near by in trains of five 30-ton automatic side-dump standard-gage cars and dumped, a trainload at a time, into the ore bin. In the center of the floor of this bin is the top of a No. 30 gyratory crusher weighing 76 tons and driven by a 200-hp. motor. This, the company claims, is the largest single crushing unit in Africa. The top of the gyratory is completely buried as each train load of ore is dumped, and the crusher proceeds to dig itself out. It reduces the ore to 4½ in. A 36-in. steel apron conveyor takes the crushed product to the primary crushing plant, where it is screened in 46-in. by 12 ft. trommels, everything smaller than 2 in. passing through. The oversize is reduced to 2-in. material by a 48-in. disk crusher. This joins the trommel undersize and is screened on an 8x4-ft. Hum-mer screen which removes the minus ½ in. material and sends the oversize to 54 by 24-in. rolls, which reduce it to ½ in. All this occurs in a closed circuit. The undersize from the vibrating screen is taken by a 20-in. inclined conveyor to the crushed ore storage section. Each crushing unit has a capacity of 62½ tons per hour. Four 750-ton steel bins, 33 ft. diameter and 22 ft. high, provide storage sufficient to assure continuous operation of the plant. Magnets are placed at advantageous points to guard against tramp iron.

The furnace plant has four preheating furnaces, 7 ft. 9 in. in diameter by 60 ft. long, firebrick lined. Their combined capacity is 1,000 tons in twenty-four hours. Combustion products from these pass to a dust chamber 20 by 13 by 102 ft., and thence by an electrically driven fan to a 100-ft. stack 8 ft. 6 in. in diameter. If found necessary these gases will be sprayed to minimize dust losses. The reducing furnace which next receives the ore, in a producer-gas atmosphere, is of similar construction, of the same diameter but 5 ft. longer. The far end of this, a section 25 ft. long, is not brick-lined. It is of steel and is cooled by water, being fitted externally with scoops which raise the water from tanks beneath and, as the furnace rotates, pour it over the shell with the object of reducing the temperature of the ore.

Conveyors now take the ore to a feeder bin at the head of the secondary crushing plant, where it is reduced to ⅛ in. by 36 by 16-in. rolls and two 4-ft. Hummer screens. In the preceding stages dust production is kept down by deferring the final fine crushing, and the heat treatment acts better on the coarse material.

Provision is made, in the system, for sampling the ore as it reaches the main crushing plant; also as it reaches the leaching plant.

Arrangements are provided by which the fine ore can be conveyed either to storage or directly to the leaching plant. The latter consists of ten 1,000-ton tanks, 54 ft. in diameter by 13 ft. 6 in. high. A conveyor belt with an automatic tripper, a movable hopper, and swiveled shoot permits the delivery of ore to all parts of any given tank. The tanks themselves have removable lids resting in water seals, so that they may be completely opened up for the introduction of ore or the removal of tailings, and the volatile ammonia solutions can be protected from loss by evaporation. An overhead crane with a three-ton grab removes the tailings, discharging them outside the building on a coco-pan conveyor, which carries them to the dump.



General layout of the company's property at the Bwana M'Kubwa mine

Metallurgy of Magnesium*

A Concise and Complete Compilation of Data on This Increasingly Important Metal

By M. Miyake and Allison Butts

Graduate student, Department of Metallurgical Engineering, Lehigh University, and Assistant Professor of Metallurgy, Lehigh University, Respectively

M. Miyake

MAGNESIUM was first isolated as a metal in 1808 by Sir Humphry Davy. The separation was accomplished by Davy both electrolytically and by passing the vapor of potassium over red-hot magnesium oxide, with subsequent removal of the reduced magnesium by mercury. In 1852 R. Bunsen prepared magnesium by the electrolysis of fused anhydrous magnesium chloride, which was the foundation of the commercial production of the metal. But the magnesium industry was of small proportions until about 1909, when an electrolytic process was developed in Germany, the operation of which depends on the electrolysis of the fused chloride, basically the same as in the method of Bunsen.

Exportation of the metal from Germany was cut off during the World War, the demand for magnesium for military purposes resulting in a development of the industry in the United States and in England. The chloride ore used in Germany not being available, new processes were devised making use of the chloride byproduct of salt works as well as the more abundant material, magnesite.

Five plants for producing magnesium were erected in the United States during the war: the American Magnesium Corporation, at Niagara Falls, N. Y.; the Rumford Metal Co., at Rumford, Me.; the General Electric Co., at Schenectady, N. Y.; the Dow Chemical Co., at Midland, Mich.; and the Norton Laboratories, Inc., at Lockport, N. Y. Three of these closed down after a short period of operation, and now only the plants of the American Magnesium Corporation and of the Dow Chemical Co. are at work. (10)†

The following table gives the production and price of the metal in the United States since the beginning of the industry here (18, 20):

Metallic Magnesium Produced in the United States

Year	Number of Producers	Quantity, Pounds	Value	Average Price per Pound Ingot	Powder
1915	3	87,500	$440,000	$5.00	.....
1916	4	75,400	311,462	4.13	.....
1917	5	115,813	233,626	2.02	.....
1918	4	284,188	615,217	1.81	$2.67
1919	3	127,465	247,302	1.85	2.85
1920	2	(b)	(b)	1.60	2.75
1921	1	48,000	86,000	1.30	2.36
1922	2	60,000	89,000	1.60	1.13
1923 (a)	2	125,000	155,000	1.30	1.24

(a) Estimate. (b) Permission for publication not given.

Magnesium ingots (99 per cent Mg) were quoted at 90 to 95c. per lb. at the beginning of 1925.

Magnesium has been used chiefly as a deoxidizer and scavenger, for photographic flashlights, for fireworks and explosives, and as a minor constituent in alloys. Recently, however, the importance of magnesium as a structural material has greatly increased. Alloys in which magnesium is the major constituent have a growing use where lightness with high strength is desired. The use of magnesium in this direction especially would expand enormously if the metal could be produced at a cost comparable with that of aluminum. A decreasing price will extend its use in many directions, and as the lowering of the price depends in large degree on an increase in the scale of production, a promising development is indicated. Interest in the metal and research being done on it lend support to this view. A regrettable feature is that the present status of the industry causes producers to keep details of their technical operations largely to themselves, so that published details of the metallurgy of magnesium are meager, and few practical data regarding the metal are available.

Allison Butts

In the following table are given the properties of magnesium that are of chief practical interest, and also, in parallel columns, the corresponding properties of aluminum, copper, mild steel, and the alloy containing 90 per cent magnesium and 10 per cent aluminum. When magnesium, aluminum, and the light alloys are used for structural purposes, their lightness and their strength in relation to weight become determining factors. The table gives the tensile strength of untreated metal expressed in the usual manner (pounds per square inch of cross-section), and also the strength per unit weight, relative to that of mild steel. Likewise, in considering electrical conductivity the weight of the conductor is an important factor; the weight of metal required to conduct a given current with a given resistance may be the prime requisite. Accordingly, the table gives, in addition to the ordinary conductivity, the conductivity in relation to weight, which may be called the mass conductivity as opposed to the volumetric conductivity, again expressed as a percentage of the conductivity of copper as standard. The cost per unit volume is also given, since this may be of importance in computing the cost of making a piece of given dimensions.

Owing to its high chemical activity, magnesium occurs in nature only in combination with other ele-

*A paper prepared in the course of graduate work in the Department of Metallurgical Engineering, Lehigh University.

†Numbers refer to references at the end of the article.

Corporation of South Africa, Selection Trust, Gold Fields Rhodesian Development, Union Corporation, Rhodesia Copper and General Exploration and Finance, and the Fanti Consolidated Mines. A. Chester Beatty, American mining engineer, now residing in London and having large African interests, is prominently identified with Bwana M'Kubwa, as is also another engineer of international reputation, M. J. H. Francke. Other directors than the three just named are Edward Birkenruth, of the Gold Fields Rhodesian Development Co., D. O. Malcolm, of the British South Africa Co., J. C. Moulden, of the Minerals Separation group, and Sir Ernest Oppenheimer, of the Anglo-American Corporation. Minerals Separation serves as consulting mining and metallurgical engineers, with P. K. Horner consulting engineer and W. G. Perkins consulting metallurgist. These are assisted at the property by the Anglo-American Corporation and Carl R. Davis.

Being grouped in with Katanga and the Rhodesian Congo Border Concession, Bwana M'Kubwa's holdings and prospecting rights to between 2,000 and 3,000 square miles do not have the imposing appearance they otherwise would. Bwana owns 64 square miles of mineral area surrounding its mine. Last year it took over the N'Kana Concession of 1,800 square miles, to which it has exclusive prospecting rights until some time in 1927, together with the right to peg and hold such mineral areas as it may discover, and to take up two additional 10 square mile areas at the expiration of the concession.

In the western part of this concession, about 30 miles from Bwana M'Kubwa, is the N'Kana mine, in which has been developed 1,000,000 tons of ore similar to that of Bwana, all above the 100 level, averaging between 3½ and 4 per cent. It gives promise of developing a considerable tonnage. In parts of this mine 4 to 6-per cent ore is developed over commercial widths. The mineralized zone has been proved for a distance of 7,500 ft., and work now being done is extending it. A proposed railway will make it possible to bring the ore 35 miles to the Bwana plant, unless there is enough to warrant another plant.

Magnesite in 1924

Statistics compiled by J. M. Hill, of the U. S. Geological Survey, show that the magnesite material marketed in the United States in 1924 from domestic mines was equivalent to 100,413 short tons of crude magnesite, valued at $789,728, a decrease of 32 per cent in quantity and 28 per cent in value, compared with the quantity marketed in 1923. Washington produced 52,876 tons, which was more than half the total output for the year. A low value on the crude uncalcined rock is reported by Washington operators. The value of California crude magnesite produced in 1924, which amounted to 47,537 tons, is estimated at $13.67 a ton, but as all the product is sold calcined or dead-burned, the value thus fixed is entirely arbitrary.

Magnesite (Expressed as Crude) Supply in the United States, 1919-24

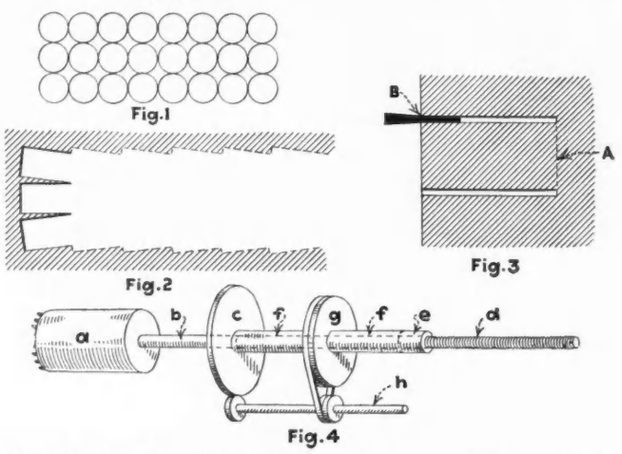
Short Tons

	Domestic Production	Imports	Total	Proportion of Consumption Supplied by: Domestic	Foreign
1919.....	156,226	25,321	181,547	86	14
1920.....	303,767	63,110	366,877	83	17
1921.....	47,904	65,569	113,473	42	58
1922.....	55,790	217,861	273,651	26	74
1923.....	147,250	151,092	298,342	49	51
1924.....	100,413	129,576	229,989	44	56

Novel Salt Mining Scheme From Russia

By J. W. Scherrer

THE accompanying sketches illustrate an ingenious method used before the war to mine rock salt in a mine in South Russia. The lower part of the salt vein consisted entirely of very pure salt, which originally was won by blasting. The explosion fumes, however, contaminated the mineral; moreover, after the explosions the salt fell in small pieces on the ground, where it was contaminated still more. As the powdered salt was marketed for table use in Russia, it was necessary that it be very pure.



Sketch showing construction of the machine and the method of cutting salt

The scheme of mining consisted in cutting cylinders of about 70 cm. diameter and 130 cm. long by means of a hollow drilling cylinder. Three rows of holes were drilled as shown in Fig. 1.

A section of the three rows is shown as in Fig. 2, it being impossible with this particular machine to drill the upper and lower cylinders horizontal. A machine could be designed that would be adjustable.

The drilling cylinder being withdrawn, a wedge was driven at *B* to break the cylinder at *A* (Fig. 3). The salt cylinder was taken out by an iron stick and afterward broken by wedges preparatory to grinding. The method is suggested for any salt minerals for which big prices are desirable.

The drill was driven with a 10-hp. electric motor, but compressed air could have been used. It was handled by two men, who could easily cut two cylinders of salt, or about one ton, per hour. The absence of explosives kept the air in the mine clean and made the mine a more safe place in which to work. The machine itself consists of a simple cylinder *a*, which on one side is provided with hard steel teeth; on the other side it is fastened to a steel shaft *b*, the back end of which is a screw *d*. By turning the small shaft *h*, the gear *c* and the belt pulley *g* are driven. The first turns the shaft *c*, the second turns the tube *f* and with it the nut *e*, which gives the forward and backward movement.

The mechanism is mounted on a light steel frame which carries also the electric motor. At each end of the frame is placed a support fastened between ceiling and floor of the gallery.

Properties of Magnesium and Certain Other Metals

	Magnesium, 99.9 per cent	Aluminum, 99.0 Per Cent	Copper, Pure	90 Per Cent Mg + 10 Per Cent Al	Mild Steel, 0.15 to 0.25 Per Cent C
Specific gravity	1.74	2.70	8.9	1.81	7.8
Brinell hardness, sand-cast metal	30	27	36	57	110
Tensile strength, pounds per square inch	25,000	18,000	35,000	44,000	65,000
Tensile strength per unit weight, mild steel = 100	172	80	47	291	100
Electrical conductivity, ordinary, copper = 100	38	53	100	10	21
Electrical conductivity for equal lengths made from the same weight of metal, copper = 100	197	201	100	49	24
Melting point, deg. C.	651	660	1,083	440	1,400
Cost, cents per pound, January, 1925	95	28	15	.....	2.1
Cost, dollars per cubic foot, January, 1925	103	47	83	.....	10.2

ments. It is widely distributed and is abundantly present in the earth's crust, of which it forms 2.24 per cent, according to the estimate of F. W. Clarke. Although the magnesium-bearing minerals are numerous, only two are used as a source of metallic magnesium—magnesite ($MgCO_3$) and carnallite ($MgCl_2.KCl.6H_2O$). Magnesite is produced commercially in more than a dozen countries, of which Austria is the leading one. Considerable amounts are obtained from Greece and the Western part of the United States. The magnesium content of the mineral averages 25 per cent. By calcining, magnesite is converted into magnesium oxide. Carnallite is the leading source of potash in the great Stassfurt deposits of Germany, and the separation of potassium chloride from it involves the production of large quantities of magnesium chloride. The magnesium content of carnallite averages 8 per cent. Magnesium chloride is also recovered as a byproduct at some salt works. The analysis of F. W. Clarke shows a magnesium-chloride content of 10.88 per cent in oceanic salt.

Three Methods of Recovery

The many processes which have been tried or used for the production of metallic magnesium may be grouped under the following three heads:

A. Carbon reduction processes.

B. Substitution processes.

C. Electrolytic processes.

In the first type of process, magnesium oxide is reduced with carbon at the temperature of the electric furnace; magnesium is liberated as a vapor and condensed. The metal is thus obtained as a powder, not easily convertible to coherent metal. In the second type, magnesium chloride is reduced with either sodium or aluminum. This kind of reduction has not been used commercially for magnesium. The third type of process is the only one now in commercial use. It is based on the electrolysis of a bath of fused salts. Formerly the bath was confined to magnesium chloride with or without the admixture of potassium or sodium chloride, but during and since the war the electrolysis of magnesium oxide in a bath of fused magnesium fluoride has been developed in the United States, following the practice in the ordinary aluminum process. The electrolysis of fused sulphide has been proposed, and the electrolysis of aqueous solutions of magnesium has also been tried, all of these attempts resulting in failure.

Only the electrolytic processes now in use will be discussed here.

1—*Chloride Process.* This involves the electrolytic decomposition of fused anhydrous magnesium chloride mixed with potassium or sodium chloride to lower the melting point. The process is employed in Germany, England, France, and to a limited extent in the United States.

In Germany, the natural double chloride, carnallite, is available in large amounts. But this salt as well as the magnesium chloride must be previously dehydrated —a difficult and expensive operation when carried to the necessary point. Heating of the hydrated chloride causes, along with driving off of water, some evolution of hydrochloric acid, with consequent formation of magnesium oxide, and the higher the temperature used the greater the amount of oxide which results. When the chloride bath is electrolyzed, the oxide is not decomposed, but builds up in the bath and prevents the operation. Another difficulty inherent to magnesium production by electrolysis is the fact that the metal is lighter than the fused mixture of salts, so that it floats to the surface, there to recombine with the chlorine evolved at the anode. However, the chief difficulties which have impeded the development of the metallurgy of magnesium have been overcome in the recent processes.

In the chlorine electrolytic process the operation has usually been carried on in an iron pot which serves as cathode as well as container, with a central graphite anode. Magnesium is plated out at the cathode and rises to the surface of the bath in small globules, which must be protected from the action of the chlorine given off at the anode. The protection is usually accomplished by inserting a diaphragm between the anode and the cathode regions, and piping the chlorine away by a slight suction. The use of a diaphragm, however, interposes a considerable electrical resistance and causes numerous mechanical troubles.

Magnesium melts at 650 deg. C., whereas the chloride melts at 711 deg. In electrolysis, however, the practice is to obtain a bath of lower melting point by admixture of some potassium or sodium chloride, or both, with the magnesium chloride. The chloride bath has been studied recently by C. Matignon and J. Valentin. (15). The best working temperature appears to be about 700 deg.; the voltage is from 4 to 8, depending on the current density and the temperature, and the cathode current density is from 10 to 40 amperes per square decimeter (90 to 360 per square foot) (2, 3, 4, 14).

The decomposition voltage of $MgCl_2$ is estimated to be less than 3.2 volts at 700 deg. (21); assuming that this number represents the value for carnallite, an energy efficiency of 40 per cent is indicated for a current efficiency of 75 per cent and a cell voltage of 6. A kilogram of magnesium would thus require 17.7 kw.-hr. for its production.

The addition of a small quantity of calcium fluoride to the electrolyte favors the coalescence of the globules of magnesium formed at the cathode (3, 5). If the globules do not coalesce, but pass into the electrolyte, they form a metal fog and are lost through oxidation or otherwise. If the carnallite is contaminated with ferric chloride, losses of energy occur owing to the continuous reduction of this salt at the cathode and its reoxidation at the anode. If too high a voltage is used, or if the magnesium content of the bath becomes too low, the metal may contain some potassium or sodium, and it is then liable to catch fire during the electrolysis (3).

Magnesium oxide present in the electrolyte is reduced

to a dark-colored suboxide, which is heavier than the normal electrolyte (6). A high temperature facilitates its formation. As the magnesium oxide cannot be removed from the electrolyte, its formation must be prevented both during the preparation of the salt and during the actual electrolysis. Traces of magnesium oxide present can be converted to the chloride by adding a small amount of ammonium chloride to the electrolyte (1, 5). The magnesium content of the bath changes continually, and the electrolyte must eventually be replaced or an additional quantity of molten magnesium chloride added.

The metal obtained from the furnace may contain as much as 10 per cent of the electrolyte, and is usually refined by remelting and skimming. Much difficulty from oxidation of the magnesium accompanies this part of the operation.

The Dow Chemical Co., Midland, Mich., also uses magnesium chloride as the raw material (11). The hydrous magnesium chloride, which is obtained as a byproduct from salt and bromine production, is mixed with common salt in the proportion of 4 to 1 and with a small amount of ammonium chloride; it is then heated in shallow vats over a slow coal fire, removing about 50 per cent of its combined water. The dehydration is completed in a second furnace. For the electrolysis, graphite electrodes are used as anodes, and cylindrical sheet-iron cells containing the bath serve as cathodes. The metal, after refining, runs as high as 99.0 to 99.5 per cent metallic magnesium, with magnesium oxide, iron, and carbon as the chief impurities.

2—*Improved Chloride Process.* A new chloride process was developed recently by the Magnesium Co. at Wolverhampton, England; it has been described by S. T. Allen (12). This process produces pure magnesium and also yields potassium chlorate as a byproduct; a very low net cost is claimed. Magnesite is the raw material used. For the electrolysis, the carbonate is converted into anhydrous chloride in the following manner:

The mineral is first calcined to the oxide, which is then ground and passed through a series of scrubbing towers. Into the milk of magnesia thus formed is passed chlorine gas, this chlorine being obtained from the cells in which the electrolysis of the chloride is being carried on. The reaction results in the formation of chloride and chlorate of magnesium in solution. The solution is concentrated, and on cooling, half its content of magnesium chloride separates out. To the mother liquor is then added potassium chloride in amount equivalent to the magnesium chlorate present; potassium chlorate, being much less soluble, crystallizes out almost quantitatively. After washing and recrystallizing, the potassium chlorate is ready for the market. If this salt cannot be marketed, complete conversion of the chlorate to chloride may be obtained by the addition of nickel oxide. The mother liquor from the potassium chlorate crystallization is returned to the system, and is concentrated so as eventually to yield all of the magnesium as chloride. The crystals of magnesium chloride are satisfactorily dehydrated by a new process. They are first passed through a hydro-extractor to remove adhering water, and then exposed to a current of air at about 150 deg. C. for several hours. Half of the combined water is thus removed, with the formation of only a little magnesium oxide. The partly dried material is now treated with dry hydrochloric acid gas at about 300 deg. The rest of the water is removed, magnesium oxide is converted to chloride, and the product is over 99 per cent magnesium chloride.

The electrolyte is prepared by mixing a little dry potassium or sodium chloride with the magnesium chloride. Molten magnesium floats on the surface of this electrolyte, but the use of diaphragms is avoided by the use of a two-stage operation analogous to the Ashcroft sodium process. In the first stage the bottom of the cell is covered with a layer of molten lead, which serves as cathode and dissolves the magnesium liberated by the electrolysis. The cell is constructed of cast steel lined with firebrick, and is provided with a gas-tight, cast-iron cover carrying the anodes of graphite. Openings are provided for carrying off the chlorine liberated at the anode, used in the chlorine preparation as outlined above. The molten electrolyte rests on the lead to a depth of only about 1 in., and the anodes dip into the bath about ½ in. Both the electrolyte and the molten lead are circulated.

This cell is operated with about 5,000 amperes, which gives a cathode current density of about 1,500 and a voltage drop of 5 volts across the terminals. The cell is self-heating through its resistance to the passage of the current. The current efficiency is about 85 per cent, and the production of a cell is about 100 lb. of magnesium per twenty-four hours, as lead-magnesium alloy.

The cell used for the second stage is similar. In it, the lead-magnesium alloy acts as anode, the electrolyte is the same as in the first cell, and the cathodes are steel rods of small diameter suspended from the roof of the cell. The molten magnesium collects around the cathodes on the surface of the electrolyte, suitable means being provided for its removal. No chlorine is liberated in this cell, as the chlorine anions recombine with magnesium from the molten anode as fast as they are liberated, maintaining the concentration of the electrolyte. The second stage thus virtually consists of an electrolytic refining of impure magnesium. The lead-magnesium alloy is circulated and is returned to the first stage for enrichment in magnesium as it becomes depleted in the second stage.

The second cell is worked in series with the first, receiving 5,000 amperes, and absorbing 2 volts. The total energy consumption for 100 lb. of magnesium in twenty-four hours amounts to 8,500 kw.-hr.; this corresponds to an energy efficiency of 40 per cent.

The purity of the magnesium produced in this process is over 99.5 per cent. This grade of metal may be melted in open vessels without danger of its catching fire.

3—*Oxide Process.* The oxide process, consisting of the electrolysis of magnesium oxide fused in a suitable bath, is used exclusively by the American Magnesium Corporation, Niagara Falls, N. Y. (17). Californian magnesite is calcined and then electrolyzed in a bath of mixed fluorides, chiefly magnesium fluoride. A specially developed electrolytic furnace is used. The lining is simply unfused electrolyte, which remains in the solid state owing to its contact with the cool walls. Magnesium oxide is added continuously to the bath, while magnesium metal is removed at one electrode and carbon monoxide is evolved at the other.

The fluoride bath will dissolve only about 0.1 per cent of magnesium oxide (21), compared with a solubility of about 20 per cent for alumina in the fluoride

bath used for aluminum extraction. Strictly speaking, the process is directly an electrolysis of the fluoride rather than the oxide. It has been suggested that the mechanism is as follows (19):

$$MgF_2 = Mg + F_2$$
$$MgO + F_2 = MgF_2 + O$$
$$C + O = CO$$

It is evident that the presence of sodium or chlorides is avoided in this process, so that the metal is free from the detrimental effects of these impurities. The metal may be refined by remelting in small retorts. The power consumption is high, but this cost is counterbalanced by the low cost of raw materials.

Details of the process have not been published. Some figures bearing on it may be obtained from the specifications of an oxide process patented by G. O. Seward (22). In this process an electrolyte of magnesium, barium, and sodium fluorides is used in a carbon-lined pot of the same size and shape as the usual aluminum furnace, with anodes of carbon or graphite. Copper is placed at the bottom of the pot, and, in starting, the electrolyte is melted by arcs from the carbon anodes to the copper. The magnesium liberated at the cathode is absorbed by the molten copper. Soon after starting, magnesium oxide is introduced upon the surface of the bath and thereafter is added continuously, stopping the liberation of fluorine at the anode. The specific gravity of the electrolyte is about 3.2 and its melting point about 835 deg. C. A good working temperature for the electrolysis is stated to be 950 deg. The compound $MgF_2.2NaF$ melts at 825 deg.; a lower melting point may be obtained by using a mixture of 50 per cent MgF_2, 12.5 NaF, 25 BaF_2, and 12.5 LiF. This mixture melts at 678 deg. Other patents of this nature are available, but their practicability is doubtful.

Development of Magnesium and Aluminum Similar

The story of the development of the aluminum industry forms one of the most interesting chapters in metallurgy. It is strikingly paralleled in some respects by the development of magnesium. Though the latter lacks the spectacular features and the rapid growth of aluminum production, the extension of the development which has begun may eventually lead it to a position as important as that of aluminum today. Both metals were first produced by sodium reduction; the expensive sodium process was replaced by the chloride electrolytic process; and although the oxide process now used universally for aluminum—and successfully used as early as 1886 for that metal—at first appeared impracticable for magnesium, it has eventually been developed. Whether it will become the only process, as in the case of aluminum, seems doubtful.

At the Cleveland meeting of the American Institute of Chemical Engineers, June 14, 1916, Prof. Joseph W. Richards regretted the tardy development of the metallurgy of magnesium, and suggested (8): "The point of attack should undoubtedly be to reduce the oxide directly. The halogen salts are hydroscopic, and the halogen is destructive of the reducing apparatus. It is almost certain that proper research will enable the electrometallurgist to feed magnesium oxide directly into an electrolytic bath of fused salts and take magnesium or magnesium alloy from it. The pure metal will float on almost any fused salts, but its alloy with heavier metals may be made such as to sink, and many of its alloys have immediate useful applications." This line of attack has since been realized, but in the meantime development of the chloride method has also progressed.

Forms of Commercial Magnesium

The products marketed by the American Magnesium Corporation include extruded ingots, sheets and plates, tubing, rods, wire, ribbon, powder, castings, and alloys of magnesium. The extruded ingots are graded as follows: No. 0 contain 99.99 per cent minimum; No. 1, 99.85; and No. 2, 99.00 per cent.

The impurities which may exist in commercial magnesium are divided into two general classes, non-metallic and metallic. The non-metallic impurities usually present are salts of magnesium, including the oxide and chloride; salts of other metals such as calcium and sodium chlorides; and carbon. These impurities may enter in the manufacture of the metal or in some subsequent remelting operation. They are suspended mechanically in the metal, but do not dissolve or form compounds with it. On account of the low density and the ease of oxidation of the molten metal, the elimination of these impurities by drossing is difficult. The metallic impurities commonly associated with magnesium are silicon, aluminum, barium, calcium, iron, sodium, and potassium. The effects of these impurities are rather complex; they are discussed in the handbook "Magnesium," published in 1923 by the American Magnesium Corporation.

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Industrial Uses of Diamonds

Mining Industries Are Prominent Consumers of These Valuable Stones

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Sydney H. Ball

ALTHOUGH diamonds were used by the Greeks ornamentally prior to 400 B.C., and although the Greek and Roman gem engravers used fragments of some hard mineral in cutting cameos and intaglios, there is no satisfactory evidence that either nation used the diamond industrially. We must look to the East for the earliest recorded industrial uses of diamonds, which certainly antedate 1,000 A.D. and the ancient Sanscrit saying "The Vajra (diamond) can only be cut by the Vajra" suggests a much earlier date. There are three well-defined varieties of diamonds, all of which are used industrially; first, the crystallized or gem variety; second, bort (bortz, boort, boart, or bowr), a round form with radiate or confused crystalline structures; and, third, carbonado (black diamond, carbon or "carbonate"), an impure aggregate of small diamond crystals, forming a rock of porous-granular to compact texture and without cleavage. In the trade, the definitions of gem and carbonado are followed, but the term "bort" is extended to all impure diamonds, and even to fragments and powder of gem diamonds, provided, on account of their small size or because of impurities, they are valueless as gem stones. Especially fine bort of round form, composed of crystals radiating from a common center, is known as ballas (balas or bolas).

Carbonado in important quantities is found only in the State of Bahia, Brazil, although a little is also obtained from Borneo and from the Brazilian State of Minas Geraes. The Bahia carbonado, occurring in stream gravels in association with gem diamonds, was first found in 1843, although up to about 1856 it was thrown aside as waste. In fact, commercial production did not begin until 1865. The production of carbonado in Bahia is not definitely known, but it probably annually approximates 20,000 to 30,000 carats, including not only that which is legally exported, but also stones that are smuggled out of the country. At present production it is nearer the lower figure.

Owing to its low value in the early days of the industry, carbonado was sent to Amsterdam in ordinary kegs. In 1843, it is said that carbonado was worth only 1c. per carat; from 1850 to 1870 about 25c. per carat, and in 1871 and 1872 approximately 50c. per carat. During this period it was used as diamond powder. In Fig. 1, per carat retail prices of carbonado (good-grade stones weighing from 2 to 3 carats) from 1879 to 1924 are plotted, the price given being the average of a number of quotations. The highs and lows in the carbonado and gem-diamond price curves are independent of one another. European carbonado prices are considerably lower than those in America, but the goods there sold are of relatively inferior quality. The value of carbonado increases with increased size of stones, the per carat value of a quarter-carat stone being about one-half that of a carat stone, and that of a stone of over 3 carats almost double that of a 1-carat stone. As no new carbonado areas are being found, and as the demand for it is increasing, the price should advance.

True bort occurs in the Brazilian alluvial deposits, in the South African pipe and alluvial mines, and in the British Guiana alluvial fields. The best are the Brazilian ballas, which are equal in value to the better grade of carbonado, but the yearly production of such stones is probably only a few hundred carats. The various grades of bort are divided into Brazilian, Cape round bort (kogel-boart), Cape ballas and Brazilian, Australian, Southwest Africa Protectorate, and South African bort. The South African bort is known by the name of the mine from which it is obtained.

The price of bort varies according to grade and the size of the stone and averages approximately 25 per cent that of carbonado.

The "rejections" from the pipe and alluvial diamond mines are also sold as bort. Almost one-half of the South African pipe mine production is suitable for industrial uses only, but the alluvial mines produce relatively less poor material. In consequence, should the world's diamond production in a certain year amount to 3,650,000 carats, with 2,000,000 carats from the pipe mines and 1,650,000 carats from the alluvial mines, the production of bort would be approximately 1,400,000 carats. In cutting gem material, a further quantity of diamond dust and small fragments is produced which would perhaps increase the amount of bort, speaking in the commercial sense, to between 1,800,000 and 2,000,000 carats.

In recent years, the use of industrial diamonds has been greatly increased, because of the fact that their use speeds up manufacturing and at the same time

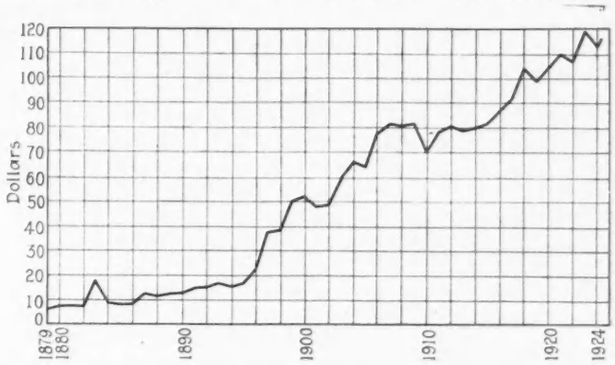


Fig. 1—Graph of retail price of carbonado per carat. Good 2- to 3-carat stones

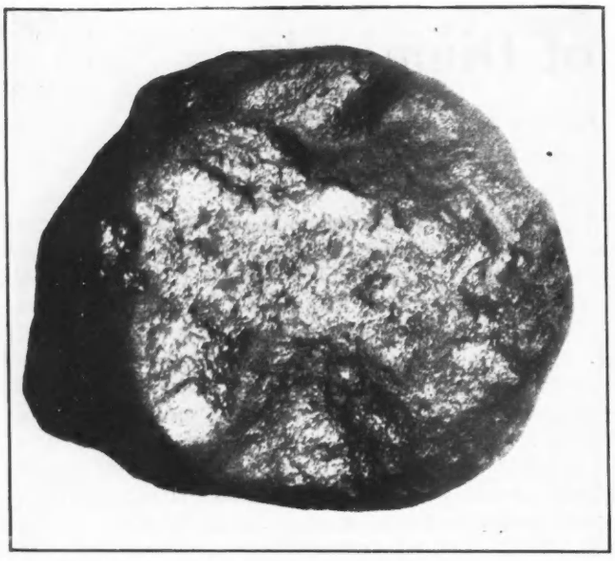


Fig. 2—Carbonado weighing 922.10 carats. Seven-eighths natural size. This and two other photographs in this article were furnished through the courtesy of I. C. Van Itallie Co., United States representatives of J. K. Smit & Zonen, Amsterdam, Holland

improves the quality and accuracy of many manufactured products. The war notably broadened the demand. Owing to its highly developed industries, America is the largest consumer of industrial diamonds.

The world's production of bort, if it be 1,800,000 to 2,000,000 carats per year, has a value of from $7,200,000 to $8,000,000. In addition, Brazil probably produces 25,000 carats of carbonado, worth at $40 per carat, $1,000,000 in value, giving a grand total of from $8,200,000 to $9,000,000. Though no authentic figures are at hand as to the world's demand for industrial diamonds, it is believed that the unmounted stones annually consumed have a value of from $6,000,000 to $8,000,000 and that the price of the finished product to the ultimate consumer is considerably more. Of the above, 20 per cent is represented by carbonado, an approximately equal sum by true bort, and the rest by diamond dust and fragments. The supply of carbonado and ballas scarcely equals the demand, but with the increased production of gem stones now taking place, a stock of low-grade bort and diamond dust is being built up.

Most mining enginers, because of their familiarity with the diamond drill, infer that mining and oil exploration are the most important users of industrial diamonds. Such is not, however, the case, and though it is difficult to determine the relative importance of various uses of industrial diamonds, it is probably thus:

1. Lathe tools (bort and carbonado).
2. Diamond dust (all varieties).
3. Diamond dies for wire drawing (gem stones and some ballas).
4. Diamond drills (largely carbonado).
5. Glass cutting (small bort and gem stones).

Diamond-Set Lathe Tools.—Diamonds are cut into various shapes and set in lathe tools which are used for a large number of purposes. In addition to the increased speed attained by the use of such tools, repeat orders may more satisfactorily be turned out, as the tool wears away very slowly. The use of diamond-set lathe tools was tremendously increased during the war, and they are replacing alloy-steel tools more and more each year. Carbonado is most suitable for this purpose, as it is less likely to fracture than are the other forms of diamond, and, as it is non-crystalline, it can be more readily shaped than can the other varieties. On the other hand, bort, because of its relative cheapness, is perhaps even more extensively used, and this is the largest single use of bort.

The most important and a constantly increasing use of such tools is in truing abrasive wheels so that they function properly. They are used also to shape wheels for grinding special parts. The use is particularly large in motor factories and munition shops. With small wheels, hand tools are used, but in shaping the larger wheels the tool is held fast in a tool post. Carbonado is alone suitable in dry turning, but the process should always be carried on with an ample supply of water. In America, 85 per cent of the stones used are ballas or bort, the rest being carbonado. The supply of well-crystallized Brazilian bort is inadequate, and the 1915 price of $8 to $15 per carat had doubled or quadrupled by 1917. The stones used for truing larger wheels weigh from 1 to 5 carats. When badly worn they are reset or used for truing smaller wheels. Some American factories buy the tools and others buy the stones and set them as required. The position of the diamond setter in some large automobile factories is now well established.

Diamond-set lathe tools are also used for cutting tough substances, such as hard rubber, ebonite, vulcanite, ivory, electric-light carbons, in pen manufacturing, tobacco-pipe making, and for the shaping and finishing of hard-rubber parts of water meters and insulating devices. Pen makers also use the diamond in chasing and engraving holders. It is stated that over 100,000 pen pieces can be cut without resetting the diamond in such tools. They are also used to shape felt rolls used in paper mills. A steel tool on this hard, fibrous substance scarcely makes an impression, but a diamond-set tool quickly gives the roll a smooth finish like that of polished wood.

Diamond-set lathe tools have for some years been used for finishing accurate turning work, such as the axes of transits. Particularly since our entrance into the war, diamond tools have been used in turning the tough aluminum and bronze alloys and the hard silicon alloys. Many of the parts of the Liberty motors were shaped by diamond lathe tools. The present use of such tools in the construction of parts of automobile motors is extensive, it being stated that one motor factory alone annually uses industrial diamonds to the value of $150,000.

Lathe tools are also used to cut out watch glasses, to cut granite, gneiss and other hard stones; to shape steel-alloy tools; to true saw blades, and to fashion precious stones.

Diamond Dust.—Diamond dust is produced in cutting and polishing diamonds, and in addition bort and carbonado are crushed to furnish it. The material is crushed in air-tight steel mortars and is then screened or is fractionated by floating in olive oil.

Immediately prior to the discovery of the South African diamond mines, diamond dust was worth from $1.20 to $4.50 per carat, but the opening up of the South African diamond mines tremendously increased the supply and broke the price. By 1902, the price

had again climbed to $2 per carat, but the opening of the Premier mine in 1903 again broke the market, and in 1909 the quotation was only 75c. per carat. Since then prices have increased to $4 per carat, but the supply now available appears to be sufficient for any probable future needs, and in consequence, prices are not likely to go higher. The optical trade prefers carbonado dust, and is willing to pay up to about $5 per carat for it.

Diamond dust is a superior abrasive, due to the rapidity with which it does its work (hence reducing labor costs); and as its grain size is not rapidly reduced, it does even, dependable work. Carborundum and other cheaper abrasives are, however, used on softer materials.

Diamond dust is used (1) in polishing diamonds. The diamond cutter's wheel was probably introduced in 1476 by Ludwig von Berquem of Bruges. The mixed oil and diamond dust from the "lap" was formerly thrown away, but is now saved, $40,000 worth of dust having been reclaimed from the Amsterdam ateliers in 1919. (2) The dust is either beaten into small circular saws of phosphor-bronze, brass, steel, or copper, or, immersed in oil, is fed on their edges. Diamonds and other hard gems are thus sawed. Wires fed with diamond dust were so used in Europe as early as 1647, according to De Laet, but have been superseded by phosphor-bronze wheels. Hard precious stones are also sawed into plates (or "bolts") to be made into watch jewels. Watch jewels were introduced early in the eighteenth century by Nicolas Facio. The industry centers in Switzerland, but at least one large American firm makes its own jewels. Diamond powder is also used in shaping and polishing the jewels and a diamond drill in piercing them. This consumption of industrial diamonds is important.

Optical glass is also split with similar saws, as in instances are alloy steels.

Diamond-dust-fed copper or soft iron wheels of small size are used, together with tiny diamond-pointed drills, in cutting intaglios and cameos, and diamond dust is used in polishing them. Forgers of antique gems touch their finished product with a drawing stump, covered with diamond dust, to remove the aspect of newness, which mitigates against the sale of their product. The same effect is produced by a miniature "sand-blast" of diamond dust. (3) Holes are bored in precious stones by spinning a copper or iron tube or drill, fed with diamond dust and oil. In instances, at least, the hole is started with a diamond splinter. Even diamonds are bored to be strung on necklaces, the start being made with a diamond point and finished with a diamond-charged steel point. David Jeffries, writing in the middle of the eighteenth century, says that Hindoos practiced the art, and in Europe it survives today at Ghent and Venice.

Dies for Wire Drawing.—One of the principal uses of industrial diamonds is for wire dies. The value of diamond dies sold annually in the United States is said to approximate $3,000,000, and a further $2,500,000 is spent yearly for dies in Europe. The cost of a die is made up about as follows: Stone, 40 to 46 per cent; diamond dust used in grinding, 22 to 30 per cent, and labor, 30 to 32 per cent. The first patent covering diamond dies was taken out by Brokedo, in England, in 1819, although dies were not used commercially until 1868. The first use of such dies in the United States was at Wallace & Sons' plant at Ansonia, Conn., now owned by the American Brass Co. The stones used are cleavage plates or thin crystals ("flats") and ballas. They weigh from a half carat to 10 carats. A hole, tapered at either end, is started in a thin fragment of diamond by a diamond point and is finished by a steel drill fed with diamond dust, the process being a long and tedious one. The small plate of diamond is then mounted in a brass or monel metal disk. When by use the aperture of a die is enlarged, it is re-drilled to draw the next larger size of wire. The average life of a die is about two years, the extremes being a few weeks and twenty-five years. The die produces a wire of uniform size and high polish, even when of very fine gage. The wires drawn vary in diameter from 0.114 in. (2.9 mm.) to 0.0008 in. (0.02 mm.), although holes as small as 0.0004 in. (0.01 mm.) have been used. In drawing fine wire, several successively smaller dies are used, and in some instances, at least, the diamond die is used only in the last drawing. Owing to the high cost of such dies, other hard stone or alloy steel dies are frequently used for the coarser work.

Dies are made principally in the United States, France and Germany, and recently their manufacture was begun in Japan. In America some of the larger wire manufacturers make their own dies. Because of the expected prosperity of the electrical industry, the use of dies will undoubtedly increase greatly within the next few years. In making tantalum, tungsten, and osmium filaments for electric lamps, the metal is said to be heated to 300 to 400 deg. C. before drawing. Copper, gold, silver, brass, bronze, iron, platinum, monel metal, nickel, and crucible steel wires are also drawn through diamond dies. The metals are named in the order in which they wear the dies, and in the case of the harder metal the diamond consumption is high. From 300 to 400 tons of copper wire can be drawn through a single die without variation in gage.

Diamond Drilling.—Diamond drilling is one of the more important uses of carbonado. In times of depression about 5,000 carats are used annually, and in boom times, in mining, the amount increases to from 7,500 to 10,000 carats. The process was invented in 1863, and is now so well known that further comment is unnecessary here, except to state that carbonados are by

Fig. 3—Splitting a large carbonado

far the most satisfactory stones to set in diamond drills. Ballas or bort, however, is, in instances, used in soft formations, due to the lesser cost of the material. The carbonado to be used in diamond drilling is broken into fragments weighing usually up to 3 carats, but, in instances, as much as 20 carats. As much as $25,000 worth of carbonado is sometimes used in drilling a single hole (for instance, that at Rybnik, in Upper Silesia, 7,000 ft. deep).

Glass Cutting.—In the sixteenth and seventeenth centuries, diamond crystals were set in rings with one of the points exposed, and these were used to engrave wine glasses and looking glasses. People then in high society used such rings to inscribe poetry on glass windows, the first recorded user being Francis I of France (1494 to 1547). Queen Elizabeth and Sir Walter Raleigh used to write verse to each other in this manner.

Natural crystals alone satisfactorily cut glass so that it breaks along the groove so produced. The cutting

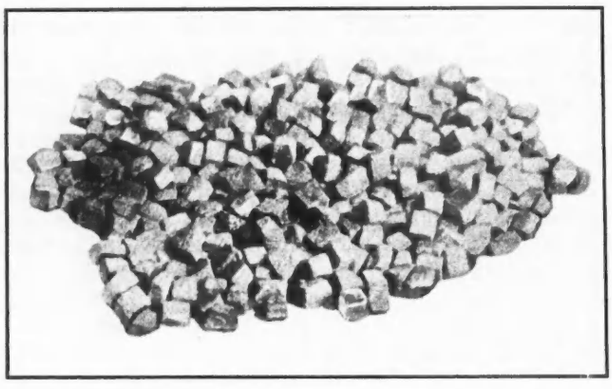


Fig. 4—A total of 329 pieces of carbonado each weighing a little less than 3 carats produced by splitting the carbonado shown in Fig. 2

edge is formed by markedly curved faces, meeting in a not too obtuse angle, the curved rhombic dodecahedron being particularly satisfactory, but octahedrons are also used. The stones used, frequently of gem quality, are small and vary in size from 1/80 to ¼ carat, most of them approximating 30 to the carat. The majority of glaziers' diamonds come from Brazil and Borneo, and good stones are scarce and the price is high (about $40 per carat). The diamond is set in a fusible metal, to which is attached a handle. Once an edge is dulled, the stones are reset in the tool. In addition to the cutting of window panes, the edges and ends of rolled plate glass, after it comes from the annealing kiln, are trimmed with a diamond of adequate size. Although a small quantity of stones is used for this purpose, it is one of the most familiar industrial uses of diamonds.

Diamond Points.—When diamonds are crushed for dust, sharp fragments are picked out, and these, together with sharp natural crystals and artificially shaped points of carbonado or bort, are used for many purposes, among them being:

1. In cleaving diamonds, a diamond with acute edge called a "sharp" is used to cut a depression into which a blunt steel knife is later inserted. Cleaving was known both in India and in Europe at least early in the seventeenth century. In Europe, the art was lost, only to be rediscovered by Dr. William H. Wollaston, in the eighteenth century. He made a modest fortune by cleaving poorly shaped or spotted diamonds.

2. The use of diamond points set in drills is widespread, particularly in boring holes in watch jewels, in drilling eyeglass lenses, in piercing pottery to be repaired, in drilling holes in porcelain teeth, and in drilling holes in other precious stones, as in agates at Oberstein. Extreme accuracy of gage is obtainable.

3. Much fine etching (the engraving of divisions on balances, glass engraving, sketching designs on precious stones before engraving and lithographing) is done with a diamond point.

4. In cutting the deeper depressions for intaglios, a diamond point is still used.

Diamond-Set Saws.—Diamond-set saws are used in Europe rather extensively, and in America to a less extent in dressing building stone. Circular saws are most common, although band saws are also made. The stones used are carbonado and bort of relatively small size (½ to 1 carat).

Miscellaneous Use.—The pivot supports of high grade chronometers and other delicate instruments are sometimes made of diamonds, but the cost of the material and workmanship is, except in rare instances, prohibitive. Diamonds are also used for bearings of large-capacity electric meters and for balances. At present, five American firms manufacture gramophone diamond reproducing points. Small pieces of bort are turned with a diamond tool into a cone about $\frac{3}{32}$ in. long, which is then set in a brass or nickel shank.

A ballas set in a holder is used by some diamond-drill firms to test hardness in selecting carbonado. Bort and carbonado are also set in instruments with which the radiating sharp-edged furrows on the grinding surfaces of millstones are cut. It is reported that, in instances, bort is used in brutting diamonds, but for this purpose both stones used are usually gems.

Obsolete Uses.—About 1825, Pritchard cut diamond lenses, but the optical anomalies disclosed and the cost of manufacture proved the stone unsuitable for this use. By cleaving gem diamonds, thin transparent guard-covers for miniatures are produced. At Queen Victoria's coronation, certain of the guests were given the Queen's likeness protected by a film of transparent diamond. In Shantung, China, the diamond is reported to have been used at times as currency, and such was the case to a limited extent at least in the eighteenth century in Minas Geraes, Brazil.

Diamond dust, formerly used in polishing granite and other building stones, has been largely supplanted by carborundum and other abrasives. Sixty years ago, channelers and gadders set with carbonado were widely used in the marble quarries in New York and Vermont.

In the Middle Ages, a diet of diamond dust was a supposedly efficacious method of disposing of one's enemies.

I cannot close these notes without recounting that in the chivalrous days of Louis XV of France, a lady of the court desired the portrait of her bird in a ring, and this the last Prince de Conti asked permission to give her. She agreed, provided no precious stones were used. Upon receiving the ring, however, she found that the miniature was covered by a diamond; the stone she indignantly returned, but kept the portrait. The Prince, not to be outdone, crushed the diamond, and with its dust dried the ink of the note he wrote to her on the subject. The Diamond Syndicate does not report that large quantities of diamonds are used for this purpose at the present time.

Discussion

The Wastage of Petroleum—Its Reality

Henry L. Doherty, advocate of the so-called "Doherty Plan" of oil conservation, replies to recent criticism

THE EDITOR:

Sir—My attention has recently been called to a communication in your issue of April 11 by H. A. Wheeler. Mr. Wheeler states that "The recently appointed U. S. Oil Conservation Committee consisting of four Cabinet officers resulted from the numerous addresses by H. L. Doherty. . . ."

I have not made numerous addresses and I do not recall making but two public addresses on this subject. I ought to be immensely flattered if I could feel that I had created such nation-wide interest in this problem that President Coolidge felt warranted in creating such an important commission as one made up of four members of his Cabinet to give consideration to representations based solely on my statements made before two relatively small audiences and with no corroboration.

Whether the men in the oil industry admit or deny that there are any wastes in the petroleum business, the great mass of thinking people do believe that these wastes prevail and I might deceive myself should I take any credit for my efforts except that possibly I have crystallized this widespread public opinion into action.

If the statements made in my various addresses are "highly misleading," as Mr. Wheeler says, then the men in the oil business other than Mr. Wheeler are sadly remiss in their duties not only to the industry but to the public as well in not calling attention to this fact, and even he should have spoken sooner. However, it is my opinion that it is worse than useless for the men in the industry simply to deny that these wastes exist. There are so many people who thoroughly believe that these wastes do exist that for the industry flatly to deny the fact will simply rob the industry of some of the confidence and good will that we still enjoy, unless those who deny the existence of these wastes can come forward with convincing proof to sustain their position. If these wastes do not exist, the industry has at last not only a fair tribunal but a highly intelligent one to which it can demonstrate that there are no wastes and opinion to the contrary is all wrong.

Mr. Wheeler accepts the statement that 70 to 80 per cent of the oil is left in the sands and that it is the natural gas that drives the oil out of the sands. I do not think there is a single petroleum engineer who will maintain that there is no waste of gas and if the exhaustion of gas determines the amount of oil left in the sand, then it is obvious that this waste of gas is also a waste of oil.

Overproduction is, in my opinion, also a waste. Some industries must have petroleum, and have nothing in sight that they can substitute for it. If we rip oil from the ground unnecessarily and use it to displace cheap steam coals, this is as much a waste for the industries that must have petroleum as though it were burned at the mouth of the well, or left in an unrecoverable condition in the sands. If there is no overproduction, as many contend, even though we are producing oil faster than it is needed for purposes other than ordinary fuel uses, then by that process of reasoning we cannot consider that we have an overproduction of oil until we are draining our remaining oil reserves at a rate that will displace the last pound of coal and there still remains oil which can find no market.

Mr. Wheeler's argument that overproduction leads to lower prices might appeal to an unthinking crowd, but not to the thinking class of our people. Petroleum is a rapidly wasting asset and the saving the buyer gets today through overproduction may cost him dearly for the rest of his life. Again, we must remember that the losses described by Mr. Wheeler in the production of oil must at least offset the saving made by the buyers of petroleum or else we are no better off as a nation.

Oil is our most important munition of war and if we can conserve our remaining resources of ground oil and make these resources immediately available for our increased needs in case of war, this will give us such a tremendous advantage over any other nation in case of war that this alone can easily be the determining factor. No other formidable power can create abundant ground resources of oil as we can do and it is folly for us to waste these resources needlessly and shorten the period through which we may enjoy the protection these ground reserves of petroleum provide.

Those who talk so glibly about our shale beds are talking pure moonshine so far as they can be considered as a war resource, and worse than this when contrasting our position with other nations. Many of the other nations not only have shale beds sufficiently extensive to provide for many years to come for all of their war and industrial needs, but these shale beds are better located in relation to their seaports and their industrial centers.

Mr. Wheeler assumes that I want to put one well to each five or ten acres. This is not what I want to do, and I don't think I have at any time made a statement that can be so construed. I want to drill whatever number of wells are necessary and so locate them as to produce the greatest possible amount of oil within the range of economy. The frequency and location of these wells will be determined entirely by the nature of the pool. On a regulation structure with gas in the upper horizon, oil in the intermediate horizon and water in the bottom horizon I would, for example, endeavor to sink my wells into the oil horizon without regard to alignment or regularity of distance at the surface of the property.

I have been courageous enough to make the statement that in my opinion at least twice as much oil can be recovered on the average by unit operation of pools than under the present system. Most petroleum technologists have struck me as being rather timid about making public statements as to what can or cannot be done. I therefore admire Mr. Wheeler's courage when he says that in his opinion double as much oil is recovered under the present system as under the system proposed by me. This is an amazing statement to me, because if we were developing pools as units we could, if we wished, do everything as we do it now, or we could do anything which brought better results. Under our present system we are powerless to do anything except what we now do.

It would certainly be an interesting target to shoot at if any reputable petroleum engineer were willing to come out with a public statement saying that he would have developed any of these pools if allowed to work under the "unit" system and would have done it in the same way it has been done.

At Cromwell my engineers estimated at one time as much as 500,000,000 to 700,000,000 cu.ft. of gas was being blown to the air every day. They also stated that other men had estimated that as much as 1,200,000,000 cu.ft. was being blown to the air each day. If the larger amount is correct, it represents a waste of energy equivalent to 48,000 tons of coal a day, or 200,000 bbl. of oil. Cromwell, I will admit, was an exceptional case and possibly all of these figures are overestimated, but there is no gusher pool in which there is not an inexcusable waste of gas that could be almost entirely avoided if the pools were developed as units. A waste of gas at the surface, I hold, means an inevitable underground waste of oil by leaving it unrecovered in the sands.

Mr. Wheeler draws a commonplace and unsensational sketch of the rise and fall of the average pool. He tells nothing of the repugnant conditions under which the men must live and work, and yet the mild description given by Mr. Wheeler of what happens in an oil pool must seem to every intelligent reader who is familiar with the conditions under which nearly all other industrial operations are carried on, as representing scenes more appropriate to an old-fashioned "mad house" before we had our modern insane asylums rather than the scenes which actually take place in the most important branch of one of our greatest and, perhaps, our most distinctive American industry.

If there were no oil wastes as Mr. Wheeler contends, how can we justify such shocking economic wastes as even those described by Mr. Wheeler? Surely such deplorable conditions and of such huge magnitude afflict no other industry.

There is an old saying that "familiarity breeds contempt," and oil men have grown used to scenes and conditions which would shock the senses of the people of all other occupations. HENRY L. DOHERTY.

New York City.

Du Ponts Not Retiring From Chile

THE EDITOR:

Sir—In your issue of March 28, page 542, under the heading "Chilean Nitrate Industry Has Hard Fight Ahead," I find the following statement:

"Significance is attached in Washington to the reported intention of the du Ponts to retire from Chile and sell their nitrate lands. They have embarked in the synthetic industry at Clinchfield, West Virginia."

We do not know the origin of the reports of our intentions, but whoever started them used his imagination without any basis in fact. We have at this time no intention of retiring from Chile or selling our nitrate lands. The report quoted above can be denied authoritatively. The erection by the Lazote company of a plant to produce ammonia by the Claude process is not expected to affect our Chilean operations.

We do not like to be compelled to discuss such rumors, but this statement seems to be going the rounds of the trade press, and I think, since we were not asked for authoritative information before publication, our position should be made clear.

Wilmington, Del. CHARLES K. WESTON,
Manager Publicity Bureau.

Unique Americana

THE EDITOR:

Sir—There may be many things in this fair land that are typically and originally American. There is the thirty-story skyscraper, and the rapid transit in huge tunnels underneath its foundations; there is the standard mass production of the Chicago packers and Ford's billion-dollar jitney; there is the pipe-line transport and the whole towering edifice of "liquid gold"; there is the climate of Florida and California and their enthusiastic booster gang; there is the Indian brother, Poor Lo, though he may be sitting pretty today on oil royalties from Oklahoma; but, for my part, give me a decaying mining town of the Wild and Woolly West!

Here have been gathered all that unique horde of thirsty souls who hunger for adventure and spectacular and sudden wealth. One "find" of gold-sprinkled rock will make a mining town in the most desolate spot that Nature's God forgot. Such a "find," reported and shown in Tonopah, Goldfield, Denver, Bret Harte's Havilah, or any little post-office center along the Mother Lode—and the rush is on. Twenty-acre claims are staked out by the early-comers as near to the "discovery" property as the staker's turn will allow. Tents and rough board shacks are thrown up almost over night, and a new mining city is in full bloom.

Before the dry law went into effect, every such rush in the mountains of the West was accompanied by the gambler, the booze peddler, and the red-light girl. The girl still camps on the appetites and passions of men in the mining town, but the others must carry on in the "blind pig" and the "go-down." The men who follow the tempter of gold are the same today, yesterday, and forever.

And yet they are the most human creatures on American soil today. They may claim to be "Original Americans"—Unique Americana. And why not?

Every man who "follows the game" consistently is known to his fellows by his first name, or by a nickname that suits him better. He stands on his merits of courage, of square dealing, and his ability to keep a promise. Many a man today respected and admired in the mining camps of the West might be followed back into a past that is far below the accepted social standards of the East. But here he stands on his merits "where a man's a man, for a' o' that and a' o' that!" The modest, self-respecting girl is safer today in the wildest one of these camps than in the crowded

streets of Chicago or New York. The essential possession is sturdy manhood, and many a slip and fall from grace is swiftly forgotten and forgiven because we are, after all, brothers beneath the skin.

But there is a peculiar contagious spirit in a Western mining town. One of experience may know when he drives into the business center of such a place whether the camp is on the "boom," a steady, consistent producer, or has gone "busted," and the life of the camp is on the wane. The signs are to be read in the faces and actions of the men and women and children congregated there. In a "boom" town every face is excited, and the voices are a trifle shrill. Laughter and horse-play come easily and are swiftly given back. The man's cigar is tilted to a sharp upward angle, the wide-brimmed hat is shoved back, and the dew of healthy perspiration glitters on the noble brow. What "night life" is left is inclined to be noisy and boisterous, for animal spirits run high in the "boom" town.

The proven steady producer likewise carries its stamp in the bearing and conduct of its citizens. Organization has here taken over the political affairs of the town. If she is a "big producer" there is a fine court house and an engine house, with its glistening modern fire-fighting machine. There will be a schoolhouse that is pointed to with pride, perhaps a church or two, one of which is sure to have a jolly Catholic priest installed. There will be an "addition" or two being put on the market by the typical "realtor," with his office downtown and his big car to take the prospect out to the new location. There will be a bank in a granite building, and stores well housed. The men and women and children congregated on its streets are serious and full of business. The shrillness has gone out of the laughter. Grave and weighty matters are occupying the minds and hearts of men. "Our town" is established now, and very much inclined to be the central hub of the universe. Such is the steady consistent producer, among mining towns of the West.

And then there is "the dead one," which, to the student of sociology in the rough, is the most interesting phase of all. No matter how promising the "boom," no matter how many years of consistent production lie to its credit, the mining town of the West is doomed to decay and death unless saved by a developing agricultural district within striking distance of transportation. Often so rude and raw is the nature of the country that carries commercial metal, so isolated is the district from settled areas, that the mining town goes through its three phases as inevitably as Fate.

Grass Valley saw its boom days, its years of steady production, and then decay. Recently a reincarnation has occurred when deep orebodies in commercial quantities seem to have been developed. When the ore is found to go to great depth the life of that mining town is indefinitely prolonged. These are the old fellows whose stock is listed on the New York Exchange, where dividends are steady and assured. They have joined up with the commercial age and are now producing the second generation of Unique Americana. A free and sturdy type is this second generation of the mining towns of the West. The fascination of the game of producing wealth out of the ground is born in their blood. Ordinary restraints of civilization mean very little to those young eyes. Time will tell!

There are many still and silent cities—"dead ones," in the mountains of the West. Bodie is a silent "one-man town," in its rarified mountain air, saved from extinction by lumbering interests in the near-by hills. In such a town that still hangs onto life with grim determination some old-timer, with more hope and determination than judgment, usually buys up the property as the less determined men and women seek other and fairer fields. This one man becomes gradually king of all he surveys. He will be banker, postmaster, merchant, stage driver, mine owner, and sole taxpayer if there is anything left to pay taxes on. A grim-beaked, silent, cold-blooded, miserly man, grimly tenacious, grimly hopeful of a return of the "boom days" when he can "cash in" and move to Long Beach. Sometimes it does, and he does; but oftener he is finally buried on a lonely hill, and a ghost city is left to weather away in the dry desert air.

An intermediate phase in this business of decay and death occurs when the big producers have stopped paying dividends, have laid off the mill force, are prospecting underground for new oreshoots, or frankly wildcatting in virgin ground in the hope of uncovering hidden masses of metal-bearing rock. This is often enough successful to make this a regular feature of mining life in the West. Such a town is Goldfield, in Nevada. The big fellows have closed up the mills and sold the contents to the junk man. Leasers are still working on property where there is a chance to follow stringers into possible "pockets" of ore, big enough to repay one or two men, but nothing for a "gang." The deep mines with plenty of money furnished by the owners of the old producers are sinking with modern machinery to try to strike the continuation of ore at greater depth and beyond the "faulting" that cut off the original pay rock. The remnant of the business of the town holds on in hope that is a little grim and sad because of memories of a past that is burned out and dead.

Randsburg, in Kern County, Calif., is a mining town which hardly knows in which class to place itself. It has seen the "boom" days of the Yellow Aster strike and all the little stringer gold mines in its neighborhood. It has seen the Yellow Aster close down except for its few sturdy leasers and the town spew its hectic life out into the Mojave Desert almost over night. It was almost a "ghost city" on its hill when a hectic resurrection drew back the adventurers with the discovery of immense tungsten deposits at Atolia, just around the hill. Again it died and was apparently buried forever in the blowing sands of the desert, when Hamp Williams and Bill Nosser stuck their tired feet into a prospect hole between Randsburg and Atolia and turned up the richest surface deposits of horn silver ever found. This gave Randsburg her third lease of life, and the great silver "boom" was on, with its rival mushroom towns springing up over night.

Then the war was over, and the price of silver dropped 50 per cent in just a few weeks. Most of the little silver fellows had to quit, although "Big Silver" continues working full blast. But the flow of "sucker money" has stopped with the flattening of this third "boom," and Randsburg hardly knows where she is at. The native booster has to take in a long courageous breath before he begins his song. The stogy of more prosperous days has a drooping angle, and the defensive posture has taken the place of the thrown-out chest. But the experienced Randsburgerite is furtively looking for an anchor to windward. The enforcement officers claim that everybody but the preacher is selling booze over there, and the natives claim, in sad lament, that

the market is ruined and shot to bits—too many peddlers and too few customers with money. It is the sign of the handwriting on the wall.

Legitimate mining is a great and prosperous business, especially in the areas of great deposits of the base metals like copper, lead, zinc, and the earthy salts like borax, potassium, nitrates, and table salt. Mining for the precious metals which occur in much smaller deposits is a great and fascinating gamble, in which many adventurous men have made and lost immense fortunes. All the side lines of real-estating and booming and boosting about any mining camp is just pure bunk to catch and separate the tenderfoot and the "sucker" from his money. One of these is born every minute, protected from the lot of slavery of pre-civilized times.

There is nothing more typically and natively American than these mushroom mining towns of the deserts and mountains of our Western states. If our children could inherit the experiences of the lives we have lived and profit by the lessons life has taught us, mining would lose its feverish taint of illegitimate gambling and take its true place as one of the great basic industries, with returns on a given supply of capital quite as sure as and rather higher than in any other line of industry in this commercial age. But our children cannot reap advantage by the lessons of the experiences we have had. The printed tale loses its glow and charm with the gambling chance removed. "Look before you leap" is elderly advice to hot young blood—for the leap into the dark is much the most exciting part of the game of growing up. So the typical hectic life of the "boomer" town of the mining West receives ever fresh impetus with each new "find" and its gathering hordes of adventure-loving tenderfeet. A. LAYMAN.

Kernville, Calif.

"The Smelters' Viewpoint"

THE EDITOR:

Sir—At the recent annual meeting of the American Zinc Institute in St. Louis, Mr. Wemple, president of the Illinois Zinc Co., speaking upon "The Smelters' Viewpoint," ventured the prophecy that the independent zinc ore producer in the Tri-State district might soon find himself without a market for his ore. Mr. Wemple then went on to say that the ore producer could not promote conditions which destroy his market without in turn hurting his own interests.

Mining and milling costs in the Tri-State district are published monthly in full detail, and it is well known that the current cost of producing zinc concentrates today is about $45 per ton. The current market price last week for zinc concentrates was $47.50 per ton. Mr. Wemple and other smelter men probably know that the average price paid for zinc concentrates in this district for the ten-year period 1904-1914 was about $42 per ton and the average cost of production was then little if any less than that figure. It is also well known that the average range of commodity prices today is about 50 per cent higher than was the average range from 1904 to 1914. Hence, in comparing the cost of zinc concentrates to the smelters today with the pre-war cost, the current price should be about $63 per ton. Consequently, anyone may see that smelters are obtaining their zinc concentrates in this district today relatively even cheaper than they did in 1914.

In this connection it is worth noting that Tri-State mining companies have improved their exploration, mining, and mine safety methods to a material degree since 1914, and a considerable and increasing number of them are effecting a mill recovery, due to improved milling practice, from 10 to 15 per cent better than in 1914. All of these things tend toward lower production costs. May we not inquire if smelter methods show equal improvement? It does not seem to me that Mr. Wemple's statements are well supported by facts.

At this Zinc Institute meeting a committee was appointed to look into the relations between the two branches of the industry, to see if a better relationship might not be brought about between miners and smelter men. In this connection it may not be amiss to refer again to a subject which has been discussed before, but which remains of fundamental importance to the zinc industry.

While the Tri-State district yields perhaps two-thirds of the zinc output of the United States, this yield comes from the mines of sixty to eighty different and independent companies. Consequently, no one company possesses large ore reserves, and therefore the work of exploration for new ore supplies is an important and continuous part of the business of mining for zinc, and "prospecting" becomes an art.

It may readily be seen that through such a period of depression as prevailed from the latter part of 1920 and through the year 1921, little incentive existed for spending money on exploration. However, with the return of normal conditions, prospecting has been resumed. The zinc-smelting companies have large capital investments of a permanent character and naturally desire steady and dependable ore supplies and preferably of the kinds of ore to which they are accustomed. Fair and steady prices for zinc concentrates insure that widespread and continuous exploration campaign which alone will yield the supply of ore necessary to meet the ever-growing needs of the smelters.

A fisherman is always willing to risk the loss of bait to catch a fish and a hunter willingly expends ammunition to bag his game. Are not those smelter men short-sighted who perennially try to buy their zinc ores at cost of production, thus destroying the incentive of the miner to find more ore? Such smelter men appear to group themselves with the man who killed the goose which laid the golden eggs (or should we make them—the eggs—of zinc?).

Joplin, Mo. TEMPLE CHAPMAN.

The Biggest Aluminum Producing States

THE EDITOR:

Sir—On page 694 of the *Mining Journal-Press* of April 25, 1925, I have noted a serious error. You are asked to state which are the biggest aluminum producing states; and you reply that "for example, Illinois is the leading producing state because the aluminum smelters are situated there, etc." As a matter of fact, not a single pound of aluminum is produced in the State of Illinois, but in that state bauxite, obtained from Arkansas and South America, is chemically treated to produce calcined alumina.

New York State is by far the largest producer of aluminum, on account of the two plants (formerly three) located at Niagara Falls and the large plant at Massena. The only other states which produce aluminum are Tennessee and North Carolina. P. H. FALTER.

New York City.

Consultation

Churn Drill Prospecting of Porphyry Copper Deposits and How It Checks With Actual Mining

"Have you any recent figures as to the check obtained by some of the porphyry copper companies of the West in mining their copper ores? I refer to the check between the churn drilling done while outlining or prospecting the orebodies, and the tonnage of copper ore and its content when finally mined."

The most recent and probably the best summary of the work of the churn drill at a porphyry copper property appears in the 1924 annual report of Nevada Consolidated Copper Co. in that section of the statement detailing the general operating record of the year—the report of C. B. Lakenan, the general manager of the company, to D. C. Jackling, the president. Mr. Lakenan in this report gives valuable technical information about the company's progress and devotes considerable space to the results of churn drilling at the mine in connection with the exploration of open pit and underground mining, and the accuracy of drill hole sampling. In the 1923 annual report, mention was made of the check obtained on the Copper Flat steam-shovel ore sections mined prior to Dec. 31, 1923, compared with the mill assay and tonnage returns of the same sections mined.

The statement was also made in that report that of the 30,701,796 tons of ore mined, averaging 1.55 per cent copper, the actual tonnage was 114.48 per cent of development expectancy, actual grade was 99.61 per cent of expectancy, and actual copper content was 114.04 per cent of expectancy. The assay plans indicated a total of 26,818,200 tons of ore carrying 1.556 per cent copper. Ore outline and assay value of the expected tonnage was based almost exclusively upon churn drill holes from the surface. Most of the excess tonnage came from the easterly and northeasterly part of the old Eureka pit, where the ore extended under extrusive rhyolite similar to the developments on the westerly side of the orebody and was not included in the original sections.

The Copper Flat orebody was prospected with 368 churn drill holes having an average depth of about 400 ft. Mr. Lakenan states that the result of the check is highly satisfactory and that it indicates clearly that drill hole sampling is as accurate as any other in developing large disseminated orebodies; that the copper grade of Nevada Consolidated holds fairly uniform between holes 200 ft. apart provided there is no change in the nature of the porphyry mass as determined by surface capping.

Nevada Consolidated draws about 79 per cent of its ore from steam shovel operations in open cuts and about 21 per cent from the Ruth underground mine. A table appears in the Nevada report for 1924 showing the sampling obtained by drill holes and the extraction actually resulting from underground mining. This table covers those portions of the Ruth mines that are considered finished, the first 50 per cent of ore drawn from branch raises, and includes the results of operations up to Dec. 31, 1924. The table follows:

Sampling of the Ruth Orebody of Nevada Consolidated Compared With the Extraction Obtained

	Expectancy		Extraction		Per Cent Extraction	
	Tons	Grade	Tons	Grade	Tons	Grade
3 Level	354,255	2.20	352,750	2.22	99.575	100.5
4 Level	121,200	2.21	121,559	2.26	100.2	102.6
5 Level Block I	839,120	2.27	874,768	2.03	104.2	93.2
5 Level Block II	201,132	1.94	192,181	1.79	95.5	88.2
5 Level Block III	206,875	1.77	212,047	1.65	102.5	95.5
6 Level Block I	236,280	1.73	234,862	1.60	99.4	91.9
6 Level Block II	1,320,859	2.01	1,429,170	1.87	108.2	100.7
6 Level Block III	1,713,420	2.09	1,754,542	1.85	102.4	90.5
6 Level Block V	164,218	1.79	171,115	1.62	104.2	94.1
7 Level Block I	68,610	1.66	71,080	1.52	103.6	95.1
6 Level Sub-scram	1,278	1.06	1,309	0.97	102.4	93.7
	5,227,247	2.06	5,415,383	1.88	103.6	94.8

According to these figures, the grade of the ore mined was 94.8 per cent of the grade computed by churn drill sampling, whereas 3.6 per cent more ore was extracted than originally estimated in the orebody. The figures would seem to show that a little dilution of the ore occurred while mining, which would have exactly the tendency shown by the table to raise the amount of ore mined and lower its grade. Whatever the cause, the results are remarkably close to the sampling and bear out Mr. Lakenan's conclusion about the accuracy of churn-drill sampling.

The Richest Ore of Molybdenum

"Please inform me which molybdenum ore is the richest in molybdenum. How many varieties are being mined commercially today?"

The rare mineral, ilsemannite, an oxide of molybdenum, is the richest molybdenum ore. Although its chemical composition and formula has not been definitely settled, it contains about 69 per cent metallic molybdenum. Another oxide, molybdite, $2(FeO_2).6MoO_3.15H_2O$, contains 66.7 per cent molybdenum. The next on the list is molybdenite, or molybdenum sulphide, MoS_2, which contains 60 per cent of molybdenum. This is followed by powellite, a calcium molybdate, $CaMoO_4$, containing 39.05 per cent molybdenum. Then comes wulfenite, a lead molybdate, $PbMoO_4$, carrying 26.16 per cent molybdenum.

Of the minerals listed, molybdenite, wulfenite, molybdite and possibly ilsemannite have been found in deposits of commercial importance. Molybdenite is the principal ore of molybdenum and, in the United States, is mined near Leadville, Colo., by the Climax Molybdenum Co. A regular market exists for molybdenite. Other molybdenum minerals are not produced in sufficient quantities to enable a steady market to be quoted. The high price of lead has helped to furnish a market for wulfenite.

Ilsemannite has been found near Ouray, Colo., and the deposit there has been partly developed, but is not producing. Molybdenum minerals occur in nearly every state of the Union, but seldom in sufficient quantity to justify mining. Very frequently they are associated with tin, tungsten, bismuth and copper deposits.

News of the Week

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

Summary

THE erection of a smelter near the town of Rouyn in Quebec by the Noranda Mines, Ltd., and the building of one or more railroads to the district seems assured.

The Interstate Commerce Commission has been memorialized both for and against the establishment of a low rate for zinc concentrate from Idaho to the Pacific coast.

The erection of a new reverberatory furnace and other improvements are under way at the Phelps Dodge smelter at Douglas, Ariz.

The new Tamarack reclamation plant in the Michigan copper country is in regular operation.

The Nevada Consolidated Copper Co. is milling 11,000 tons of ore daily in addition to direct smelter shipments.

Plans are completed for the consolidation of the Park-Utah and Park City Mining & Smelting companies at Park City, Utah.

The Hollinger Consolidated, producing $13,429,226 during the year, has increased its dividend rate from 5c. to 8c. every four weeks.

Operations of the old McCracken silver mine in Mohave County, Ariz., has been started by the New Signal Mines Co.

Good silver-lead ore has been cut by the Bunker Hill & Sullian company in its Pilgrim property in the Deadwood Basin in Idaho.

Exploitation of copper ore near Skelleftea, Sweden, is to be undertaken by Swedish interests.

Nevada Consolidated Milling 11,000 Tons Daily

Extensive Underground Operations in Pit Area in Two Years—High Extraction in Concentrator

An average of 11,000 tons of 1.1 per cent copper ore daily is being treated at the reconstructed milling plant of the Nevada Consolidated Copper Co., in addition to the tonnage of high-grade ore put through the smelter. Mill recovery at present is better than 92 per cent of the copper content and about 90 per cent of the silver.

The mill, which has a capacity of 13,000 tons daily, uses combined water concentration and oil flotation of all ore from the pit mines. Flotation tailings are put over scavenger tables using water concentration. High-grade ore from the underground mines at Ruth is treated in the smelter.

Costs for the first quarter of 1925 were 10.89c. per pound after crediting gold and silver. This includes plant and equipment depreciation and all fixed and general charges.

Information from authentic sources is to the effect that steam-shovel mining will be continued for another five years, when exhaustion of surface deposits will necessitate underground mining. Extensive underground mining within the pit areas will begin in two years, however, and preparatory work to that end is already under way. Four new roasters and a concentrate feeding system have been installed with increased efficiency in performance and costs. A new 12x30-ft. converter is ready for use.

Tintic Standard Starts Work at Iron Blossom Mine

Possession of the Iron Blossom property, in the East Tintic district, in Utah, was taken last week by the Tintic Standard Mining Co., which recently purchased the assets and holdings of the Iron Blossom company for $375,000. The purchase price of 37½c. a share for the capitalization of 1,000,000 shares is being paid to stockholders as rapidly as indorsed stock is received.

For some time the staff of the Tintic Standard Mining Co., under the direction of assistant-general manager James Wade, has been making an exhaustive study of the Iron Blossom estate. No radical departures in the policy of operations will be put in force.

Work will probably be centered on the ore zone, opened up by the Iron Blossom company several years ago, to the east of that which produced in the early history of the mine over $3,000,000 in dividends.

Snow Storm Ready to Produce

The work of sinking and cutting a station on the property of the Snow Storm Silver-Lead Co., near Troy, Mont., will be completed soon. The depth attained will be sufficient to provide 640 ft. of backs to the tunnel level. The capacity of the compressor plant has been doubled and it is expected to be in ore on all levels within 30 days. The company has made a long-time contract for its lead with the American Smelting & Refining Co., and for its zinc with the Vielle-Montagne Co. of Belgium.

Phelps Dodge Will Use "Reverbs" Only at Douglas

Large Program of Construction at Smelter—Blast Furnaces for Reserve

Extensive additions to its reduction works at Douglas, Ariz., will be made by the Phelps Dodge Corporation. Twelve Queen type nine-hearth roasters will be built to provide sufficient roasting capacity to make possible the operation of three reverberatories. At present two of the latter are being used. Enough new waste-heat boilers will be installed to double the amount of power now obtained from this source. The waste-heat plant supplies steam for the steam plant at the smelter and electric power for Douglas, several points in Mexico and the mines at Bisbee. New dust-proof calcine cars will be built for carrying the hot calcine from the roasters to the reverberatories and a Cottrell plant will be installed for the recovery of metals from the roaster smoke. Work on the new construction will start immediately under the supervision of A. G. McGregor, who has designed most of the smelters in Arizona.

Present production of the smelter with two reverberatories in operation is 13,000,000 lb. per month. The smelter was started originally in 1904 with ten blast furnaces, of which seven remain. The first reverberatory was built in 1912. It is planned to keep several of the blast furnaces in repair as an auxiliary plant, but with the completion of the present construction work practically all of the ores smelted will pass through the reverberatories.

Calumet & Hecla's new Tamarack reclamation plant

End of plant, showing housing of belt conveyor that carries sand from the shore plant to the regrinding machines

Torch Lake, with the suction dredge that recovers the sand for retreatment in the mill

Old McCracken Mine Producing in Mohave County, Ariz.

The old McCracken silver mine, in the southern part of Mohave County, Ariz., is being rejuvenated after being shut down for thirty years. C. H. Maxey Adams and associates, of San Francisco, purchased the property from Frank A. Garbut, of Los Angeles, and organized the New Signal Mines Co., in 1923. Since taking over the property the new company has erected a modern 150-ton mill at the collar of the 600-ft. shaft which has recently been sunk. Water is pumped from the old mill town on the river, a distance of eight miles. A 50-hp. Fairbanks-Morse hot-head engine belted to a horizontal triplex hydraulic ram is used. The mill is equipped with coarse and fine crushers, a large Marcy rod-mill, Dorr classifiers and settlers, Minerals Separation flotation cells, Oliver filter presses, and concentrating tables. The saving of values has been improved by the addition of tables. The mill is sending out an average of twelve tons of concentrates per day averaging 50 per cent cent lead and 80 oz. silver and a small amount of gold. The concentrates are hauled by trucks to the Santa Fe railroad at Yucca station 37 miles from the mine.

Leasers Ship From Tungsten Comet

Leasers are shipping some high-grade ore from the Comet district near Pioche, Nev. The mill is being operated at the Tungsten Comet property. About twenty-five tons of concentrates are on hand. This product is worth approximately $190 a ton.

Ore from the Smith lease assaying $75 a ton is being shipped. Work is being done at the Lyndon mine and on the Bingo claim, a new discovery by John Crowe, a veteran prospector of the district.

Hematite Developed in Ontario

Promising hematite deposits have been developed in Laird Township, about four miles from Bar River and a short distance northeast of Sault Ste. Marie, Ont. Diamond drilling has been carried on by the Smith & Travers company of Sudbury, a total of about 1,000 ft. having so far been bored in eleven holes. James Tearle has estimated that 2,000,000 tons of red hematite of good grade has already been indicated. Further trenching and drilling over the four miles of outcroppings will proceed immediately.

New Tamarack Reclamation Plant in Operation

IN THE Michigan copper country steady production now is under way at Calumet & Hecla's new reclamation plant on the Tamarack conglomerate sands, difficulties at the shore plant having been overcome with installation of pump and pipe line to remove small boulders which clogged the screens. The plant will add approximately 700,000 lb. of refined copper per month to production.

The process consists of regrinding the sands, flotation, leaching the copper in the tailing with ammonia, and distillation of the leach liquor to recover the metal.

International Smelting Co. Starts Development at Tintic, Utah

A hoist is to be installed by the International Smelting Co. at the shaft of the Yankee Consolidated Mining Co. in the East Tintic district in Utah. As soon as this is accomplished, development of the claims secured by the International company to the east of the Yankee will be undertaken from the 2,000 level.

By securing options, on the east end of the Yankee, the Addie, the East Tintic Coalition, and other groups, the International now controls an almost unbroken strip of mineral territory extending from the Yankee to the Tintic Standard.

Rescue Eula Develops on 1,200 Level at Tonapah

The Rescue Eula, at Tonopah, Nev., has made arrangements with the Buckeye Belmont for use of its shaft in starting new work to the southwest on the 1,200 level, and a crosscut has been driven 50 ft. from the shaft. The crosscut has entered trachyte formation, in which the Green vein discovered on the 1,050 level occurs, and should cut the vein within 50 to 100 ft. The Green vein, so called because of the greenish cast of the vein material, has been profitable above the 1,050 level, from which section probably 1,500 tons of ore of mill-grade has already been mined, and ore of like grade is exposed on the floor of the 1,050 drifts. This new work on the 1,200 will cut the vein approximately 175 ft. on the dip of the vein below the 1,050 level, and it is quite possible that an important body of ore may be opened.

Fluxing Ore Opened in Virginia Louise, at Pioche

The downward extension of the great bed of flux ore which has produced several million tons for Salt Lake smelters has been cut in a crosscut from the winze below the fifth level of the Virginia-Louise mine, at Pioche, Nev., now being operated by the Prince Consolidated Mining Co.

Two shots opened up a 12-ft. face of ore that assays 40 per cent iron and 7 per cent insoluble. This type of ore will net the company one-third more than previous shipments from the property.

Unwatering of the Prince Consolidated shaft has been accomplished and drifting on the 830 level to catch the ore deposits found by diamond drilling several years ago is making good progress. A drift along the Great Western fault is being pushed to open up the Virginia-Louise bedded-ore deposit several hundred feet deeper than the lowest present working.

Bingo Sack Increased Assay From $1 to $17

At the preliminary hearing of the charge of fraud against Joseph Myers, managing director of the Bingo gold mine, in the Winnipeg Police Court, D. J. Kennedy, superintendent of the mine, stated that he brought down a sample of rock in September, 1923, and submitted it to the Milton Hersey Co., Ltd., for assaying. That firm reported the value as low as $1. On bringing the matter to the attention of Myers, he suggested that the pulp be obtained from Hersey, put in a Bingo sack that was in the office and sent to Widowson's for assay. This was done and the assay result showed a value of $17. The witness said that at the time he thought that the difference might be accounted for by one or two particles of free gold being in the rock.

Goldfield Deep Mines Co. Sinks

The shaft of the Goldfield Deep Mines Co., in the Goldfield district, in Nevada, is down 1,700 ft. and is progressing at the rate of 2.5 ft. per day. The original plan to sink to 2,400 ft. before crosscutting to the vein has been changed and the present idea is to sink to the 2,100 and crosscut to the vein at that elevation. Careful precautions, in the way of steel and concrete doors and bulkheads, will be taken before the expected large flow of water in the vein channel is encountered.

Quebec Officials Name Rouyn as Smelter Site

Withdraw Opposition to Ontario Railway—Big Boost for Mine Development and Prospecting

THE SMELTER of the Noranda Mines, Ltd., will be erected at the town of Rouyn, in the Abitibi mining district of Quebec. The Quebec Government had reserved the right to determine the location of the smelter, and its decision in favor of Rouyn was arrived at on May 15 at a conference held in Quebec attended by Premier Taschereau; J. E. Perrault, Minister of Colonization and Mines; Sir Henry Thornton, president of the Canadian National Railways; and representatives of the Noranda Mines, Ltd.

At the same time it is reported that the deadlock in the railway building situation has been broken and that the Quebec officials have reconsidered their attitude. It is understood that plans are under way to enable the Canadian Pacific Railway to build into the district from Ville Marie and for the T. & N. O. to extend its Kirkland Lake line east in order to connect with the C. P. R.R. This should give decided impetus to development work throughout the district, which has suffered since Quebec announced its opposition to the construction of the Ontario line. Following this there was a general slackening of interest, which, if allowed to go on for any length of time, would have had an adverse effect. Once interest in a new district dies down it is hard to revive. There has been some resentment among northern Ontario business men over the Quebec attitude and this was being reflected in decreased orders for Quebec firms, which may have had some effect upon the change of heart.

More than $1,000,000 in additional working capital has been assured for the treasury of Noranda Mines as a result of the recent capital increase.

The company originally had 10,000 shares of the par value of $100 each. These recently rose to about $650 per share. The development of the property was so promising that a decision to raise the capital to 20,000 shares was unanimously indorsed. The present shareholders were given the right to subscribe for new shares at $100 each to the extent of one new share for two already held. This absorbed only about half the increase, and left about 5,000 shares for disposal as directors might arrange.

For services rendered by Managing Directors S. W. Thomson and H. W. Chadbourne, an additional 750 shares are being issued. This has left more than 4,000 shares in the treasury for disposal. Reports state that Noah Timmins and Hollinger associates, who are already deeply involved in Noranda, are also interested in the purchase of these additional 4,000 shares — this block alone representing over one-fifth interest in the company. The shares taken up by present stockholders have placed close to $500,000 in the treasury. Also, the block now underwritten will bring in well over $400,000. In addition to this, the Noranda already had more than $200,000 in its treasury.

By the time the railway arrives, the development of the mine will have advanced to such an extent as to make it reasonable to undertake a capital increase to perhaps $15,000,000, in order to take care of installation of the huge mining and reduction works that will be required.

At the Horne property of the Noranda company, the No. 1 shaft has been completed to 300 ft. and the sinking crew is moving over to the No. 2 shaft, which is 1,100 ft. away and is now down 75 ft. This shaft will also be continued to the 300 level, at which depth the two shafts will ultimately be connected.

On the Amulet property, which lies to the north of the Horne, a new surface discovery of copper-gold ore is reported. The Amulet is considered to be a promising property, although the gold values obtained to date have not been as high as on the Horne.

Bunker Hill Opens Good Ore in Deadwood Basin

The Bunker Hill & Sullivan Mining & Concentrating Co. has cut at a depth of 500 ft. a vein of excellent silver-lead ore in its operations in the Deadwood Basin, in Valley County, Idaho. Since Nov. 15, 1924, the company has spent about $180,000 on the Hall-Interstate and Pilgrim groups. The recent showing is in a tunnel now 1,000 ft. long. According to recent reports, the orebody already has been penetrated 35 ft. The Bunker Hill company has the properties under bond for $450,000. It is hoped to develop enough ore to warrant the Oregon Short Line Railway Co. to build a branch line from Banks up the Payette and Deadwood River valleys. Aside from developing the once productive silver-lead region of central Idaho, such a line would serve a large but isolated agricultural and lumber region.

Reopen Champion Mine, in Idaho

The Esperanza Gold Dikes Mining Corporation, of Portland, Ore., has taken over what is known as the old Champion group of eighteen patented claims, of about 300 acres, siutated on Crooked River about halfway between Elk City and Orogrande, in Central Idaho. This property was closed down about twenty years ago, because at that time the metals in the ore could not be successfully extracted.

It is not the high-grade ore found in the property that makes it so attractive, but the large bodies of low-grade ore averaging from $2.50 to $4. Massive bodies of this low-grade ore are waiting for modern and up-to-date methods, such as steam-shovel mining.

Buy Ajax Property in Arizona

The Ajax property, in the Mineral Hill district, northeast of Florence, Ariz., has been reported sold to a Hurley, N. M., company for $40,000. It is said that a 20-ft. orebody has been opened from the bottom of the 200-ft. shaft. The ore contains lead, zinc, and silver.

Montana Railway Commission Protests Rate on Zinc Ore

Smelter Interests Claim Injury to Montana Industry—Spokane Organizations Oppose Change

Protest against a new freight rate established by the Union Pacific Company on zinc ores and concentrates from the Coeur d'Alene mining district in Idaho to Portland, Ore., for export has been made to the Interstate Commerce Commission by the Montana Railroad Commission.

The protest is made for the reason that the rate, which became effective May 18, is "extremely injurious to the best interests of Montana."

Great Falls Plant Loses

Much of the zinc ore from the Coeur d'Alene district now goes to the plant of the Anaconda Copper Mining Co. at Great Falls. Under the new rate ore will be shipped by rail to Portland and by water at extremely low rates to Belgium, where a lower wage scale will permit serious competition with American industries, according to the Montana commission.

The traffic bureau of the Spokane Chamber of Commerce and the Spokane Merchants' Association have sent a telegram to the Interstate Commerce Commission at Washington, supporting the Coeur d'Alene zinc producers and requesting the commission not to suspend the rate.

"Anaconda had a chance to bid for the purchase of this ore even after the Belgian company submitted a bid, but the bid Anaconda made was far less attractive to the producers than that of the Belgians so a contract was made with them," says Frank M. Smith of the Bunker Hill company, which with the Hecla Mining Co. is an equal owner of the Sullivan Mining Co., owner of the Star mine, in which a large body of zinc-lead ore has been opened, in the Coeur d'Alene region.

"The Bunker Hill, through Stanley A. Easton, general manager, and the Hecla Mining Co., through James F. McCarthy, general manager, have informed the Interstate Commerce Commission that their Sullivan company has entered into a contract in good faith with the Vielle-Montagne and will rely on the rate from the Coeur d'Alene to Portland which the Union Pacific published," said Mr. Smith. "This rate stipulates a charge of $3.50 to the ton on ore valued at $30 a ton; $3.75 on $40 ore; $4 on $50 and $4.25 on $60 ore.

"We represent that a suspension of the freight rate will work a hardship, as a contract has been closed and preparations made for shipments."

Other Contracts Made

Besides the Star, contracts have been made by the Vielle-Montagne for the purchase of zinc ore from the Highland-Surprise Mining Co. of Kellogg, Idaho, the Snow Storm Silver-Lead Co. of Troy, Mont., and it is believed but not announced officially that a contract has been made for ore of the Tamarack & Custer Consolidated Mining Co. of Wallace, Idaho. The Bunker Hill i still considering the erection of a zinc plant at Kellogg.

Active in Chalk Mountain District

In the Chalk Mountain silver-lead mining district, 45 miles southeast of Fallon and 15 miles from the old camp of Wonder, Nev., the Chalk Mountain Silver-lead Mines Co. has opened ore on the 145 level, and values are good, with the vein as much as 10 ft. wide in places. This company is reported to be shipping two cars of ore per week that will average $75 per ton. The Chalk Mountain Extension Co. has started sinking a two-compartment vertical shaft, and hoisting machinery is already on the ground. Many smaller properties have started limited work, and commercial ore has been found over a large area.

Consolidation of Four Park City Companies Assured

Plans Complete—Anaconda Officials on New Directorate—Park-Utah Consolidated Mines Co. New Name—G. W. Lambourne Remains as Manager

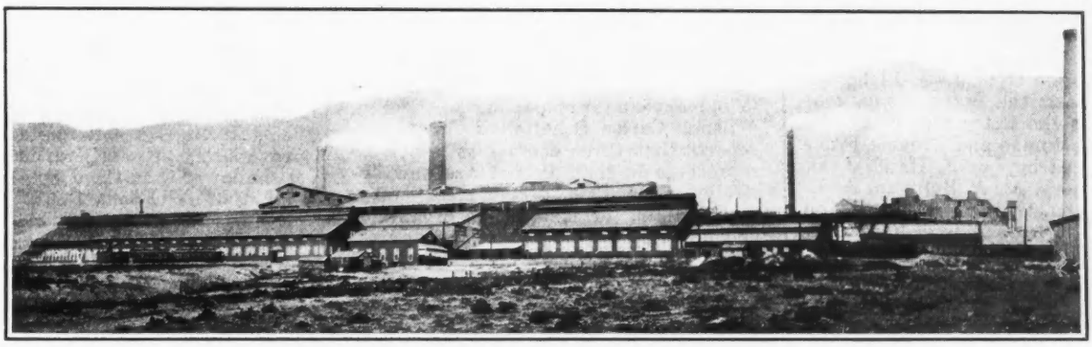
TERMS for the consolidation of the Park-Utah, Park City M. & S., Ontario, and Daly companies, four of the principal producers in the Park City mining district in Utah, have been made public. Final action will be taken by the stockholders of the two companies first named at special meetings called for June, but no doubt is entertained as to the consummation of the present plans.

An interesting feature of the proceeding is the inclusion of J. O. Elton, general manager of the International Smelting Co., Anaconda subsidiary, and William Wraith, vice-president of the Anaconda Copper Mining Co., on the new directorate. The International Smelting Co. last year remodeled the former Utah Consolidated concentrator at Tooele, Utah, to treat zinc-lead ores, and the chief source of supply has been the Park City mines included in the merger.

According to present plans the Park-Utah company will take over the assets and properties of the Park City Mining & Smelting Co. Exchange will be on a basis of one share of Park-Utah for one share of the Park City M. & S. Co.; 1,006,000 shares will be involved in the exchange. After the consolidation of these companies, the Ontario and the Daly are to be taken over, the control of both already being held by the other two companies. The capitalization of the Park-Utah is to be increased to 2,500,000 shares. Approximately 400,000 shares will be reserved for corporate purposes. The name of the Park-Utah Mining Co. will be changed to the Park-Utah Consolidated Mines Co. and stock will be listed on the New York Stock Exchange. The management of the property will remain unchanged, George W. Lambourne being the directing head. A dividend of 15c. a share is to be paid by the Park City M. & S. Co. on July 1 to stock of record June 15. Available balances and present earnings of both companies are such, in the judgment of directors, as will warrant payment of dividends on the stock of the Park-Utah Consolidated Mines Co. when the plan is completed.

During a half century of activity the mines concerned in this merger have produced more than $125,000,000 in gold, silver, lead and zinc and paid more than $31,000,000 in dividends. Production of the four properties during the first quarter of 1925, after deductions for smelting and railroad charges, amounted in value to $1,331,312.69; metal output included 1,211,292 oz. of silver, 9,833,643 lb. of lead, 10,351,806 lb. of recoverable zinc, 484,000 lb. of copper and 3,304 oz. of gold, from a total of 77,200 tons of ore.

Consolidated balances of the Park-Utah and the Park City M. & S. Co. as of April 1 were: Bank deposits, $530,885.30; United States bonds at par, $1,300,000; and loans, $74,758.07; making a total balance of $1,905,643.37 after paying the April dividend of $131,400. Receipts of the two companies aggregated $1,234,782.24; operating expenses $555,710.85, leaving a profit, before taxation and depletion, of $679,071.77.



International smelter at Tooele, Utah

In conjunction with this plant is the flotation plant at which the Park City zinc ores are concentrated

Will Fly to Dease Lake Gold Fields

A party of prospectors headed by Archibald Little, mining engineer, of Detroit, is at Prince Rupert, B. C., preparing to leave for the Dease Lake area of the Cassiar gold fields by airplane. A seaplane which was shipped to Prince Rupert from Three Rivers, Que., is now being assembled for the journey. Is is expected that, weather conditions being favorable, the trip from Prince Rupert to Lake Dease can be made in four or five hours, enabling the party to reach the scene of the latest gold strikes before any of the other prospectors in the overland rush, which has been in progress for some weeks.

Rich Silver Ore Found at Spring Valley, Nevada, Mine

A good strike has been made at the Piermont mine, in Spring Valley, near Ely, Nev., a property known for its production of rich silver ore in the early 70's. At a point 250 ft. below the surface in a crosscut from a winze a 5-ft. contact vein of rich silver ore has been exposed. The vein has been drifted on for 50 ft. Values and width of the ore have been consistent. Ten assays show that the ore ranges in value from 14 to 99 oz. of silver to the ton and from $1 to $5 in gold.

The property is owned by W. H. Venable and E. W. Venable, who are developing the mine. There are on the dumps from 50,000 to 75,000 tons of dump ore that contain, it is estimated, from 8 to 15 oz. of silver per ton.

Deficit for Alaska Juneau in April, $21,150

The Alaska Juneau Gold Mining Co. mined in April, 275,400 tons, which yielded $155,000, or 56.28c. per ton. Operating expenses were $145,500, or 52.83c. per ton; operating profit was $9,500, or 3.45c. per ton. Expenditures on capital account were $15,000; on Ebner property, $150, and interest on indebtedness was $15,500, or a total of $30,650, leaving a deficit for the month of $21,150.

Additions to milling plant are 40 per cent completed and Ebner preliminary work is 39 per cent completed.

Bond Providence Mine

The Providence mine at Greenwood, B. C., has been bought by J. W. Williams and associated stockholders in the Jubilee Mining Co. from Madden Brothers of Chicago and William Madden of Greenwood, under bond and lease for two years. Ore on the dump valued at $30 per ton is to be treated in a small concentrator.

Walter Johnson, Pitcher, Now Nevada Mining "Magnate"

WALTER JOHNSON, star pitcher for the Washington Senators of the American League, is vice-president of the Nevada Gilbert Gold Mining Co. Johnson and his father-in-law, E. E. Roberts, Mayor of Reno, have formed a company which has purchased six claims and one fraction at Gilbert, Nevada's newest mining camp.

The seven claims form a compact acreage in South Gilbert, where there have been proved several ledges strongly mineralized. The claims taken over and their locators are: Mohawk group of three claims consisting of the Mohawk, Mohawk No. 1 and Mohawk No. 2 were bought from J. Q. Lisle and H. B. Pratt; the Betty group, consisting of the Betty and Betty No. 1 and the Jumbo and Trouble Fraction, owned by Lee F. Hand, J. D. Montgomery, M. A. Sullivan, A. L. Kvello and Walter Bell; and the Peat claim, owned by Charles A. Joseph, G. C. Perras and A. E. Neilson.

J. Q. Lisle will have charge of the preliminary work of prospecting the ground before entering into any extensive undertaking.

Striking Miners at Boleo Demand Recall of Governor

Striking miners at the El Boleo property, in Lower California, are reported to be demanding the recall of the Governor of that district in Mexico. It is declared that both the mine owners and the miners are dissatisfied, as they say the Governor of the lower district of Lower California has done nothing to attempt to settle the strike, although approximately 1,000 miners have been idle since the middle of April. A committee was named by the Governor to look into the strike conditions, but the reports declare that nothing has been done by either the Governor or the committee to attempt to arbitrate or settle the strike, whereby the men are demanding increased pay and improved working conditions.

Providence Mine in British Columbia Will Be Reopened

J. W. Williams. of Spokane, has purchased the Providence mine, at Greenwood, B. C., and has begun to reopen it. This mine has produced some of the richest gold-silver-lead ore found in the Boundary district, and at one time an offer of $1,000,000 was refused for the property. In 1920, 945 tons of ore yielded a return of 578 oz. of gold, 148,613 oz. of silver, and 32,479 lb. of lead. At the end of this year the property was bought by Chicago interests, who floated a $50,000 bond issue, but failed to pay the interest on the bonds. Last year, the property was sold at a sheriff's sale for a ridiculously small amount, but the purchasers had not sufficient capital to rehabilitate it.

Hollinger Increases Dividend Rate

Commencing June 17, the Hollinger Consolidated Gold Mines, Ltd., will pay 8c. every four weeks instead of the 5c. dividend heretofore in force. The annual report just issued shows production, $13,429,226; other income, $561,-887; mining costs, $5,133,252; milling costs, $1,565,801; general costs, $705,-844; taxes, $318,377; depreciation, $1,162,800. Surplus is now $7,616,852. Ore reserves total 6,518,393 tons averaging $9.10 per ton, whereas the average grade of the ore treated was $8.39.

Much Development Reported in Nayarit Mining Districts

Road Building Important Phase of Work—La Cucharas Installs Machinery

The state of Nayarit, in Mexico, is the scene of renewed activity in development and prospecting.

Senor Carlos Schulte, of Acaponeta, reports that three companies which he represents in that district are now actively engaged in development work, road building or installation of mining and milling equipment. El Tigre mine, under local supervision of Pat Andy Wickam, is making substantial progress in its program of new exploration. El Tigre has a record as a former gold producer.

The Cori Mining Co., under management of Raymond Guyer, is located near El Tigre and is also a free gold property. The company at present is engaged in a road-building program to permit the installation of machinery now stored in Acaponeta and awaiting transportation to the mine.

La Cucharas Mining Co., a famous old high-grade copper and silver producer, is rehabilitating its property after a shut down of many years. Work is under supervision of J. Edward Lacy, one of the owners. This company is owned by the Lacy Manufacturing Co., of Los Angeles. This property is now experimenting with a newly patented process of copper recovery. The mine is located thirty miles east of Acapaneta.

William Ferris, who operated the Minitas gold mines at Rosa Morada successfully during the Mexican revolutions, is now engaged in opening up La Luz, a promising new property located in the Nanchi district, south of Yago. Work done on La Luz has disclosed a showing of gold, silver and lead ore. The property is located about three miles west of the S. P. de Mexico railroad.

The properties of the Cia. Minera El Zapolote y Annexes and the adjoining property Tenamache have been taken on option and work has already commenced. The new operators are Americans. At El Zapolote are twenty stamps and two ball mills and an equipment for cyanidation. The ore is valuable chiefly for its silver content. These properties are located near the San Pedro River, east of the town of El Venado, and shipping point is Ruiz on the S. P. railroad, about ten miles distant from the properties.

Another carload of concentrates from the La Corona Mining & Milling Co.'s property was shipped from Yago on May 8, consigned to Selby, Calif. Concentrates contain gold, silver, antimony and copper. This property is producing regularly, although production is handicapped by shortage of water, which will be remedied in the near future by installation of a mile-long pipeline. William Ferris is underground superintendent and Lucas Gonzalez is in charge of milling operations of La Corona properties. F. E. Davis is manager.

Michigan Gracefully Disowns Deepest Mine Honors

RECENTLY it was stated in a government publication quoting bureau of labor statistics, that the deepest mine in the world is not in Brazil, "as erroneously stated in many text books, but in the copper seam of Michigan. The American man-made hole in the ground is 8,700 ft. deep, or at least a third of a mile deeper than the premier Brazilian shaft, situated in the state of Minas Geraes."

As much as Michigan would like to claim this distinction, it cannot truthfully do so, for the honor still belongs to Brazil, just as "many text books" say it does. The shaft referred to as 8,700 ft. deep in the Michigan copper district is one of Calumet & Hecla Consolidated's shafts in the conglomerate vein. It is not a vertical opening, however, being inclined at an angle of approximately 38 deg., which makes it shallower than the deepest workings of the St. John Del Rey Mining Co., Ltd., in Brazil, which reach 6,726 ft. vertically. The deepest vertical shaft in the Michigan copper region is Tamarack No. 5 of Calumet & Hecla Consolidated, bottomed at a depth of 5,309 ft.

Durango Smelter at Capacity

After the completion of various improvements, the Durango plant of the American Smelting & Refining Co. at Durango, Colo., is running at capacity.

During the past year 54,000 oz. of gold, 1,300,000 oz. of silver, 12,000 tons of lead and 1,200 tons of copper were produced from 54,488 tons of concentrates and ore. Most of the shipments came from Silverton, Rico and Telluride, while a small part of it came from the La Platas.

The sulphating plant is now running steadily. About 1,000 tons of zinc a month is being extracted in this plant.

Will Float Zinc and Lead in Old Swedish Dumps

For the purpose of extracting various minerals from the waste ore dumps at its plants located in Kaveltorp, Kopparberg, Swedish Metal Works, Inc., has decided to erect a flotation recovery plant. The present dumps, amounting to more than 100,000 tons according to tests, are estimated to contain from 1½ to 8 per cent of zinc and lead, which would make the operation of flotation recovery profitable. It is planned in the future to extract these minerals from all ore mined by the company.

Washington News

By Paul Wooton
Special Correspondent

See Decrease in Consumption of Silver for Coinage

People Do Not Like Metal "Halves" Any Better Than Dollars—Bills and Bank Checks Prevail

The Treasury Department has proved to its satisfaction that the silver dollar cannot be restored to its former place in the currency structure. Despite an intensive effort, extending over nearly a year, to popularize the coin, complete failure now is admitted. The dollars flow back into the Treasury very quickly after they are issued. The efforts to increase their circulation in the West were but little more successful than those in the East. Apparently there is no way of reducing the large expense the public must pay to maintain paper currency. It costs 1.7c. to manufacture a paper dollar and keep it in circulation during its life, which is less than a year at best. This rolls up a large aggregate, as nearly $50,000,000 in one dollar bills must be put in circulation each month.

Half dollars are scarcely more popular than the dollar coin. There is a large stock of this coin on hand in the Treasury. Efforts to keep it in circulation are scarcely more successful than those in connection with the larger coin.

The fact that even halves are unpopular shows that a dollar of somewhat smaller size would not remedy the situation. It has been suggested that all alloy metal could be removed so as to reduce the size of the coin. This is impractical, because the removal of the alloy would result in rapid abrasion. Moreover, the total alloy in the dollar weighs less than does a one-cent piece. Suggestions also have been made that a metal token of convenient size be coined to represent a dollar. This is not favored, because of the ease with which tokens can be counterfeited by unscrupulous persons.

The waste involved in the handling of gold precludes its general use as a circulating medium. Western bankers for many years absorbed the losses incident to the abrasion of gold coin, but they no longer seem to be willing to do it.

The belief is that Great Britain and France and other European countries will find it difficult to abandon the use of their small paper money. There is no prospect that our law will be changed which requires the deposit in the Treasury of a silver dollar for each silver certificate issued against it. The expectation at the Treasury, however, is that the amount of silver per capita required for coinage purposes will decrease. Before the war the trend was downward. Abnormal conditions since have caused large increases in the amount of silver used for this purpose, but the increasing use of bank checks and the convenience of the dollar bill are factors likely to militate against this use of silver. The situation in foreign countries presents a somewhat different aspect, particularly in Central Europe.

Barry-Hollinger Starts New Mill at Kirkland

THE NEW MILL of the Barry-Hollinger property in the Kirkland district in Ontario will start operations during the week of May 17. There are about 3,500 tons of ore available on the dumps, and stopes have been started on several levels. The mill has a capacity of between 50 and 75 tons a day and the company expects to maintain mill heads at about $20 a ton.

Plan Exploitation of Copper Ores in Sweden

About a year ago the Swedish Geological Survey reported on some important deposits of pyrite, arsenic, and copper ore in the so-called Skelleftea district in the north of Sweden. According to report, the Centralgruppen's Emissions Co. intends to commence mining operations this summer. The doubtful factor has been the lack of railways or other means of transportation before the projected railway has been built. It is now stated that the bank's representatives are negotiating with the town of Skelleftea, on the Gulf of Bothnia, for delivery of electric current and for reservation of port facilities at Skelleftea harbor. In order to solve the transportation problem a cableway will be built from the mines to an existing crossline railway to Skelleftea, a distance of about ten miles, which will cost about 200,000 kroner. The output planned from the start is 100,000 tons of copper and pyrites ore.

France Will Help Iron Mines of Lorraine

Due to the agitation of the important iron-mining interests of Lorraine, work on the canalization of the Moselle River will be undertaken in accordance with a law that has just been passed in the French Parliament.

Today the Briey and Longwy basins, wholly French, must have cheap transport for raw materials and semi-finished products of the blast furnaces and steel mills of the region. In addition the river taps the Thionville basin. Here alone are 168 iron-mining concessions, covering more than 40,000 acres. Briey has fifty-one concessions of 100,000 acres and the Longwy group of twenty-four concessions covers 18,000 acres.

Metal Mines May Profit by Couzens Tax Inquiry

As a result of the work of the Couzens committee, which is investigating internal revenue matters for the Senate, it seems likely that the depletion allowance made for discovery will be interpreted more to the advantage of metal deposits. It may be necessary to amend the law before this benefit can be secured, but the committee has revealed clearly that the allowances made for discovery of metals is entirely out of line with those allowed for oil.

Mexico City Letter

By W. L. Vail
Special Correspondent

Boleo Copper Strike May Lead to Long Shutdown

Government Officials Encourage Strikers, It Is Alleged—Pachuca Properties in Good Condition

Mexico City, May 10—It is reported here that the strike at the Boleo Copper properties, in Lower California, if not settled soon may lead to a shutdown for an indefinite period. Burdensome local legislation is one of the irritants to the management, in addition to the encouragement said to be afforded the strikers by the authorities of the southern district of Lower California. El Boleo is one of the largest copper producers in Mexico, and has been for many years.

The plant of the San Rafael & Anexas, at Pachuca, will be increased to 700-ton daily capacity, according to instructions from the board of directors in Paris. La Esmeralda and San Augustin, in the same district, have increased their joint output of ores to about 1,500 tons daily. General conditions in the Pachuca camp are favorable.

Reports of damages because of earthquakes in the Chalchihuites district, State of Zacatecas, are entirely exaggerated. Though numerous light shocks have been felt, covering a period of several weeks, not a single building has been destroyed in the entire region and none of the underground operations in the mining districts have been interrupted for a single day.

The Mazapil Copper Co., in Zacatecas, has begun active mining in the Noria de Bajan mines, situated in the Ramirez Mountains and recently acquired from native owners. The ores will be shipped to the company's smelter at Saltillo.

The Santa Cruz section of the Boarda Antigua mine, in the district of Tasco, State of Guerrero, is again being worked in a satisfactory manner. For several years the buscones have been impoverishing the property of rich ores, but that work has been stopped.

Considerable capital from Oklahoma and Kansas City is being invested in a group of low-grade properties in the Totoloapam district of Oaxaca. Development work has been going on for the last three years, and sufficient quantities of ores have been blocked out to justify the erection of a mill, in the opinion of the directors.

Shortage of both timber and water is causing the temporary closing of several smaller mining properties in the State of Hidalgo. The state government recently issued a decree prohibiting the cutting of timber within state limits, under any pretense. The decree is presumed to be in the interest of forest conservation. Water is scarce because of tardy rains.

The Pacific Mining Co. and the Federal Copper Co., both concerns organized with California capital, are taking up properties in the Altar district, in Sonora.

London Letter

By W. A. Doman
Special Correspondent

Lena-Soviet Transaction Needs Confirmation by Both Parties

Porcupine Goldfields D. & F. Affair Has Queer Angles—Rolls-Royce for Market Jobber

London, May 5—As showing that the Soviet government is desirous of attracting foreign capital again to develop its mineral resources, it may be mentioned that it has signed an agreement with the representatives of the Lena Goldfields in Moscow permitting a resumption of work on the Lenskoie mines, and also on the Altai and Sissert properties. Terms are not yet officially made public, but it is understood that the consideration is 25 per cent of the product. According to a report, New York banking groups have agreed to lend the Lena company up to £500,000. The company itself has increased its capital by 1,500,000 shares, to £2,905,000. Although an agreement has been signed, it must be confirmed by the Lena directors, and afterward be ratified by the Soviet authorities. This is similar procedure to that in the case of the Russo-Asiatic Consolidated. The Soviet government has not yet ratified this, and it is possible that similar delay may be experienced with the Lena Goldfields.

When the question "What is wrong with Canadian mining?" was being asked in London, Canadian journals retorted that there was nothing amiss, and that if anything were wrong it was due to the way in which companies with head offices in England managed their business. The journals may possibly find matter for another tilt in the Porcupine Goldfields Development & Finance affair. The New Consolidated Goldfields and the National Mining Corporation appealed to the public for £250,000 for the finance company. Whether they obtained this sum is uncertain, as I do not think any official statement on the point was made. But the public subscribed something on the faith of the names of the two finance corporations. It is now announced that both companies have withdrawn from the Porcupine Goldfields Development & Finance, and the public is asking the reason. New directors have been appointed, and their names are not disclosed. It is said, however, that the old and the new boards have been in negotiation, and that the shareholders will soon be called together. In one way the business seems to require elucidation, as according to report it has been more in the nature of a share deal than financing Canadian properties. In connection with this, rumor has it that some months ago a pool was formed in the shares. The price was worked up from 11s. to about 19s., and there were more fully paid shares sold to the pool than existed. Here seemed to be an opportunity of squeezing the "shorts." But all Stock Exchange men are not fools. Having sold fully paid shares they bought partly paid on the market, made them fully paid and delivered them. This was quite a legitimate proceeding, and naturally did the pool no good. However, so the story goes, the jobber who worked up the price of the fully paid was presented with a Rolls-Royce for his success—before the finale!

Mexico Mines of El Oro has come on offer during the week, and experienced a rather heavy relapse, the reason being rumors cabled from Paris that the latest developments at the mine are not giving the satisfactory results hoped for, and that the next dividend may be either reduced or passed. The board, it is said, will utilize present profits to prosecute research work.

Toronto Letter

By Our Special Correspondent for Northern Ontario

Mining Corporation Plans Several Subsidiaries

Frontier Mines, Ltd., Organized—Dividend From Lorrain Trout Lake—Good Showing at WAD Property

Toronto, May 16 — At the annual meeting of the Mining Corporation, which operates in Cobalt and South Lorrain, the president stated that the affairs of the company were in excellent condition and that the company was nearer to a dividend-paying position than at any other time since 1920. A new financial policy was also announced which will be of considerable interest to the shareholders. On account of the large number of properties owned by the corporation, their development will require large expenditures, which must be taken from the company's earnings or from money received from the sale of shares of subsidiary companies. If the company uses its own money for this purpose, development will be slow and dividends will be delayed, so the corporation has decided to form subsidiary companies, part of the stock of which will be offered for sale.

The first step in this new program has been the formation of a new company known as the Frontier Mines, Ltd., having a capital of $3,000,000, and to this new company has been transferred the Frontier, Crompton, Haileybury Silver and two other claims. These claims constitute the company's present productive area in South Lorrain. As developments justify, a similar policy will be considered in respect to other properties owned by the corporation, the ultimate aim being for the corporation to control a number of subsidiaries. The directors, however, have not yet decided the time or the manner in which shares of the new company will be offered for sale.

On April 15, the corporation received a dividend of $25,000 from the Lorrain Trout Lake Mines, Ltd., which is under the management of the corporation and in which the corporation has a one-third interest. The shaft in this property has been carried to 475 ft. and drifting on the 465 level, on the Woods vein, has shown more cobalt than on the upper levels, although the silver values so far encountered have been low.

Approximately 4,000 tons of milling ore have been shipped to Cobalt for treatment, averaging 24 oz. to the ton, and the high-grade production is being maintained. Some time ago a diamond-drill hole was put down a considerable distance to the south which showed substantial silver values and the assays were sufficiently encouraging to decide the company to sink a two-compartment shaft at this point, work on which has already been started.

A. D. Miles, of the Anglo-Canadian Explorers, Ltd., has recently returned from England, where he completed a deal for a substantial interest in the holdings of the WAD Syndicate in central Manitoba. The Anglo-Canadian Explorers is a subsidiary company of John Taylor & Sons of London. It already has the Oro-Grande property, a few miles to the east of the WAD holdings, but the latter appeared to be much the more important.

The Perino mill above Telluride
On the road to the Tomboy mine in the San Juan district in Colorado

The WAD properties cover a length of about 4½ miles. In one place the vein has been opened up for a length of 900 ft., and surface sampling indicates an average of approximately $15 over a width of 5 ft.

Teckotto Gold Mines, Ltd., is the name of a new company that has been formed to take over the old Swastika property. A contract is being let for 10,000 ft. of drilling, and it is expected that work will start immediately. The Swastika was the original property of the Kirkland district and is fully equipped with a plant and mill. Results, however, were disappointing and the property was forced to close down and has remained idle for a number of years. An effort will be made to find new vein systems.

Men You Should Know About

Arthur Clark Terrill, for the last four years professor of mining enginering at Pei Yang University, at Tientsin, China, is now lecturer in geology at the California Institute of Technology.

Dr. Marcus J. Goldman, geologist of the U. S. Geological Survey, recently visited the University of Cincinnati and spoke informally to the members of the Department of Geology on the subject "The Cap Rock of Salt Domes."

J. B. Mertie, Jr., will sail from Seattle May 28 to make a geologic reconnaissance in the upper Yukon River region. **F. H. Moffit** will sail from Seattle May 30 to make geologic surveys in the Prince William Sound region.

Prof. W. A. Parks, of the University of Toronto, has been appointed president of the section on geology for the next annual meeting of the British Association for the Advancement of Science, to be held in Southampton, England, from Aug. 26 to Sept. 2.

Colonel Birch Helms, of Blair & Co., New York, recently visited Australia to investigate financial and economic conditions there, and while in Sydney discussed the shipment of gold from the United States to Australia in connection with the proposal to return to a gold standard.

H. G. Washburn, who was general manager of the Federal Lead Co. up to the time that company sold its mines in southeast Missouri to the St. Joseph Lead Co., recently assumed the position of assistant general manager of the Federal Mining & Smelting Co. His headquarters will be in Wallace, Idaho.

F. M. Waterhouse, representing Boston capital, recently visited Oaxaca, Mexico, in connection with negotiations concerning a gold and silver prospect at Taviche and which he has had under option. Mr. Waterhouse is well known in many mining camps, and is an old-time operator in the Taviche district, but at present resides in Boston.

Major R. B. M. Wilson, of Chicago, and **T. Skewes Saunders,** a Mexico City mining engineer, have recently made an extensive examination trip among the mines of the Sierra Juárez and Totolapam districts of the State of Oaxaca. It is reported that engineers of the American Smelting & Refining Co. will make an examination of the San Juan Taviche mine.

Alexander M'Intosh Reid has been twelve years in the service of the gov ernment of Tasmania, Australia, has been eight years on its Geological Survey, and is now the Senior Government Geologist of that state. His father, a civil engineer, when in the employ of the British Government in India, migrated to Tasmania and took up farming land there. M'Intosh Reid was born at Ulverstone, in the island state of the Australian Commonwealtn, forty-four years ago. In 1890, soon after the discovery of silver-lead ores in Zeehan, Tasmania, he accompanied his father to that field, and there received his early training in mining and metallurgy. Before embarking on his scientific career he was sent to a high school in Hobart, and later entered the Zeehan School of Mines, University of Tasmania, from which he was the first to graduate with honors in mining science and metallurgical chemistry. Mr. Reid was particularly successful in the subjects of geology, mineralogy, and petrology, and decided to specialize in that work. An opportunity for further study, especially in the economic branches of the science, which presented itself was gladly accepted. In 1903 he visited the gold fields of Western Australia, and there accepted positions as mine surveyor and metallurgist. He next joined his father in Johannesburg, South Africa, and was for some time associated with mines on the Rand and at Niekerk, Transvaal. Later, in the capacity of consulting geologist, Mr. Reid accompanied expeditions to Southwest and Central Africa. On his return he joined the staff of the De Beers Consolidated Diamond Mines

A. McIntosh Reid

at that company's Wesselton mine, Kimberley, Cape Colony. In 1908, returning to Australia, he for some time was in private practice as consulting geologist and mining engineer on some of the leading fields of the mainland states and in the western district of Tasmania. During this period of his career Mr. Reid made rapid progress in his profession, and also devoted much time to the study of civil engineering. In May, 1913, he was appointed by the Tasmanian Government as assistant engineer in charge of railway surveys and construction, resigning in 1917 to take up the post of Assistant Government Geologist. Following the reorganization of the Mines Department of Tasmania, he was appointed Senior Government Geologist. Since joining the Geological Survey he has written many reports and other works that have been issued by the Mines Department of his state. Mr. Reid is a fellow of the Royal Society, a member of the Australian Institute of Mining Engineers, and a fellow of the American Geographical Society. He is chairman of the oil shales and coal panels of the Standards Committee, and is technical adviser to the government of Tasmania.

A. C. H. Gerhardi, managing director of the Consolidated Homestake Mining & Development Co., has returned from London, where he arranged for the financing of the construction of a mill at the Toric property in British Columbia.

G. H. Prince has been appointed Deputy Minister of Lands and Mines for New Brunswick.

Obituary

Terence Lyon, a well-known prospector of northern Ontario and one of the pioneers of the Porcupine camp, was recently drowned in the Laflamme River, Que. He left Porcupine several weeks ago with a companion for a prospecting trip in the Rouyn district, and on the return trip the canoe upset and Lyon, being unable to swim, was carried away by the current, his companion having a narrow escape. Mr. Lyon was 33 years of age.

Edward Converse Voorheis died recently in San Francisco at the age of seventy-four. He was born in Ann Arbor, Mich., on Aug. 7, 1850, and went to California in 1879, where he became associated with his uncle, C. J. Barland, in one of the first chlorination plants at Sutter Creek, Calif. Later he became partner with E. S. Barney in the same business. He continued mining and treating ores in the Mother Lode region for a number of years. He was state senator from 1890 to 1898 for Amador, El Dorado, Mono, Alpine, and Calaveras counties. For many years he was president of the California Miners' Association, which took a prominent part in continuing hydraulic mining activities. He continued in the mining business and was later president of the Atolia Mining Co. Mr. Voorheis had held many positions of public trust and had many friends. His last mining activity was in the initiation of asbestos mining.

George Smart, managing news editor of *Iron Age*, died on Saturday, May 16, of erysipelas at his home in Forest Hills, N. Y. Funeral services were held on Monday and a memorial service is planned for Sunday, May 24. in the Church-in-the-Gardens, Forest Hills, to commemorate the esteem in which he was held as a friend, neighbor, and citizen. Mr. Smart was born sixty-one years ago in Chillicothe, Ohio. At the time of his death he was president of the Men's Club of Forest Hills and chairman of the Student Aid Endowment Fund of Phi Kappa Psi fraternity. He had been president of the Ohio State University Alumni Association, national president of Phi Kappa Psi, chairman of the Editorial Conference of the New York Business Papers' Association, member of the executive committee of the National Conference of Business Paper Editors. and president of the Community Council of Forest Hills. For many years Mr. Smart had been intimately connected with the activities of the technical and trade press.

Societies, Addresses, and Reports

Mineral Property Rights Discussed

President's Oil Conservation Board Receives Communication From Earl Oliver, of Ponca City, Okla.

By Paul Wooton
Washington Correspondent *Mining Journal-Press*

COMMUNICATIONS to the President's Oil Conservation Board again have aroused interest in the nature of mineral property rights. This is having the effect of renewing the discussion that was aroused when Congress had under consideration the existing oil and coal land leasing laws. One of the primary causes of overproduction of coal and one of the obstacles to consolidation is the wide dissemination of coal ownership.

Earl Oliver, of Ponca City, Okla., a widely known oil operator, in a letter to the Oil Conservation Board, discusses some pertinent phases of property rights as applied to minerals. Among other things in his letter, he says:

"It was a Supreme Court Justice of the State of Pennsylvania back in 1875 who initiated the line of analogy out of which was eventually phrased the dictum 'oil and gas belonging to him who reduces them to possession.' The jurist, who first ruled directly on the point, had before him a difficult problem of identification in 'confusion of goods.' He might have followed the prevailing law regarding minerals — namely that they were 'property in place,' in which event the complete body of common law, as applied to minerals generally, would have fitted oil and gas at every point, except that it would have been necessary to formulate some method of equitable division according to the principle of 'confusion of goods.' of which he had an adequate body of law as precedent.

"However, these goods differed from any that had previously come before courts for division. Little was known regarding their laws of accumulation. In fact, it was thought that in effect they 'roamed at will.' Under these circumstances, the formulation of any satisfactory method of division was difficult. An easier, although new, way suggested itself to the ingenuous judge. 'Why not use the law of ownership as applied to wild animals?' He did this. Of course in doing so he violated the Fourteenth Amendment to the Federal Constitution, in that 'without due process of law' he divested the land owner of mineral under his own land, leaving to him only a right to reduce his oil and gas to possession, provided some other person did not beat him to it.

"It was soon found, however, the law of wild animals would fit the oil industry only at a few points, and the laws of other forms of property were drafted to supplement these. As a consequence of this incidental analogy of Justice Agnew, in 1875, followed and enlarged upon by later courts, a legal and economic monstrosity has been built up in which oil is wild fish for one purpose and domesticated fowl for another. It is wild game at times, and real estate at others.

'Thornton, 'Oil & Gas,' Chapter II, Section 22, states: 'It has been said repeatedly by the courts and writers that the owner of the soil owns the gas and oil beneath its surface; and expressions to this effect will be found in this work. This is an acknowledgment of the absolute ownership of the gas and oil beneath the surface by the owner of the land; but when they escape and go into other land, or come under another's control, the title of the former owner is gone.'

"As a consequence of this crossbreeding, this legal monstrosity does not respond readily to certain of the economic forces that act as stabilizers on industry generally. This peculiarity of oil and gas, above described, has no counterpart in the law of any other character of property that rises to the dignity of articles of commerce. It is this peculiarity of the law of oil and gas that makes the industry that is producing crude oil unresponsive to the law of supply and demand.

"If the government devises a form of title to property, the enjoyment of which is dependent upon ignoring those basic principles of sound industry, it must expect them to be ignored. Had the Pennsylvania jurist taken the other course, as he had every right to do— namely, that title vests to oil and gas 'in place' — some permanent system might, and I think could, have been devised whereby an equitable and satisfactory division between land owners would have been possible.

"In fact, now that the habits of oil and gas are becoming better known, courts are tending more and more to drift away from this peculiarity of law fastened upon these products. The Supreme Court of Arkansas, illustrative of this tendency, said in a recent decision: 'According to many writers on this subject, the view most generally entertained by geologists at present is that gas and oil are not of a vagrant character and do not migrate, but maintain their situs until they are drawn out or expel themselves by pressure through artificial openings in the surface, and that tendency of later decisions is to hold that oil and gas while in place and before being drawn out by artificial openings are as much a part of the realty as fixed minerals, such as coal or iron.'"

It is not generally realized that there is more coal on the public domain than in all the territory east of the Mississippi. The leasing act has recognized a distinction between subsurface and surface ownership, but it still conveys title to small blocks of tonnage. If some equitable plan can be worked out whereby the development of this resource in large blocks can be encouraged some think the West will profit from the experiences in the East. The question involved goes to the heart of mineral rights and will affect other minerals as well as coal.

Laws applying to mineral rights still are in process of formation. Property rights in agricultural lands are firmly established in all countries as a result of experience since the dawn of civilization. Mining as we know it dates from the invention of the steam engine. There has been, of course, some recovery of mineral since ancient times, but mines as a great source of energy and power and of materials for manufacture constitute a relatively recent development. As a consequence the laws applying to mineral property have not been so thoroughly settled. They differ widely as between countries.

In the United States the guiding principle has been the common law, which gives to the owner of the surface all that lies beneath. This principle works badly when applied to concentrated mineral resources. There are various reasons why the two distinct types of property represented by the surface and the mineral beneath it should be divorced where possible so that the title to one is not confused with the title to the other.

The pioneer miners in California had to develop their own civic law as well as their criminal code. They saw the inequity of giving ownership to the center of the earth when land was bought primarily for surface rights. They set up the law of the apex and substituted for the common law principle the doctrine of extralateral rights. Later, Congress accepted these principles and wrote them into the mining law. There was no way, however, of applying such legislation to Eastern states, where the common law principle had become thoroughly established. Great waste and various difficulties have followed the effort to apply this principle to mineral deposits. In petroleum it forces competitive drilling and overproduction.

In like fashion this is an underlying cause for overproduction of coal. With ownership of coal deposits divided among thousands of owners, as is the case with surface lands, the tendency is toward a multiplicity of operations. This is proving the chief obstacle to the present effort to consolidate coal mine holdings. The right of patenting mineral rights along with surface rights so scatters ownership that many difficulties accompany efforts to acquire a large block of tonnage.

Foreign Appreciation of Institute of Metals' Work

The ballot for the election of members of the Institute of Metals (London), taken on May 4, resulted in the addition of the names of fifty-three persons to the membership roll. Of these thirty-one are resident in Great Britain and twenty-two abroad, the secretary states. The high proportion of foreigners joining the Institute is striking. It is interpreted as an indication of the desire on their part to secure, through the Institute's *Journal*, the latest scientific information regarding non-ferrous metallurgical research work.

Recent Technical Publications

Reviews, Abstracts, and References

The Problem of Financing

Financial Organization and Management. By Charles W. Gerstenberg Published by Prentice-Hall, Inc., New York. Price $5.

This book treats of the whole field of corporation finance, in simple, understandable English, leaving nothing to the imagination. Financial subjects which, to the layman, appear extremely complicated, are here clearly reduced to their essentials, so that without any previous introductory reading a splendid picture of the methods of the promotor, financier, and security sales organizations may be obtained.

The entire text is germane to mining, although its principles are applicable to any industry. To begin with, the author takes up the function and operation of the promoter and outlines his usefulness and necessity as well as his rewards. This is the clearest description of the promoter's work that we have seen. Then the forms of corporate organization are described. Next the topic of borrowing funds is discussed—both short- and long-term funds—and the many forms in which they may be obtained and divided. This is one of the most important sections of the work. Last but not least a description of and the advantages of combination, intercorporate relationship, holding companies, and other forms of organization follow.

The book is intensely practical, and yet theoretical also, for the author never fails to give the underlying reason for procedure under certain conditions. Added interest is given the text by the many examples from business practice—some of them from mining—used to drive home the author's remarks. He has succeeded strikingly in making a subject that could be drab and cold, extremely vital and absorbing. The book will be valuable to any one interested in the financial aspects of a business enterprise and will appeal to both the specialist and the embryo financier, with its refreshing and useful material. F. E. WORMSER.

The Porcupine Gold Area. By A. G. Burrows. Thirty-third Annual Report. Ontario Department of Mines, Part II, Toronto. Free on request.

This newest report on one of the most important gold-mining districts in the world will be read with great interest, especially in view of the long study which Mr. Burrows has put upon the region. The bulk of the report is given up to the discussion, by Mr. Burrows, of the geology. There are also papers on Mining Methods, and Milling Practice, by George E. Cole, E. L. Longmore, C. W. Dowsett, and A. Dorfman.

One of the interesting features of the geology is the mapping of a number of individual lava flows in the Keewatin, thereby unraveling the general structure. This structure has aided in determining an unconformity between the Keewatin and the overlying Temiskaming sediments. Later than the Temiskaming is Algoman or quartz-porphyry, which occurs as stocks and dikes. This is the porphyry of the Hollinger and other mines. The latest expression of igneous activity is in a few diabase dikes.

The gold deposits are related to the granitic intrusions of the Algoman, to which intrusions belong the quartz porphyry with which the ores are closely associated.

The ores are pegmatitic in character, containing feldspar in places. They have been injected under heavy pressure. Quartz and ore have also replaced the wall rocks. Alteration in the wall rocks has produced sericite, involving an increase of potash in the rocks.

The report is illustrated with many photographs and diagrams.

J. E. SPURR.

First Aid—The American Red Cross has recently published a third edition of its abridged textbook on "First Aid," Industrial Edition. This book of 262 pages is an authoritative reference book for use in all kinds of emergencies where bodily injuries or sicknesses must be attended to very promptly. A large number of illustrations showing how to prepare bandages, carry the injured, and revive the drowning are included. Obtained for 60c. per copy from The American Red Cross, Washington, D. C.

Density Tables—U. S. Bureau of Standards Circular No. 19, 72 pages, price 15c. from the Superintendent of Documents, Washington, D. C., is entitled "Standard Density and Volumetric Tables." This is the sixth edition of this bulletin, which is a valuable reference work for physical and chemical laboratories.

Northern Ontario Mining — *The Northern Miner*, of Cobalt, Ont., issued a special "Investors' Edition" of 40 pages as its issue of April 18. This is a very creditable effort to describe the various mines and prospects of that part of Canada in a way that will appeal to the intending investor. Copies may be had for 10c. each.

Borates—The Imperial Mineral Resources Bureau has published a statistical bulletin of 26 pages giving data on borates for the years 1920-1922. Price 1s. 1d.; obtainable from The British Library of Information, 44 Whitehall St., New York City.

Idaho Gold—The "Geology and Gold Resources of Boise Basin, Boise County, Idaho" are discussed by Samuel M. Ballard in Bulletin No. 9 of the Idaho Bureau of Mines and Geology, recently issued. This is an old placer district that offers good possibilities for lode mining. Other minerals than gold are present, including bismuth. The Gold Hill is the only operating property at present. Copies of this bulletin are obtainable for 50c. from the Idaho Bureau of Mines and Geology, Moscow, Idaho. (80 pages, 13 plates, 2 maps.)

Patents

Lime and Magnesia—No. 1,532,500. April 7, 1925. G. S. Kilbourn, Owen Sound, Ont. Lime is extracted from materials containing both lime and magnesia by calcining and slaking the material, and allowing it to settle in a tank. The bottom of the tank contains a 200-mesh screen covered with porous material, through which a stream of water is introduced, thus floating off the lime and leaving the magnesia.

Chloridizing Volatilization — No. 1,532,503. April 7, 1925. Harai R. Layng, San Francisco; Hattie F. Layng, administratrix. A mixture of ore and a chloridizer is heated in a furnace, and an additional chloridizer in the form of a solution is added during the heat treatment to assist in volatilizing the metals.

Furnace Skewback — No. 1,532,568. April 7, 1925. F. L. Antisell, Perth Amboy, N. J. A new form of skewback suitable for securing the arches of reverberatory furnaces.

Calcium Arsenate—Nos. 1,532,577-8. April 7, 1925. J. F. Cullen, Midvale, Utah, assignor to United States Smelting, Refining & Mining Co., Portland, Me. Methods of making calcium arsenate from arsenic trioxide.

Sintering—No. 1,533,108. April 14, 1925. J. E. Greenawalt, New York City. Design for a hood and a rectangular sealing frame, in connection with sintering apparatus. Patent No. 1,533,109, issued to the same applicant, covers a method of igniting the charge by projecting several jets of flame diagonally against the surface.

Amalgamator—No. 1,533,557. April 14, 1925. W. P. Jobson, Philadelphia, and H. S. Souder, Souderton, Pa., assignors to Souderton Mfg. Co., Souderton, Pa. Design for a centrifugal amalgamating machine.

Roasting Furnace — No. 1,533,572. April 14, 1925. R. H. Richards, Boston, Mass. An ore-roasting furnace of the shaft type, with drying, ignition, reducing, and cooling zones, the ore and fuel being mixed in the feed.

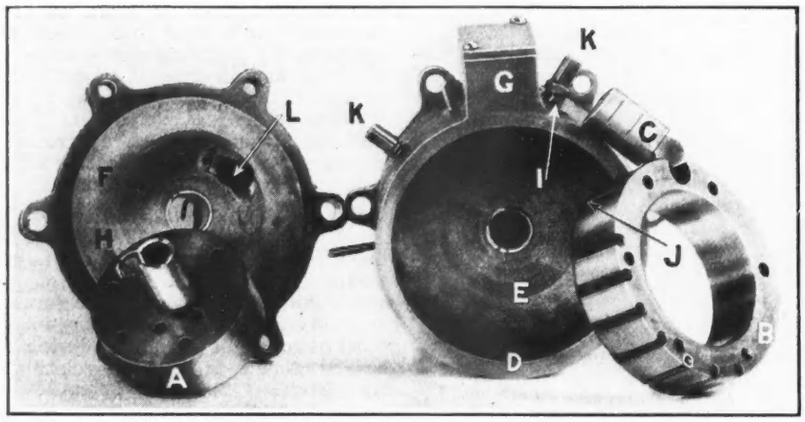
Sulphur Extraction—No. 1,535,468. April 28, 1925. E. E. Hedges, assigned as above. Sulphur is extracted from its ores by cascading the material through an elongated retort, introducing a fluid heated to the sulphur vaporizing temperature at the end opposite the charging end, to absorb the sulphur vapors, and condensing the vapors.

Dry Concentrator — No. 1,535,630. April 28, 1925. W. H. Powell, Albuquerque, N. M. A pneumatic device for separating mineral from gangue.

Briquetting—Nos. 1,536,032-3. April 28, 1925. A. L. Stillman, Plainfield, N. J., assignor to The Smelters' General Briquette Corporation, New York. Material containing ferrous oxide is treated with an agent having agglutinant or corrosive characteristics that will form a binder, and compacting the mixture by pressure.

Patents are obtainable for 10c. each only from the office of the Commissioner of Patents, Washington, D. C. "Mining Journal-Press" has none for sale.

New Machinery and Inventions



Parts of novel rotary compressor designed by John Milne. Letters refer to text

Rotary Compressor Designed on Novel Lines

A valveless rotary compressor that is compact and simple in design and that will run with little vibration at high speeds, the inventor claims, has been developed by John Milne, 273 Greenwich St., New York. It is intended for pumping fluids as well as compressing air. In an accompanying cut, one of these machines is shown mounted directly on the motor shaft. It has no external moving parts. It consists of a cylinder *D* inclosed between two end covers, *F*, the cylinder being divided internally into two chambers by a hollow transverse partition *E*, through the center of which the motor shaft passes; on this shaft is mounted, on either side of the partition *E*, an eccentric piston, *A*, which rotates within a ring *B*, the ring itself being kept from rotating by engaging with a "sliding partition," *C*, which is free to slide up and down in ways within the boss *G* on top of the cylinder casing.

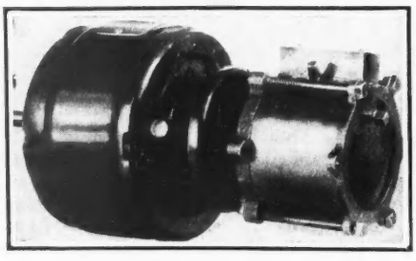
Compression takes place in the narrow annular space between the peripheral surface of the ring *B* and the inner wall of the cylinder *D*. Kept from rotating as it is by *C*, which is free to slide vertically on its ways in *G*, the ring receives from the eccentric rotor piston *A* the only motion possible for it, which is as follows:

Starting at a point immediately to the right of *C*, the sliding partition, the peripheral surface of the ring *B* is brought into momentary elemental contact with the inner surface of the cylinder *D;* this elemental contact of the two surfaces continues in a clockwise direction as the eccentric piston turns, until, at last completing the cycle, contact has been made immediately to the left of the sliding partition *C*. The air inlet is at *I*. Before the cycle of contact or compression above described is begun, air enters this port, filling the space between the ring and the cylinder wall. This port is first closed by the ring itself as the rotor begins to turn. As the turning continues, the air thus entrapped is squeezed or compressed between the ring and cylinder wall and forced into a continually decreasing space ahead of the advancing point of contact, until, just as the cycle is completed, the three outlet ports, *J* in the ring, *H* in the rotor piston, and *L* in the cover, come into register with each other, permitting the compressed air to escape from the cylinder. Thus it is seen that from the time the air first enters the cylinder until the outlet ports register to permit its escape, it is compressed in a space that gets smaller and smaller until the minimum space and maximum pressure are reached at the moment of discharge. The sliding partition *C* serves as a partition between the inlet and outlet portions of the cylinder — whence its name. Thus no communication is possible between intake and outlet ports. When the ports are not in register they act as a check valve for the air in the cylinder and the air in the outlet piping.

Cooling water or other cooling medium is circulated through the cavity within the hollow partition, entering and leaving through the pipes *K. K.*

The operation described is possible at high rotative speeds. A minimum of vibration is obtained by proper balance of the parts. On the opposite side of the hollow partition *E*, the cylinder, rotor, and ring and sliding partition are duplicated, so that there are two compressors having a common cylinder casing. These are arranged to balance each other, and may be independent of each other, one functioning as a compressor while the other is producing a vacuum. With a machine on each end of the motor shaft it is therefore possible to have four compressors on one motor, compressing 90 deg. apart. Unloading devices are said to be unnecessary, and for many purposes the compressor can be used without a receiver.

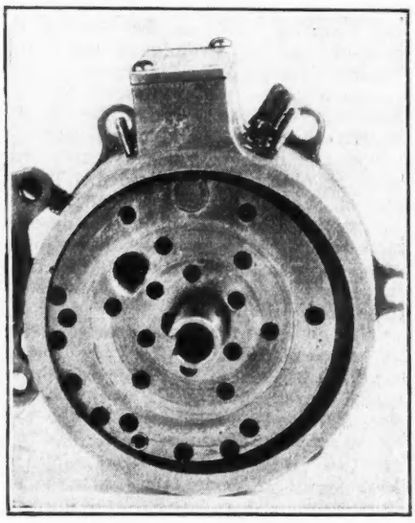
The numerous small holes seen in the rotor piston and ring in the accompanying illustrations were intended simply to reduce the weight of the parts and are unnecessary.



A rotary compressor mounted directly on motor shaft

A Continuous Flexible Wire Belt

A flexible belt made of wire of suitable gage for the work for which it is designed is announced by the Industrial Conveyor Co., of Newark, N. J., in a recent catalog. It is constructed by weaving together wire spirals into a continuous fabric, of such mesh as required. It may be made in any width and in any length without break or irregularity, it is claimed. If desired, it may be made endless. It can be furnished in aluminum, brass, bronze, copper, monel metal, and in plain, tinned or galvanized steel.



Ring, rotor piston and sliding partition of rotary compressor are shown assembled. Note the space in which compression takes place. See text.

Trade Catalogs

Diesel Engines—Bulletin No. S-171 of the Worthington Pump and Machinery Corporation, 115 Broadway, New York, is devoted to a description of the new Worthington double-acting two-cycle oil engine of the Diesel type. This engine was announced in 1924.

Motor—An automatic self-starting squirrel-cage motor without moving parts in the starting mechanism is described in a 4-page folder of the U. S. Electrical Manufacturing Co., Los Angeles, Calif. It is known as the U. S. Auto-Start motor.

Flotation Machine—A bulletin on the Simpson pneumatic flotation cell has just been issued by the Simpson Engineering Co., of 1460 Anaheim St., Long Beach, Calif. It describes the construction and operation of the new machine. Specifications for different models are given. A laboratory testing machine is also described.

The Market Report

Daily Prices of Metals

May	Copper N. Y. net refinery*	Tin		Lead		Zinc
	Electrolytic	99 Per Cent	Straits	N. Y.	St. L.	St. L.
14	13.30@13.375	53.50	54.50	7.925	7.70	6.90@7.00
15	13.375	53.25	54.25	7.925	7.75	6.90
16	13.375	53.25	54.25	7.95	7.75	6.90@6.925
18	13.375	53.25	54.25	7.95	7.80	6.90
19	13.35	53.25	54.25	8.025	7.825	6.90
20	13.35	54.00	55.00	8.05	7.75@8.00	6.90
Av.	13.360	53.417	54.417	7.971	7.783	6.910

*The prices correspond to the following quotations for copper delivered: May 14th, 13.55@13.625c; 15th, 16th and 18th, 13.625c.; 19th and 20th, 13.60c.

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

May	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic						
	Spot	3M		Spot	3M	Spot	3M	Spot	3M
14	60 1/4	61 1/8	63 1/2	244 1/4	246 1/4	31 13/16	31 11/16	34	33 3/8
15	60 3/8	61 3/8	63 3/4	243 5/8	246	32 3/16	32 2/16	33 15/16	33 5/16
18	60 3/8	61 3/8	63 3/4	244 3/8	246 3/4	32 1/2	32 3/8	34	33 1/2
19	60 1/4	61 1/8	63 1/2	245	247	32 1/8	32 1/8	33 7/8	33 3/8
20	60 1/8	61	63 1/2	246 1/2	248 1/2	32 5/16	32 1/4	33 7/8	33 5/16

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

May	Sterling Exchange "Checks"	Silver		Gold London	May	Sterling Exchange "Checks"	Silver		Gold London
		New York	London				New York	London	
14	4.84 3/4	67 1/2	31 3/16	84s 11 1/2d	18	4.85	67 1/4	31 3/16	84s 11 1/2d
15	4.84 3/4	67 1/2	31 3/16	84s 11 1/2d	19	4.85	67 1/2	31 1/2	84s 11 1/2d
16	4.85	67 1/4	31 1/8	....	20	4.85 1/2	67 1/4	31 1/8	84s 11 1/2d

New York quotations are as reported by Handy & Harman 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.

Lead the Bright Spot in the Metal Markets

New York, May 20, 1925—Copper, zinc, and tin have been in only moderate demand in the week ending today, though no day went by without a few small sales being recorded. Lead, on the other hand, has sold in good volume and at advancing prices, with spot metal practically unobtainable.

The fact that other metal markets have not shown the life exhibited by lead in the past three weeks has acted somewhat as a damper upon the forward movement of lead prices. There is a more or less sympathetic movement of all the non-ferrous metals and when conditions in most of them are unsatisfactory this sentiment is reflected generally.

Copper Prices Steady

The week ending today has been much like last week, with no price change of importance and only moderate tonnages sold in the domestic market. In general, it may be said that all producers have been trying to sell at 13⅝c., delivered, and all consumers have been endeavoring to buy at 13½c. The producers have had the best of it, for by far the largest amount of the copper that has been sold has been booked at 13⅝c. delivered in Connecticut and other nearby points. In the Middle West, 13¾c. has ruled. Last Thursday there was more difficulty in getting 13⅝c., some prompt metal going for 13.55c., and slight concessions have also been made in the last two days, one or two interests being willing to release small tonnages of prompt copper at 13.575@13.60c. Most sellers continue firm at 13⅝c.

Consumers report that advance orders have been disappointing during May. The mills are all exceedingly busy, but there are indications that the present rate of operations cannot long be maintained without more orders. Producers are for the most part well sold up and there is no indication of any particular pressure on the market in the immediate future.

Export business, both to England and the Continent, has been relatively better than has domestic. Yesterday and today 13.75@13.825c., c.i.f. was done by several sellers.

Lead Moves Upward Again

Two advances were made in the contract price of the American Smelting & Refining Co. during the week. The first raise was made on May 14 to 7.90c. per lb., New York, and the second to 8c. on May 19.

Lead is not very plentiful. One producer has begun to ration his supplies of June metal, but is more liberal with July shipments. However, the situation is different from that in previous rising lead markets in that there does not seem to be any scramble to buy. In fact, some producers report only a moderate inquiry. Buying is good and, as usual, is mainly confined to near-by delivery. June metal is the cheapest; July and May positions command higher prices. In St. Louis the market has advanced almost daily, carrying prices today up to 8c. per lb., with some lead available below this level. One producer will sell June lead to his regular customers at 7.75c. today, a price that is admittedly below the market elsewhere. St. Louis and New York have moved close together again. New York lead was sold for as much as 8.20c. per lb. recently.

Corroding lead has not been in so good a demand as other grades, owing partly to the falling off in paint business in recent weeks. Manufactures of paint early in the year were at a high rate, but a reaction has set in which has affected the call for corroding metal. Other consuming lead branches are doing well, especially cable and storage battery manufacturers.

Corroding lead has brought the usual premium of $2@$3 per ton over common grades.

Producers have only small stocks of lead available. They have not had any opportunity to accumulate a reserve supply of lead to take care of these sporadic outbursts of buying which cause the market to move rather

sharply upward and then downward, much to the dislike of both producers and consumers.

Zinc Held at 6.90c.

The zinc market has not been active, though all sellers report a little business, chiefly from galvanizers for May and June delivery. The price has declined slightly below 7c., but at 6.90c, which has been maintained most of the week, seems to have hit bottom for the time being. Zinc for delivery several months forward was sold slightly below that level, but in general the spot and future market is the same. World stocks of zinc are increasing slightly, according to reports. High-grade continues unchanged at 8⅛@8¼c. delivered in the domestic market.

Tin Market Dull

Tin prices have moved only slightly during the week. For the most part Straits tin hung around 54.25c. per lb., with only a small tonnage going into the hands of actual consumers. London remains the guiding star of the market. Forward tin has been sold for about ¼c. per lb. under the price of prompt or May shipment. A sale of Chinese tin was made early in the week at a concession of 1c. per lb. below Straits, which is the difference between the two grades at present.

Silver Market Narrow

Fluctuations in the silver market during the past week have been extremely small, and the market has been narrow, with demand and supply both limited here.

London reports China both buying and selling. The Continent was a moderate seller. India remains a moderate buyer on recessions, but shows no disposition to follow up any advance. The undertone appears to be steady at the moment.

Mexican Dollars: May 14th and 15th, 52c.; 16th and 18th, 51¾c.; 19th, 52c.; 20th, 51¾c.

Francs and Lire Weaker

Francs and lire are slightly below the levels of last week, but sterling cables sold as high as $4.85 13/16 yesterday. Closing cable quotations on Tuesday, May 19, were as follows: francs, 5.155c.; lire, 4.025c.; and marks, 23.81c. Canadian dollars, par.

Other Metals

Quotations cover large wholesale lots unless otherwise specified.

Aluminum—99 per cent grade, 28c. per lb.; 98 per cent, 27c. London, £118.

Antimony—
Chinese brands, 17c. per lb.
Cookson's "C" grade 17½@18c.
Chinese needle, lump, nominal, 10c.
Standard powdered needle, 200 mesh, 11½@13c.
White oxide, Chinese, 99 per cent Sb_2O_3, 16c. nominal.

Bismuth—$2 per lb., in ton lots. London, 7s. 6d.

Cadmium—60c. per lb. One producer reports being unable to get more than 50c., at which level small amounts have been sold. Others report all sales at 60c.

Iridium—$375@$400 per oz. London £70.

Nickel—Ingot, 31c.; shot, 32c.; electrolytic, 38c.; London, £172½ per long ton.

Palladium—$79@$83 per oz. London £16.

Platinum—$120 per oz. refined. London, £25 per oz.
Crude, $115.

Quicksilver—$81.50 per 75-lb. flask. San Francisco wires $81. Quiet. London £13½.

The prices of **Cobalt, Germanium Oxide, Lithium, Magnesium, Molybdenum, Monel Metal, Osmiridium, Osmium, Radium, Rhodium, Ruthenium, Selenium, Tantalum, Tellurium, Thallium, Tungsten,** and **Zirconium** are unchanged from the prices given in the May 9 issue.

Metallic Ores

Tungsten Ore—Per unit, N. Y.:
High-grade wolframite $11@$11.50 per unit. Ordinary quality, $11. Scarce.
High-grade Western scheelite, $11 nominal.

Chrome, Galena Radio Crystals, Iron Ore, Manganese, Molybdenum, Tantalum, and **Vanadium Ores** are unchanged from May 16 quotations.

Lead Higher—Zinc in Light Demand

Joplin, Mo., May 16, 1925

Zinc Blende	Per Ton
High	$53.30
Premium, basis 60 per cent zinc	$50.00@$52.00
Prime Western, 60 per cent zinc	$48.50@$47.50
Fines and slimes	$47.00@$44.50
Average settling price, all ore	$45.95

Lead Ore	
High	$97.80
Basis 80 per cent lead	$95.00
Average settling price, all ore	$92.21

Offerings of $95 basis for lead are being declined by some sellers, but a considerable tonnage was sold on that basis.

Prime Western zinc offerings were lowered this afternoon by buyers $1 per ton, but no large quantity is reported purchased on this basis. Several of the stronger companies are asking a $50 basis.

Shipments for the week: Blende, 12,707 tons; lead, 1,869 tons. Value, all ores the week, $755,780.

Last week was the end of settlements for lead ore purchased several months ago on a basis of $100 per ton, and the drop in shipment indicates the stand of producers on a lower price level.

Platteville, Wis., May 16, 1925

Zinc Blende	Per Ton
Blende, basis 60 per cent zinc	$50.00

Lead Ore	
Lead, basis 80 per cent lead	$100.00

Shipments for the week: Blende, 919 tons; lead, 30 tons. Shipments for the year: Blende, 14,797; lead, 767 tons. Shipments for the week to separating plants: 1,882 tons blende.

Non-Metallic Minerals

Amblygonite, Asbestos, Barytes, Bauxite, Beryl, Borax, Celestite, Chalk, China Clay, Corundum, Diatomaceous Earth, Emery, Feldspar, Fluorspar, Fuller's Earth, Garnet, Gilsonite, Graphite, Gypsum, Ilmenite, Iron Oxide, Lepidolite, Limestone, Magnesite, Manjak, Mica, Monazite, Ocher, Ozocerite, Phosphate, Potash, Pumice, Pyrites, Quartz Rock Crystals, Rutile, Silica, Spodumene, Sulphur, Talc, Tripoli, and **Zircon** are unchanged from May 9 prices.

Mineral Products

Arsenious Oxide (White arsenic)—5@5¼c. per lb. Concessions from the 5¼c. price generally quoted by producers have been made, and a few odd lots have been available at 5c. Imported arsenic has been offered for even less.

Copper Sulphate, Sodium Nitrate, Sodium Sulphate, and **Zinc Oxide** are unchanged from May 9 prices.

Ferro-Alloys

Ferrocerium, Ferrochrome, Ferromanganese, Ferromolybdenum, Ferrosilicon, Ferrotitanium, Ferrotungsten, Ferrouranium and **Ferrovanadium** are unchanged from the prices given in the May 9 issue.

Metal Products

Copper Sheets—Base price 21.75c. Wire, 15.875c.

Nickel Silver, Yellow Metal, Zinc Sheets and **Lead Sheets** are unchanged from the issue of May 9.

Refractories

Bauxite Brick, Chrome Brick, Firebrick, Magnesite Brick, Magnesite Cement, Silica Brick, and **Zirkite** are unchanged from May 9 prices.

Steel Prices Hold Steady

Pittsburgh, May 19, 1925

Steel mills are now running at an average slightly below 70 per cent and operations continue to decrease, trending toward 60 per cent or less by July. Buyers are liquidating their stocks as rapidly as possible, yet are taking fairly large deliveries. Consumption continues at a very high rate. Steel prices in the main hold steadily at levels of the past few weeks. Sheets show a little additional weakness, through mills forcing sales.

Pig Iron—The expected decline in pig iron has occurred, and without the expected occasion, of good-sized inquiry developing to produce greater competition. On small sales prices have gone down $1 to $20 for bessemer and $19 for foundry, f.o.b. Valley furnaces, whereby basic, without sales, automatically declines to $19 also. Merchant furnaces are piling iron and additional stacks will probably blow out.

Connellsville Coke — Spot furnace coke remains at $3@$3.15, with very little activity. Spot foundry coke is off 25c. at $3.75@$4.25, with sales continuing light. Production continues to decrease.

Company Reports

Chile Copper Co.

Following is a consolidated report of the operations and activities of Chile Copper Co., and of its subsidiary, Chile Exploration Co., which holds the title to all property in South America, and through which the operations are actually conducted.

During the year the Chile Exploration Co. operated continuously, producing 212,325,972 lb. of electrolytic copper at a cost delivered of 7.992c. per lb., including depreciation, all taxes, interest and discount on bonds, but not including depletion.

There was expended during the year, in construction and extensions for capital account, $3,650,015.54. Charges to obsolescence and profit and loss amounted to $1,539,685.51. resulting in a net increase in the book value of assets from $140,165,760.92 at Dec. 31, 1923, to $142,276,090.95 Dec. 31, 1924.

On Dec. 31, 1924, the company had on hand in marketable securities and cash $14,910,945.29.

Consolidated Balance Sheet, Dec. 31, 1924

Assets		
Fixed plant and property	$142,276,090.95	
Less reserve for depreciation	17,060,060.50	
		$125,216,030.45
Deferred charges including discount on bonds		3,075,691.43
Current		28,851,485.68
		$157,143,207.56
Liabilities		
Capital stock		
Issued—4,391,060 shares		$109,776,500.00
Collateral trust gold bonds		35,000,000.00
Reserve for renewals and replacements		520,153.03
Current		4,682,459.36
Surplus		
Surplus Dec. 31, 1923	$6,788,807.51	
Net income, per statement annexed	11,352,937.66	
	$18,141,745.17	
Distribution to stockholders	10,977,650.00	
		7,164,095.17
		$157,143,207.56
Consolidated Income Account		
Operating revenue		
Copper sold—213,418,044 lb. at an average of 13.255c. per lb.		$28,289,013.06
Production cost		11,812,499.88
Operating profit		$16,476,513.18
Other income		1,297,007.53
		$17,773,520.71
Charges against income		
Taxes and miscellaneous	$1,781,538.14	
Interest and discount on bonds	2,240,000.00	
For depreciation and obsolescence	2,399,074.91	
		6,420,583.05
Net income, carried to balance sheet		$11,352,937.65

Tonopah Belmont Development Co.

Tonopah Belmont Development Co.'s report for 1924 states that the production of the Belmont mine, operating expenses, net earnings, and net profits for the last two years are as follows:

	1924	1923
Gross value of production	$777,333.80	$842,963.75
Losses in treatment	6,979.13	31,328.36
Net values realized	$770,354.67	$811,635.39
Operating expenses	579,616.74	630,764.06
Net earnings mine and Tonopah mill	$190,737.93	180,871.33
Net earnings of other plants	1,238.23	74,118.00
Total net earnings from operation	$189,499.70	$254,989.33
Other income	19,270.42	*a*62,187.21
Gross income	$208,770.12	$317,176.54
Administration, taxes, etc	50,489.33	*b*152,119.27
Net profit	$158,280.79	$165,067.27

a Includes dividends from Belmont Surf Mines, Ltd.
b Includes $97,371.57 depreciation, etc., shown on income account.

The shutdown expense at the Belmont Mill and Millers Mill for the year amounted to $17,660.61, which was $1,238.23 more than the final amount realized in the clean-up. The slimes re-treatment plant at Tonopah and the Millers tailings plant were dismantled, after having completed the work for which they were built.

The loan to the Jim Butler Tonopah Mining Co., amounting to $133,459.46, was extinguished by the payment of 870,495 shares of the stock of the reorganized Jim Butler Mining Co. at 15c. per share. In addition the company took and paid for 294,473 shares of the Jim Butler Mining Co. at 15c. per share, since the close of the fiscal year. Total holdings in the Jim Butler Mining Co. are, therefore, 1,164,968 shares out of a total of 2,000,000 issued and outstanding.

During the year an extensive campaign of deep development at Tonopah was determined upon. Before this work was undertaken, leases were secured upon adjacent ground owned by the Mizpah Extension Mining Co., the North Star Tunnel & Development Co., and the Boston Tonopah Mining Co., and crosscuts on the 1,500 level are now under way to prospect this ground. A crosscut is also being driven on this level toward the ground of the Jim Butler Mining Co.

The Belmont Wagner property near Telluride, Colo., was relinquished on Aug. 26, 1924, and the property turned over to the owners.

Balance Sheet, Dec. 31, 1924

Assets			
Property			$1,718,296.40
Investments			
Belmont Surf Inlet Mines, Ltd.		$1,292,352.94	
Esmeralda Power Co.		2,500.00	
Tonopah Divide Mercantile Co.		10,650.00	
Tonopah Mines Hospital Association		575.00	
Jim Butler Mining Co.		133,459.46	
			1,439,537.40
Available assets			671,733.27
Deferred charges			52,459.55
			$3,882,016.62
Liabilities			
Capital stock			
1,500,000 shares fully paid			$1,500,000.00
Current liabilities			37,409.45
Surplus arising from the revaluation of mining property		$2,989,040.84	
Surplus account			
Balance Dec. 31, 1923	$1,128,556.81		
Net income for the year 1924	158,280.79		
		1,286,837.60	
		$4,275,868.44	
Less investments written off			
Belmont Shawmut Mining Co.	$959,422.91		
Belmont Wagner Mining Co.	971,848.36		
		1,931,271.27	
			2,344,607.17
			$3,882,016.62

Hecla Mining Co.

A statement for the first quarter of 1925 of Hecla's operating results follows:

Gross income		$1,054,032.36
Operating expenses	$384,652.53	
Taxes accrued	71,000.00	
Depreciation (estimated)	39,514.15	495,166.68
Net profit		$558,865.68
Tons mined		78,910
Pounds lead produced		12,964,064
Average lead price		$8.83
Ounces silver produced		364,324
Average silver price		$0.68

Nipissing Mines Co., Ltd.

During 1924 there were produced by the Nipissing Mining Co. for Nipissing Mines Co., Ltd., approximately 85,000 tons of ore, which contained 3,000,000 oz. of fine silver. The cost of production per ounce of fine silver was about 37c., and the per-ton cost of ore produced was about $13. The higher silver production cost was due to the larger amount of exploration and development, and to the fact that the per-ton silver content of the ore was less than in 1923.

The net value of all Nipissing shipments was $1,911,000; net income for the year was $1,116,000.

The average silver content of all ore milled was 36.36 oz. per ton. The known ore reserves contain approximately 1,500,000 oz. of silver. There was paid in dividends during the year by the holding company, $1,080,000, or 18 per cent. The operating company surplus as of Jan. 1, 1925, was $4,500,000.

Benguet Consolidated Mining Co.

Gold; Philippine Islands

The annual report for 1924 of the Benguet Consolidated Mining Co. states that 89,621 tons of ore, of an average value of 29.10 pesos, were treated. [The peso is equal to 50c. in United States currency.] The gross value of gold and silver produced was 2,394,998.04 pesos.

As set forth in the following table, the profit-and-loss statement shows a net profit for the year of 1,067,461.70 pesos.

The following is a brief summary of receipts and expenditures:

	Pesos	Pesos
Receipts		2,433,280.68
Expenditures		1,081,218.69
Gross profit		1,352,061.99
Less depreciation	177,708.26	
Less development written off	79,521.22	257,229.48
		1,094,832.51
Less 2½ per cent bonus to general manager		27,370.81
Net profit		1,067,461.70

Estimates of ore reserves as of Dec. 31, 1924, were as follows:

	Tons	Pesos
Positive ore—exposed on four sides	126,758	4,436,704.80
Probable ore—exposed on at least one side	79,515	2,278,908.00
Total	206,273	6,715,612.80

Dividends were paid for 1924, as follows:

	Centavos Per Share
March 31, quarterly dividend	10
June 30, quarterly dividend	10
August 15, extra dividend	5
September 30, quarterly dividend	10
December 20, quarterly dividend	10
January 20, 1925, extra dividend	5

Balance Sheet, Dec. 31, 1924

Assets

	Pesos
Fixed assets	952,919.96
Working assets	38,413.68
Development	118,490.30
Calvin Horr option	21,904.90
Inventories	311,802.59
Investments—bonds securities in United States	60,048.62
Current assets	686,192.76
	2,189,772.81

Liabilities

	Pesos	Pesos
Capital stock 2,000,000 shares at 0.70 peso each, fully paid		1,400,000.00
Current liabilities		58,716.44
Reserve for depreciation of supplies		62,620.87
Profit and loss account		668,435.50
Balance from Dec. 31, 1923	700,973.80	
Add profit for year ended Dec. 31, 1924	1,094,832.51	1,795,806.31
Less dividends paid	1,100,000.00	
Bonus to general manager	27,370.81	1,127,370.81
		2,189,772.81

Nevada Consolidated Copper Co.

The Nevada Consolidated Copper Co.'s copper production for the first quarter of 1925 follows:

First Quarter, 1925	Pounds	Fourth Quarter, 1924	Pounds
January	5,752,830	October	5,770,592
February	5,898,412	November	5,782,720
March	5,944,092	December	5,999,300
Total	17,595,334	Total	17,552,612
Ave. monthly production	5,865,111		5,850,871

A total of 937,112 tons dry weight of ore, averaging 1.08 per cent copper, was treated at the concentrator, compared with 905,908 tons, containing 1.11 per cent copper, milled in the preceding three months. In addition to the company ore handled, 4,988 tons of custom ores were concentrated and 14,803 tons smelted direct.

The cost per pound of net copper produced, including plant and equipment depreciation and all fixed and general charges, and after crediting gold and silver and miscellaneous earnings, was 10.89c., against a cost, figured on the same basis, of 11.27c., for the final quarter of 1924.

The financial results of operations for the quarter are shown below in comparison with those of the previous quarter:

	First Quarter, 1925	Fourth Quarter, 1924
Operating profit from copper production	$521,279.52	$383,396.59
Gold and silver and miscellaneous income	257,171.16	206,736.20
Nevada Northern Ry. Co. dividend	75,000.00	100,000.00
Total income	$853,450.68	$690,132.79
Plant and equipment depreciation	167,862.51	150,429.72
Increase in earned surplus	$685,588.17	$539,703.07

Earnings for the first quarter are calculated on the basis of 14.36c. per pound of copper produced, compared with a carrying price of 13.77c. for the quarter ended Dec. 31, 1924.

Asbestos Corporation of Canada, Ltd.

The profits of Asbestos Corporation of Canada, Ltd., after making allowance for bond interest, government taxes, and other charges, were $396,355.07, for the year ended Dec. 31, 1924, compared with $402,330.57 the previous year. From these profits, $67,293.50 has been provided for exhaustion of minerals, and dividends were declared at the rate of 6 per cent on the preferred stock, and 2 per cent on the common stock, amounting to $300,000, leaving a balance of $29,061.57.

Comparative Statement of Profit-and-Loss and Surplus

	1923	1924
Profits from operations for the year after providing reserve for income tax, but before depreciation and depletion	$368,936.82	$419,248.77
Interest on company's investments	183,393.75	127,106.30
	$552,330.57	$546,355.07
Deduct Bond interest and depletion	150,000.00	217,293.50
	$402,330.57	$329,061.57
Deduct dividends	380,000.00	300,000.00
Surplus profits for the year	$22,330.57	$29,061.57
Add Surplus balance from previous year	2,211,076.94	2,233,407.51
Surplus, as per balance sheet	$2,233,407.51	$2,262,469.08

Balance Sheet, Dec. 31, 1924

Assets

Property account (less reserves)		$9,139,900.92
Royal Trust Co.		7,703.42
Investments		
Dominion Government bonds		$1,209,486.16
Company's own bonds and other securities	$773,006.50	
		1,982,492.66
Current assets		1,243,403.07
Deferred charges		41,259.45
		$12,414,759.52

Liabilities

Capital stock		
Preferred—authorized and issued—40,000 shares	$4,000,000.00	
Common authorized and issued—30,000 shares	3,000,000.00	
		$7,000,000.00
First mortgage 5 per cent coupon bonds		2,740,200.00
Current liabilities		307,605.20
Reserves for contingencies and government taxes		104,485.24
Surplus		2,262,469.08
		$12,414,759.52

Lorrain Trout Lake Mines, Ltd.

Lorrain Trout Lake Mines, Ltd., began operations in April, 1923, with a working capital of $150,000. A total expenditure of $46,841.43 was made from that time until receipts from ore production came in. Since then, the cash and liquid resources of the company have increased, until at the end of 1924, they amounted to $200,778.02. Profitable production has continued to date, enabling the directors to announce an interim dividend of 5 per cent on March 13, 1925, less than two years from the beginning of operations.

Production started in March, 1924, and has continued steadily, resulting in 263,912 oz. of silver being recovered to the end of the year. The company's largest shareholder is the Mining Corporation of Canada, Ltd.

The Mining Corporation of Canada, Ltd.

Operations of the Mining Corporation of Canada for 1924 show a net profit of $67,438. The value of the company's production amounted to $887,047.71 and the net profit at the mines was $247,467.81. The company has $238,369.36 in cash on hand. Production of silver totaled 1,373,158 oz. from Cobalt and South Lorrain properties.

Exploration and development will be vigorously continued as in the past, both as to the developed and partly developed areas owned and controlled by the company.

Nipissing Mining Co., Statement of Operations

Gross value of 1924—Nipissing production		$2,119,967.09
Net cost of production		1,116,501.35
Net income from 1924 production		$1,003,465.74
Add interest on bonds, interest on bank balance, and profit on sale of securities		185,376.28
		$1,188,842.02
Less work on outside properties		72,428.36
Net profit		$1,116,413.66
Surplus Jan. 1, 1924		4,499,819.46
		5,616,233.12
Less dividends declared and paid during 1924	$755,000.00	
Dividend payable January, 1925	360,000.00	1,115,000.00
Net surplus—per balance sheet		$4,501,233.12

Balance Sheet, Dec. 31, 1924

Assets

Plant and property	$250,401.23
Current	2,469,836.61
Investments	2,641,469.84
Total	$5 361,707.68

Liabilities and Capital

Capital stock issued and outstanding	$250,000.00
Current	610,474.56
Earned surplus (per statement of operations)	$4,501,233.12
Total	$5,361,707.68

Utah Copper Co.

Utah Copper Co. reports copper production for the first quarter of 1925 as follows:

First Quarter, 1925	Pounds	Fourth Quarter, 1924	Pounds
January	17,946,842	October	17,635,180
February	17,915,934	November	17,849,316
March	17,845,906	December	17,845,936
Total	53,708,682	Total	53,330,432

During the quarter the Arthur plant treated 1,404,300 dry tons of ore and the Magna plant 1,625,800 dry tons, a total for both plants of 3,030,100 dry tons.

The average grade of ore treated at the mills was 1.08 per cent copper and the average mill recovery of copper in the form of concentrates was 85.82 per cent of that contained in the ore, compared with 1.06 per cent copper and 85.89 per cent recovery, respectively, for the previous quarter.

The average cost per pound of net copper produced, including depreciation of plant and equipment and all fixed and general expenses and after crediting gold, silver, and miscellaneous earnings, was 8.6c., compared with 9c. for the preceding quarter, computed on the same basis.

The following tabulation shows the financial results of the company's operations for the quarter, compared with the previous quarter:

	First Quarter 1925	Fourth Quarter 1924
Net profit from copper production	$2,764,500.27	$2,261,360.72
Miscellaneous income including gold and silver	586,154.84	566,989.27
Bingham & Garfield Ry. Co. dividend	75,000.00	.....
Total income	$3,425,655.11	$2,828,349.99
Depreciation	294,250.21	314,237.83
To surplus	$3,131,404.90	$2,514,112.16

Earnings for the first quarter of 1925 are computed on the basis of 14.269c. per pound carrying price for copper, compared with 13.725c. for the fourth quarter of 1924.

A quarterly distribution to stockholders of $1 per share was made on March 31, 1925, and amounted to $1,624,490.

Ray Consolidated Copper Co.

The Ray Consolidated Copper Co. reports production for the first quarter of 1925 as follows:

First Quarter, 1925	Pounds	Fourth Quarter, 1924	Pounds
January	12,349,494	October	12,746,709
February	11,630,747	November	11,732,357
March	12,261,998	December	11,809,579
Total	36,242,239		36,288,645

The total ore milled during the quarter was 1,470,200 dry tons, averaging 1.54 per cent copper, compared with 1,423,000 tons, of an average grade of 1.58 per cent copper, treated during the fourth quarter of 1924.

After crediting the value of gold and silver recovered and the miscellaneous income applicable to operations, the net cost per pound of copper produced from all sources was 10.86c., compared to a cost of 10.87c. for the preceding quarterly period. These costs include all operating and general charges of every kind, except depreciation and reserve for federal taxes.

The financial results of operations follow:

	First Quarter 1925	Fourth Quarter 1924
Operating profit from copper produced	$1,127,034.58	$917,629.07
Miscellaneous income, including value of precious metals	71,353.78	70,113.28
Total	$1,198,388.36	$987,742.35

Earnings for the first quarter are computed on the basis of 14.14c. per lb. of copper, as compared with 13.46c. for the fourth quarter of 1924.

Great Northern Iron Ore Properties

The receipts of the trustees of the Great Northern Iron Ore Properties from all sources during the year ended Dec. 31, 1924, and the disbusements therefrom were as follows:

Receipts

From proprietary companies			
Arthur Iron Mining Co.	$1,575,000.00		
Grant Iron Mining Co.	1,925,000.00		
Harrison Iron Mining Co.	870,000.00		
Leonard Iron Mining Co.	200,000.00		
North Star Iron Co. of West Virginia	382,135.00		
Polk Iron Mining Co.	650,000.00		
Tyler Iron Mining Co.	474,000.00		
Van Buren Iron Mining Co.	3,865.00		
Total receipts from proprietary companies		$6,080,000.00	
Interest		10,835.24	
Rental		1,245.00	
Total receipts			$6,092,080.24

Disbursements

Administration of the trust			
Salaries		$85,479.59	
Expenses		9,567.02	
Total		$95,046.61	
Distribution to holders of certificates of beneficial interest:			
No. 29, April 30, 1924, $2 per share	$3,000,000.00		
No. 30, Dec. 24, 1924, $2 per share	3,000,000.00	6,000,000.00	
Total disbursements			6,095,046.61
Excess of disbursements over receipts for year			$2,966.37
Undistributed receipts—Dec. 31, 1923			197,529.26
Undistributed receipts—Dec. 31, 1924, as per consolidated balance sheet			$194,562.89

Consolidated Balance Sheet Dec. 31, 1924

Assets

Mineral and non-mineral lands and leases		$45,761,753.20
Office building—Marble, Minn.		10,836.67
Residence, Hibbing, Minn.		8,823.43
Automobiles, engineers' equipment and furniture		8,231.92
Advance royalty disbursements (leaseholds first class)	$882,820.85	
Advance royalty disbursements (leaseholds second class)	87,500.00	
		970,320.85
Advance account Alworth lease		149,407.60
Advance underminingcontracts		1,056,188.57
Deferred accounts		3,884,514.98
Securities		677,171.54
Current assets		1,751,176.81
		$54,278,425.57

Liabilities

Capital stock			$8,308,400.00
Current liabilities			628,049.66
Deferred accounts			3,776,114.71
Surplus			
Paid-in surplus at date of acquisition	$23,927,352.68		
Earned surplus by development	15,981,200.32		
Paid-in surplus—non-mineral lands	468,642.08		
		$40,377,195.08	
Undivided surplus—proprietary companies	994,103.23		
Undistributed receipts	194,562.89		
		1,188,666.12	
			41,565,861.20
			$54,278,425.57