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ENGINEERING AND MINING JOURNAL-PRESS

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

Radium-bearing Silts of Southeastern Utah

By George O. Williams

The unique character of a deposit found by the Norton-Williams Explorations on the floor of Montezuma Canyon makes it especially interesting, despite the lowness of its grade.

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Experiments in Oil-less Flotation Of Minerals

By T. M. Bains, Jr.

Attention is now directed to the electrification of the air bubble, heretofore ignored, though electrostatic charges on minerals, colloidal slimes and oils have been referred to frequently.

Petroleum Regions Of New Zealand

By P. G. Morgan

Data on promising areas that may be of value to those interested in the world-wide search for oil. The author is the Director of the New Zealand Geological Survey.

The Magma Mine

By W. C. Browning and F. W. Snow

Geology and Operations — the first authentic article thus far published. The authors are the former general manager and the assistant mine superintendent.

From Rhodesia to The Congo

Photographs

More views of mining camps in Africa and spots of interest in between, taken by A. W. Newberry, of New York, on his recent trip across the continent from the Cape to Cairo.

Assaying Fine Bullion At the Nipissing

By A. P. Van Zwaluwenburg

How results are obtained that compare favorably with those secured in mints with more elaborate equipment. A curious incident regarding the company's bullion in China is related.

Pig Iron From Utah Ores

By George J. Young

A further step in the development of a steel industry in the far western states. In this article the new plant of the Columbia Steel Corporation at Provo is described.

Factors in Mine Accounting

A discussion by G. A. Denny

Constructive comment on the article by Benjamin F. Tillson published last September is made by this engineer, who is so well known for his work in South Africa and elsewhere abroad.

ENGINEERING AND
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JOSIAH EDWARD SPURR, Editor

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Efficiency or Waste

MR. HOOVER, in Washington, proceeds pertinaciously on his campaign of what he called some years ago "the elimination of waste in industry." At a recent meeting of Engineering Council he justified the work of the Department of Commerce in this direction, stating that with a total expenditure of $100,000 the department had brought about simplification of standards in industry which had effected a saving of at least $600,000,000 annually. Mr. Hoover is not in the habit of making loose statements, or of citing incorrect figures: so we are bound to accept his estimate of advantages of these simplified standards, arranged through conferences at the Department of Commerce with the assembled representatives of various industries.

Waste is easily discernible in every industry, in every walk of life. Its manifestations are legion; its removal means just so much more net results of endeavor, so much more wealth, so much less of unnecessary labor. In the commercial competition between peoples there are two sources of advantage: cheap living and low wages; and the omission of waste effort and material and processes. Whatever success American products have had in the export market has been due to the latter method; and it has held its own in competition with the former. Henry Ford's method is typical and famous—high wages and high efficiency—with the result of a product so low-priced that neither in this country nor abroad can competition match it. Through efficiency the Germans obtained a pre-eminent place in manufacturing and commerce in the pre-war days; Mr. Hoover would like to see that the United States does not fail through lack of it in the future. It is a virtue that harms none, and helps all—for it enables the purchase of articles at home and abroad more cheaply than would otherwise be the case.

The mining industries are interested in these principles as much as our other industries. What waste is going on in your mine, in your mill, in your office? There is always some; usually there is a great deal. Waste takes various forms: waste of time, of materials, of opportunities. It is often a waste to be using old and inefficient machinery if scrapping it and buying new would enable swifter and cheaper operation. The mining industries, like others, have been extravagant and wasteful. The time has come to stop the leaks, to realize on minor opportunities.

Much wealth has been blown up smelter stacks, run out in mill tailings, buried in ill-developed mines, scattered in mine dumps. Much wealth has been lost by peculating promoters, by witless mine presidents, by bumptious politician-directors of mines. There are many aspects to this; and of these one of the most important might be called The Utilization of Waste Products. Are you throwing anything away that could be fixed up and marketed? Here is a simple and intelligible question, though not so easy to answer. Many mine managers have turned loss into profit by solving this problem. We hope to present various phases of it, from time to time.

Killing the Exportable Surplus

ANOTHER PLAN of Mr. Hoover's, which is attracting widespread comment, requires more hesitation before accepting. It relates to the farmer, and has apparently won the commendation of Mr. Coolidge, to judge from his invitation to Mr. Hoover to become Secretary of Agriculture. Mr. Hoover proposes the tariff as a measure of protecting the farmer against foreign competition and consequent low prices for his foodstuffs; and since the existing tariff is rendered null on many commodities, such as wheat, by an exported surplus, he proposes to procure a condition whereby there will be no surplus. He visions increasing the domestic consumption so that it takes all the product of the farmer. Internal consumption is to be stimulated by the "elimination of waste," which will increase productivity in general, and industrial wealth, and bring up the general standards of living, so that the average individual will consume more food—or waste more, which will be as satisfactory to the farmer, and is essentially what happens as "higher standards of living" obtain. Also, Mr. Hoover urges, as many have before and with him, co-operative marketing for the farmer, the economic advantages of which—to the farmer—are not to be questioned.

The idea of limiting domestic food production to domestic consumption, however, demands careful and suspicious scrutiny. If the idea is good for the farmers, it is good for the miners. Indeed, the same remedy as Hoover visions for the farmers is being advocated by Mr. F. W. Paine for the copper industry, in our pages and elsewhere. If this solution is good for the farmers and miners, it is good for the manufacturers: indeed, for all American industries. The exportable surplus, which annuls the effect of a protective tariff, is to be lopped off. We shall continue to import, for there are many things we need from foreign countries, and which we do not produce ourselves, or not in sufficient quantities: but we shall not export. According to these ideals, we surround ourselves with a Chinese Wall protection, our ports being gates that swing inward, but not outward: our balance of trade becomes definitely and secularly "unfavorable": our gold flows out and never returns—a condition that our domestic gold production is far, far too insignificant to remedy. No tariff can in the nature of things be erected in favor of the gold industry: and if it could, it would not stimulate gold production in any notable degree. Within our Chinese Wall, we should all grow wealthy and overfed off of each other, by the "elimination of waste in industry."

The picture is not convincing. The ambition to balance one economic group against another until so far as possible every one is well off and free from adversity

is a laudable and noble one. However, it will not work out so easily. If we want to buy from the world—and the more prosperous we would become, the more burning would be this popular desire—we must sell to the world—we must have export surpluses. And these export surpluses must be whatever we have an excess of—not coffee or rubber and the like, but wheat and copper and the like. To attempt to artificially and by governmental devices prevent the export of wheat and copper and the like appears suspiciously like folly. We can only realize the Utopia for the farmers and the miners visioned by Mr. Hoover and Mr. Paine if we can forbid imports—make the gates of our ports so they swing neither out nor in. One wonders whether the recent slogan of "less government in business" is not as good as any of the others which are being hawked around.

Poisoning from Copper

"THE WIND blows east, the wind blows west, the wind blows over the cuckoo's nest," and though the little bird may have been mystified at the lack of definite direction, it is not on record that he said "Cuckoo" or anything at all. As with the wind, so with opinion: now west, now east, now yes, now no. Differing from the bird, we cannot restrain ourselves when we read in Saturday's bulletin of the American Chemical Society that research has shown copper cooking utensils to be harmless and in Monday's *Times* that the Harvard University Press is publishing a report by Dr. F. B. Mallory, of the Boston City Hospital, that copper thus used is responsible for wide poisoning.

M. Effront, according to advices from Paris to the society, has shown by many experiments that vegetables prepared in copper vessels absorb copper salts, but that these salts stay fixed in the vegetable fiber so that no poisoning results.

On the other hand, Dr. Mallory is quoted (in the *Times*) as saying "Evidence is steadily accumulating to prove that chronic poisoning with copper is the cause of hemochromatosis. . . . The lighter forms are fairly common, but are necessarily unrecognized by the clinician and commonly overlooked by the pathologist. . . . Studies of clinical cases show that ordinarily it takes fifteen to twenty-five or more years to produce the symptom complex of the disease known as hemochromatosis. Now that the danger of poisoning has been pointed out, steps should be taken to prevent copper getting into liquors and foods and to protect workers in occupations involving copper from inhaling or ingesting copper dust." One gram of copper a day would kill a man in a short time, Dr. Mallory is reported to state, but the clinical picture would be that of one suffering from enlarged liver, diabetes, sclerosis of the heart and other complications.

National Taxation

WHILE taxes in France have increased 300 per cent since 1913, as compared with 250 per cent in the United States and Great Britain, the ratio of taxes to national income in France has increased in that period only 25 per cent, as compared with 80 per cent in the United States and 107 per cent in Great Britain. These estimates are from a recent bulletin of the National Industrial Conference Board in New York. The net result is that the tax burden today in the United States is just half of that in Great Britain and about two-thirds that in France. In France, the report explains, the increase in territory and population brought about by territorial rearrangements since the close of the war, and also the absence of important unemployment, has helped to increase rational earnings and thereby to lessen the increase in the tax burden, while in Great Britain strikes and unemployment have helped to cut down the national earnings and to increase the tax burden.

According to these figures the tax burden in France at the present time is less than that in Great Britain. France has avoided further increases in taxes by a hazardous system of mild inflation, with large issues of paper money, and much borrowing by internal and external bond issues. Yet, in spite of her difficulty in balancing her budget, it seems that she has certainly no more reason for flirting with the idea of repudiating her foreign debts than had Great Britain, to whom the thought never occurred. Repudiation, aside from ethics, is poor business: because it shuts off for the future the beneficial effects of good national credit.

In the United States, federal taxation has decreased, while state and municipal taxation is increasing. The reason for the latter is largely due to highway improvement, which again is largely a function of the automobile industry. While we all object to high taxes, none of us are against good roads: indeed, when one is balanced against the other, we shall be likely to choose the roads, and pay the high taxes, even if not happily.

Losing a Friend

"IF YOU WISH to lose a friend, lend him money" is an old and an unfortunately apt adage. In many cases you lose both your friend and your money. This has proved true of nations as well as individuals. France is the latest example, among others. We have loaned France money, and lost a friend; and France also assures us with acrimony and epithets we will lose our money also. Evidently, the more money you lend, the more bitterly your friend hates you. France protests that she has already paid in blood, and tears and glory; but even these she has kept on her side of the water. France was presented by the United States with Alsace-Lorraine, the great mineral prize of Europe—the bone of contention between Germany and France for many decades; the treasure house which kept Europe an armed camp. Seized by Germany at the time of the Franco-Prussian War, France made a cult of the intention of taking it back, and therefore made a fetish of her army. Germany, intent on holding the spoils, also made a fetish of her army, and by greater efficiency succeeded better than France. When she found, however, that the military burden was too great, she started a war to end it. The United States came in late. It was not our fight; we laid no claim to Alsace-Lorraine or to the rest of the spoils of war. We were prodigal of men and money after we went in; and France is here to tell the tale, which she otherwise would not be. Likewise, France borrowed money, for the war and for many other purposes—borrowed it from our government and from our bankers. Both types of loan came ultimately from our private citizens. But the idea of repayment is repulsive. Some years

ago we quoted the noble sentiment of a French statesman: "We shall never cease saying that we owe you." Even this magnanimity has now disappeared.

Senator Borah hits the nail on the head when he asks the French to state outright, cutting out the oratory, whether they do not mean repudiation. If they do, he says, well and good. There is nobody to stop them. Certainly the United States will never get so heated up over the question of getting its money back as the French public is over the idea of giving it back. Repudiation being amiably recognized, it would be well henceforward to adopt the insects' slogan, "We ants never borrow, we ants never lend." We loaned money to Russia, and she plots the overthrow of our government. Our citizens invested much money in Germany, and it went down a sink hole of governmental dishonesty. Likewise our citizens have already lost much money to France through the depreciation of the franc and a shrinkage in value of her internal bonds. France's internal policy has been to borrow rather than tax to the limit; and this has kept down her franc, and robbed foreign and domestic investors in her internal bonds. The isolation policy for America, so often condemned, seems not so bad when we come into actual contact with certain phases of European mentality.

Ore Injection at the Cananea-Duluth Mine

THE ARTICLE on the geology of the Cananea-Duluth mines, in Sonora, Mexico, by Dr. G. J. Mitchell, in our issue of Jan. 10 describes an exceptionally interesting occurrence. Not only the occurrence of the ores, but that of the igneous rocks with which they are associated, is suggestive and significant. A pipe of aplite (being of quartz and orthoclase chiefly, we should be inclined to call it alaskite aplite instead of monzonite aplite, as Dr. Mitchell terms it—though it is not of major consequence, and there is a justification for his term) about 600 ft. long and 100 ft. at its widest has been pushed up through bedded volcanic tuffs, presumably Tertiary. When followed downward in mining operations it is found to change in less than 1,000 ft., gradually into a monzonite porphyry—i.e., besides the orthoclase feldspar, andesine feldspar comes in and quartz may or may not be present. Biotite also occurs. Quartz and pyrite are seen to be later than biotite. This occurrence alone is of great interest, showing the magmatic differentiation of a monzonite neck of pipe after intrusion, the elements of the rock magma having shifted relatively, on a large scale, after the magma came to rest, so that quartz and orthoclase were greatly concentrated at the top of the pipe, which may or may not have been closed, but very likely was.

The sulphide ores ascended subsequently and mainly through two much smaller pipes, one at each end of the elongated monzonite-alaskite pipe. Arriving at a horizon which is now 200 ft. below the surface, they proceeded to flood this level, so that the ore here appears as a sheet spreading over most of the horizontal cross-section of the monzonite-alaskite pipe. These sulphide ores, which include angular unattached fragments of tuff and aplite, are referred by Dr. Mitchell to that large class of sulphide ores which have been injected in a highly concentrated and viscous form—a true though tardy member of an igneous injection series.

The sulphides are varied—tetrahedrite, sphalerite, pyrite, chalcopyrite, galena, and argentite, with a gangue of quartz, with some siderite and adularia. Tetrahedrite, pyrite, chalcopyrite, sphalerite, and galena, with quartz, appear to be essentially contemporaneous. Argentite is later, as is siderite and adularia. The grouping of sulphides clearly indicates a mixed or telescoped ore magma—a magma which arrived at this horizon at a relatively high temperature, and was suddenly crystallized. What brought this crystallization about? The horizontal flooding of the ore magma at the 200 ft. level, shown in Fig. 7 of Dr. Mitchell's article, suggests an invisible dam—a "thou shalt not pass" zone, which, however, does not in the section seem to coincide with any definite change of rock formation. This might represent the top of the "dumping horizon," or upper limit to which ore magmas can approach the surface, as argued by J. E. Spurr, this upper limit being shown in other cases to be, say, 500 to 1,000 ft. below the surface at the time of ore injection. Rock magmas spill out over the surface, as lavas: ore solutions or ore magmas do not, and the presumption from that fact and from the circumstance that geologists universally agree that they have come within say 500 to 1,000 ft. of the surface, is that they are as a group inhibited from rising higher. It cannot always be a question of temperature, as the frequently high temperature of fumaroles in volcanic regions proves. A physical or pressure limitation is indicated; and the hypothesis has been put forth that near the surface the gravity pressure is no longer sufficient to resist the gaseous pressure of the volatile constituents which make up an important and essential part of ore magmas. When this critical horizon is reached, therefore, the ore-magmatic gases escape, and the solid constituents, including metallic sulphides and gangue, which were held fluid by these volatile components, perforce consolidate. This is the "dumping horizon"; and this explanation accounts well for the exceeding richness, mineral complexity, and failure to persist in depth of the Tertiary bonanza ores.

Removing Temptation

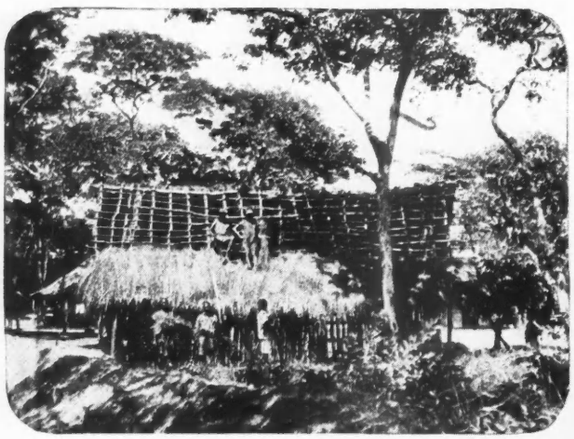
THE GREAT INCREASE in gold production from Leadville, Colo., is largely the consequence of mining very rich gold ore in the Little Johnny mine of the Ibex Mining Co. This is an old property with a production record of many millions, but lessees recently have opened rich pockets of bonanza ore. For the first time in history gold has comprised a greater part of the value of Leadville's output than any other metal, the total for 1924 being more than $1,000,000.

A novel scheme for handling the extremely high-grade material has been devised by J. G. Newton, assistant superintendent of the Arkansas Valley Smelter of the American Smelting & Refining Co. The metallics first are picked out and sent directly to the mint. The remainder—still too rich to allow the smelter superintendent comfortable sleep—is diluted with low-grade ore and mixed with water and portland cement. This aggregate is sacked and allowed to set. The solidified sacks are then charged to the blast furnace. This seems to be a rather complicated process, but if smelter men are not tempted to "high-grade" they certainly will not do it. There is nothing alluring about a big block of artificial rock, even if it contains considerable gold, for the simple reason that nobody would buy it.

From RHODESIA to the CONGO

Stripping at Bwana M'Kubwa copper mine, Northern Rhodesia

Guest house and attendant, N'Kana mine



Building construction at N'Kana mine, Northern Rhodesia

Stoped-out high-grade vein, Bwana M'Kubwa mine
A large tonnage of low-grade ore adjoins this

Ferry across Kafue River, Rhodesia
Congo Border Concessions

Principal street in Elisabethville, Belgian Congo

Photos by courtesy of A. W. Newberry

Geology and Operations of the Magma Mine

With Its Own Concentrator and New Smelter and an Excellent Orebody, the Magma Copper Co. Is a Well-rounded Enterprise

By W. C. Browning and F. W. Snow

Formerly General Manager, and Assistant Mine Superintendent, Magma Copper Co.

THE MAGMA AND SUPERIOR MINES of the Magma Copper Co. are situated in the Superior district, Pinal County, Ariz. The property of the company has been acquired since its organization in 1910 by the purchase and location of a number of groups of claims, the result being a very large compact area. Although the first development work done by the company was started in 1910, several of the claims were originally located in 1875 to 1880, at the time the district first attracted mining interest, due to the discovery of the Silver King mine, three to four miles in a northerly direction from Magma. The Silver King was one of the famous old Arizona silver producers, and the early locators of the Magma were evidently looking for another deposit of silver ore. Of the two mines, the Magma and the Superior, the Magma has been by far the larger producer. Until 1910 the underground work done in the Magma mine consisted of a shaft down to the 400 level, and a rather limited amount of work on the 100, 200, 300, and 400 levels.

At the time the first property was acquired, the situation can be summed up as being not any too promising. The outcrop of the Magma vein is rather limited in size, and the work done down to the 400 level had only disclosed an occasional small and isolated orebody. Furthermore, the property was 32 miles from a railroad, and during the early life of the mine all supplies were hauled by wagon at a cost of $10 per ton.

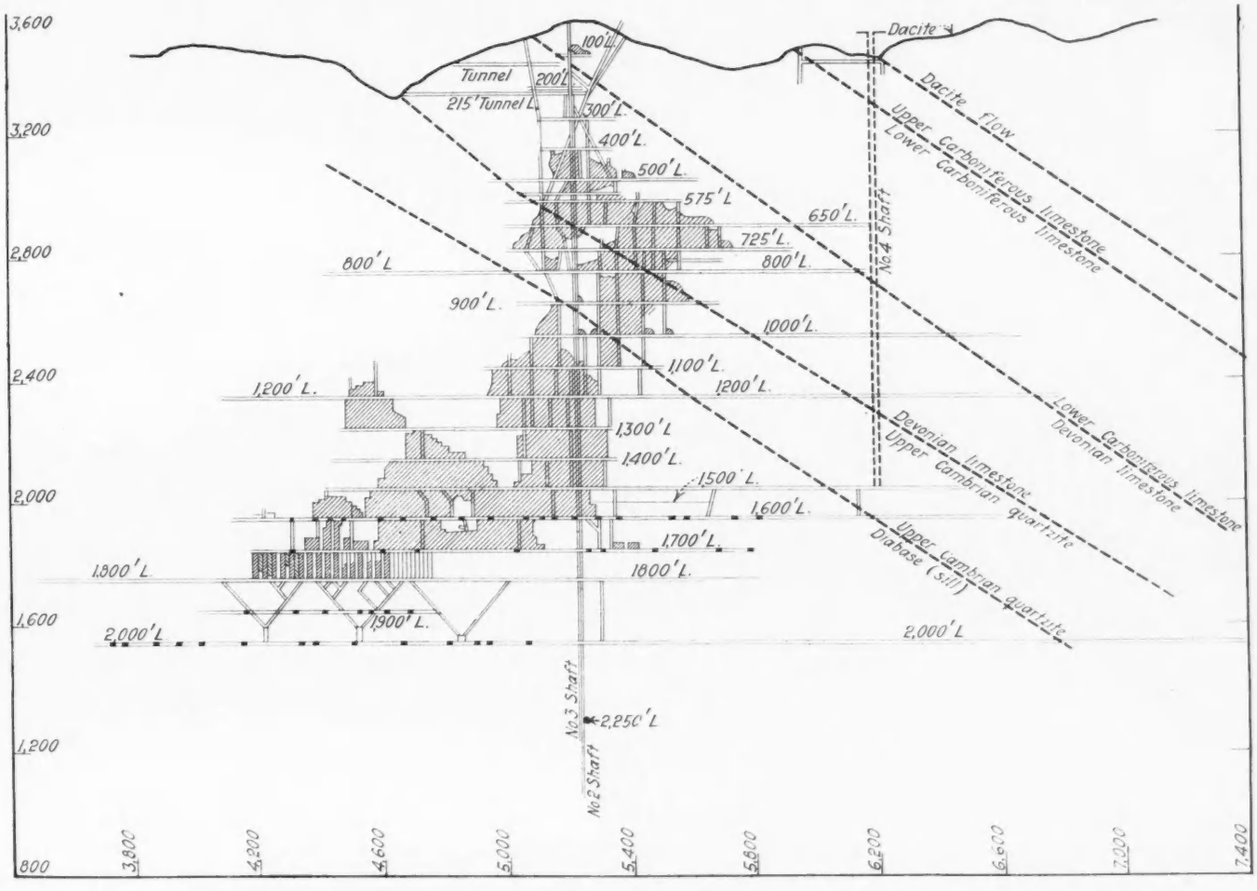
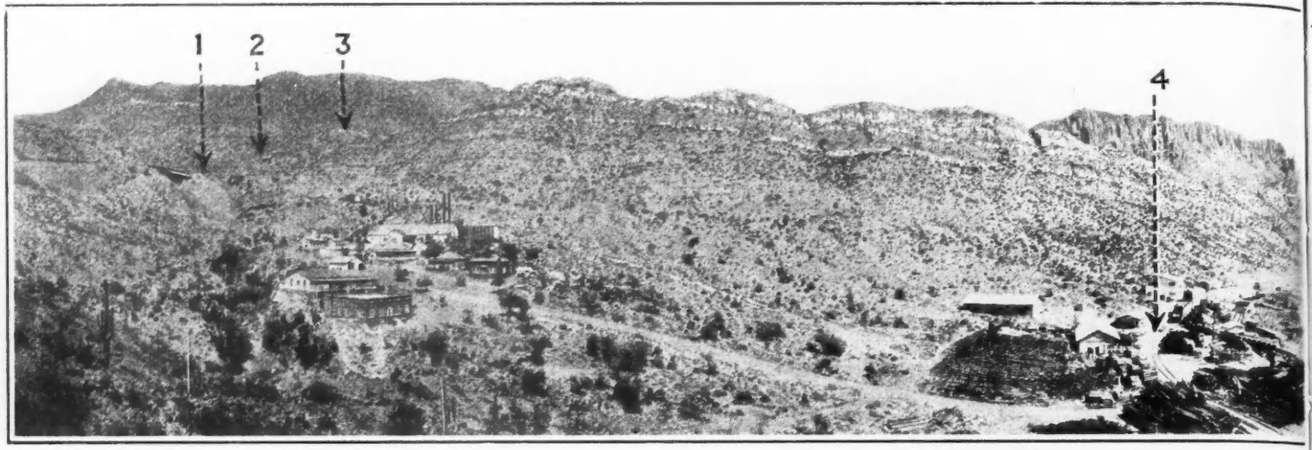


Fig. 1—East-west longitudinal projection of the Magma mine, showing main geological features and the principal workings

Since 1910 the history of the company has been one of gradual and steady growth. Starting with a 150-ton concentrator, built in 1913, and a narrow-gage railroad, constructed in 1914, the plant has been gradually enlarged as the mine warranted. More recent improvements have been the enlargement of the concentrator to a capacity of 600 tons per day, and the construction of a broad-gage railroad to replace the old narrow-gage line. The completion, or what might be termed the final rounding out of this policy, occurred early in 1924 when the smelter was put in operation.

The series of rocks found in the Superior district, in the ascending order of their occurrence, are: first, Pre-Cambrian schist; second, a series of Cambrian sedi-



(1) Main working shaft (2) Outcrop (3) Upper dump (4) 500 or adit level to mine

Panorama of the Surface Plant of the Magma

mentaries consisting of conglomerate, shale, conglomerate, lower quartzite, limestone, and upper quartzite; third, Devonian limestone; fourth, Lower Carboniferous limestone; fifth, Upper Carboniferous limestone.

In addition to this series are found, first, a large intrusive diabase sill usually occurring near the base of the Upper Cambrian quartzite, and, second, a dacite flow which has in many places, especially in the eastern part of the district, covered all of the older formations.

The Magma mine orebodies occur as shoots in a strong fault-fissure vein which strikes east and west. To date the deepest workings are still in diabase, and underground work shows that the vein cuts the diabase, and all sedimentary rocks above the diabase, at approximately right angles to the strike of the bedding planes, which dip 30 to 35 deg. to the east.

The dacite flow occurred after the formation of the vein, and, as a result, completely covers the extension of the outcrop to the east. Reference to the accompanying east and west longitudinal section through the Magma mine shows the various underground workings and their relationship to the formation. The various rock contacts in the north and south walls of the vein indicate that there has been a horizontal fault throw of approximately 600 ft., the north wall having moved east in relation to the south wall. The major movement along the vein has taken place on both walls, the result being that in some parts of the mine occurs a horse of wall rock showing the same sequence as that found in the walls; the contacts in the horse, however, are about halfway between like contacts in the north wall and in the south wall.

In many places, an altered porphyry intrusion can be recognized in the vein. The porphyry is so completely altered that its proper classification is rather difficult. However, it has been generally assumed that it is quartz diorite. It is easier to identify this porphyry in the upper part of the mine, where sedimentary walls are present, than in the lower part of the mine, where the walls are diabase, for the reason that in many places in the lower part of the mine it is quite difficult to differentiate the altered mineralized porphyry from the altered mineralized diabase.

The Magma orebodies are of value chiefly for their copper, silver, and gold content. In a number of places are found zinc sulphide ores of good grade, and these ores may prove some day to be of considerable commercial importance.

Most of the ore found between the surface and the 400 level has been oxidized, with only an occasional kernel of chalcocite remaining within a body of carbonate ore.

From the 400 level down to the 1,600 level, underground development work and diamond-drill holes show that the zone of oxidation dips to the east approximately parallel with the sedimentary bedding planes. The lower zone of oxidation is more or less parallel with the center of the Upper Cambrian quartzite in the north wall of the vein.

Below the zone of oxidation occurs one of secondary enrichment. This zone of enrichment also tends to dip to the east, and the lower limits are roughly parallel with the base of the Upper Cambrian quartzite as found in the south wall of the vein.

Zone of Secondary Enrichment

In the oxidized zone, the important copper minerals are malachite, chrysocolla, some chalcocite, and, in places, cuprite. The chief mineral of importance in the zone of secondary enrichment is chalcocite associated with some bornite and pyrite. The primary ores consist principally of bornite, chalcopyrite, and pyrite. In the deeper levels, some tetrahedrite and primary chalcocite are found, but these minerals are of minor economic importance.

Gold and silver are usually associated with all classes of ore. In the zone of secondary enrichment the ore usually shows one ounce of silver to each per cent of copper, while the primary ores usually contain 0.6 oz. of silver to each per cent of copper.

The gold values remain much more uniform than the silver in ranging down from the zone of secondary enrichment to the primary ore, averaging from 50 to 75c. per ton.

A high percentage of the ore mined has come from one large central oreshoot. This oreshoot has been continuous from a little below the 400 level down to the deepest workings in the mine. The lower levels show this shoot to be from 1,200 to 1,500 ft. long, and an average of 20 ft. in width. It is very much larger on the lower levels than on the upper ones. For example, the lower levels are making approximately ten times the tonnage per vertical foot of oreshoot as was mined in the upper levels. The ore on the deepest developed level—the 2,000—is of very good grade, averaging better than 6 per cent copper. The bornite and chalco-

(5) Old mine workings, L. S. and M. claim. (6) Town of Superior. (7) Magma smelter.

Copper Co., the town of Superior, Ariz., and the Magma Smelter

pyrite found between the 1,700 and the 2,000 levels seem to be much more massive than on the levels above.

Although most of the tonnage mined has come from one shoot of ore, a number of smaller shoots have been to some extent developed laterally in other parts of the vein. There are excellent chances to develop additional orebodies with further work along the strike of the vein, especially to the east of any orebody uncovered up to the present.

Four Shafts Have Been Sunk

To develop and mine the ore, four shafts have been sunk. Old No. 1 shaft, which, as already mentioned, was 400 ft. deep when the property was first acquired by the present company, was afterward sunk to the 800 level, and the first ore discoveries of importance were made from this shaft.

Two main working shafts have been sunk. No. 2 is 400 ft. north of No. 1 shaft, and has been sunk from the 200 level to 63 ft. below what will eventually be the 2,500 level. No. 3 shaft, which is 400 ft. south of No. 1 shaft, has been sunk from the surface to 84 ft. below the 2,250 level. No. 2 and No. 3 shafts are connected with the main crosscut on the 2,250 level, but no other underground development work has been done on this level. No. 4 shaft is 1,000 ft. east of No. 2 shaft, and has been sunk to the 1,500 level.

Ventilation an Important Problem

Underground ventilation has been one of the big problems at the Magma mine. No. 2 and No. 3 shafts are used for inlets for fresh air from the surface, and No. 1 and No. 4 shafts are used for outlets for stale air from the mine workings. To secure proper ventilation, exhaust fans are installed on the surface at No. 1 and No. 4 shafts, and pressure fans which pull fresh air down No. 2 and No. 3 shafts are installed in the deeper levels of the mine.

All hoisting of ore and mining supplies, and the handling of workmen, is done through No. 2 and No. 3 shafts. These shafts contain three compartments, consisting of a manway and two hoistways. They are equipped with electric hoists and with counterbalanced skips with cages hung underneath.

The main working tunnels connect with the 200 and 500 levels. All concentrating ore is hoisted through No. 3 shaft to the 200 level, and an aërial tramway, approximately half a mile long, connects the portal of the 200-level tunnel with the concentrator. The timber framing sheds, the miners' change-house, and the foremen's office are situated at the portal of the 500-level tunnel.

Direct smelting ore is hoisted through No. 2 shaft to a large ore pocket on the 500 level. Waste rock from development work is also hoisted through No. 2 shaft to the 200 level, where it runs by gravity through an incline raise to an incline waste raise which extends from the 1,600 level up to a glory hole on the surface. Waste rock for filling stopes is mined in this glory hole.

All direct-smelting ore, limestone for the smelter, and mine supplies are handled through the 500-level tunnel. The portal of this tunnel is connected with the various parts of the plant by means of a broad-gage railroad, which in turn is part of the broad-gage railroad system extending 30 miles in a southwesterly direction to Magma Junction, on one of the branch lines of the Southern Pacific R.R.

Both Trolley and Storage-Battery Locomotives Used for Haulage

Electric trolley locomotives are used on the 200 level and on the 2,000 level, which is the main extraction haulage level at present. Storage-battery locomotives are used on the 500-tunnel level and the 1,600 level, which is now the main waste fill level.

Two general mining methods are used in extracting ore. The choice depends on the character of the ore when stoping operations are started. In a general way the vein gangue can be given two classifications. In one type the predominating gangue is altered, partially silicified diabase or porphyry, and in the other the predominating gangue is quartz. In the lower levels, the vein quartz predominates over the altered diabase or porphyry. In many places there is a rather treacherous hanging wall due to there being considerable soft gouge between the ore and the wall. Experience has shown that an ore with altered diabase or porphyry gangue, in conjunction with the poor hanging wall, makes it necessary to use considerable timbering in the stopes. In ground of this character, timbered rill stopes are used. Where the ore has predominating quartz gangue, it stands much better, and a combination rill stope and top-slice pillar system has proved successful. Ore from the various stopes on levels above is conveyed by means of incline raises down to central ore pockets on the main 2,000 haulage level.

All of the extraction work is driven in the footwall 20 to 30 ft. away from the vein, and usually stands fairly well without timbering. The practice has been to mine the ore in lifts of 100 ft. between levels, although in some cases 200 ft. has been mined.

In developing a block of ground for the timbered rill stoping system, the vein is crosscut from the footwall drift at intervals of approximately 150 ft. From these crosscuts a drift is driven in the ore along the footwall of the vein, and stopes are silled out from this drift.

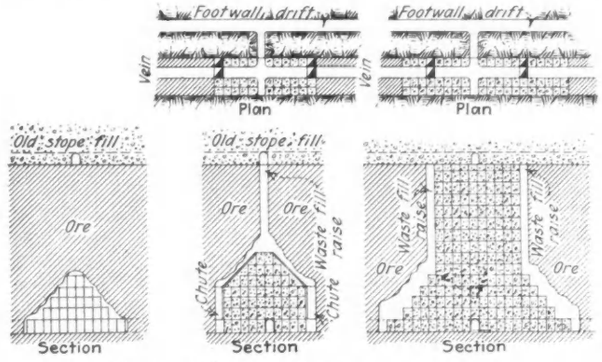


Fig. 2—Details of timbered rill stope

The length of the stope along the vein depends on the width of the vein. For example, where the vein is 10 ft. wide, the ground is silled out for a 60-ft. stope, and where the vein is 15 ft. or more in width, the ground is silled out for a 30-ft. stope. In either case, the back of the stope is stepped up from one set high at the ends to approximately five sets in the center, and from the top line of sets a raise for waste filling is driven in the hanging wall to the level above. The waste rock from the raise is used in the stope for waste fill. Two square sets, for a manway and extraction raise, are carried up at each end of the stope. These raises are in turn used for filling adjoining blocks as the ore is mined. The slope angle of the waste fill in the stope is approximately 35 to 40 deg. After filling the stope, floors are laid on the fill. A 7-ft. slice is now mined, parallel with the fill, and this ground is timbered with square sets as the breaking of ground progresses. This is repeated twice; or a total slice of 21 ft. is taken out before the stope is again filled. As succeeding blocks of ore are stoped, the square sets are pyramided to the old stope, the length along the vein of these secondary stopes depending on the width of the vein, or from 15 ft. for wide sections up to 30 ft. for the narrower parts of the vein. Fig. 2 illustrates this system. To date, most of the ore mined from the timbered rill stopes is hand trammed short distances to one of the ore raises from the main haulage level.

In the combination rill and top slicing pillar system, the section of the vein to be mined is blocked out, theoretically, into 15-ft. units along the strike of the vein, 15-ft. rill stopes and pillars alternating, the length of each being the width of the vein at that point, which may vary from 15 to 45 ft. The reason for adopting 15-ft. widths in rill stopes was that experience showed this was the maximum width that could be safely carried in an open stope. Under some conditions, where the vein is narrow with good walls, and where widths do not exceed 10 to 15 ft., a 45-ft. rill stope along the vein is used.

Having established definitely the position of the vein by development crosscuts from the footwall drift, a series of incline raises is driven at an inclination of approximately 52 deg., from the main haulage level. These raises are driven to cut the footwall on the level to be mined. From these main incline raises, branch raises of the same inclination are driven to cut the footwall at the center line of each rill stope, or in a 45-ft. rill stope, at each end. This gives a gathering raise along the vein every 30 to 45 ft. From the development crosscuts, drifts are driven in the ore along the footwall connecting with the gathering raises from the haulage level below.

Mechanical Scrapers Used

From these drifts the sill floor of each rill stope is cut out, shoveling or mechanical scrapers being used to handle the ore directly into the gathering raise. Stringers of 10 by 10 timber, 15 ft. long, are placed on the sill floor, parallel to the vein and at 5-ft. centers across the vein, and a double 2-in. plank floor is laid.

Three square sets are placed along the footwall, which are afterward used as bottom sets of a three-compartment raise as stoping operations above are carried on. The two outside sets are used for extraction raises, one for smelting ore and one for milling ore. The center set is used for a manway. These raises and the manway are used later to extract the pillars.

Square sets are placed across the vein on one side of the rill stope, and single 7-ft. posts are stood across the vein on the opposite side of the rill stope to form a gob line. When the stope is filled, the square sets are held open, which affords a means of access to future stoping operations from below. This arrangement of timber on the sill floor is illustrated by Fig. 3.

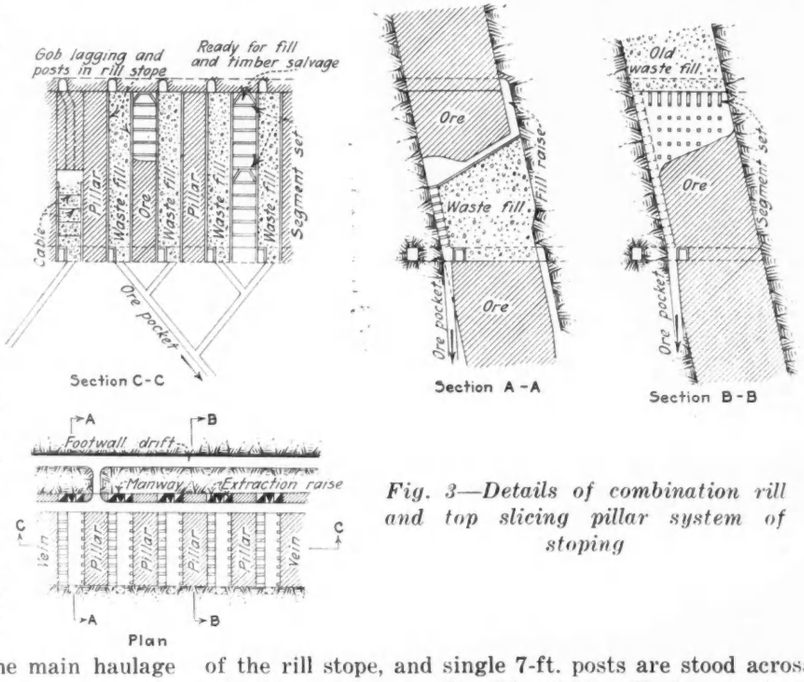


Fig. 3—Details of combination rill and top slicing pillar system of stoping

After all sill-floor timbering is in place, a small

raise is started in the hanging wall of the vein. The broken waste from the raise is dropped on to the sill floor for filling purposes. When the stope becomes full, a floor is laid on the waste, and a 7-ft. slice of ore is taken.

Old Hoist Cables Bind Posts

New gob lines, consisting of single posts end on end, and lagging, are placed along each side of the rill stope. The posts are framed in half, and a single strand of old hoist cable is used to tie together corresponding posts on opposite sides of the stope, the cable passing around the joints of the posts.

The rill stopes are arched to the hanging wall, the slope of the back roughly paralleling the angle of rest of the waste fill, which is about 35 deg. The stope at its highest point is about 30 ft. above the sill floor by the time the raise in the hanging wall reaches the level above. Square sets are used to extract the ore under the floor timbers in the old filled stopes on the level above.

The pillars between the filled rill stopes are extracted by a top-slicing pillar system which is a modified form of the Mitchell slicing system used in Bisbee. With this system a line of segment sets is placed immediately below the filled sill floor at the top of the pillar and between the line of posts already set in the rill stope. The ore as broken is allowed to run by gravity into the square-set raises which have already been placed in the adjoining rill stopes, the raise on one side being used for smelting ore and that on the other for milling ore. To date, in addition to the segment sets put in below the old filled floor, only one other segment set, 50 ft. below, has been placed in slicing a 100-ft. pillar, and this second set of segments has been placed only as a precautionary measure. So far, in slicing the pillars, the whole 100 ft. has been mined without any waste filling.

As stoping progresses below the top segment sets, stringers are placed every 7 ft. vertically between the rill stope posts. When a stope is finally filled, 75 per cent of the stringers used are recovered. Fig. 3 illustrates this method of mining.

All ore is mined by contract, the average price for rill stopes being 8½c. per cubic foot, and for pillars being 6½c. per cubic foot.

Copper Utensils Harmless

Copper cooking utensils are harmless, French research has shown, according to Paris advices to the American Chemical Society. M. Effront, it is said, has resumed the study initiated by Galippe and has carefully ascertained the amount of poisoning by copper salts.

"He has shown," according to the report, "by many experiments that vegetables absorb copper salts, so that vegetable foods such as salads or legumes and cooked herbs (spinach), prepared in copper vessels, become impregnated with copper salts, but these salts remain fixed to the vegetable fiber in such a way that, even in the stomach and intestine, they do not pass into the organism. There is therefore no poisoning. When the action of the stomach is too acid, however, there is a partial liberation of these salts and poisoning may result. These experiments are all the more interesting as they tend to make more general in France the use of aluminum bronze, which is more or less rich in copper, as cooking vessels."

Radium-bearing Silts of Southeastern Utah

A Low-grade Deposit of Unique Character that Forms Floor of Montezuma Canyon

By George O. Williams
Geologist, Norton-Williams Explorations

DURING the mining of some carnotite ore in Montezuma Canyon, in southeastern Utah, the miners for the Norton-Williams Explorations found a very low-grade deposit of radium which differs from any other of which a description can be found. It seems to be a uranium phosphate saturating silts of late Tertiary or of Quaternary age. Montezuma Creek is a tributary of the San Juan River, deriving its flow from the snows of the Blue (or Abajo) Mountains just west of Monticello, and from occasional summer showers. The entire course of the creek is within San Juan County, Utah.

In the vicinity of Montezuma and its tributaries, the uplands are formed by the Dakota sandstone, underlain by McElmo shales and sandstones, and below them the Navajo sandstone—the last two of these being of Jurassic age. Montezuma and some of the other larger streams of the district seem to have existed on the Dakota plain after the intrusion of the Abajo laccolith, and before the folding and uplift which has marked the Colorado plateaus with dozens of long anticlines.

With that folding and uplift, the antecedent Montezuma Creek, as well as the other streams of the region, cut a canyon through the Dakota and McElmo formations, and well into the Navajo sandstone. The section exposed along the sides of the canyon includes 70 ft. of Dakota sand; 30 ft. or more of basal conglomerate, probably Dakota; about 400 ft. of McElmo shales, containing some impure beds of phosphate and many calcitized and silicified tree trunks; 300 to 400 ft. of McElmo sandstones, carrying the carnotite beds, with many plant remains and a few bones; and below this the Navajo sandstones, into which the canyon has cut several hundred feet in some places.

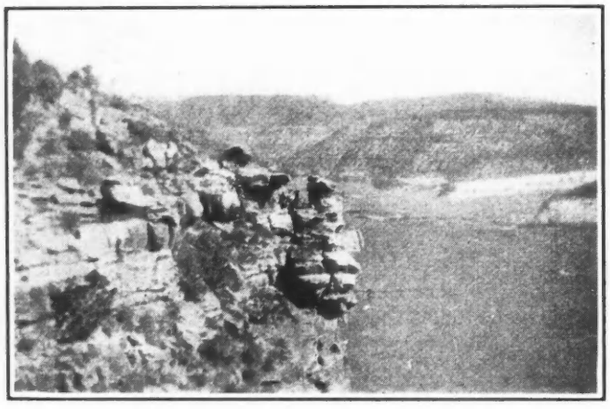
Following the cutting of the gorge, its sides have retreated and both the main canyon and its many side canyons have been partly filled with silt. By this filling the main canyon, a quarter to three-quarters of a mile wide, and the side canyons, 200 or 300 ft. up to 2,000 ft. wide, were floored with silt beds, 20, 40 and in places at least 60 ft. thick. The top of these silt beds follows a regular grade, about 15 ft. to the mile. No animal remains were found in these silt beds; but at depths of 6 in. to 2 ft. there were frequent evidences of the cliff-dwellers, such as charcoal beds, arrows, pottery chips and similar relics. (The cliff dwellers are considered by the authorities at Mesa Verde National Park to have inhabited the region at least 800 years ago.)

Beds Formed by Sudden Floods

Judging from exposed sections, these beds must have been formed by sudden flows of water rushing out of the side canyons onto the floor of the canyon, heavily loaded with silt. The water soon filtered through to the actual rock floor of the canyon, depositing its load of silt on the floor close below its source. A bed of boulders and pebbles on the rock floor below the fine silts, and comparatively free from sand and clay, seems to have been the water-bearing zone, since early in the filling of the canyon there was, and still is, a tendency

for coarse material to be swallowed by the silts, and gradually to be carried down to the bottom. Away from the edges of the canyons, bedding is very conspicuous in the silts, but along the edges, where the greater number of boulders have gone down, the bedding is broken or missing entirely.

There are cliff-dweller carvings of the "water-sign"—a series of concentric circles with a trickle-like tail wandering off a little from the outside circle—for some distance around the few springs of the canyon; which suggests the great importance to the cliff dwellers of



Shaky Point, southeastern Utah

A characteristic view of Montezuma Canyon, with its silt floor, and the wash cutting through it. Here the sheer wall next to the silt floor is about 30 ft. high

this spring water. There are no evidences of the existence of permanent streams in the canyon during their occupation of it.

From the days of the earliest whites in the region, up to about twenty-five years ago, there was no permanent stream channel across the silt beds. Snow water in the spring and the water from the summer storms spread out over the canyon floor until it had all sunk through the silt beds into the water bearer below. It was only from an exceptional storm that the water would go from the head of the canyon to the San Juan without sinking.

Washes Formed Suddenly

About twenty-five years ago, however, deep washes began to appear in the silt beds. Within three years the washes cut back the full length of the canyon—30 miles or more—and up most of its branch canyons, to a depth of 10 to 30 ft. The cattle men of the country maintain that the washes followed back up the stock trails, and more particularly the horse trails, where the sod had been cut out. So bitter did the ranchers become that until recently there have been frequent drives to kill off the uncorraled horses, in hopes of saving some of the land. But the grass is gone, and the washes continue to cut up the flats in the bottom of the canyons.

Since that time the washes have widened and deepened somewhat, but the walls still stand sheer to a height of 20 to 45 ft., with the wash 100 to 500 ft. wide. The wash in the bottom of the main Montezuma deepened itself from 6 in. to 2 ft. in the twenty months before May, 1924. Many slabs caved off the sides, but left sheer walls as before. In places one can go along the floor of the wash for two or three miles without finding a slope gentle enough to climb out over. Between these washes and the walls of the gorge still remains the old floor of the canyon, which has now become covered with sagebrush and greasewood, with a few scattering cedars, and thousands of cliff-dweller ruins.

Carnotite Found at Three Horizons

Near the base of the McElmo sands are three horizons that carry carnotite, or its parallel, tyuyamunite. One of these is at the division between the McElmo and the Navajo; one about 30 ft. higher; and one about 40 ft. higher yet. Only the middle one of these carries carnotite in minable quantities. But at these horizons, for a thickness of one sixty-fourth of an inch up to 2 or 3 ft., the sands are impregnated with rather high-grade uranium-bearing minerals, so that the whole rock at these positions carries from 3 to 5 per cent of uranium oxide. From midway between the lower two of these horizons to 30 ft. above the upper the sands are saturated with a measurable amount of uranium, averaging 0.05 per cent.

The silts of the floor of the canyon carry small quantities of uranium and radium in balance (that is, about 2½ mg. of radium to each 20 lb. of uranium oxide). The radioactivity of the silts seems to be restricted entirely to the clay and its contained phosphate, for it can be separated mechanically with the clay from the sand. These clays are richer immediately below the outcrops of carnotite ore, but they carry some radium almost everywhere. The richest part of the deposit that was found carried a little under one-fifth of 1 per cent of uranium oxide, in a bog that antedates the cliff-dweller period, the bog being at the mouth of a long and narrow tributary canyon, which canyon is lined for two or three miles with the outcrops of carnotite in rather thick beds.

Phosphate in Clays Precipitated Uranium

It seems probable that the storm waters and seepages leached a part of the uranium from the low-grade uranium-bearing sands and from the ore beds, and carried it in solution onto the canyon floor and through the filter-like silts. Within the silts the uranium was precipitated by the phosphate in the clays, and in time developed a radium content in balance with the uranium.

A careful search of the silt beds below carnotite outcrops of other districts found that there were no other radium-bearing silts in this country, except on East Rifle Creek, near Rifle, Colo. At that place one small patch of silt carries one-sixtieth of a milligram of radium per cubic yard. Rifle was the only place, other than Montezuma Canyon, where the silts occupy anything other than an anticlinal valley. In an anticlinal valley the ground waters would tend to flow away from the outcrop, and would so carry their dissolved uranium farther back into the ground. The creek at Rifle lies on a rather steep monocline, and has cut deep enough to expose the basal McElmo sands. Montezuma lies on a monocline, and its richest radium-bearing tributary, Devils' Canyon, follows a broad syncline.

Leaching of a quarter of the uranium from the sandstones for 500 ft. back of the outcrop, and its redeposition in the silt beds of the canyon floor, would be ample to develop all of the radium that has been observed in the silts.

The Nipissing Assay for Fine Bullion

Results Compare Favorably With Those Obtained in Mints at Home and Abroad With More Elaborate Equipment

By A. P. Van Zwaluwenburg

A. P. Van Zwaluwenburg

THE FACT that the Nipissing Mines Co., of Cobalt, Ont., has shipped more than 10,000,000 oz. of fine silver bullion to London, New York, and the Far East without a single dispute as to the quality of its product has given rise to more or less favorable comment. This fact is, of course, chiefly due to the selective action of the sodium sulphide used to recover the silver from the pregnant solution, which gives a precipitate practically entirely free from contaminating metals, and to the excellence of the work of the refinery, but probably also, in some slight measure, to the method employed in determining the fineness of the bullion. Since sulphide precipitation of silver from cyanide solutions seems destined to find a wider use in the near future, a few details of the Nipissing bullion assay should be of interest.

Volhard Method Used

The process employed is the well-known Volhard method, titrating the sample in dilute nitric acid solution against an equal weight of c.p. silver foil, under exactly similar conditions, with a solution of potassium thiocyanate, using a ferric salt as indicator. This method is convenient and suitable for a variety of purposes in ordinary laboratory work, but the conditions at Nipissing called for something more than ordinary laboratory results. Distinctions in tenths of a point between 998 and 999 bullion and even between 999 and 1,000 were required. The usual plan of using a larger volume of more dilute solution could not be employed, for the largest practical burette had a capacity of only 100 c.c., and repeated filling and adjusting a burette introduced a possibility of error not to be ignored. With a 100-c.c. burette one point of bullion fineness represents one-tenth c.c. maximum and fractions of a point mean titration to one-hundredth c.c., a refinement never contemplated in ordinary volumetric work.

The first obstacle encountered in trying to secure uniform and dependable results was the instability of the thiocyanate solution. When exposed to the air, the commercial salt decomposes, and solutions made up from the salt alone rapidly lose strength. It was found that, as in the case of cyanides, a sufficient quantity of protective alkalinity prevented this decomposition by air almost entirely. Solutions are made up in carboy lots, the strength being so adjusted that slightly less than 100 c.c. are required to precipitate a solution containing 0.500 gram of pure silver foil. The addition of 10 grams of KOH or NaOH to the contents of the carboy is sufficient to preserve its strength under ordinary conditions indefinitely. One test solution was thus kept for three years without appreciable loss of strength.

The accurate reading of a burette to within one-tenth c.c. requires extraordinary precautions. Holding the eye even slightly above or below the level of the meniscus may easily make a difference of a tenth c.c. The time of titration may also cause a variation of as much as 0.25 to 0.30 per cent of the total volume, due to the descent of more or less of the skin film of solution always adhering to the inner walls of a burette when the contents are withdrawn. Tests showed a rise of as much as 0.35 c.c. of the meniscus after the solution had stood for five minutes. With the Volhard method the amount of stirring and the quantity of indicator used also influence the depth of color after the titration is completed.

To insure absolutely horizontal readings, the following system was adopted: The burette was filled by means of a siphon to a point very little above the zero mark. It was then held between the thumb and finger and allowed to swing free, like a pendulum, and the meniscus raised to the level of the eye, sight being taken against a point on the wall known to be the same height above the floor as the operator's eye. This insured a vertical burette and horizontal reading. After this reading and making sure that the delivery end of the burette was free from bubbles and adhering drops, the burette was placed in position in the stand and not readjusted before titration, the slight rise in the meniscus due to the descent of the skin film being assumed to be constant.

To insure a similar accuracy for the final reading after completion of the titration, the burette was always placed in the stand at a predetermined altitude, and since all the readings fell within a very few millimeters of the same point, an arrow on the wall immediately behind the burette was placed at the altitude of the reading for the pure silver foil, so that by keeping the meniscus between the eye and the arrow point the reading must be in a horizontal line.

All Titrations Timed Closely

Since the assay is in effect a careful comparison of pure silver foil with an equal weight of the unknown bullion, under similar conditions, it was only necessary to make sure of this similarity of conditions. To equalize and therefore neutralize the effect of time due to the descent of skin film in the burette and the effect of stirring upon the final tint of the indicator, all titrations were timed by the clock. Five minutes' stirring was found to complete the reaction definitely. So five minutes was fixed as the elapsed time between the reading after filling and the final reading after titration was complete.

In making the determinations the samples were prepared by taking saw-cuts of the sample bars, the first cuttings being rejected and the sample being tested with a magnet for particles of iron or steel. Of the cuttings half a gram was weighed out on a fine assay balance and placed in a clean beaker. Usually a number of samples were run at the same time, a row of beakers similar in size and shape being used. As many controls of pure silver foil were placed at intervals in the series of beakers as seemed necessary. But since the solution of thiocyanate did not vary in strength, the controls were used rather as a check and to furnish a

tint for comparison than as a guide for the titration of the other samples.

The samples were dissolved in 15 c.c. of "one-to-one" nitric acid, employing a gentle heat until red fumes had disappeared. Boiling was carefully avoided, to minimize the danger of loss by spurting. After cooling, 100 c.c. of pure water at room temperature was added to each beaker and a measured quantity of saturated solution of ammonium ferric alum. The first titration was usually that of a sample of silver foil to make sure of the solution and to furnish a tint for comparison. The solution was run in rapidly from the burette to the point known to be indicated, the subsequent rise of the meniscus due to the descent of skin film being ample to cover variations in samples and allowing enough room for final adjustment. The samples were stirred vigorously for five minutes, and the burette was adjusted to even tenths of a cubic centimeter. The division of tenths into hundredths on the burette being impossible, this was accomplished by a comparison of tints of color in the completed titrations.

With this method the Nipissing laboratory, with a very mediocre equipment, has held its own in comparison with the government testers connected with the mints of England, the United States, and Japan, besides commercial assayers in various parts of the world.

A Curious Incident

This Nipissing method came into conflict with an odd method of determining the fineness of bullion during the winter of 1919. For some months the bulk of the mill's product had gone to Chinese ports, where the bullion's exceptional purity due to sulphide precipitation commanded a price some cents above the London quotation. The practice at the time was to take a dip sample of each refining furnace charge before pouring and to take the resulting assay as the fineness of the entire thirty bars in the batch. The mail one day brought in a curious envelope bearing a Chinese postmark and superscription. It contained a letter of protest signed by fourteen persons of distinctly Chinese names. After paying full respect to the quality of Nipissing bullion in the past and the high integrity of the company in all its past dealings, the writers thought it hard that a bar which had been purchased in good faith as 999 bullion should turn out to be so poor in quality that it assayed a bare 998.5, and that without reduction in price. The object was, of course, a rebate of a part of the price paid. Pinned to the letter was an assay certificate from the official assayer of the Japanese Government in Yokohama, showing that in fact the bar in question had been only 998.5 fine.

Subsequent inquiries revealed a curious phase of Oriental industrialism. It appeared that the fourteen protestants were in fact members of the same guild of silversmiths, which had handed down methods from father to son for perhaps a thousand years. It was their custom to join in the purchase of a single bar of bullion and then separately to take each his portion and work it up in his own minute forge or shop. On this particular bar they felt that they had been defrauded, and each guild member individually and collectively protested.

As to how this guild detected the inferior quality of the bar, information was equally interesting but less illuminating. It seemed that every guild had its bullion tester, a position also handed down from generation to generation. This bullion tester maintained with great care what might be called a technically educated fingernail. By drawing this nail, held at a certain angle, over the surface of the bullion, the operator was able to determine by the feel the character of the sample. Whether this hereditary Oriental assayer was actually able to detect the minute difference between bullion of 998.5 and that of 999 fineness, the company in Cobalt never learned.

A Gigantic Belt Conveyor

By M. W. von Bernewitz

Mining folks are so accustomed to seeing or reading of steam shovels and ore trains moving ten, twenty, thirty, forty, and fifty thousand tons a day, or of hoists hauling thousands of tons of ore from depths of a few hundred to several thousand feet, that gigantic installations of this sort no longer surprise us. But a belt conveyor, 4½ miles long in twenty sections, operating underground, and capable of carrying 10,000 tons a shift, is an engineering feat that confronts the visitor at the Colonial coal mine of the H. C. Frick Coke Co., at Scottdale, Pa., a short run from Pittsburgh.

During the first week in December the Coal Mining Institute of America met as usual at Pittsburgh. One of the papers read was that by T. C. Dawson, chief engineer for the H. C. Frick Coke Co., and one of the excursions held was to inspect the conveying system he described. Two man-trips of storage-battery locomotives and mine cars carried 120 engineers 4½ miles into the mine. The 4-ft. belt conveyor, loaded with coal for the entire distance, parallels the track within a few feet, and its operation could be studied from the cars.

Above the inner end of the belt is a hopper holding 1,250 tons, and motor-driven feeders regulate the coal fed onto the belt. All of the coal from three connected mines is hauled by trolley locomotives in trips of as many as forty-four mine cars to two rotary dumps above this hopper, and a whole trip is dumped at one time. Following the coal from this point to the Monongahela River we learn the following facts:

Width of belt (different makers), feet	4
Number of belts	20
Carrying length of belt, feet	22,927
Total length of belt, linear feet	47,080
Shortest section, feet	321
Longest section, feet	1,514
Net rise of slope (an entry of an old mine) from feed hopper to mouth, feet	357
Speed of belt, feet per minute	1,500
Capacity of belt, tons per hour	1,500
Electric motors (20, General Electric), total horsepower	2,850
Total running horsepower	1,933

Drive system from motors—gear reduction (Falk).
Type of conveyor (Stephens-Adamson) trough and return idlers.

The smoothness of operation, the almost entire absence of noise from carriers and return rollers, and no spillage are at once apparent. The belt dumps its load onto two shuttle conveyors at the steel and concrete tipple at the river bank. These dump into two bins of 1,200 tons' capacity each, from which the coal is loaded into 850-ton barges, one of which is filled in ten minutes. The coal is then taken down stream to Clairton, where is the largest byproduct coking plant in the world. There is made coke for blast furnaces and house heaters, gas for open-hearth furnaces, benzol for automobiles, and ammonium sulphate for fertilizing soil.

Doubtless it will be agreed that the belt conveyor briefly described is a great engineering feat, apart from the fact that the slope of 4½ miles is supported by steel "timbers" standing on concrete, and it is possible that in other large slope or drift coal and metal mines the system might be copied to advantage.

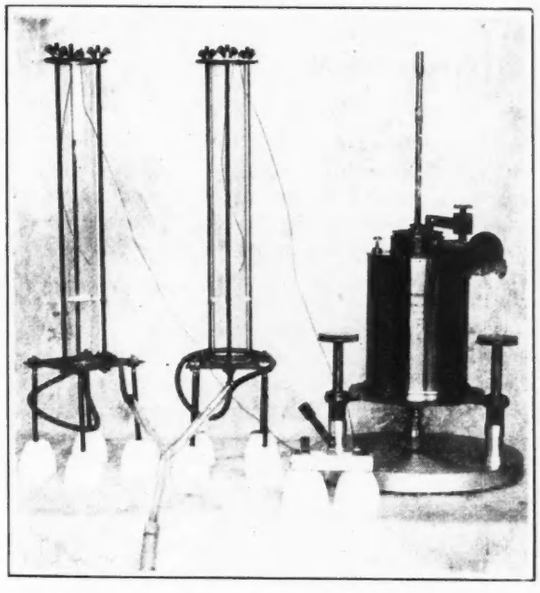
Oil-less Flotation of Minerals

Tests With an Electrometer Give Results of Possible Practical Application—Further Work to Be Done in Japan

By T. M. Bains, Jr.

Associate Professor of Mining, Colorado School of Mines

FOR YEARS, laboratory tests have indicated that certain ores will float readily without the addition of any oil or other reagent save a small amount of an alkali, such as sodium hydrate. I did considerable work of this nature at the University of Minnesota in 1918 on a gold ore from California. The recent article by Mr. Fredrick[1] is of interest in this connection. So far, no attention has been paid to the *electrification of the air bubble*, although the electrostatic charges on the minerals, colloidal slimes, and the oils are referred to frequently. Until now, so far as my knowledge goes, no simple method of determining these charges on the colloids, minerals, and oils has been offered.



Equipment for making electrometer tests

During the last year, at the Mining Laboratory of the University of Illinois, I have been experimenting with the flotation of sulphides without the use of oils or coal-tar derivatives, and have at the same time been utilizing the method described in my article of May 31,[2] to make preferential flotation tests on ores of chalcopyrite and pyrite, and also on ores containing galena, sphalerite, chalcopyrite, and pyrite.

While using a Pachuca tank to agitate and aërate slime from a gold quartz ore, in cyanidation, sodium hydrate instead of lime was used for protective alkalinity. A heavy froth resulted, flowing over the sides and on the floor several feet deep. This froth, after drying on the floor, was scraped up and used as a flotation reagent in the preferential flotation of chalcopyrite from pyrite. Although the ore assayed only 1.8 per cent copper, a concentrate assaying 19 per cent copper was obtained, after cleaning the rougher product with a minute quantity of nitric acid, using no other reagent. As there was possibility of oil or other reagent having been introduced into the pulp between the crushers and the Pachuca tank, a check was run with a colloidal slime produced by sliming clean gold quartz in a porcelain pebble mill with distilled water in which sodium hydrate and cyanide had been dissolved. The same results were obtained under these conditions. Ore from Mexico, assaying 3.2 per cent copper and containing a large amount of pyrite, was concentrated to 29 per cent copper. Also, a complex ore from Leadville, containing 16½ per cent zinc, 12½ per cent lead, and 20 per cent iron, was tested with this slime reagent and a 53 per cent zinc concentrate was produced. This was contaminated with the chalcopyrite contained in the ore. The galena was separated by tabling the flotation concentrate.

Although these results are nothing unusual at present, when oil, with thiocarbanilid and ortho-toluidin are used as reagents, or when sodium or potassium xanthate is used, still, when compared with the results of electrometer tests, more light is thrown on the theory of preferential flotation. Referring to the curve shown in Fig. 3, on page 886, *Mining Journal-Press* of May 31, 1924, it can be seen that nitric acid *reverses* the charge on the air bubble. This was proved also by the researches of Lord Kelvin and others during the last part of the last century.[3] Such reagents as potassium permanganate, chromium bioxide, hydrogen peroxide, rosaniline and methyl violet were found by Sir J. J. Thomson[4] to reverse the electric charge on the air bubbles. Oxidizing agents have this characteristic.

My experiments have indicated the following:

(a) The bubbles of air are charged but *very feebly*.

(b) The colloidal slime has an opposite charge from the bubbles in the alkaline-cyanide solution.

(c) The sulphides which float, such as the chalcopyrite, have the same charge as the bubbles, from the electrostatic charges on their surfaces, owing to immersion in the alkaline-cyanide solution.

(d) The gangue and sulphides have either feebler electrostatic charges than the chalcopyrite, or else have the opposite charge or none whatever, owing to immersion in the alkaline-cyanide solution.

(e) In cleaning with an oxidizing reagent, the air bubble has its charge reversed, as shown by the electrometer, while the colloidal matter and the sulphide concentrate from the rougher carry the same charges as before.

Applying these principles, the feebly charged bubble in the flotation process attracts the colloidal matter of the opposite charge, which acts as the film of oil does in ordinary oil flotation; the colloidal matter attracts

[1] "A Basis for Selecting Flotation Agents," by H. F. Fredrick, *Mining Journal-Press*, July 5, 1924, page 11.

[2] "Electrometer Tests in Flotation," by T. M. Bains, Jr., *Mining Journal-Press*, May 31, 1924.

[3] *Phil. Mag.*, Vol. 29, page 56; Vol. 30, page 148; Vol. 37, page 341; Vol. 38, page 225; Vol. 42, page 392; Vol. 43, page 241; and Vol. 45, page 125. Also the *Electrical Review* (London), Vol. 36, pages 321 and 370.

[4] "Discharge of Electricity Through Gases," by Sir J. J. Thomson, 1898.

the sulphides having the same charges as the air bubble. The other particles are not attracted or else only faintly so, depending on their electrostatic charges. This gives a rougher product of colloidal slime and the floated sulphides. Then when a small amount of nitric acid or other oxidizing agent is added to the cleaner cell, the reversal of the charge on the bubble throws off the colloidal slime, having now the same charge as the bubble, and the bubble attracts directly the sulphide of opposite charge. It will be obvious that the sulphide must be crushed so that it will be fine enough to be attracted to the feebly charged bubble—about 200 mesh, to get the best results, according to my experiments.

I wish to bring out particularly that the air bubbles must be very feebly charged, not highly charged, as is the theory of some metallurgists. Preferential flotation of sulphides cannot be done with conditions such that, if tested by the "electrometer test," a high voltage is produced in the apparatus. It will be well to emphasize the fact that high voltages are secured in these electrometer tests under certain conditions. A voltage of 340 volts was secured at Illinois with a basic ferrous solution. With pure water, the voltage rises rapidly, often in less than a minute to a hundred volts, in these tests. But by the addition of a drop of alkaline-cyanide solution, the voltage will return nearly to zero. By adding a drop of nitric acid or other powerful oxidizer, the voltage reverses, and after a drop in the opposite direction of several volts, will gradually return to the original voltage. It is therefore necessary to keep adding oxidizers to have the voltage continue reversed.

An improvement over the apparatus used at Rolla, and described in my article of May 31, 1924, was developed at Illinois. The first type of aëration tube was simply a 2-in. iron union with canvas disks between the two parts of the union and with a bushing for the air pipe on the bottom and a glass tube on top, fastened into the union. It was not practicable to clean this device. So the latest type was made of thick glass tubing, in two pieces, the under part being about 3 in. long and the upper about 1 ft. The edges were ground and pressed against the disks, by tie rods, as shown in the illustration. Also, there was no way, with a single tube, to check on a standard tube. As shown in the cut, two similar tubes are connected to the same air pipe by a "Y" glass tube. This gives the same air pressure under each tube. Then, if the tubes and disks have been washed in the same distilled water and the same amount and quality of liquid is placed in each tube, the curves of the two tubes will be identical, no matter what the leakage of the electrometer is. This is important in most climates. By adding the reagent to be tested to one tube and not the other, the effect of the reagent can be plotted accurately. If it is desired to froth off the concentrate in one tube, a special shaped top to the tube can be made of glass and used with this design. The electrometer shown in the illustration is a Szilard electrometer on which voltages up to 450 can be read. It was on this electrometer that the 340-volt reading was made. This high reading was made with plain tap water from the faucet in the laboratory, but the aëration cell was an old one made of a 2-in. iron union; it had been used some months before and had been put away by a student without drying or cleaning. It was rusty and probably had a residuum of basic iron sulphate on the inside surface. Water was placed in this cell and the platinum wire to the electrometer was connected. Within a few minutes, the voltage had reached 340 volts, where it remained without increasing or decreasing for more than an hour, when the cell was grounded. In a few minutes it reached the same voltage.

With care and the use of two tubes and nothing but glass and canvas in contact with the liquid, accurate curves may be secured for every type of reagent, for different ores, for different water, and for various combinations. With check tubes, curves made at one place may be checked against curves made at a distant point. The curves are as accurate as the steam indicator diagram, and if sufficient are available will be valuable to the profession at large. The first work on this, besides that which I have done, is to be undertaken at the Engineering College of the Tohoku Imperial University, at Sendai, Japan, by T. Mayeda. It will be interesting to see what results will be accomplished there.

One-man Mining in Mongolia

By H. A. Finch

The man who has visited that part of California where hydraulic mining has been and is now being carried on is tremendously impressed with the magnitude and expensiveness of the operations involved. He sees where in days gone by the "hydraulickers" washed entire hillsides into the valleys below in sluicing out the gold-bearing gravel carried in the pre-historic river courses. He likewise notes the great ladder dredges, now costing up to a million dollars apiece, engaged in handling an enormous yardage of river gravel, running perhaps 13c. a cubic yard in flake gold, and leaving behind them a no-man's land of boulder mounds stretching for miles along the river banks.

With these pictures in mind, it comes as a curious anticlimax to read in Ossendowski's book, "Beasts, Men and Gods," of the one-man mining methods used by the natives of the sandy and streamless stretches of Mongolia. According to Ossendowski the Mongolian gets results with no more elaborate equipment than a feather and a small buckskin bag. The hand placer mining apparatus used in California in the '50s would be worse than useless in that arid country.

With his buckskin bag tied around his neck and with his feather in his hand, Mr. Mongolian goes forth to his favorite bit of desert. Stretching out on his stomach he begins to blow a hole in the sandy surface. With his feather he lifts out the heavier particles of stone which his breath cannot lift and which from time to time tumble to the bottom of his "crater." Also from time to time a flake of gold tumbles to the crater bottom. This the "miner" secures with a wet forefinger and deposits in the little bag hanging conveniently from his neck. When the crater reaches the blower's wind power limit, a slight shift is made and a fresh hole started. According to Ossendowski, a man thus averages 50c. a day.

What a contrast! A million-dollar dredge against a feather and a buckskin bag! I have repeated this story to many mining men, and some of them immediately remarked on what a rich return could be counted on if modern methods were applied to soil yielding 50c. a day to a single man using the bag-and-feather process. Possibly so, if the scarcity of water could be overcome. But modern methods are not always successful in the Far East. There human labor is so cheap that it frequently undercuts mechanical methods.

Petroliferous Areas of New Zealand

A Study of the Possibilities of Finding Commercial Deposits of Oil

By P. G. Morgan
Wellington, New Zealand

THE OLDER SEDIMENTARY ROCKS of New Zealand (Palæozoic, Triassic, and Jurassic) are in general too metamorphosed to contain oil except such as may have been introduced from younger strata. This opinion is confirmed by the "carbon ratio" wherever it is ascertainable. On the other hand, the Cretaceous, more especially the Upper Cretaceous, and the Tertiary strata are usually not much altered, and in many localities contain at least traces of petroleum. The areas of New Zealand occupied by Cretaceous and Tertiary formations, exclusive of igneous rocks associated with them, and by Quaternary sediments, beneath which Tertiary strata do or may occur, are shown in the following table, the figures being in square miles:

	North Island	South Island	Total
Post-Tertiary strata	7,151	11,481	18,632
Tertiary strata	15,304	4,231	19,535
Cretaceous strata	5,117	557	5,674
Totals	27,572	16,269	43,841

This table shows that probably two-fifths of New Zealand contains strata that may possibly yield mineral oil, and the thorough prospecting of those portions which afford indications of petroleum appears to be justifiable.

Seepages of oil have been observed in the following localities: The Dobson and Liverpool state coal mine, near Greymouth; Kotuku, in North Westland (east of Greymouth); Warwick River valley and Mangles River in Central Nelson; Cheviot district in Southeast Nelson; Ure River and near Ward, in Marlborough; Paraparaumu north of Wellington (in peat); near New Plymouth; at various localities between Gisborne and East Cape; Waiotapu, 20 miles south of Rotorua; Whangarei district (?); and perhaps elsewhere. Emanations of inflammable gas, and other supposed indications of oil, such as brine springs, have been observed over very large areas, more particularly in that region lying east of the Tararua-Rimutaka-Ruahine-Raukumara range, which extends from Wellington northeastward to near Cape Runaway, and includes the Gisborne-East Cape district just mentioned.

In three districts the indications of petroleum are unusually strong. These are: North Westland; New Plymouth and adjoining areas; and the Gisborne-East Cape district. A few sentences will be devoted to each of these, and some of the other localities will be briefly discussed.

North Westland—The strongest indications of petroleum occur at Kotuku, which is 21 miles by rail east of Greymouth, near Lake Brunner. Here over an area of several acres the surface gravels are heavily impregnated with oil, and considerable quantities can easily be collected by digging holes. One shallow bore is said to have produced 14,000 gal. (English) of oil, most of which was lost, and several hundred barrels have been obtained from other shallow bores and a shaft sunk in the Pleistocene sands, gravels, and clays underlying the surface gravels. Below these beds come Middle Tertiary mudstone and limestone. Beneath the limestone are some marly and sandy beds, also of Tertiary age, underlain by a conglomerate, which in turn rests on Palæozoic argillites and greywacks. The structure is obscure, but there appears to be a gentle anticline in the Tertiary rocks, slightly complicated by faulting. A good many bores have been drilled into the Tertiary strata, but the results have not been satisfactory. Several bores, on entering the limestone, struck salt water and carbon dioxide in large quantity, but obtained nothing better than "shows" of oil, which in one or two instances are said to have continued until the Palæozoic rocks, which, owing to their metamorphic

Sketch map of New Zealand

character, are hopeless as a source of oil, were entered.

The oil produced at Kotuku was of good quality, with a paraffin base, and such as one would expect to be associated with a considerable body of petroleum. Unfavorable features are the widespread cover of fluviatile and glacial gravels, almost everywhere hiding the Tertiary strata, and the somewhat limited extent of the possible oil-producing area. The north part of this lies between the Southern Alps and the coastal Paparoa range, and the southern part extends as a narrow belt between the Southern Alps and the area at least as far south as Ross. There are localities other than Kotuku in this comparatively long strip which offer possibilities to the oil seeker. At Fireball Creek, near Kumara, the middle Tertiary limestone along an anticlinal axis (Brunner anticline) has a petrolaceous smell. Not only the structure but other conditions are here favorable for the accumulation of oil.

New Plymouth and Adjoining Areas—Oil films were observed on the sea near the Sugar-loaves, New Plymouth, by the Maoris long before the coming of Europeans. Oil-prospecting operations have been car-

ried on at intervals since 1866. Numerous wells have been drilled, and many of these yielded a little oil. In 1905 a bore, afterward known as the Birthday well, struck oil in some quantity, and a few years later several bores drilled by Taranaki Oil Wells and one drilled by the Blenheim Company for short or even long periods began to yield oil. These bores were all between New Plymouth and its port to the west at the Breakwater. At present there is still a small production. I have no exact data, but believe that the total oil production at New Plymouth is between 1,500,000 and 2,000,000 English gallons, or, say, 40,000 to 50,000 bbl. Most of this oil came from a depth of a little more than 2,000 ft.; some from over 3,000 ft. The oil was associated with a large amount of gas (mainly methane, but containing much carbon dioxide) and with a moderate amount of salt water. It comes from Pliocene strata, which are underlain by Miocene beds and overlain by 250 ft. or more of volcanic agglomerate and tufa, so that the structure is obscured.

So far as can be ascertained from an examination of the bore logs and general considerations, the dips are gentle. Volcanic rocks rising through the Pliocene sediments and the overlying volcanic agglomerate form the conspicuous steep-sided hill of Paritutu and the neighboring islands known as the Sugar-loaves. A paper by Dr. T. H. Easterfield, which was read before the Pan-Pacific Congress in September, 1923, shows that the oil so far produced at New Plymouth has probably been affected by volcanic heat. It is of good quality, with a paraffin base, which perhaps indicates a vegetal origin.

One bore at New Plymouth, the Blenheim, has been drilled to a depth of more than a mile (5,726 ft.) in the Upper Tertiary strata. Although at a depth of about 2,200 ft. this well produced an appreciable amount of oil, no flow was encountered at deeper levels. Its lower portion, however, passed through a great thickness of brown claystone or shale, which was slightly petrolaceous, showing on analysis about one-fifth of 1 per cent of petroleum.

Wells have been drilled a few miles south of New Plymouth, some miles to the northeast, and again at Inglewood and Huiroa, which are places well inland to the southeastward. Only light shows of oil were encountered. Even the deepest of these wells, the Huiroa, with a total depth of 4,921 ft., probably has its bottom in Pliocene rocks. These are probably underlain by several thousand feet of Miocene strata. Recently F. G. Clapp, of New York, has reported favorably on the prospects of oil in Taranaki, and Taranaki Oil Wells, Ltd., a company with headquarters at Melbourne, but possessing the name of a former New Zealand company, is about to bore at a point a mile and a half northwest of Tarata (17 miles southeast of New Plymouth), where a favorable structure has been found.

Gisborne-East Cape District—Indications of oil in the Gisborne-East Cape district are plentiful, and a considerable amount of boring has been done at Whatatutu and other localities within 20 miles or so of Gisborne, and in the Rotokautuku block, Waiapu Valley, far to the north. A few barrels of oil, mostly of a light character, have been obtained. The oil seems to come from Upper Cretaceous beds, which are much crumpled and faulted. These are overlain unconformably by several series of Tertiary strata, ranging in age from Eocene to Pliocene, which are not folded to any extent, but are broken into tilted blocks by important faults usually striking either east-north-east, or south of east.

Recent work by the Geological Survey shows that the Upper Cretaceous shales, sandstones, and limestones of the northern part of the Gisborne-East Cape district are petroliferous over considerable areas. Although these rocks present very irregular structures, the geologists who have done the field work believe that the area has possibilities. They are, in fact, hopeful that one or more oil pools exist.

Other Localities—At Chertsey, a few miles north of Ashburton, Canterbury, a wildcat bore was drilled a few years ago to a depth of 2,170 ft. This bore penetrated 500 or 600 ft. of the recent and late Pleistocene gravels forming the Canterbury Plain; it may then have entered late Tertiary gravels, sands, and clays. From a depth of 1,368 ft. downward these strata yielded a little petroleum in the form of black very viscid globules, and a little inflammable gas. The oil and gas were probably derived from buried vegetal matter.

At Tane, northeast of Eketahuna, East Wellington, a bore has been drilled to a depth of 3,000 ft. through late Tertiary claystones. This yielded traces of oil and gas. At Waipatiki, near Weber, east of Dannevirke, some distance to the north, two wells have been drilled to considerable depths, through Tertiary sediments, principally calcareous claystones. The deeper well encountered some gas, and at a depth of 1,140 ft. or thereabouts there was a light show of oil from a greensand layer. I also saw a faint, somewhat doubtful "show" at the other well.

At Waiotapu, 20 miles south of Rotorua, in the "Hot Lakes" district, a little amber-colored oil reaches the surface of a small sinter terrace near the ordinary water level of the Waiotapu Stream. It rises with a little hot water and some non-inflammable gas. The heat of the water causes the more volatile portion of the oil to evaporate, and a small ring of pitchy material appears round each little pool. This oil appears to owe its origin to the distillation of carbonized wood buried in the underlying pumiceous tuffs.

Various other New Zealand oil occurrences, though economically unimportant, are of an interesting character, but need not here be described. As indicated in the previous paragraphs, the North Westland, New Plymouth, and Gisborne-East Cape districts possess possibilities, and all deserve further investigation. Blind stabbing or wildcatting is most inadvisable, and further prospecting should be carried out only by concerns or persons with large capital, employing experienced geologists and drillers.

A New Method of Finding Radium

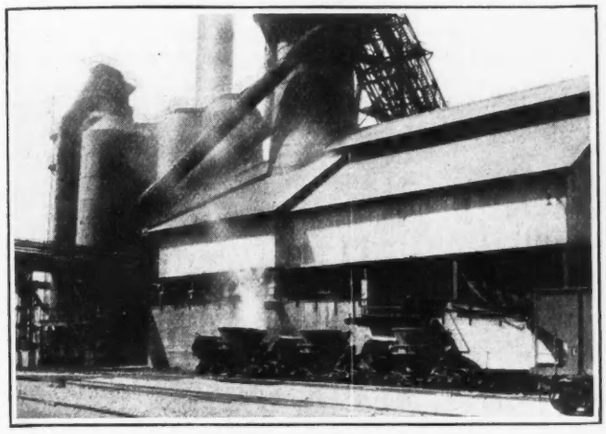
A French precious-metal prospector of assured standing has developed a new process for the location and extraction of radium which he wishes to introduce in America. He believes that it could be profitably applied to certain of the mineral sections in this country and to other minerals than the radio-active. A technical pamphlet in French on the general subject of mineral exploitation, of which he is the author, has been forwarded to the Department of Commerce and is available for loan upon application to the Minerals Division, or the appropriate district office, with reference to this paragraph. Interested persons can be put into direct communication with the prospector if desired, the department states.

Making Pig Iron From Utah Ore

Recently Erected Plant of Columbia Steel Corporation at Provo Obtains Its Raw Materials from Within the State

By George J. Young
Associate Editor

THE COLUMBIA STEEL CORPORATION'S pig iron plant at Provo, Utah, derives its raw materials, coal, iron ore and limestone, from deposits in Utah. The iron mines[1] are in the Iron Springs district, 21 miles south of Lund on the Salt Lake & Los Angeles division of the Union Pacific R.R. The coal mine operated by the company is near Sunnyside and is served by a branch line from the Denver & Rio Grande R.R. A branch line has also been constructed to the iron mines by the Union Pacific. Limestone is derived from local sources near Provo. The iron mine has been opened by an adit and the ore is mined by a series of surface mill holes. Ore is graded into two classes and is discharged from the railroad cars into the charge bins, or stockpiled, at the Provo plant. Coal is crushed by toothed rolls to 1½-in. at the mine and sent to the coal preparation plant or stockpiled.

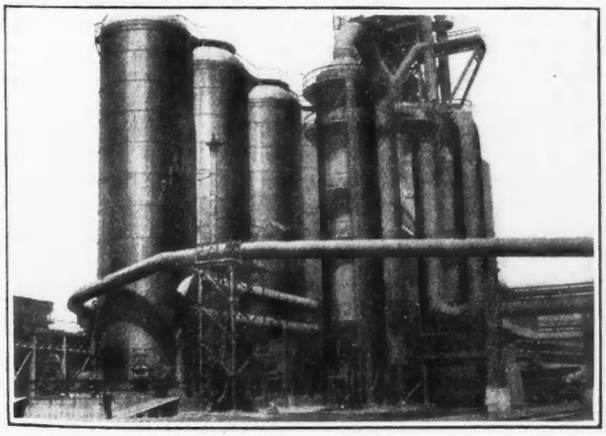


Blast-furnace slag is handled in ladle cars, three of which are shown here

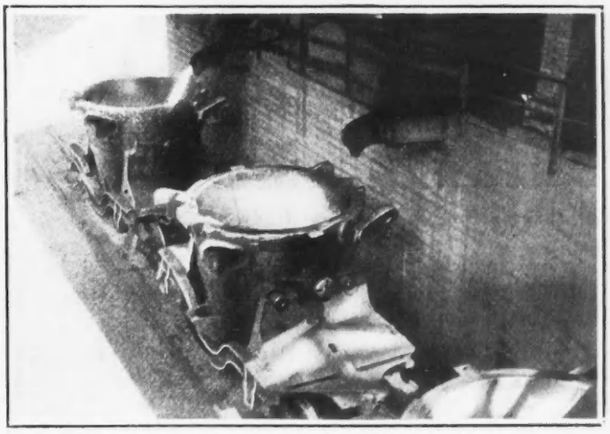
Tapping the 350-ton blast furnace

The plant at Provo is three miles south of the town on a site that slopes gently to Utah Lake. Freyn, Bassert & Co., of Chicago, designed the installation, which was erected by the engineers of the Columbia Steel Corporation. It was completed early in 1924, and has since been in operation.

The equipment consists of a single blast furnace, coal preparation and conveying machinery, a byproduct coking plant, power plant, shops and laboratories, and charging bins. The plant is modern in all respects and complete within the limits of its objectives. Steel and concrete have been largely used in construction. Conveyors and electric locomotives are used for transportation, and the handling of materials involves a minimum of labor.



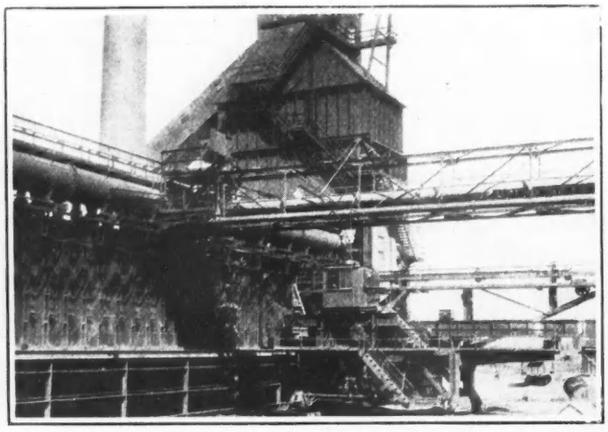
Hot blast stoves and scrubber. The furnace is provided with four stoves, as customary



Molten iron is handled in ladle cars, which are hauled by wire rope to the casting plant

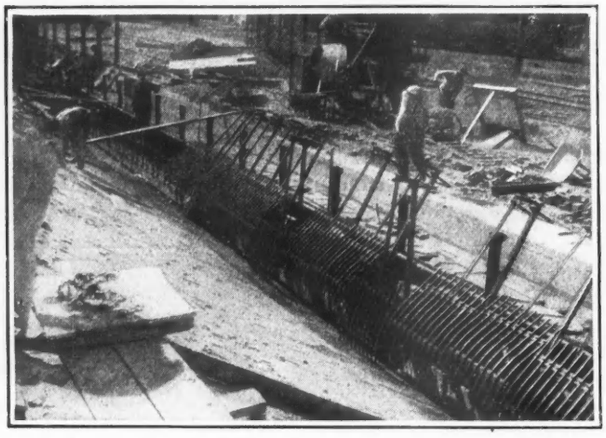
The blast furnace is rated at 350 tons of pig iron per day. It is 15 ft. in diameter, bosh diameter 19 ft., and height 83 ft. Eight tuyères distribute the air at the hearth. Skips operated by an automatic Otis hoist are used for charging. Upper and lower bells are operated by air cylinders. The furnace is completely

[1]See "Iron Ore Deposits of Southern Utah," by D. P. Rohlfing, *Mining Journal-Press*, Vol. 115, p. 716; also "Pacific Coast and Its Significance for Western Iron Mining," by E. Y. Dougherty, *Mining Journal-Press*, Vol. 117, p. 447.



This battery includes thirty-three Koppers coke ovens with an accessory byproduct plant

equipped with recording indicators for height of charge, blast pressure and temperature. Four hot blast stoves with accessory dust catchers and washers handle the gaseous products. The water from the gas washers is laundered to a Dorr thickener for the removal of solids which are high in iron and are returned to the furnace. The gas is piped to the steam generating plant. The iron and slag are handled in ladle cars. The ladle cars carrying the molten iron are hauled by wire rope to the casting plant. The casting plant consists of two lines of molds which are arranged on the pan-conveyor principle, receiving the iron from spouts and discharging the pig iron after passing under cooling sprays into



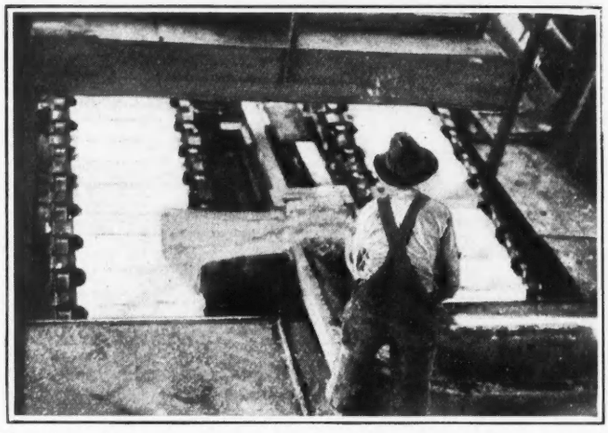
The coke-cooling floor slopes to and discharges on to a 30-in. belt conveyor

steel cars for shipment. A 50-ton Cleveland traveling crane serves the casting shed.

Coal preparation is effected by a hammer pulverizer which reduces 75 per cent of the coal to ⅛-in. size. A conveyor system discharges the coal into hoppers above the coking ovens which are used to load the lorries. The battery of coking ovens consists of 33 Koppers ovens with accessory byproduct plant. Benzol, coal tar, and ammonium sulphate are made, and the clean gas is used for heating the ovens. The ovens are 14 in. wide.

The coke is discharged by a pusher into a special car, which is moved by a wire-rope haul to the quenching tower, where the coke is drenched. The car is returned and the contents are discharged upon the cooling floor, which slopes to and discharges upon a 30-in. belt conveyor. Gates control the discharge to the belt. The coke is conveyed to the screen house. Three sizes are made: furnace coke, which is conveyed to the charging bins; domestic coke, which is received into cars for shipment, and breeze, which is loaded into cars and used at the power plant. A Koppers rotary grizzly and a Mitchell screen are used for sizing. The benzol product is sold locally, the tar is sold to the Barrett Co., which has a small plant near by, and there is a steady demand for the ammonium sulphate, which is shipped to Hawaii.

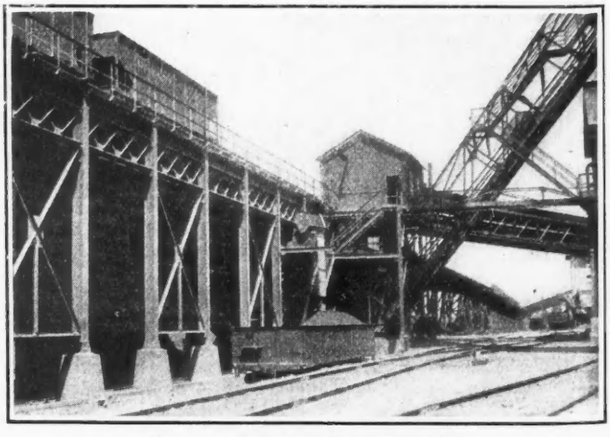
The boiler plant is equipped with five 617-hp. boilers of the modified Heine type. Blast-furnace gas is used for fuel. Coke-oven gas is piped to the boilers and used to compensate for any deficiency. Excess gas is



Casting pig iron. There are two lines of molds arranged on the pan conveyor principle

wasted. The boiler plant and power house are in close proximity and both are near the blast furnace.

The power equipment is housed in a brick and steel building which is served by a twenty-ton Cleveland traveling crane. Two General Electric generators, driven by Curtis turbines, each of 1,500-kw. capacity, supply alternating current for the plant. Two Ingersoll-Rand rotary blowers, each of variable capacity from 30,000 to 50,000 cu.ft. of air at 18 lb. pressure, supply the air for the blast furnace. They are driven by steam turbines. In addition, two rotary converters supply direct current at 250 volts for crane, trolley, and miscellaneous service. Condensing equipment for the steam turbines is placed on a lower floor of the power house. Additional power is supplied by the Utah Power Co. The plant is in charge of L. F. Rains.



Ore- and coke-charging bins

Discussion

Factors in Mine Accounting

THE EDITOR:

Sir—In your issue of Sept. 20, 1924, p. 463-466, under the title "Factors in Mine Accounting," Benjamin F. Tillson writes most ably and with unusual breadth of view. In his opening remarks Mr. Tillson puts his finger on a fatal defect in mine accountancy—namely, the unreliability of the figures which are collected at the fountain head—that is, in the mine itself. For the most part these figures originate from men who have little or no knowledge of account keeping. If detailed costs are to be accurately collected it is worth while to train men specially, who though forming part of the office staff, spend part or all of their time underground, depending on the scope of the duties of the individual. It would be the work of these men to make a daily tabulation of all labor, supplies and other materials in every subsection of the underground work, and in any detail that would be prescribed by the accountancy department. This would give some real foundation for the elaborate cost distribution so replete with inexactitudes, with which we are all familiar today.

"But," Mr. Tillson says, "even though charges are correct in their sources, and all of the clerical work in handling them is exact, there are many opportunities for a difference of opinion in the handling of the figures." This is unfortunately true. The "differences of opinion" may also be unprejudiced, or may be the reverse; it largely depends on the latitude permitted to the management in the way of allocation between capital and operating costs. Mr. Tillson sees in this also a bar to the satisfactory "comparison of cost between two different organizations." I do not think that any very useful purpose is served by cost comparisons. It would be practicable to compare costs of different mines if they were exactly similar in all respects; otherwise, and I think this will include all mines, no fair comparison is possible.

Comparisons of cost have often led to the substitution of inefficient for efficient production, brought about as follows: The directors of mining companies have been taught to regard the *cost per ton* to mine and treat an ore as the touchstone of comparison between the production costs of mining companies, neglecting altogether the many different features in mines, which have been outlined in the preceding paragraph. If we give any thought to the matter, we must conclude that the only mineral deposits for which we can rightly decide the working efficiency, on the basis of the cost per ton, are such things as coal, lime, some iron deposits, and non-metallic substances, in which a ton of the material mined is represented by a ton of the same material sold. But in dealing with practically all forms of metalliferous deposits, other than the iron, above excluded, we mine enormous masses of material—being of the order of 100,000 to 1, gangue and metal respectively, when dealing with $6 gold ores—all of which is simply refuse. The only part of this unequal mixture that we can market is the gold.

Now, here is the point I wish to emphasize. In the mixture of 100,000 parts of gangue to 1 of metal, only the gold is limited. The gangue may, by bad mining, or by design, be increased to any extent, and if and when it is increased, it creates the impression that the economic work of the mine has been improved, because the *cost per ton* will have been lowered. This is the illusory bait held out to the mine manager, when comparisons of cost per ton are made with other mines, to his detriment. He is made to recognize that the final standard of efficiency by which his results will be compared is not the maximum profit he earns but his operating cost per ton, and because of constant reminders from the directorate that his cost per ton is unsatisfactory, being higher than that of his neighbors, he resolves to abandon the policy of working for profit and adopts instead the principle of seeking a low cost per ton.

FUNDAMENTAL CHARACTERISTICS OF MINING

Under the subheading of "Practice Widely Variable" Mr. Tillson says, "The boundary lines between capital, maintenance, and operating charges are often very vague." This statement is unfortunately only too true, and will remain true so long as mining accounts are so often treated by accountants upon the same footing as those of ordinary industrial ventures. The fundamental difference in the two cases is, of course, that from the day a mine begins to produce ore the process of its exhaustion has begun—it announces its demise. Capital commitments in mines of the normal type are much more speculative than are ventures of the ordinary commercial kind. In these latter, definite supplies of the raw material—so to speak—are available for unlimited periods. If the business has been wisely launched, is well administered, and exists in a field of wide demand, its capital value should increase from year to year, and theoretically such businesses have no "life" limit. The original capital invested in such industrial enterprises as these are a fixed asset of the business, to remain permanently, or be increased, depending upon the financial success of the operations.

In mines, on the other hand—a class of enterprise having a limited stock of raw material, and a limited life—the original capital is not an asset, but a liability, the repayment of which is a first charge on the operations. The question is, "How should that charge be made?" This can only be answered by considering some of the varying capital requirements of mining companies. Mines which are in the hands of strong financial groups are usually financed upon a definite basis of equipment and output from the beginning. Such mines are launched as completed economic units, with the stocks of raw material (that is, ore) made accessible, and equipped with a manufacturing plant, to convert the stocks into marketable products.

If the operations prove to be profitable on the scale

originally decided upon, and there is no inducement to broaden that scale, no new capital should be required. Therefore, apart from the original sum expended, there should be no capital account in the books, excepting for mine development, the treatment of which is suggested elsewhere.

Any expense incurred in the current repair and upkeep of plant should be charged direct to working cost, through a maintenance account. These latter charges are usually made by arbitrary allocations over a limited period of months, the underlying idea being that the expense on any given item will have been extinguished before it is likely to recur. To safeguard against extraordinary expenditure in the breakdown or obsolescence of plant, a renewals account is sometimes kept by mining companies, to which monthly allocations are made of a sum which is calculated to amount in a reasonable time to that which would be required to cover any likely emergency. If this account should accumulate to proportions which more than fill the margin of safety, it is an easy matter to suspend temporarily the credit to it, through the working account.

When More Capital Is Needed

Another class of mine altogether is that which is equipped and developed on a scale which proves to be inadequate to produce the best financial results from the deposit. Additional capital expenditure being a necessity, it may be raised in one of the following ways: (a) By a fresh capital issue; (b) by a bond issue to be retired by annual drawings, or by other stipulated means; (c) by appropriations from profits. How would these steps affect the mine accountancy? Not at all, in the case of (a). If (b) or (c) were resorted to, the appropriate charges would be deducted periodically from profits, as a lump sum.

Under the subheading "How Development Charges Are Complicated" Mr. Tillson asks if it is proper to charge extra development required for any of several reasons to capital expense or should not the costs of production bear this buried in a deadwork or development account? To this specific question I would reply that all development work on any given level or any subdivision of a mine, apart from permanent works, such as shafts, main crosscuts from shafts, stations, ore bins or like equipment, should be charged against the special section that it affects, through the mine development account. This account would be debited with all the expense incurred in the general layout of the mine workings, whether original or supplementary, and credited with a monthly amount, assessed biannually, designed to extinguish the total outlay when all the pay ore in the subsection has become exhausted. If, for example, a subsection of the mine had 100,000 tons of payable ore developed at the end of 1924, representing an investment of $100,000, and was exhausting the ore at the rate of 25,000 tons per annum, the monthly debit to working cost for the redemption of the capital invested would be, say, $2,000. The accounts for each subsection would be kept in detail for each block of ore comprised within it, but the capital liquidation might be done by lump sums as suggested.

In subsequent remarks under this subheading, on the subject of "True Costs," Mr. Tillson says: "Some accountants, when it suits their objects, will put much stress on 'true costs,' and indicate that they refer to the costs of the particular units of ore under consideration. For instance, if some ore received at the smelter is dumped directly upon the charging floors and some goes to the stockpiles before being used, the latter receive an extra burden for stocking and loading again. The excuse for such a procedure is that they are 'true costs.' . . . Are such distinctions proper or wise?"

The policy followed out by the accountant in charging the ore in the stockpile for the extra handling involved is one that I agree with, and is precisely the principle which I advocate for the assembly of cost in the mine, for reasons which I will try to explain.

No one will deny that we should have our accounts kept in such a manner that we know the profit value of each block of ore in the mine, *on its own merits*. We cannot arrive at this figure by calculating in averages, as is usually done. The average of the cost to develop the many separate and often wholly different sections of a mine gives grossly misleading figures in many cases within my own experience. In one section, for example, the rock drills easily and breaks well, the orebody is wide and of consistent value over long stretches, giving a high percentage of payable development in the total distance driven; the walls need a minimum of support, and the section is well situated with respect to transport and distance from the main shaft. It is obvious that the costs of development in such conditions will be only fractional compared with those of another section in which the features were all reversed. An average figure derived from the cost of development in these two extremes might either condemn the good section, because of the weight of the cost of the bad in the average, or cause the bad section to be worked because the good would be rich enough to bear the loss.

Costs Should Be Computed Each Day

The abandonment of the system of averaging results would, I believe, be a very important step toward this most desirable end. It would eliminate, almost immediately, the existing system—on nearly all mines with which I am acquainted—of making up accounts only once a month. I do not believe that any system of accountancy which details expenditure at intervals of one month gets within more than a small percentage of the possible usefulness such detailing is designed to serve. To be of real value, details of cost should be as fully available from day to day as are those of the revenue, which latter is strictly kept in all departments as a daily return. If it be good economics to know the daily revenue position, it must be even better to regulate the daily expenditure, because revenue can be controlled only within restricted limits, whereas the detailed control of expenditure provides infinite opportunity.

To institute a daily accounts system would necessarily involve a simplification of the monthly method, respecting the headings of accounts. But as in the monthly sheets the figures represent the averages for a considerable number of separate and perhaps wholly different daily quantities, and, moreover, give those averages long after the event, the practical value of the elaborate distributions and subdistributions, is often nil. Working under a daily balance system, the details of any or all departments can be closely watched, and days of highest efficiency marked. The special conditions which have produced the days of highest efficiency, and the causes for days of low efficiency, may be closely investi-

gated, so that the former may be incorporated, and the latter conditions eliminated, to the greatest possible degree.

Under the same subheading which we have been considering in the preceding paragraphs, Mr. Tillson says: "We do not know in any month just the work necessary to produce the particular ore we hoist, so we either profit from some past work or lay up a debt against some ore to be mined in the future." Though this statement is true, if applied to shrinkage stoping and to any system of mining which builds up large reserves of broken ore, it is otherwise when mining systems which deliver the currently mined ore daily, obviating all undue accumulations, are considered.

Under the shrinkage system only about one-third of the current ore mined becomes immediately available, leaving two-thirds to accumulate in the stopes, until the whole of the pay ore in the block has been mined. If the blocks are so laid out in a mine that it requires nine months of mining operations to break out all the ore, the bottom layer of the broken ore by that time will have lain for six months in the stope. During the six months that will have elapsed since that ore was broken, the cost of mining may have varied up or down, by an appreciable figure, and might have been, therefore, much higher or lower than current figures. From an accountancy point of view an objection additional to that raised by Mr. Tillson would be the loss of interest on locked-up capital in the accumulated ore reserves. In a large mine this latter might amount to an appreciable sum.

The question is, "Can any constructive suggestions be made to mitigate these disadvantages?" To meet the difficulty of the errors which may arise by charging current cost against operations performed in the mine possibly many months earlier, I make the following suggestion: That each block or subdivision into which nearly all mines are apportioned during development operations should be assigned a special symbol or number, indicating its position relatively to some agreed datum. If there were ten blocks of ore thus delimited, between the 9th and 10th levels, lying west of No. 1 shaft, they would be numbered in order, retreating from the shaft, from 1 upward, and their localities indicated by symbols. Thus 1W$\frac{4}{10}$ refers to the No. 1 shaft, 4th block west on the 10th level.

Allocation of Operating Charges

We know that development, mining, and tramming cost will vary for each particular block. To meet the difficulties which are presented by the variables I suggest that an account be opened in the books for each individual block, under its own symbol, against which would appear all the cost items, these embracing, among others, the following charges: (a) Actual cost of development, including drives, rises, crosscuts, oreshoots, manways, ventilating, timbering, tramming, hoisting, proportion of general administrative charges, maintenance and renewal costs, and other items, if there be any; (b) actual cost of mining, including every item of cost for ore breaking, walling, timbering, filling, shoveling, maintenance, renewals, and proportion of general and administrative charges; (c) actual cost of tramming and delivery at shaft, including all maintenance and renewal of track, cars, shoots, tools, and other material, and proportion of general and administrative charges; (d) actual cost of hoisting, including power, labor, maintenance and renewals to shaft, stations, headgears, hoists, skips, ropes, and other equipment.

If the cost be separately kept for all the blocks in the manner suggested in outline above, any ore drawn from a block would be charged at the cost booked against it at the time the ore was mined, and not with current cost, which may be something quite different. The daily tonnage milled would thus be divided into two parts: (1) That falling to be debited with a former cost, culled from the accounts of the period, and (2) the current ore of the day, against which the corresponding current cost would be charged.

Interest Charges on Ore Broken in Stopes

The other point to deal with is that of the interest in the locked-up capital in accumulations of ore in stopes. This is not fundamentally a question of accountancy, but of practical mining systems. We require to know if it is essential to the working of the mines that ore should be accumulated, or are there other methods of mining which are applicable to the problem, and as economical in operation, which would supply the daily tonnage demand, without simultaneously creating ore accumulations. In my opinion there is no real necessity for such recourse to the shrinkage system as is found in North America. It would take me too far afield, however, to discuss the advantages and disadvantages of shrinkage versus rill stoping.

After discussing the possibilities of "unit costing," which I take to be a plan of the same general design as that I have suggested, Mr. Tillson asks, "What shall we do about deadwork, development, and timbering charges," and continues "perhaps we will conclude that it is reasonably fair."

Deadwork should, I think, be included in the general cost of development. It has been incurred, rightly or wrongly, for the purpose of finding ore or of making it available. On the system which I suggest, the development cost for each level in the mine and for each subdivision of that level would be separately kept as has been suggested in preceding paragraphs.

Under "Allocation of Working Costs" Mr. Tillson indicates that the most dangerous pitfall in accountancy is the "allocation of distributable working cost." He then gives a definition of distributable working cost, which would limit its application to metallurgical operations, when, as a matter of fact, he has most usefully "stumbled" into this "pitfall" throughout his article. What are all the separate account headings he mentions —namely, Capital, Maintenance, Development and Operating—but divisions for the "allocation of distributable working costs"? It is for the standardization of these divisions that he so ably pleads. Without such standardization, there is always the temptation to transfer sums expended on working account to capital account, when returns are not up to expectations.

The distribution of operating costs can never be standardized on present systems of accountancy. There are items such as administration and other fixed charges which are allocated according to the opinion or whim of the management. It is surely possible to evolve a standard form of accounts for mines, in which all expenditure would be divided into that which is fixed, such as administration, pumping, lighting, taxation, and similar factors, and that which is direct, such as labor, supplies, power and supplies in general. The cost would

then be stated in terms of the cost under these separate divisions.

As it is in the fixed charges that the cost on different mines may vary so widely, the separation of cost as above suggested would enable a far better judgment to be formed of the efficiency of those operations in which the experience, skill, and executive ability of the management had full play. Incidentally, it would bestow credit on many a mine administration from which it is now withheld, because, through uncontrollable circumstances, such as large volumes of water, top-heavy financial control, and so on, a high cost per ton may result.

The principles which Mr. Tillson applies to concentration products are exactly the same as those which I urge for the many departments into which the business of mining is divided—namely the allocation of *itemized* as distinct from *averaged* cost, throughout.

London, England. G. A. DENNY.

"The Explosives Engineer"

THE EDITOR:

Sir—We are, of course, pleased with the appreciative remarks about *The Explosives Engineer* in your Dec. 13 issue, but since in the same editorial you have called *The Explosives Engineer* a house organ, would it not be fair to also point out that in the commonly accepted meaning of that term this was a misnomer?

It is true that *The Explosives Engineer* is published by the Hercules Powder Co., but it is also true that the Hercules Powder Co. and its products are never exploited, and practically never mentioned, in our editorial columns, which are always open to representatives of any explosives manufacturer. Articles accepted for publication in *The Explosives Engineer* are judged as critically and presented as impartially as those which appear in your journal.

The Hercules Powder Co. advertises in *The Explosives Engineer*, but any reliable explosives manufacturer may do likewise; some have already taken advantage of the opportunity.

There is no more reason for calling *The Explosives Engineer* a house organ of the Hercules Powder Co. than there would be in referring to *Mining Journal-Press* as a house organ of the McGraw-Hill Company.

Wilmington. Del. N. S. GREENSFELDER.

Pyrite as Fertilizer

THE EDITOR:

Sir—May I say a word on the subject of pyrite as a fertilizer, to which you are giving some attention, and also to further prove that vegetation is a guide to the finding of mineral veins? I have a prospect with two parallel veins consisting of calcite and quartz with an abundance of pyrite and pyrrhotite, besides other minerals. The capping is decomposed and altered to a limonite for 40 ft. in depth. Since a large forest of white pine has recently been cut off, one can easily trace the veins by following in the path of a weed growing on or near the vein known as the pigweed and also called lambs' quarters, sometimes used as greens. This weed was never known to grow except on rich garden soil or on a manure pile, but the pyrite with the lime has evidently enriched the soil to make it suitable for the growth of the plant. FRED ENGSTROM.

Calder, Idaho.

Carbon at Porcupine

THE EDITOR:

Sir—There are many loci of black (carbonaceous) schists at Porcupine where no veins are present and there are many veins in rocks in which the carbon is absent or inconspicuous. As far as this line of evidence goes, there is no necessary genetic relationship between carbon and veins. I have noted that the carbonaceous material is frequently concentrated where the rocks have been strongly sheared, as in the carbon slips that Robinson mentions. Since many of these carbon slips are post-ore in age (displacing the lodes), it is obvious that if carbon came up and was deposited along them, the period of carbon deposition was separated from the period of ore deposition by a stage of faulting. Faulting at Porcupine is at least in part Keweenawan or post-Keweenawan in age, as shown by the displacement of post-ore Keweenawan dikes, and as ore deposition took place almost certainly during or immediately subsequent to Algoman time, a tremendous period of geological time elapsed between ore deposition and at least some carbon faults that I have studied. Hence it is impossible to maintain that carbon deposition (if there was such deposition) along the faults could have occurred during the same period of magmation as ore deposition.

At Porcupine, a careful discrimination must be made between minerals produced by dynamic or static metamorphism and those resulting from ore deposition solutions. Some minerals have clearly been formed by both agencies. For instance, abundant carbonates and sericite intergrown with or included in lode quartz certainly owe their origin to ore-depositing solutions, but there are abundant carbonates and sericite in the country rocks of metamorphic origin, widely distributed over the Porcupine area both in or outside the ore zones, and the origin of these country-rock carbonates and sericite antedates and is entirely independent of ore deposition agencies. In many samples carbonaceous material is intimately intermixed with these metamorphic minerals as well as with abundant chlorite, likewise rocks of metamorphic origin. It is necessary to understand the significance of this intermixture before we can make convincing deductions as to the origin of the carbon. Frequently carbon is arranged in elongated strips parallel to the elongation of chlorite and sericite and has obviously been sheared with these minerals. Whether the shearing produced or accompanied carbon formation, or accentuated the carbon, and whether the carbon shearing is ever pre-ore in age, wholly or in part, are open questions, but the original mashing of the rocks certainly antedated ore deposition.

An important point for investigation is to fix the age of the carbon; whether it was present in the metamorphic rocks before the ore lodes were formed, and therefore cannot be referred to the same period of magmation, or whether it can be definitely assigned to this period. The possibility of two or more ages of carbon, pre-ore (or contemporaneous with the ore or nearly so) or post-ore, should also be considered.

The above discussion touches upon a few of the problems and features of carbon occurrence at Porcupine, perhaps enough to justify a protest against the assumptions of yours and Mr. Young's writings. To answer many of these problems we must call on the petrographer and chemist. ELLSWORTH Y. DOUGHERTY.

Heroult, Calif.

Consultation

Use of the Airplane for Transporting Tailings

"There are at this place (Sonora, Mexico) approximately 15,000 tons of tailings which the owners are thinking of shipping, either wholly or in part (they may possibly be subjected to a newly discovered concentration process first). The nearest railroad is about 15 miles away, by burro trail. About one-half of this trail is along an abandoned wagon road and could perhaps be put in condition for the use of trucks or caterpillars. The freight by burros or mules would probably come to from $5 to $6 a ton. It would be advisable to ship at least 1,000 tons a month—the more the better. Under present conditions it is quite a problem how to do this, there being but little feed for animals around the country.

"What do you think would be the chance for having this freighting done by airplane? Is the industry far enough advanced to tackle such an undertaking on an economically sound basis? And is such a thing being done at present successfully in other places? Realizing that you, being in direct touch with everything that pertains to mining and metallurgy, are in a better position than I am to know about these things, I am turning to you for advice. I remember having read an article ten or twelve years ago either in the *Engineering and Mining Journal* or in the *Mining and Scientific Press* about a mining camp at some inaccessible place in British Columbia where they were having provisions and light supplies brought to the camp by airplane. It strikes me that if such a thing could be done ten years ago there ought to be no difficulties about it today."

The use of the airplane for the transportation of men and materials to and from mining districts difficult of access seems to be growing, but we have not heard of its being employed for the work of carrying any but the higher-grade ores and concentrates. Surely, a tailing would have to be exceptionally rich to stand the cost of airplane transportation. An article was published in the Nov. 10, 1923, issue of *Mining Journal-Press*, by Adrian Van Muffling, entitled "Transporting Ore by Airplane," which gave an estimate of the cost of using aërial carriers in mining work. For the conditions outlined in that paper—i.e., a 20-mile flight, or round trip of 40 miles—the author figured that sixteen trips could be made carrying 1,200 lb. ore in each, or 9.6 tons per working day of eight hours, at a total cost of $88.10, or 55c. per ton mile. This would not seem to be prohibitive, and if applied to the case in question would indicate that the cost of transporting the tailings by airplane might be cheaper than the cost of packing by burro, provided that the distance of travel by airplane were shorter than by burro—a reasonable supposition.

During 1923 and 1924 the airplane has been used extensively in the development of the new gold fields in northern Ontario and Quebec, saving those prospecting the country much time and effort in reaching their destinations. It has also been used in British Columbia, Alaska, and other mining districts.

Perhaps some of our readers who have had experience with the use of the airplane in conveying materials will be glad to give us the benefit of their knowledge of this new method of transportation to more or less isolated mining districts.

Scrap Metal Definitions and Specifications

"Please tell me the exact definition or specifications as recognized by the trade of the following scrap metals: Heavy copper, light copper, scrap zinc, No. 1 composition, and babbitt metal."

Although the specifications of most grades of scrap metals are not rigid, classification has been attempted by dealers and refiners in the last few years that has helped immeasurably in standardizing the secondary metal business throughout the United States. The National Association of Waste Material Dealers has taken a leading part in the work of classification, and during 1924 adopted the following definitions for the grades of scrap metal inquired about:

Heavy Copper: This shall consist of copper not less than one-sixteenth inch thick, and may include trolley wire, heavy field wire, heavy armature wire that is not tangled, and also new copper clippings and punchings, untinned and clean, and copper segments that are clean.

Light Copper: This shall consist of the bottoms of kettles and boilers, bathtub linings, hair wire, burnt copper wire which is brittle, roofing copper and similar copper, free from radiators, brass, lead, and solder connections, readily removable iron, old electrotype shells, and free of excessive paint, tar, and scale.

No. 1 Composition metal generally refers to turnings, in which event it must be free of aluminum, manganese, plastic, and yellow brass turnings, not to contain over 2 per cent iron, to be free of grindings or foreign material, especially babbitt, and free from adulterations made to resemble metal.

Scrap zinc: This material must consist of clean sheet and cast zinc; also cast batteries; to be free of loose oxide and dust, sal ammoniac cans, and other foreign materials.

Babbitt metal: Bearing metal of all kinds, but shall not contain scrap hard metal, Allen metal (a copper and lead alloy), die cast, zinc boxes, or type metal.

Narrow Market for Wulfenite?

"Can you give me any information on the subject of wulfenite, the molybdate of lead? I would like to know if there is any market for this mineral, where, and what price the mineral brings."

We are informed by a large domestic producer of molybdenum that the low content of molybdenum and the relatively high cost of recovery have made the use of wulfenite as a raw material for the production of molybdenum impracticable and unprofitable.

However, there is a market for the mineral abroad, even though domestic consumers seem uninterested in buying wulfenite at present. At least two firms, the Société Electro-Metallurgique de St. Beron, 3 Rue Paul Baudry, Paris, France, and Siegfried Pels, 21 Nonnenstieg, Hamburg, Germany, are in the market for the mineral at present.

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

CONTINUED EXPANSION of its operations in Mexico is planned by the Cia. Minera de Peñoles, the subsidiary of the American Metal Co. Extensive underground development and new construction are features of this work.

Reports indicate that the Granby Consolidated Mining, Smelting & Power Co. will resume production at its mines at Allenby, B. C., early in the spring.

The Nabob Silver-Lead Co., operating in the Coeur d'Alene district, in Idaho, has started shipping to the Timber Butte concentrator at Butte, Mont.

Operating profit of the Alaska Juneau Gold Mining Co. in December totaled $43,500. Additions to the milling plant are nearly complete.

Metal production, estimated to total $65,000,000 in 1924, makes Utah the leading state in the Union. Montana was second with $54,000,000.

Senator T. L. Oddie, of Nevada, will introduce a resolution soon providing for the continuation of the Senate Commission of Gold and Silver Inquiry.

Gold mining dividends on the Rand during 1924 showed a moderate gain over the preceding year.

The Mexican Government announces its intention of enforcing Article 133 of the mining code. Under it a "titled" engineer must be at each operating mine.

The Union Sulphur Co. has worked out its property in Calcasieu Parish, La., from which 17,000,000 tons have been produced.

Preparations are nearing completion for additional sinking in the Tonopah district, in Nevada.

Steady Development at Contact, Nev., Copper District

Railroad, to Be Completed This Year, Will Help—Metallurgy Presents Various Difficulties

The Nevada Bellevue Copper Co. and the Gray Copper Co. are both continuing development at Contact, Nev., in anticipation of the completion of the new railroad from Wells, Nev., to Rogerson, Idaho. The road should be completed by the end of 1925, but connection between Contact and Rogerson is expected to be made by June. This will afford transportation and should stimulate operations in the Contact district.

The ores of the district are exclusively oxides, carbonates, and silicates. A large monzonite intrusion in the limestone is the source of the copper minerals. There are two types of deposit. Around the contact of this intrusion are found beds and lenses of ore, and cutting through it are several well-defined ore-bearing veins. So far, no sulphide ore has been found. The treatment of the ore presents a difficult metallurgical problem. On account of the character of the copper minerals concentration cannot be effected with reasonably high recovery. Leaching experiments have been tried, but the presence of lime in the ore and the inability to dissolve the considerable content of gold and silver makes the treatment costly and unsatisfactory. The absence of sulphides makes local smelting impracticable also.

Granby Probably Will Resume at Allenby Copper Mine

THE Allenby mines of the Granby Consolidated Mining, Smelting & Power Co. near Princeton, B. C., are expected to be in operation by early spring. The Voight group of sixty-three claims adjoining the Allenby has been added to the holdings of the company, and a crew are now at work driving into the Bonanza group, where it is expected that a rich body of copper ore will be encountered.

The quantity of ore in the Allenby mine has been estimated by engineers to total 12,000,000 tons, of which 10,000,000 tons is assured and 2,000,000 probable. The mine is equipped with a concentrator capable of treating 2,000 tons of ore per day, which can be increased to 3,000. It is reported that the company may erect a blister copper plant at Oroville, on the United States side of the boundary.

Probably the most important work at the present time is that being conducted by the Nevada Bellevue. This company has a relative good showing on a 4,000-ft. vein ranging from 2 to 5 ft. in thickness which it has developed to a depth of 500 ft. Portions of the vein average 5 per cent copper and contain 3 or 4 oz. silver and some gold.

Nabob Silver-Lead Co. Shipping to Timber Butte Mill

Coeur d'Alene Producer Has Contract for 3,000 Tons Per Month—Development Continues

Regular shipments of ore to the Timber Butte mill at Butte, Mont., are made by the Nabob Silver-Lead Co., operating in the Pine Creek district in the Coeur d'Alene region of Idaho. Last year the company had its property in condition for production when a forest fire swept the district. It destroyed the concentrator, which had just been remodeled and re-equipped, and the tramway and ore bins. Smelter returns show that the mine has produced to date 35,650 oz. of silver, 1,882,000 lb. of lead, and 1,400,000 lb. of zinc. The gross value of this ore was $214,000.

Since the fire the company has reconstructed the tramway and ore bins and has advanced development work 120 ft. on the main oreshoot, thereby adding 8,000 tons to the reserves. According to a recent report ore now in sight will provide 3,000 tons per month for more than a year.

The railroad company has repaired its Pine Creek branch so as to cut three miles from the six-mile truck haul formerly necessary. A lower through rate on ore shipments to Butte has been put into effect, so that the cost of shipping has been reduced by about $3 per ton. At the Timber Butte mill a differential separation of the lead and zinc is made by flotation.

Sally Does Well by Miners and Shareholders

WALLACE MOUNTAIN MINES, Ltd., a Penticton company operating the Sally mine, at Beaverdell, in the Boundary district of British Columbia, has shipped 688 tons of high-grade silver ore, with a low lead and a small gold content, and as a result of the year's operations has disbursed dividends amounting to 100 per cent on the company's capitalization among the shareholders. The employees, too, have shared in the company's prosperity.

At the end of June the company gave the men a bonus of 5 per cent on the wages earned during the first half of the year and at Christmas a bonus of 7½ per cent on wages earned during the second half. One miner expressed the appreciation of the group by saying: "Sally's the best little girl in British Columbia."

Tonopah Hasbrouck Ships High-grade Gold Ore

The Tonopah Hasbrouck is preparing a shipment of high-grade gold ore from its mine in the Divide district in Nevada. In the Tonopah Hasbrouck the gold vein from which ore is now being mined was found in the hanging wall of a stope on the silver vein.

The gold vein was discovered in workings from what is called the upper tunnel, and is now being developed by winzing. A winze down 25 ft. followed 12 in. of high-grade ore and still shows this amount in the face. Development will be started from the lower tunnel to locate the gold vein at that depth, as well as further to develop the silver vein on that level. The present shipments have been estimated to run $250 per ton.

Receivership Asked for Florence Silver Mines, Ainsworth, B. C.

The bondholders and employees of Florence Silver Mines, which owns and operates the Florence mine, at Ainsworth, B. C., recently instituted legal proceedings for the appointment of a receiver. The application was opposed by counsel for the company on the ground that negotiations were in progress for the sale of the mine and the appointment of a receiver at this time would terminate them. Justice W. A. McDonald granted an adjournment for one week.

The Florence mine is equipped with an excellent mining plant and 300-ton mill, but there is sufficient water to operate the mill for only a few months in the year. An attempt was made about eighteen months ago to reorganize the company and to obtain funds to put it on a sound financial basis, but after a considerable sum had been spent in improvements the Detroit interests who were backing the enterprise dropped out. It is understood that the present negotiations are with the same interests.

Peñoles Company Expands Operations in Mexico

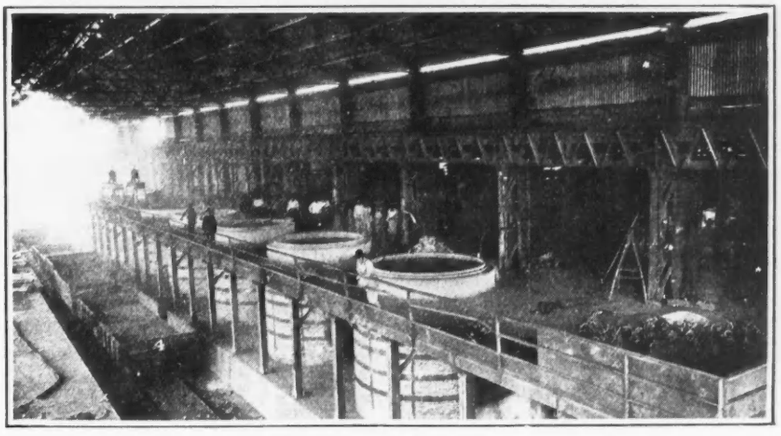
Heath Steele Tells of Various Development and Construction Projects of American Metal Subsidiary—Smelts One-third of Lead and One-quarter of Silver Produced in the Republic

By A. B. Parsons
Assistant Editor

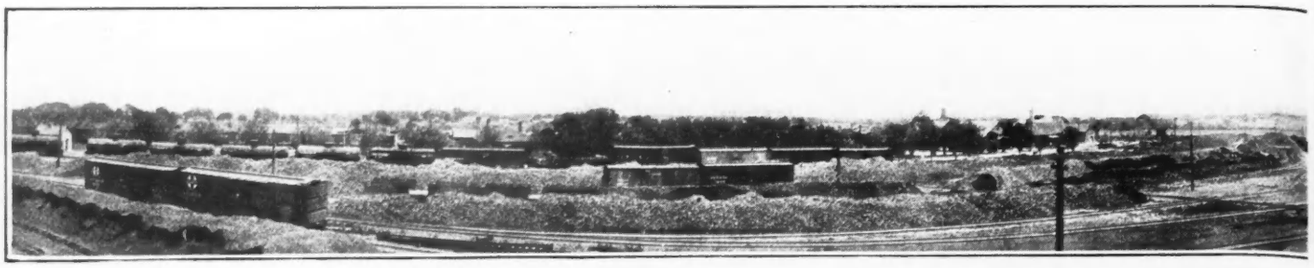
EXPANSION of its many mining, milling, and smelting operations in Mexico, which marked 1924, will be continued energetically by the Cia Minera de Peñoles, according to Heath Steele, president of the company. Plans for intensive underground development at several of the properties will be pushed, and further important additions to plant and equipment, looking to increased production and more economical operation, will be made. Owing to the increased cost of fuel oil in Mexico, coal-pulverizing equipment is being installed at all of the steam power plants. and they will be running exclusively on coal before the end of the year. Additional heavy electric equipment is a feature of the new installations. The Peñoles company is the Mexican subsidiary of The American Metal Co. During 1924 production from the mines and smelters operated by the company was approximately 64,529 short tons of lead, 22,309,592 oz. of silver, and 129,064 oz. of gold. This was about one-third of Mexico's total lead production and one-fourth of its silver output.

Executive offices for the Peñoles company are at Monterey, where G. H. Harbordt, general manager, makes his headquarters. One of the two smelters operated by the company is situated there; the other is at Torreon. Both treat custom ores in addition to those produced by the mines of the company. Concentrates and cyanide-plant products, including bullion and zinc precipitates, are included in the intake. It is significant to note that the Peñoles company formerly operated lead smelters at Villaldama, Cerralvo, and Mapimi, but that it has been found more economical to concentrate operations at two points. Increased costs of

Silver-gold (doré) bullion, with plenty of protection
The bullion is cast in the form of anodes ready for parting in the electrolytic plant.



Pre-melting pots in the lead refinery at Monterey
Equipment for conducting the Harris refining process will be installed, probably between each pair of pots.



The Peñoles Company's smelter

Residential and office section with coke piles in front.

transportation are offset by the greater efficiency of larger smelting units. One factor is the arrangement whereby the Peñoles company operates its own trains over the tracks of the National Railways. It has its own locomotives and other rolling stock, and is therefore not dependent for cars on the railroad company. Transportation of ores and fuel consequently is reliable.

At the Monterey smelter is the only lead-refining plant in Mexico. It has a capacity of 7,000 tons of bullion per month; and in connection with it is an electrolytic silver parting plant which turns out two tons of refined metal per day. The parted gold is shipped to Mexico City for minting, and the silver is exported. The power plant for smelter and refinery was rebuilt in 1923, but owing to increased production an additional 500-kw. turbo-generator set and uniflow engine have been installed since. Improvements in the arrangements for feeding the lead blast furnaces are also planned. Another addition will be the installation of equipment for conducting the Harris process for removing arsenic, antimony and copper from the lead. U. H. Berthier is superintendent of the smelter and refinery.

The company has decided to rebuild the copper department of the Torreon smelter, and plans are being prepared for the construction of copper blast furnaces, the remodeling of the convertor department, and the erection of a Cottrell treater to handle copper-furnace fumes. The six-furnace lead department at the plant was rebuilt in 1921. J. N. Goddard is superintendent at Torreon.

A new 750-kw. turbo-generator set has been installed at the Agujita and Lampacitos coal mines in the Sabinas district, in Coahuila, to meet increased demand for power. A subsidiary of the Peñoles company operates the mines and ovens and supplies coke to the smelters and coal to the various mines. More fuel is required and expansion is under way.

The Santa Eulalia unit, in charge of John M. Brooks, Jr., comprises a group of six lead-silver properties east of the city of Chihuahua. The company controls a large area south of the Potosi and San Toy properties, where extensive shaft sinking, drifting, and underground diamond drilling have opened shipping ore. A power line from the Boquillas hydro-electric plant recently has been finished to Santa Eulalia. It supplies the power necessary to increase development operations.

The Aurora property, in the Cerro Colorado district, was taken over from Madero Brothers in 1924. Development work here and at the Prosperidad and Mosqueteros properties, near the well-known Ahumada and Erupcion mines, is in progress.

After several years of litigation an agreement has been reached with the Stoppeli heirs whereby operation of the rich Naica mines, in Chihuahua, has been resumed. A pumping plant is being installed to make possible development below the water level, where no work has been done heretofore. The same situation exists at the Ojuela property, one of the oldest operating mines in Mexico. Although there are 300 miles of workings, virtually no development has ever been done below water level at 1,200 ft. In preparation for extensive deep development the company now is adding to the generator-set and pump installation, made in 1924, the following: Two 1,500-kw. turbo-generator sets, three all-steel water-tube boilers with auxiliaries, and new pumps.

Ojuela ores contain considerable arsenic. This is recovered in the Cot-

Map of part of Mexico showing the location of properties being operated by the Cia. Minera de Peñoles

and refinery at Monterey

Refinery. Sampling mill. Smelter furnaces.

trell treater at the Torreon smelter and returned to the arsenic plant at the old Mapimi smelter, formerly operated exclusively on Ojuela ores. The arsenic is refined and barreled at Mapimi, and the lead-silver residue is returned to Torreon. George Littlejohn is superintendent of the Ojuela unit.

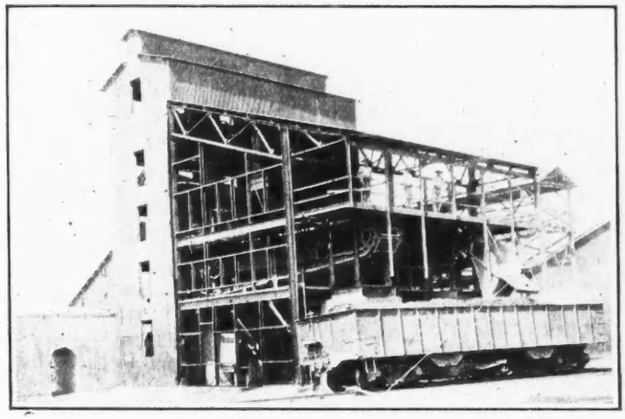
The erection of a milling plant is in prospect at the San Vicente property of the Guanacevi unit if present development of low-grade ore continues. High-grade silver ore has been opened under the direction of E. Monson and will be shipped to Torreon.

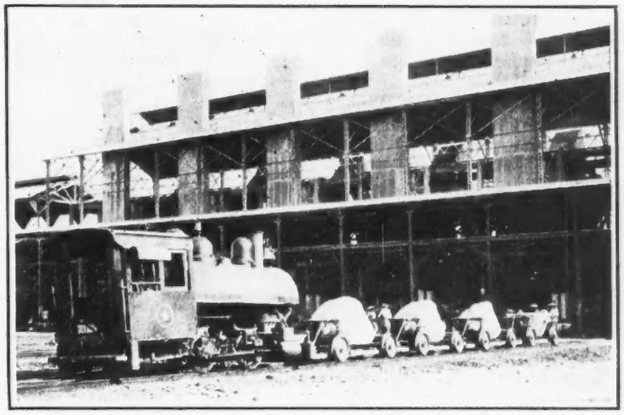
The Avalos unit consists of the Providencia and Albarradon mines, in Zacatecas. The ore is brought from the mines to Avalos by aërial tram and narrow-gage railway for shipment to Monterey, via Saltillo. These mines have for several years supplied the major part of the siliceous lead-silver ores for the Monterey smelter. E. A. Manderfield is superintendent.

Development at the Achotla mines, in Guerrero, has disclosed several hundred thousand tons of high-grade silver-gold milling ore. E. R. Richards is in charge of an experimental plant which is giving good results, and a large mill and cyanide plant in all probability will be constructed in 1925. The bullion will go to the silver refinery at Monterey for treatment.

The Natividad, a high-grade silver mine in Oaxaca, was acquired recently, and operations will be started early in 1925. Work will be directed toward preparing the mine for the extraction of milling ore in the upper levels, and shaft sinking will be started to open new levels. High-grade ore and cyanide precipitate will go to Monterey.

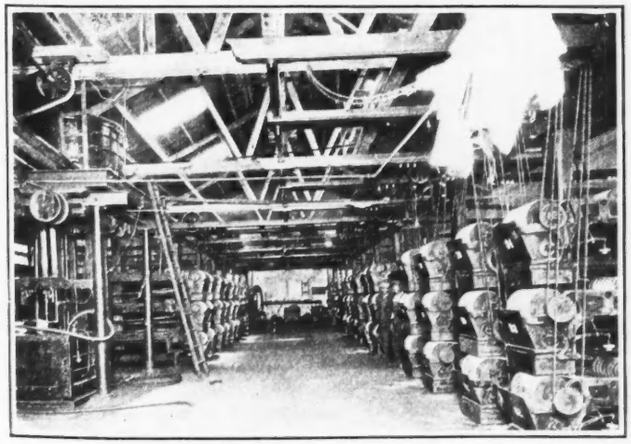
The erection of a new concentrator at Cerralvo is being considered. The Cerralvo unit includes El Refugio, El Barradon, and El Oso mines, the ores of which formerly were treated at the company's local smelter. Shipments now go to Monterey, but a large development program has been outlined for 1925, and a concentrator may prove necessary. R. E. Sunde is in charge.

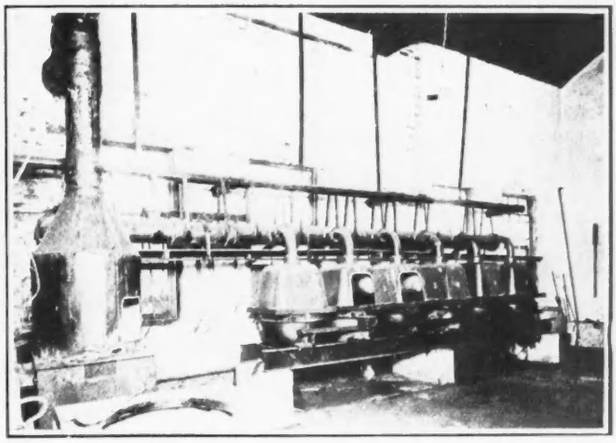




At the lead smelter at Torreon

Dwight-Lloyd sintering machines. Blast-furnace tapping floor.

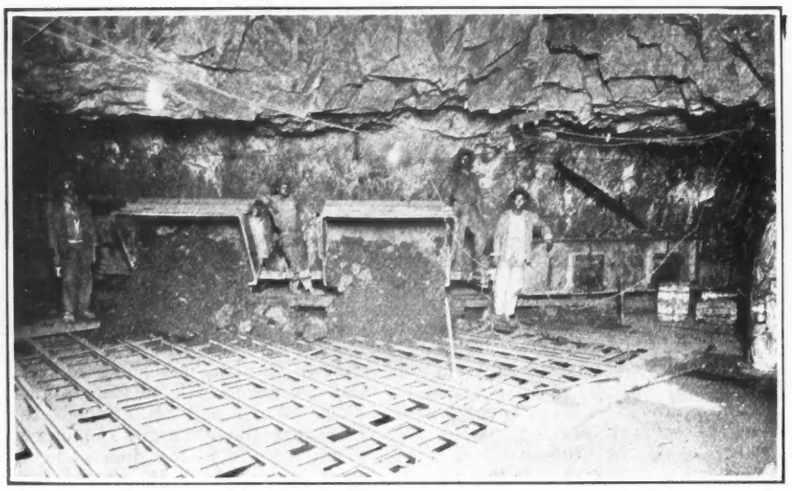




In the silver refinery at Monterey

Electrolytic parting of silver and gold. The silver comes off in crystal form, ready to be melted into fine bullion.

Gold sludge is acid treated to remove the last traces of silver; it is then melted to produce bullion



Station in the Ojuela mine

Bottom of American No. 2 shaft. Note the electric motor and the checkerboard grizzly

Recent developments at the Higueras mine, between Saltillo and Monterey, have made it possible to increase shipments of lead ore carrying a moderate amount of silver. Work on company account is to be resumed at the Minas Viejas property, east of Villaldama, early in 1925.

The Sierra Mojada unit comprises various mines owned by the Parreña Mining Co., and leaseholds on the Constancia company and the Fronteriza company. This gives the Peñoles company about 90 per cent of the holdings in the Sierra Mojada district. Extensive development is under way, and the mines have become the chief source of lime-silver fluxing ores for the Torreon smelter. Leady iron ores go to both the Torreon and Monterey plants.

The best evidence of the faith that both the Peñoles and American Metal officials feel in mining in Mexico is the expansion that is taking place. New properties are being acquired and the old ones are being further developed and equipped. A smooth-working organization, divided into fifteen operating units, has been established under the direction of Mr. Steele, and a period of real prosperity seems assured.

Will Investigate Results of Copper Roasting in Place

The results of a rather novel experiment in roasting "in place," at the property of the Shannon Copper Co. at Gleason, Ariz., will, it is reported, soon be made known. Some time ago the sulphide orebody in this mine was set on fire as an experiment, with the purpose of roasting the ore directly in the mine. This was done under the supervision of J. M. Bennie, the general manager and a well-known metallurgist.

Reports from Gleason state that "There is only one conjecture in regard to the results of firing the Shannon company's mine. After several attempts the orebody was finally ignited and large volumes of smoke for months indicated continued combustion of the sulphur and consequent oxidizing of the copper ore. The smoke is now rapidly lessening, and exploration may be attempted before long to determine the degree of success of the novel scheme. The plan is to leach the oxidized copper in place."

Alaska Juneau Operating Profit $43,500 in December

Operating profit of the Alaska Juneau Gold Mining Co. during December totaled $43,500, leaving a surplus of $1,750 for the month after providing for capital expenditures and accrued charges. Ore mined and trammed to the mill totaled 262,200 tons. The additions to the milling plant, which will largely increase the capacity, are about 28 per cent complete, and preparatory work at the Ebner mine is 24 per cent complete.

The following statement shows the income and operating expense for December, 1924:

		Cents per Ton
Receipts		
Gold	$175,000	66.74
Lead and silver	8,000	3.05
Totals	$183,000	69.79
Operating Expenditures		
Mining and tramming	$69,000	26.31
Milling	63,000	24.03
All other Juneau operating costs	5,000	1.91
Taxes, legal, insurance, New York stock transfer and San Francisco office expenses	2,500	.95
Totals	$139,500	53.20
Operating profit	$43,500	16.59

Sulphur Mine, Producer of 17,000,000 Tons, Worked Out

The Union Sulphur Co. has stopped all operations at its mine at Sulphur, in Calcasieu Parish, La., except the shipping of the accumulated stocks. The last well was shut down on Dec. 27, 1924, after the mine was completely exhausted. The Frasch hot-water process for the extraction of sulphur from underground deposits was developed at this property during the 90's. The first big production of sulphur was made about 1903, and since that time approximately 17,000,000 tons of brimstone have been produced.

Develop Christmas Gift Mine, in Southern California

Under the stimulus of improved silver and lead markets, the Christmas Gift mine, in the Owens Lake district in California, is being operated by the Lead Mines Corporation. High-grade ore is being exposed at several widely separated points in the property, according to W. L. Skinner, manager.

In a southwest drift on the 50-ft. level of the new Portland shaft, ore assaying 100 oz. silver and 40 per cent lead has been followed for a distance of about 30 ft. In consequence, it has been decided by the management immediately to continue the shaft to 100 ft., and explore the find at that depth.

The Salem shaft, also a new working situated 700 ft. west of the Portland and about 1,000 ft. northwest of the Gift shaft, has gained a depth of 100 ft. Crosscuts extended from a drift along a diorite-gray limestone contact are cutting stringers of silver-lead ore, varying in width from 3 to 8 in. Operations at the Gift shaft are being confined for the present to the 250-ft. level to develop ledges which in years past proved good producers on the 150 level. All three shafts on the mine are equipped with machinery, including air drills, and good progress is being made in all workings.

"White Mule" Instrumental in New Nevada Gold Discovery

A new gold strike has been made 17 miles northeast of Tonopah, 4 miles east from Rye Patch, where water for Tonopah is obtained. Many locations have been made. A shallow shaft on the main strike, called Teapot Dome, and a few open cuts comprise all the work that has been done on the entire district to date, and though some good assays have been obtained, it is too early to predict that an important strike has been made. The customary pack animal, which usually turns over the first rock and exposes the ore for the tired prospector, was supplanted by a supply of "white mule," which led indirectly to the discovery. If the find turns out to be worth while, wets will have another argument.

Famous Weaver Placer Diggings To Be Reworked

The Armstrong syndicate, of Los Angeles, is installing placer-mining equipment at the famous Weaver diggings, north of Wickenburg and 11 miles east of Congress Junction, Ariz. Water is to be brought from a point near Anteloupe in a 4-in. pipe line.

In the vicinity are several thousand acres of gravel and sand washed down from the slopes of the Bradshaws, from one of the richest gold fields of the Southwest, and near by is the hill from which Pauline Weaver's party in 1863 and 1864 took nuggets valued at hundreds of thousands of dollars. The Walnut Grove dam was built especially for provision of water through which this gravel could be worked by hydraulic giants. For forty years the district has been worked by Mexican *gambusinos* or *placeros* by gold pans and rockers.

Tonopah Companies Ready To Sink in New Areas

Midway No. 2, and Gipsy Queen Shafts Equipped—Plenty of Money at Hand

The Tonopah Divide Mining Co., which last year absorbed the Tonopah Midway by stock exchange, is installing its new Nordberg hoist at the Midway No. 2 shaft and will be prepared to operate within thirty or sixty days. The lowest level from this shaft is the 1,650, and work will be resumed there.

No detailed plans have as yet been announced by the management, but it is believed that the shaft will not be deepened at present, but that an underground hoist will be placed on this bottom level preparatory to the sinking of a deep winze on one of the large veins exposed in a north crosscut.

The Montana Tonopah Reorganized has completed installation of a new headframe at the Gipsy Queen shaft, the hoist and compressor are in place, the shaft has been unwatered, and all preparations have been made to resume sinking from the 1,500 level. No mine work has been accomplished for several months, owing to the necessary changes in surface equipment.

Both the Divide and Montana companies are financed for extensive work and will start under auspicious conditions. Large veins have been found in both properties, the occurrences being low grade at the horizon where cut.

The success of the Tonopah Extension in finding large and rich orebodies below the 2,000 level has encouraged controlling interests in other companies to prospect their ground at corresponding depths, and there appears to be every possibility of success in this work.

American Cyanamid Co. Buys Nova Scotian Mine

The American Cyanamid Co. has purchased the Stirling zinc mine, in Cape Breton, N. S., where ore has been disclosed carrying zinc, copper, and $2 or $3 per ton in gold and silver. The plans of the company include the construction of a smelter near the mouth of the Saguenay River on the north shore of the St. Lawrence, in Quebec. Power has been contracted for from the Duke-Price development at $12 per horsepower. Ore from the Stirling mine will be transported to the smelter by water from Louisburg, N. S.

More Gold in Iron Dyke Ore, in Oregon

At the Iron Dyke mine, near Homestead, Ore., which produces the greater part of the copper shipped from the state, unexpected gold values are found in the ore from the 800 level, according to Tyler Lindsay, manager. The mine has been in constant operation for the last three years. The values in gold in the upper levels averaged $1 per ton until the 800 level was reached, when they jumped to $5 per ton. The mine is equipped with a concentrator with fine-grinding and flotation units. The product is shipped to the Utah plant of the U. S. Smelting, Refining & Mining Co.

Utah Leads Metal-mining States in Output and Dividends

A TOTAL gross value of ore produced by Utah mines in 1924, amounting to $65,609,000 (as estimated by the U. S. Geological Survey), places that state first for the year in the list of producing states. Montana came second, with $54,288,700. Utah produced 17,000,000 oz. silver compared with 13,370,000 oz. for Montana. Utah led also in the production of arsenic and was first in the amount of dividends paid by its mines during the year, the total amounting to $10,300,000, compared with $4,638,400 by Idaho and $2,250,000 by Montana.

Washington News

By Paul Wooton

Special Correspondent

Oddie Hopes to Perpetuate Gold-Silver Commission

American Silver Producers' Association Advocates Completion of Work—Cost Data Need Interpretation

The President of the Senate has caused to be printed in the *Congressional Record* the resolutions of the American Silver Producers' Association commending the work of the Senate Commission of Gold and Silver Inquiry. In the resolution the hope is expressed that the commission may be given "full opportunity to complete the work which is now in progress and that the commission's existence may be continued for such period beyond the Sixty-eighth Congress as may be necessary to enable it to complete fully such investigations."

Senator Oddie, the chairman of the commission, will present a resolution in the near future proposing to extend the life of the commission during the next Congress. He will point out to the Senate that this is the only way in which Congress, the mining industry, and the public can realize the full benefits of the investment of time and money which the commission has made.

An important activity of the commission has been the collection of figures on mining costs, investment, and yield on investment. This statistical survey has covered copper, lead, and zinc, in addition to gold and silver, because of the important amounts of those metals which are mined in conjunction with copper, lead, and zinc. The gold survey extended to both placer and lode mining operations. These highly important figures have been collected at a cost of $30,000 of public funds and at a cost of $150,000 to the industries that have co-operated in furnishing them. Unless these figures can be studied and interpreted it would be another example of spending for the crop and foregoing the harvest. The interpretation of these figures promises to be of particular value to the mining industry, as the aggregates are to be referred to those who have contributed confidential returns with the belief that the industry can co-operate in the preparation of the deductions which may be drawn from them.

Much the same situation prevails in connection with the hearings conducted in the field by Fletcher Hamilton. It would be impossible to carry out the recommendations of Mr. Hamilton, based as they are on the testimony of those actually engaged in mining operations, unless the official status of the commission is maintained. To deal with the Interstate Commerce Commission and other government agencies in the way that would be necessary, an official status would be a requisite.

In 1922 Only 61 Metal-mining Companies Paid Dividends

Of the 152 metal-mining companies making income-tax returns in 1922, sixty-one paid cash dividends aggregating $26,005,120; thirty reported net profits of $3,505,119 but did not pay cash dividends; and four reported a book loss but paid cash dividends of $1,675,124.

The returns from ninety-one companies engaged in metal mining show that they had surplus and undivided profits at the close of the year of $217,950,457. Their net book profit for the year was given as $26,050,623. The total net taxable income of the 152 companies making returns was $34,871,917.

Of the 230 concerns engaged in the manufacture, smelting, or refining of precious metals, ninety-four paid cash dividends during the year aggregating $2,855,951. With eighty-six other companies which had net book profits but did not pay cash dividends, they had surplus and undivided profits totaling $31,116,042. The net taxable income of the 230 companies was $9,334,271.

Rico-Wellington Gets $22,871

Three claims aggregating $25,400 have been recommended for payment by the War Minerals Relief Board. The largest of the awards was to the Rico-Wellington Mining Co. of Salt Lake City, Utah, the amount being $22,871. All three of the awards have been certified by the Comptrolled General for settlement by the government. The names of the claimants by states with the amounts awarded them follow:

Utah

Sammon & Toole, Salt Lake City, $1,701.20.

Rico-Wellington Mining Co., Salt Lake City, $22,871.93.

Washington

W. H. Seagrave and W. L. Gazzam, Seattle, $865.24.

Non-metallic Ore-grinding Plant

The Spar Mining & Milling Co., Ltd., of Toronto, has been formed for the treatment of non-metallic ores to produce finely ground dolomite, crystalline limestone, barytes, and talc. A mill is being established at Lakefield, Ont., with modern equipment.

The deposit from which supplies of ore will be drawn is in South Burleigh Township. F. D. S. Robertson, a metallurgical engineer, is president of the company.

London Letter

By W. A. Doman
Special Correspondent

Constancia Enterprise Proves Big Disappointment, Admits Baker

Tin Demand Must Be Met by Current Production—F. M. S. Sold 9,680 Tons in 1924

London, Jan. 13—Shareholders in mining companies have experienced another disappointment. In 1922, the late W. A. Prichard recommended the purchase of the Constancia mine, which was bought by the Colombian Corporation. He estimated the developed ore reserves at 117,500 tons, averaging over $7 a ton, but the total, including stope fillings, was put at 300 000 tons averaging $6 to $8 a ton. Working costs were estimated not to exceed $3 a ton, and extension in depth was predicted without diminution in size or value. The plant was to treat 600 or even 1,000 tons of ore a day.

On Mr. Prichard's death in 1923, J. D. Hoffmann was sent to Colombia to report. He could not confirm the previous estimate in any respect. His estimate of reserves was 114,000 tons, not definitely proved, averaging $6.65. Mr. Hoffmann thinks there may be a further 40,000 tons of very doubtful ore, the value of which is problematical. F. L. Thomas has confirmed J. D. Hoffmann's figures. The last two mentioned engineers put working costs at $4.50 for the ore above the third level, though below they may be reduced by $1. The chairman, F. W. Baker, though admitting the disappointment, says the prospects of future development are not affected.

Encouraging results are being obtained at the new Gooty property of the North Anantapur Co. (India). The principal operations are on No. 2 block. At 200 ft. a level has been opened for a length of 130 ft. Of this, 39 ft. was driven during November, the quartz being 4 ft. wide and averaging more than 14 dwt. of gold to the ton.

The tin position is creating a considerable degree of interest. Messrs. Ricard & Freiwald state that at the beginning of 1924 the quantity in sight was 18,631 tons, and at Dec. 31 last, 23,160 tons. During the year the F.M.S. Government disposed of 9,680 tons under the Bandoeng agreement, just covering its outlay and interest on the money. Demand during the current year will have to be supplied by current production, and all companies are working to the utmost of their capacity. The outlook is regarded as bright.

Platinum discoveries in the Transvaal have induced much speculation in the shares of land companies which are anywhere in the vicinity of the finds. Transvaal Consolidated Lands and Transvaal Estates & Development are most in the limelight, owing to a report by F. Reiss, chairman of Transvaal Platinum. Payable values have been found down to 100 ft.

The Soviet Government is permitting private companies to be registered, and seems to be actually assisting them. Russo-Asiatic Consolidated is expected to benefit.

Diamonds are now at such a price that nothing further can be added. The public in fact will not pay more. Ross Frames' speech at the De Beers meeting, published a few days ago in the London press, was cabled to the Continent, and has caused considerable stir there. The producers and the Diamond Syndicate are still negotiating, and these protracted negotiations—they have been in progress since last November—are creating anxiety. I learn from Amsterdam that buyers are holding aloof, and those who are inclined to do business are breaking the seals. Should no agreement be come to, the effects would be far reaching, for it is on the credit of the Diamond Syndicate—who take all the risks—that the diamond trade continues. The result is expected to be known this week.

Minas Pedrazzini Has 3,000,000 Oz. Silver in Developed Ore

Power Plant at Nacozari Completed—High-grade Ore Opened on 900 and 1,000 Levels

Minas Pedrazzini Gold & Silver Mining Co., operating in the Arizpe district in Sonora, Mexico, has largely increased its ore reserves through the policy of intensive development followed during the past year. Antonio Pedrazzini is general manager and Morton Webber consulting engineer.

On Dec. 31 the mine had 3,000,000 oz. of silver assured, according to a report, which stated further that when this ore is mined it will probably result in a silver production larger than estimated. The cost of exploration and development for 1924 has been partly covered by sales of silver from ore obtained from development. A power plant has been completed at Nacozari and has operated from the start without trouble. A 43-km. transmission line has also been completed.

One of the most important strikes of high-grade ore was encountered during 1924. A crosscut from the 800 level intersected a bonanza, which for 20 ft. assayed 15.3 oz. gold and 1,850 oz. silver. Several other bonanzas of less importance have been opened on the 900 and 1,000 levels of the mine.

United Verde Will Have Mill

Steam shoveling at the top of the United Verde mine, at Jerome, Ariz., is being continued at the rate of about 150,000 yd. per month, making a deep valley where the company's smelter, offices, and headframes once stood. A large proportion of the material removed is available for smelting.

The next project is to be the erection of a concentrating plant. If built at Jerome it will be the first plant of the kind in the district. In mining operations, down to 2,400 ft., enormous quantities of chalcopyrite have been developed of a character suited to handling by flotation. The company is also exploring new ground in the Venture claims by an extension of the Calumet and Jerome tunnel.

Johannesburg Letter

By John Watson
Special Correspondent

Gold Mine Dividends for 1924 Were Generally Up

Crown Mines Paid 80 per Cent—Osmiridium Brought £58,624 in Nine Months

Johannesburg, Dec. 23.—Dividends have recently been declared by the gold-mining companies, as shown below. Rates for the first half of 1924 and for the last year are also given for comparison:

	Rate, per Cent		
	1923	1924	
	Year	First Half	Second Half
Aur. ra West	15	10	10
Brakpan Mines	42½	20	25
City Deep	45	25	25
Consolidated Main Reef	6¼	6¼	6¼
Crown Mines	67½	40	40
Geduld	27½	16¼	17½
Geldenhuis Deep	5	5	5
Government Areas	60	32½	32½
Langlaagte Estate	17½	7½	5
Meyer and Charlton	100	50	50
Modder B	110	60	50
Modder Deep	140	70	75
New Modder	100	50	50
New Primrose	5		7½
New Unified	5		2½
New Kleinfontein	2½		2½
Nourse Mines	8¼	3¼	2½
Randfontein Estates			5
Robinson Deep A (a)	10s.	11s.6d.	5s.6d.
Robinson Deep B			1s.
Rose Deep	17½	11¼	11¼
Simmer and Jack			20
Springs Mines	30	15	17½
Sub-Nigel	7½	5	3¼
Van Ryn Deep	52½	30	32½
Van Ryn Estate	15	10	10
Village Deep	10	5	3¼
Witwatersrand	27½	12½	5
Witwatersrand Deep	15	7½	7½

(a) Rate per share.

On Dec. 17, through the breaking of a wire hoisting rope, at Randfontein Estates, one white man and thirty natives were killed. The skip dropped about 1,200 ft. to the bottom of the vertical shaft. A government inspector of machinery who next day examined the broken rope said it gave no outward indication of any defect. As usual, thorough investigation is being made by government officials.

The Union output of osmiridium, for the nine months ended Sept. 30, was 2,301 oz., valued at £58,624.

Attention is now being given to gold mines in the Klerksdorp and Potchefstroom districts, on what is known as the Black Reef. Several of these properties have been shut down, as gold mines; but it is now argued that, using corduroy and concentrators, the osmiridium content, added to the gold, would help to turn many of these mines into paying properties.

Anglo-Canadian Gets Option on Rice Lake Claims

The Lotus claims, near English Brook, in the Hole River area of the Rice Lake district, Manitoba, have been taken over on option by the Anglo-Canadian Exploration Co., which has acquired several claims in the district. A substantial cash payment has been made, the ultimate price being $100,000. The property shows a wide vein of telluride ore, and assays have returned high gold content.

Mexico City Letter

By W. L. Vail

Special Correspondent

Government Wants Mexican Mining Engineers to Have Work

Each Mine Must Employ "Titled" Engineer—New Plant at Tampico —Outlook Good

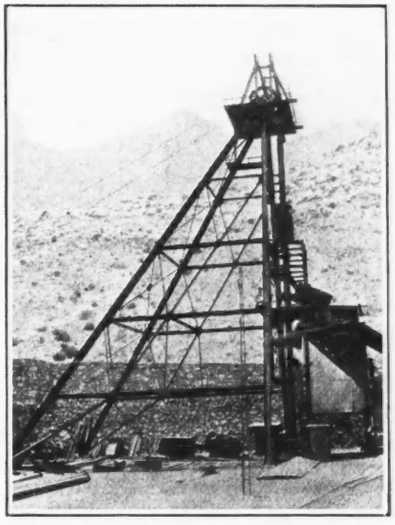
Mexico City, Jan. 19—The Secretary of the Department of Commerce and Labor is about to issue a circular giving mining companies ninety days in which to comply with Article 133 of the Mining Code—hitherto regarded as a dead letter. This article requires all companies to maintain in their employ a titled mining engineer who has passed the proper examination under Mexican laws. At this time, it is alleged, a great majority of the engineers are foreigners, none of whom have complied with the legal requirements, and many of whom, of course, cannot, because of their lack of knowledge of local laws and of the language. Because of this preference for foreign engineers it is stated that of 218 mining engineers in Mexico who have received their diplomas, only 11 have secured employment. The situation has been so disheartening for native engineers that in 1917 there were only seven students in the engineering and mining school of this capital, and last year but one had continued his studies. The principal object of the government in insisting upon a strict compliance with the law in this connection is evidently for the purpose of protecting and stimulating the Mexican engineer. Under the circular it will be necessary therefore (a) that foreign engineers pass an examination and secure a diploma from the local mining school; (b) that titled engineers shall reside at all mines that are operating; (c) that the engineers shall devote their time exclusively in supervising the works in the interests of the government and shall be responsible for the strict enforcement of all laws referring to mining operations.

The International Ore & Smelting Co. (Belgian capital) is installing an ore "elevator" at Tampico, at a cost of 140,000 pesos. The installation is presumed to be in the interest of economy. At present about 45,000 tons of ore and concentrate pass through the port of Tampico yearly. The elevator as planned will be able to load ships at the rate of 150 tons per hour, thus saving considerable sums in rail demurrage and ships at the wharf.

According to Alexander V. Dye, American Commercial Attaché in this city, the mining industry here is due for a period of prosperity. Mr. Dye says: "The mining industry is reaping the benefit of the high price of lead in the world's markets, the price in London of £42 per ton having exceeded even the high prices of the war, and the lead-silver industry in Mexico is a large one.

"Antimony is at a high price, due to the disturbances in China, which normally supplies the markets in the United States, and the lead-antimony mines of Mexico are reaping a profit from this occurrence, even if it be only temporary."

F. W. Saunders, secretary of the American Chamber of Commerce of Mexico, also gives out rather an optimistic résumé of the situation, in which a bright outlook for the miner is included. Reports of denouncements throughout the mining districts and increased investments on the part of the larger concerns now operating here all tend toward a justification of optimism.



Headframe at American No. 2 shaft of the Ojuela mine of the Peñoles company in Mexico

There are a few minor discords in the carol. In the State of Guanajuato, for example, compliance with the new labor laws has been pronounced impossible, and several of the larger companies have given notice of a shutdown unless the laws are materially modified. The attention of the President has been called to the situation, and it is hoped that a suspension of the obnoxious legislation will be ordered pending the investigation of a competent federal commission.

Fire in Bawdwin Mine Prevents Stocking Ore for Wet Season

Cable advices to London from the Burma Corporation officials at the Bawdwin mine, Burma, say that there has been considerable subsidence of ground in the mine caused by burning of timber in levels, rises, and stopes and subsequent flooding with water. There does not appear to be smoke or gas issuing from the area, which, however, will remain flooded and sealed until the position is considered absolutely safe for reopening.

All stopes south of the internal shaft, representing 15 per cent of the total stoping area, have been temporarily lost and will not be available again for some time. New stopes are being opened in other sections of the mine to replace this loss, and output from the mine for current production is being maintained, though it is impossible to accumulate stocks for use during the next rainy season.

Toronto Letter

By Our Special Correspondent for Northern Ontario

Labor Conciliation Board Act Found Unconstitutional

Setback to Workers — Menago Produced 425,000 Oz. in 1924— Frontier Ships

Toronto, Jan. 21. — Canadian mine labor feels that it has received a severe setback by the recent decision of the Privy Council in which the validity of the Lemieux Act was attacked by the Hydro-Electric Commission of Ontario. The decision states that the act is unconstitutional and that it usurped a right belonging only to the provincial governments.

The Lemieux Act, which was passed in 1907 by the Dominion Government, has always been held up as a forward piece of legislation. It provided for the settlement of disputes regarding wages or hours of labor by arbitration and, though the decision of a special Conciliation Board was not necessarily binding upon the parties to the dispute, it has been a big factor in the friendly settlement of many vexatious questions. The act was really intended to provide for arbitration in the case of public utilities, the only other industry specifically mentioned being that of mining.

The Menago Mining Co., of Cobalt, produced 425,000 oz. of silver last year, valued at approximately $275,000. Shipments are being maintained at the rate of about 2,000 tons a month, the ore averaging approximately 20 oz. to the ton. Most of this ore is coming from the 1,080 level, which is the deepest horizon in Cobalt from which profitable ore is being obtained.

The Frontier mine, of South Lorrain, owned by the Mining Corporation, has started shipments of mill rock to the company's concentrator in Cobalt, at the rate of 100 tons a day.

The Lorrain Trout Lake, which is under the management of the Mining Corporation, but in which English interests are a large factor, has also started shipping 50 tons a day to the same mill.

The Cobalt Contact property, in Cobalt, has been optioned to a representative of English interests. This property is shipping a small tonnage daily to the mill of the Mining Corporation, and the ore is understood to run about 60 oz. a ton.

The Canadel Gold property, in Porcupine, which is controlled by English interests, has been closed down temporarily, pending reorganization and provision for further financing. It is understood that approximately £100,000 is to be provided. This company has also secured a large acreage in northwestern Quebec, practically on the railroad. Prospectors followed up what they believed to be the continuation of the Porcupine gold belt, and in addition to having found favorable geological structure also found gold float. Prospecting has resulted in the discovery of a vein which has been stripped for 50 ft. and from which assays of $4 to $40 have been obtained.

Societies, Addresses, and Reports

New Minerals Division Active

This Section of Commerce Department Desirous of Serving as Bureau of Markets for Miners

The Minerals Division of the Bureau of Foreign and Domestic Commerce handles the work of the Department of Commerce in its contact with the mineral and non-ferrous metal industries, including petroleum. The division was organized in July, 1924, to co-ordinate and make more effective the work previously carried on by the Petroleum Division and the Minerals Section of the Iron and Steel Division.

The functions of the division include (1) the collection and dissemination to American firms of information on foreign markets for mineral and petroleum products, as well as data relating to foreign development and production of the various minerals, non-ferrous metals, and petroleum; and (2) current surveys of foreign and domestic mineral, metal, and petroleum activities.

The work of the division includes the distribution to the respective trades of information on foreign markets for such of the above-named products as are sold abroad, and data regarding the supply of such minerals and raw metals as are not available in this country. This material is published in the form of Trade Information Bulletins; articles in *Commerce Reports;* special circulars; commodity, country, and world surveys; releases to the press, and through answers to direct inquiries and personal contact with the various industries. Recently the issue of a weekly bulletin, "Foreign Trade Notes," was established, as a medium through which considerable foreign trade data are brought to the attention of domestic manufacturers and exporters which, although important, can in no other way receive publicity.

By questionnaires distributed to consulates and the commercial attachés and trade commissioners of the bureau throughout the world, surveys of foreign mineral industries have been compiled for publication in Trade Information Bulletin form. Seven such bulletins have been published, covering world surveys on fluorspar, zinc, asbestos, magnesite, and cement; aluminum, lead, manganese, and others are now in preparation for release.

In addition to the regular dissemination of appropriate material, specific information is collected regularly through government representatives abroad on opportunities for the sale of American mineral and petroleum products. This information is published through the medium of the trade opportunity section of Commerce Reports, supplemented by special circulars and personal contact through the bureau and its district offices when necessary.

It is the desire and intent of the division to act as a "bureau of markets" for the mineral industries, and complete files are maintained on foreign markets, foreign legislation relating to minerals and petroleum, and other pertinent subjects. In addition to constant advice and information given to the trades through interviews and conferences, about 20,000 inquiries per year of both domestic and foreign markets and related subjects are handled through the Minerals Division by correspondence.

A.I.M.E., Montana Section, Elects Officers

The Montana Section of the A.I.M.E. held its annual meeting Jan. 28, in the new Engineering Building of the Montana State School of Mines, at Butte. Officers for the coming year were elected and a delegate was appointed to the national meeting in New York in February. The alumni association of the school joined with the student body in entertaining the members of the section.

Humble Burro to be Honored by Colorado Mining Men

By C. H. Vivian

The burro, faithful companion and unflagging partner of the prospector, is to be immortalized in stone or bronze by Colorado mining men in token of the great part this quaint member of the animal kingdom has played in the discovery and development of the metal producing camps of the West. The suggestion was made by William C. Russell, Denver mining engineer and mine operator, at the conclusion of a tribute to the burro which proved one of the features of the second annual "sowbelly dinner" of the Colorado Metal Mining Association at Denver Jan. 22. An initial subscription of $100 accompanied the proposal and a committee of three was appointed to further the project.

The dinner was the froth of the convention, a light, informal end to the business sessions. It drew double the attendance of the initial function of its kind a year ago, and its unqualified success insures a gathering in the future that will tax the capacity of any restaurant in Denver. Former Governor Oliver H. Shoup acted as toastmaster, the welcome being extended by Mayor Ben F. Stapleton.

Several resolutions were adopted by the convention. Officers were elected for the ensuing year.

Except for the inclusion of John T. Barnett, of Denver, as first vice-president to represent the oil division, officers of the association were re-elected as follows: Jesse F. McDonald, of Leadville, president; R. M. Henderson, of Breckenridge, second vice-president; E. A. Colburn, of Denver, third vice-president; M. B. Tomblin, of Denver, secretary; and A. M. Collins of Denver, treasurer.

On the final day of the convention, the delegates made a trip in a special train to the east portal of the Moffat tunnel, where they were conducted underground and shown how this six-mile railroad bore through the Continental Divide is being driven.

Slate Industry Holds Annual Meeting

The largest gathering of slate quarrymen, manufacturers, and dealers in the history of the industry met in annual convention at the Commodore Hotel, New York City, on Jan. 19 and 20. Not only was a season of good fellowship enjoyed, but many technical and commercial problems in production, manufacture, and use were considered in detail.

The outstanding feature of the convention was a decision to give somewhat less attention to the general publicity of slate, and to emphasize more intensive activity in the various districts. Problems differ in different localities, and each district will be encouraged to give special attention to production, distribution, advertising, and sales promotion in its own field.

The names of the leading officers of the National Slate Association for the ensuing year as proposed by the nominating committee are as follows: President, N. M. Male, Pen Argyl, Pa.; vice-president, F. C. Sheldon, Granville, N. Y.; treasurer, A. H. Morrow, W. Pawlet, Vt. W. S. Hays will continue as secretary, with his office, as heretofore, at 757 Drexel Building, Philadelphia, Pa.

B. C. Chamber of Mines Meets in Vancouver

The annual general meeting of the British Columbia Chamber of Mines was held at Vancouver on Jan. 13, when the following officers were elected for the current year: Honorary president, William Sloan, Minister of Mines; honorary vice-presidents, G. W. Bowen, R. W. Brock, H. T. Lockyer, H. S. Munroe, W. G. Murrin, R. S. Stewart, L. D. Taylor, A. B. Trites, W. L. Uglow, and Charles Villiers; president, Frank E. Woodside; vice-presidents, H. P. McCraney and G. S. Eldrige; treasurer, W. M. Rooke; committee, W. L. Bland, G. S. Cradock, S. L. Crawford, S. J. Crocker, F. J. Crossland, W. Godfrey, F. W. Gurnsey, B. G. Hawkins, G. Matthews, Montague Moore, Nicol Thompson, A. M. Whiteside, A. S. Williamson, and Charles Woodward.

Mr. Woodside reviewed the work of the last year, emphasizing the good that had been derived by the series of lectures given to prospectors by mining men last winter, and which was being repeated this winter.

State Mining Meeting Held in San Francisco

Mining and industrial leaders of the state were called by the California Development Association to meet Jan. 16, in the Ferry Building, in San Francisco, to adopt a state-wide program of activity in behalf of the mineral industry, which has been worked out by the committee of ten, headed by W. J. Loring. The association has pledged itself to carry out this program.

Lloyd L. Root, State Mineralogist; Dean Frank H. Probert of the University of California College of Mines,

and Robert I. Kerr, secretary of the California Metal and Mineral Producers' Association, presented at this meeting the rough draft of a legislative bill to create the state Department of Mines and Minerals, to function for the miner just as the State Department of Agriculture functions for the farmer. It will co-ordinate all state agencies dealing with mining under one head.

Mining Regulations Drafted for Washington

A code of signals and other regulations as to hoisting operations in metal mines are covered in a bill that has been prepared by the Northwest Mining Association, the mining committee of the Chamber of Commerce of Spokane, the Associated Engineers, and the Columbia Section of the A.I.M.E. This bill is to be presented before the Washington State Legislature now in session. The code includes most of the provisions that are in effect in the neighboring states of Idaho, Montana, Oregon, and the Province of British Columbia.

Committee on Mine Ventilation Proposed

A group of members of the American Institute of Mining and Metallurgical Engineers have asked the board of directors to establish a standing committee on the general subject of underground ventilation. Particularly it is proposed that this committee should promote the correlation and interchange of data now being accumulated at various sources, formulate the more important problems, suggest methods of attack, and secure papers on the work that is being and will be done.

At the coming annual meeting of the Institute, therefore, a conference will be called on Feb. 17, to consider the desirability of forming a separate standing committee of the Institute on underground ventilation.

Kirchen Heads Nevada Operators

The Nevada Mine Operators' Association held its annual meeting in Reno, Nev., on Jan. 13. Officers elected to serve during the ensuing year were as follows: John G. Kirchen, president; Arthur H. Lawry, first vice-president; Clyde A. Heller, second vice-president; and Henry M. Rives, secretary and treasurer.

Charles McCrea Honored at Toronto

The Toronto branch of the Canadian Institute of Mining and Metallurgy recently gave a complimentary dinner to Charles McCrea, Minister of Mines for Ontario, in appreciation of the valuable services which Mr. McCrea has rendered to the industry. In his speech Mr. McCrea referred to the growing importance of mining in Ontario and to the much greater public recognition which it is receiving. He pointed to the necessity of closer co-operation by the banking interests, which has heretofore been noticeably lacking.

Recent Technical Publications

Reviews, Abstracts, and References

"The Wonderful Story"

A book obviously intended for our most high-brow subscribers is "The Wonderful Story of Gold and Silver," by Henry Hamilton Harwood, "an anthropological, mythological, chrysological, argyrological, photochromatological, and psychological study." Any one wishing to get this most "logical" book should order it at once from the publishers, the Lewis Printing Co., of Richmond, Va., as only 225 copies were printed.

Oil Shale—*Chemical and Metallurgical Engineering* (New York; price 25c. each issue) is running a series of articles on oil shale, by S. D. Kirkpatrick, the first appearing in the Oct. 20 issue. This is a survey of the oil-shale resources of the country and a history of their development and technology.

Wyoming Geology — Professional Paper 132-F of the U. S. Geological Survey, Washington, D. C., 15 pages, obtainable on request, is entitled "Relations of the Wasatch and Green River Formations in Northwestern Colorado and Southern Wyoming," with notes on oil shale in the Green River formation. It is by J. D. Sears and W. H. Bradley.

Bolivian Mining—An article on "Mining in Bolivia," by H. L. Venables and E. J. Howard-Wright, 6 pages, appears in *The Mining Magazine* for December. (London; price 1s.) Brief mention is made of the equipment and operations of the various individual mining companies, and general conditions in the country are described.

Mine Sanitation—A brief paper by R. R. Sayers, "Sanitation in Mines," was recently published by the U. S. Bureau of Mines, Washington, D. C., as Miners' Circular 28, 16 pages, obtainable on request. Drinking water, sewage disposal, and ventilation are the topics discussed.

Mineral Resources—Recent separates of "Mineral Resources of the United States," obtainable on request from the U. S. Geological Survey, Washington, D. C. include: "Mineral Waters in 1923," 16 pages, by W. D. Collins; and "Secondary Metals in 1923," 18 pages, by J. P. Dunlop.

Hoisting—In the October issue of the *Journal* of the South African Institution of Engineers a paper has been published entitled "Notes on Deep Level Winding," by J. A. Vaughan, which deserves more than passing notice. It is a comprehensive description of South African hoisting practice and how the problems of deep level hoisting on the Rand are being solved. The value of the paper is enhanced by the inclusion of many detailed diagrams and sketches of important South African hoisting installations, together with operating data. Mr. Vaughan really brings up to date the treatise which was written in 1901 by Hans C. Behr about "Winding Plant for Great Depths." He discusses such topics as the size and design of the shafts used, the skips and cages, types of hoisting engines, kinds of ropes used, and underground engine rooms. This excellent paper is a noteworthy contribution to mining engineering literature. It is issued by the Transvaal Chamber of Mines, Johannesburg.

Patents

Petroleum—No. 1,520,012. Dec. 23, 1924. Rudolph Conrader, Erie, Pa. A method of treating oil wells which consists in maintaining the well under pressure but below the rock pressure; and heating the well cavity.

No. 1,520,052. Dec. 23, 1924. Rudolph Conrader, Erie, Pa. Maintaining the pressure on an oil well approximating the vapor pressure of the most volatile constituent of the oil.

No. 1,520,077. Dec. 23, 1924. V. H. Palm, Butler, Pa. A pumping apparatus for wells.

No. 1,520,173. Dec. 23, 1924. J. D. Carr and J. F. Ritch, Humble, Texas. A pump plunger.

No. 1,520,376. Dec. 23, 1924. E. B. Verneuil, Mangum, Okla. Design of an oil-well strainer.

No. 1,520,737. Dec. 30, 1924. R. L. Wright, Fort Dodge, Iowa. A method of increasing oil extraction by extending channels into oil-bearing strata.

Crushers—No. 1,520,202. Dec. 23, 1924. D. J. Nevill, Denver, assignor to The Stearns-Roger Manufacturing Co., Denver. Design for a jaw crusher.

No. 1,520,319. Dec. 23, 1924. Emil Barthelmess, Dusseldorf - Oberkassel, Germany. A ring-roller crushing machine.

Metal Oxide Reduction—No. 1,520,240. Dec. 23, 1924. W. B. Hamilton, Lancaster, England, and Fergus Reid, Norfolk, Va. Metal oxide is reduced and separated from ore by adding a reducing agent for silica to a slag containing silica and the oxide of the metal to be reduced.

Concentrating Table—No. 1,520,451. Dec. 23, 1924. E. A. Sperry, Tientsin, China. Design for a reciprocating concentrating table.

Mine Car Wheels — No. 1,520,688. Dec. 30, 1924. F. S. Barks and G. B. Bell, Jr., St. Louis, Mo., assignors to Lincoln Steel & Forge Co., St. Louis. Design of a journal box for mine-car wheels.

Rock Drills—No. 1,520,728. Dec. 30, 1924. F. M. Slater, Easton, Pa., assignor to Ingersoll-Rand Co., Jersey City, N. J. A fluid-actuated inlet valve for rock drills.

Ball-mill Lining—No. 1,521,169. Dec. 30, 1924. W. M. Barker, Canton, Ohio. This patent covers the application of a plastic material to the lining of a ball mill, which, after it has set, forms a resilient, single-piece wearing surface that is self-cemented in place.

Men You Should Know About

Allen H. Rogers, of Rogers, Mayer & Ball, mining engineers, is en route to New York from Chile.

Courtenay De Kalb delivered an address before the Army and Navy Club, in Washington, D. C., on Jan. 10, his subject being "The Moroccan Menace."

William H. Peirce, manager of refineries for the American Smelting & Refining Co., sailed from New York on Jan. 24 on a business trip to Europe.

Sir James T. Currie, president of the British-Mexican Petroleum Co., and of the Lago Petroleum Co., a Venezuela corporation, recently arrived in New York.

Norman Carmichael, director of the Phelps Dodge Corporation, recently left New York to make his annual visit to the properties of the corporation in the Southwest.

Franklin B. Hanley, recently instructor in geology, Washington University, St. Louis, has joined the staff of the McGraw-Hill Book Co. as traveling college representative.

Stanley A. Easton, of Kellogg, Idaho, has been in New York and New England on one of his periodical business trips in connection with the affairs of the Bunker Hill & Sullivan company.

William B. MacPhee, formerly mill superintendent of the Como Consolidated Mines Co. and the Olympic Mines Co., in Nevada, is now mill superintendent of Cia. Minera Exploradora de Promontorio, S. A.

C. M. Loeb, president of the American Metal Co. Ltd., sailed from New York on Jan. 24 for France, England, Egypt, Palestine, Turkey, Italy, Greece, and a number of other countries. He will be away about three months.

Ludwig Vogelstein, vice-president of the American Metal Co., has just returned from a trip to Mexico. He was accompanied by **Siegfried Hirsch,** of Berlin. Mr. Hirsch will remain in New York two weeks before returning to Germany.

Philip D. Wilson has resigned his position of chief geologist of the Calumet & Arizona Mining Co., which he has held for many years, and has sailed for the west coast of South America to examine mines for the American Metal Co.

Gar A. Roush, associate professor of metallurgy at Lehigh University since 1912, has been appointed staff specialist in the Officers' Reserve Corps of the United States Army, with the rank of major. He expects to begin his first series of lectures before the end of the current month.

O. M. Kuchs and **A. A. Hoffman,** of the Andes Copper Co., with a party of engineers and representatives of the company, are en route to Chanaral, Chile, where they will start development of the properties for which the Andes company recently raised $40,000,000 by an issue of bonds.

H. T. Stearns, of the U. S. Geological Survey, who recently finished work on the geology of the Kau district, island of Hawaii, that had been started by Messrs. Meinzer, Clark and Noble, left Honolulu late in 1924 for a trip around the world, primarily to view the volcano fields of Japan, Java, and Italy.

Walter L. Remick, formerly engineering editor of the Keystone Mining Catalogs, will assume active management of the Hydrotator Company after Feb. 1. This company has acquired the patents and engineering business of L. C. Trent, who has been operating as the L. C. Trent Engineering Co. in Philadelphia.

Louis S. Cates

Louis S. Cates, vice-president and general manager for the Utah Copper Co., has been in New York from Salt Lake City. He will present a paper on "Factors Affecting Bank Slopes in Steam-shovel Operations," at the forthcoming meeting of the A.I.M.E. opening in New York on Feb. 16.

O. C. Martin, formerly plant manager of the Maurer plant of the American Smelting & Refining Co. and manager of the Nichols Copper Co.'s plant at Laurel Hill, Long Island, will sail the first of February for Europe, where he will take up his duties as consulting metallurgist with the Société Générale Metallurgique de Hoboken and the Union Minière du Haut Katanga, with offices in Brussels and Antwerp. Mr. Martin will superintend the construction and operation of a refinery which these companies intend to build at Oolen, Belgium.

George M. Wood, since 1887 editor for the U. S. Geological Survey, recently celebrated the seventy-fifth anniversary of his birth. As on practically every day since 1887, he was on the job. Somewhat to his own perturbation he did not cover as much ground as usual in the editing of manuscripts on that day, because there was almost a continual stream of friends from the U. S. Geological Survey and the other bureaus in the Interior Building, presenting themselves at his desk to pay their respects. All who have occasion to read the reports of the Survey owe Mr. Wood a debt of gratitude for his ceaseless efforts to make clear the thoughts which the author puts forward. To those within the Survey, who have benefited so greatly from his kindly but firm criticisms, Mr. Wood is much beloved. He has taught many young scientists how to write, and much of the clarity and force of expression which characterize Survey publications are due to his efforts.

Obituary

Richard Aykroyd, a prominent oil operator of Wainwright, Alberta, who took an active part in the development of the Wainwright oil field, died recently at the age of forty-three.

Leighton I. Baldwin, a mining engineer of Salt Lake City, Utah, died suddenly on Jan. 16 at the age of about fifty years, at Portland, Ore., where he had gone on a business trip. Mr. Baldwin came west twenty years ago, settling in Boise, Idaho, where he was city engineer for several years. After coming to Salt Lake City three years ago, Mr. Baldwin engaged in the practice of consulting mining engineering.

Miss Nellie Cashman, known as the "champion woman musher of the world," and one of the first women to enter the Alaskan gold fields as a prospector, died recently in Victoria, B. C. Miss Cashman was more than seventy year old. She had grubstaked many miners who made fortunes, had sent expeditions into Alaska, which she outfitted and accompanied, and, in addition to prospecting, had served as a nurse in many mining camps. She was held in high regard by a very wide circle of acquaintances. Among her numerous and noteworthy exploits was her trip from Koyukik to Seward, Alaska, over a 750-mile snow trail.

Joseph Farren, an old-time mining man of the West, died recently in Salt Lake City, at the age of ninety-eight. During the latter years of his life, until forced to retire owing to advancing age, Mr. Farren was superintendent of the Glascow & Western Co. at Golconda and Cherry Creek, Nevada, and Beaver, Utah. Born in New York on Dec. 21, 1826, and receiving his early education there, Mr. Farren went to Plumas County, Calif., as a mere boy, where he engaged in placer mining. When this form of mining ceased to be profitable, in 1855, Mr. Farren made a trip to British Columbia, which proved to be unfruitful. Later he went to Virginia City, going from there to the Walker River country, 50 miles southeast of Carson. From there he went to Carson itself. Mr. Farren was one of the chief owners of the Eureka Consolidated, and built a smelter at Bullion. He was one of the first miners on the Owyhee, and took part in the opening of the Tuscarora. He was interested in copper mining at Tacoma, on the Southern Pacific. He mined in practically all of the districts in Utah. Mr. Farren was one of the latest survivors of the picturesque past. His name is associated with the well-known names of Head, Fair, Lent, Gashweiler, Hearst, Raymond, Ashburner, and the Jannins, in Nevada and California. He was at one time a partner of "Uncle Billy" Lent in a search for diamonds in New Mexico and Arizona.

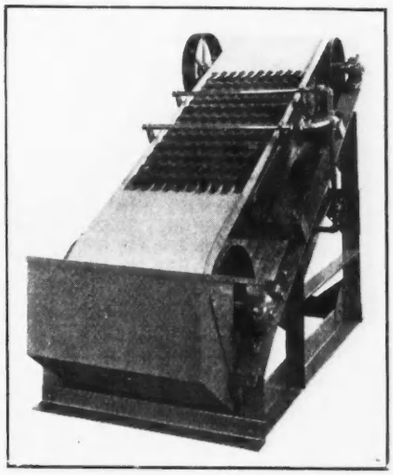
New Machinery and Inventions

Some Developments Reported in Electromagnetic Separating Equipment

Some new things in electromagnetic separating equipment were developed during the last year. A new ore concentrator adapted to the treatment of magnetite iron ore by the wet process was produced by the Magnetic Manufacturing Co., of Milwaukee, Wis. Patent has been applied for covering features embodied in this machine. The feature for which newness is claimed is in the design and construction of the magnet, which materially assists in bringing about a high concentration with notably low losses in the tailing.

The powerful magnet holds the magnetic particles against a flow of water which is used in washing the ore. The water used frees the gangue matter from the ore. The poles of the magnet alternate and are further arranged in zigzag relation to each other. By this arrangement of the pole faces of the magnet, a jigging action is set up by the magnetite while it is under the influence of the magnet, the ore moves backward and forward across the face of the belt, and, further, turns over a number of times in passing from pole to pole, and thus the ore treated is thoroughly washed. The concentrator is shown in one of the accompanying photographs.

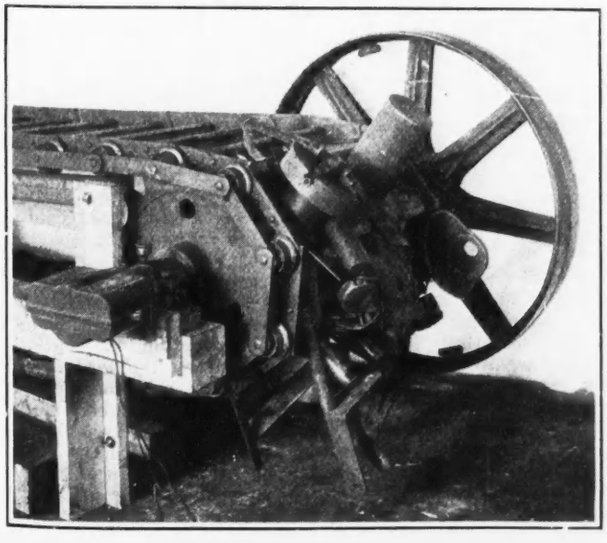
The application of an electromagnet to steel pan conveyors was also accomplished by the same company. Magnetic pulley installations have been made for a number of years in the ordinary belt conveyor installations feeding the crusher, for the purpose of removing tramp iron. Many installations have been made where the belt conveyor cannot be used, so that the application of the magnet to the pan conveyor is of some importance. The photograph illustrates an apparatus built up on wood frame structure for demonstration purposes. This demonstration was made for the benefit of the Link Belt Co.'s engineers. Link Belt equipment was used, and the "High Duty" ventilated magnets were mounted in the feeding end as shown in the cut.



Electromagnetic concentrator adapted to the wet treatment of magnetite iron ore

It was thought by many before this demonstration was made that the lines of magnetic force would spread to a considerable extent, throughout the unit; however, the demonstration showed that there was practically no difference in the action of the magnet as applied to a steel pan or apron feeder than when applied to the ordinary belt conveyor. Application has been made for a patent covering this use.

The company also developed in the period mentioned a suspended safety type magnet for removing tramp iron from belt conveyors, a drum-type separator for concentrating magnetite iron ore by the dry process, and a magnetic clutch for power transmission. Particulars regarding these will be furnished by the company on request.



Magnetic pulley applied to a pan conveyor

It has been demonstrated that there is practically no difference in the action of the magnet as applied to a steel pan or apron feeder than when used with the ordinary belt conveyor.

Two New Lines of Locomotives Now Available

Locomotives of both trolley and storage-battery types were introduced during the last year by the Vulcan Iron Works of Wilkes-Barre, Pa. One of the salient features of these locomotives is the cross-equalization which provides for three-point suspension. This practice is the same as followed in the steam locomotives of the four-coupled type made by the company. The trolley locomotives are furnished in standard sizes of four, six, eight, ten, twelve and fifteen-ton weights in all practical gages. They are made with cast-steel frames, cast-iron bumpers, steel-tired wheels, cast-iron driving boxes with bronze bearings, semi-elliptic springs with cross-equalizers, screw-type brake, and four sand boxes. Modified standard or special designs will be built by the company to suit unusual service conditions.

The locomotives of the storage-battery type are built in chassis weights of three, four and five tons and larger, and for all practicable track gages. This type is worm-gear driven with cast-steel frames, steel bumpers, steel-tired wheels, easily removable cast-iron journal boxes provided with roller or ball bearings, semi-elliptic driver springs with cross-equalizers, quick-acting cam brake, and with four sand boxes.

An Improved Wilfley Drive Introduced

During the last year a new method of driving Wilfley tables by means of an individual electric motor has been developed by the Mine and Smelter Supply Co., of Denver, Colo. Heretofore this drive has been accomplished by using the usual back-geared type of motor as produced by the electrical companies, this meshing into a spur gear on the head motion. It was an open drive, and the spur-pinion and spur-gear were of fine pitch and quite fragile in construction. To overcome this the company has developed a worm drive in which the worm wheel is mounted directly on the crankshaft of the motion with the worm and shaft carried above and extending out so that it can be direct-connected through a flexible coupling to a little electric motor. The worm and wheel are mounted in a cast-iron box securely fastened to the motion. It is all inclosed and running in oil, thus protecting it and reducing the amount of attention of the operator in keeping it up. With this type of a drive, the back lash is practically overcome, because with this worm drive there are several teeth in mesh all the time, whereas with the spur gear only one tooth is in mesh. The worm wheel is made of phosphor bronze and the worm and shaft are cut from a solid piece of steel and are carried on Timken roller bearings.

Another improvement which was investigated and developed during the last year is the use of rubber riffles in connection with concentrating tables. One of the large mining companies in Missouri has given it a careful trial.

The Market Report

Daily Prices of Metals

Jan.	Copper N. Y. net refinery*	Tin		Lead		Zinc
	Electrolytic	99 Per Cent	Straits	N. Y.	St. L.	St. L.
22	14.55	56.125	56.625	10.00	9.75	7.60@7.65
23	14.60	57.125	57.625	10.00	9.75	7.575–7.625
24	14.60	57.125	57.625	10.00	9.75	7.60@7.625
26	14.60	57.25	57.75	10.00	9.725	7.60@7.625
27	14.60	56.75	57.25	9.95	9.70	7.625
28	14.625	57.375	57.875	9.95	9.70	7.625
Av.	14.596	56.958	57.458	9.983	9.729	7.617

*These prices correspond to the following quotations for copper delivered: Jan. 22d, 14.80c.; 23d to 27th incl., 14.85c.; 28th, 14.875c.

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

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

Quotations for zinc are for ordinary Prime Western brands. Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

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

London

Jan.	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic						
	Spot	3M		Spot	3M	Spot	3M	Spot	3M
22	64 7/8	65 7/8	69 1/2	257 1/4	260 1/2	39 7/8	38 1/4	37 5/16	36 1/2
23	65 1/2	66 5/8	70	261 1/4	265	39 7/8	38 1/4	37 1/4	36 1/2
26	65 1/2	66 1/2	70	263 1/4	267	39 13/16	38 3/16	37 1/4	36 5/8
27	65 3/8	66 3/8	70	261 3/4	265	39 3/4	38	37 1/4	36 5/8
28	65	66	69 1/2	263 5/8	266 3/4	39 1/4	37 3/4	37 3/8	36 5/8

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

Silver, Gold, and Sterling Exchange

Jan.	Sterling Exchange "Checks"	Silver		Gold London	Jan.	Sterling Exchange "Checks"	Silver		Gold London
		New York	London				New York	London	
22	4 79	68 1/2	32 3/16	87s 0d	26	4.79 3/8	68 3/4	32 3/16	86s 9d
23	4.80	68 1/4	32	86s10d	27	4.79	68 3/8	32 1/8	86s11d
24	4 79 5/8	68 1/2	32 1/16	.....	28	4.79 1/4	68 3/4	32 5/16	86s11d

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

Prices Hold Steady in Quiet Metal Market

New York, Jan. 28, 1925—The week ending today has been an uneventful one in the non-ferrous metal market, perhaps the leading feature being a further weakening in the position of lead, which has been offered quite freely in the New York market below the 10c. level. The present inactivity is not confined to this country, sales also being in an extremely small volume in the European markets. As has been the case in the stock market, after the continual advances in the last few months, a slight reaction has been expected, but fundamental business conditions continue excellent.

Copper Still Available Below 15c.

Copper sales in the week ending Jan. 28 have been the smallest of any week since the holidays. Practically all of the larger producers have continued to quote 15c. delivered, and show no indication of an early recession from that level. After the active business that they have had in the last two or three months, they will be willing to accept a small total for January. One or two of the custom smelters and some interests handling resale lots sold fair amounts on Thursday and Friday around 14⅞c. delivered, but in the last three days most of this business was booked at 14⅞c. However, for January and February shipment to near-by points, 14⅞c. could have been done as late as yesterday, and possibly today also. In spite of the slight decline in London today, the market here seems slightly better and the large producers feel that they will again be able to obtain 15c. soon. The speculative lots of copper seem to have been pretty well sold, both here and in London.

With a month's lull in buying behind them, producers feel that an early resumption of market interest is to be expected. Consumers' plants continue to operate on as large a scale as they did early in the winter, and many March and April requirements remain to be booked.

The foreign market has been extremely quiet all week, with no pressure to sell by the representatives of American producers. Today, 15c., c.i.f. is about the best that could be done; in fact, one Continental sale of near-by copper at 14.85c. was reported.

Lead Offered Below 10c.

The contract price for New York lead, set by the American Smelting & Refining Co., continues at 10c. Lead is freely offered by practically all producers at this level, but consumers seem to have suddenly come to the conclusion that they do not need to buy quite yet after all, though three or four weeks ago, when the market was going up, their clamor was incessant. The volume of business, both in the East and Middle West, has been decidedly small. The first break reported in the 10c. level occurred on Monday, when one of the smaller producers offered lead for forward delivery at 9.90c., New York; yesterday, this interest offered spot at this price, and actually sold forward lead at 9⅞c. Today, 9⅞c. can be done for any position. Even at these concessions, sales have not amounted to much, and most of the lead has gone to consumers on contract at the 10c. level.

In the Middle West, producers have dropped somewhat below the 9⅞c. quotation in the last two or three days, and lead has been sold in St. Louis as low as 9.65c. Sellers there seem inclined to find a level at which consumers will be interested.

During the week, lead-covered cable manufacturers and ammunition makers showed perhaps the greatest interest in buying. Practically all consumers report business as excellent; no let-up in demand is seen by the largest consumer of all. Production, of course, has been stimulated by the high lead prices, but as long as the demands for lead are so heavy, any prolonged weakness in the market is unlikely.

Corroding grades of lead have sold during the week at premiums of from $2 to $3 per ton above the price of common grades.

Zinc Hovers Around 7.60c.

Few galvanizers or brass makers have been in the market for zinc during the last week, and the export demand has also been poor, but producers have been in no mood to reduce prices. With ore at its present level, smelters are complaining of little or no profit. Zinc for near-by shipment has commanded about 0.05c. per lb. more than that for March and April. The English market is now below American parity. The market for high-grade zinc continues good at 8¾c. per lb., delivered in the East, the demand for this grade of zinc by rolling mills constantly expanding.

Tin Market More Active Today at 57⅞c.

The tin market has shown little price variation during the week, and buying has not been active. Today, consumers showed a little more interest and pushed the price above the 57¾c. level first quoted. Forward deliveries have sold at from ⅛ to ¼c. above spot.

Arrivals of tin to and including Jan. 27 total 8,290 long tons, according to the New York Metal Exchange.

Silver Steady

China markets have been closed since Jan. 24 on account of the New Year holidays, but the silver price has not been affected, on account of the small part which China has played in the market of late. Support continues from India and London.

Mexican Dollars—Jan. 22d, 52⅜c.; 23d, 52⅝c.; 24th, 52⅜c.; 26th, 53c.; 27th, 52⅝c.; 28th, 53c.

Foreign Exchanges Quiet

Foreign exchanges have been generally quiet, with no price variations of importance. Closing cable quotations on Tuesday, Jan. 27, were: Francs, 5.4125c.; lire, 4.1825c.; and marks, 23.805c. Canadian dollars advanced to $\frac{3}{32}$ per cent discount.

Other Metals

Quotations cover large wholesale lots unless otherwise specified.

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

Antimony—Per lb.:
Chinese brands, 16¾c.
Cookson's "C" grade, 19½c.

Chinese needle, lump, nominal, 10c.

Standard powdered needle, 200 mesh, 11½@13c.

White oxide, Chinese, 99 per cent Sb_2O_3, 14¾@16c.

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

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

Iridium—$325 per oz.

Nickel—Ingot, 31c.; shot, 32c.; electrolytic, 38c.; London, £162½ per long ton.

Palladium—$79@$83 per oz. Crude, $60@$65.

Platinum—$117 per oz. for refined. Crude, $111@$112.

Quicksilver—$82@$83 per 75-lb. flask. San Francisco wires $81.65. Quiet. London, £14.

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 Jan. 3 issue.

Metallic Ores

Chrome Ore—Indian ore, $21 per ton, c.i.f. Atlantic ports.

Tungsten Ore—Per unit, N. Y.:
Chinese wolframite, $9.
High-grade Western scheelite, $9.50.

Iron Ore, Galena Radio Crystals, Manganese, Molybdenum, Tantalum. and **Vanadium Ores** are unchanged from Jan. 3 quotations.

Lead Ore $16 Lower—Zinc Blende $2 to $3 Lower

Joplin, Mo., Jan. 24, 1925

Zinc Blende	Per Ton
High	$61.40
Premium, basis 60 per cent zinc	$55.00@$56.00
Prime Western, 60 per cent zinc	53.00@ 52.00
Fines and slimes	51.00@ 49.50
Average settling price, all	$57.23
Lead Ore	
High	$147.75
Basis 80 per cent lead	130.00
Average settling prices, all	140.87

Shipments for the week: Blende, 12,352; calamine, 125; lead, 3,139 tons. Value, all ores the week, $1,153,210.

With prices crowded down $2 to $3 per ton on blende, buyers bought 21,690 tons of ore, almost as much as in the two preceding weeks. Prices were lowered in the two weeks $5 per ton.

Lead ore made one of the most sensational declines ever recorded, with a fall of $16 per ton basis price.

Production was decreased approximately 500 tons this week, but a number of mills are still being operated on double shift. Except for the fact that so large a tonnage is purchased ahead of production, stocks would show an increase.

Platteville, Wis., Jan. 24, 1925

Zinc	Per ton
Blende, basis 60 per cent zinc	$57.50
Lead	
Lead, basis 80 per cent lead	$130

Shipments for the week: Blende, 743 tons; lead, 80 tons. Shipments for the year: Blende, 2,186; lead 160 tons. Shipments for the week to separating plants, 1,178 tons blende.

Non-Metallic Minerals

Feldspar—Per net ton, in bulk, f.o.b. mill.

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

Other feldspar quotations in Jan. 3 issue.

Amblygonite, Asbestos, Barytes, Bauxite, Beryl, Borax, Celestite, Chalk, China Clay, Corundum, Diatomaceous Earth, Emery, 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 Jan. 3 prices.

Mineral Products

Arsenious Oxide (white arsenic)—5¾c. per lb.

Copper Sulphate, Sodium Nitrate, Sodium Sulphate, and **Zinc Oxide** are unchanged from Jan. 3 prices.

Ferro-Alloys

Ferromanganese—Domestic, German, and English, $115 per gross ton, f.o.b. works, or duty paid at seaport.

Ferrocerium, Ferrochrome, Ferromolybdenum, Ferrosilicon, Ferrotitanium, Ferrotungsten, Ferro-uranium and **Ferrovanadium** are unchanged from the prices given in the Jan. 3 issue.

Metal Products

Rolled Copper—Sheets, 23c.; wire, 17¼c.

Lead Sheets—Full lead sheets, 14c. per lb.; cut lead sheets, 14¼c. in quantity, mill lots.

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

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

Refractories

Bauxite Brick, Chrome Brick, Firebrick, Magnesite Brick, Magnesite Cement, Silica Brick, and **Zirkite** are unchanged from Jan. 3 prices.

Iron Trade Holds Firm

Pittsburgh, Jan. 27, 1924

Steel mill operations are running slightly heavier than in the fore part of January, the month promising to show an average above 85 per cent, against 68 per cent in 1924 and 80 per cent in 1923. Doubt has increased whether the present pace can long be maintained, but the outlook is fairly clear for the next two months.

Fabricated steel awards have been moderately heavy for the last fortnight. The Pennsylvania Railroad has placed 100,000 tons of rails, its order being smaller and later than usual on account of a large tonnage carried over, and there is fair inquiry for freight cars. General line buying of steel products has been rather light.

In bars, shapes, plates, sheets and wire products there is much talk of prospective price advances, but as buyers in general are showing no anxiety to buy, there is room for suspicion that price advances are contemplated for the purpose of encouraging buying at present prices. There is more shading in black sheets than a week ago. Tin plate specifications were heavy for January but are now running a trifle slack.

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

Connellsville Coke—There has been much coke on track, with sales of distress lots of furnace coke at well below $3.50, at which figure the market is nominally quotable. Merchant coke production is being reduced. Spot foundry remains $4.75@$5.25, but is much easier.

Facts for the Stockholder

XXXVI—Copper Range Company

COPPER RANGE CO. was incorporated in Michigan, January, 1899. It acquired the property and assets of the Copper Range Consolidated Co. in August, 1915, and the Baltic and Trimountain properties upon the dissolution of those two mining companies. It owns the entire capital stock of the Trimountain Mining Co. and the Copper Range R.R. Co., 97.256 per cent of the Atlantic Mining Co. and 50 per cent of the Champion Copper Co. The company owns also $870,000 of bonds of the Copper Range R.R. Co., which owns about 122 miles of lines and operates about 162 miles. It is the second largest producer of copper in the Lake Superior district, including the output of the Baltic and Trimountain mines and half the output of the Champion mine.

Properties owned by the company aggregate over 23,500 acres, mostly in Houghton County, Mich.; and its subsidiary companies own 12,240 acres in addition.

Production from Baltic, Trimountain and half that of Champion has been as follows, in millions of pounds per annum: 28.9 in 1912, 18.7 in 1913, 19.9 in 1914, 37.0 in 1915, 37.9 in 1916, 31.2 in 1917, 26.6 in 1918, 28.0 in 1919, 16.9 in 1920, 22.3 in 1921, 19.2 in 1922, and 23.6 in 1923. The copper recovery in pounds per ton was about 20.8 in 1911, 31.94 in 1917, 33.61 in 1918, 37.57 in 1919, 37.42 in 1920, 37.52 in 1921, 36.32 in 1922, and 39.74 in 1923.

The cost of production per pound of copper, before depreciation and depletion, was about as follows: 10.51c. in 1912, 11.71c. in 1913, 10.66c. in 1914, 8.06c. in 1915, 9.56c. in 1916, 12.58c. in 1917, 14.46c. in 1918, 15.35c. in 1919, 17.77c. in 1920, 12.74c. in 1921, 13.43c. in 1922, and 19.01c. in 1923. Cost of depreciation and depletion combined has been as follows: 2.5c. in 1914, 1.9c. in 1915, 3.1c. in 1916, 3.2c. in 1917, 3.4c. in 1918, 3.5c. in 1919, 4.1c. in 1920, 3.73c. in 1921, 3.91c. in 1922.

The copper was sold at an average price of 28.73c. a pound in 1917, 24.76c. in 1918, 18.67c. in 1919, 17.14c. in 1920, 13.19c. in 1921, 14.17c. in 1922, and 14.8c. in 1923.

Capital stock consists of 394,727 shares, par value $25. There is no funded debt. At the beginning of 1924 the company had about 7,300 stockholders, compared with 6,771 on Sept. 15, 1920; 6,644 on Jan. 1, 1920; 6,515 on Jan. 1, 1919; 6,163 on Jan. 1, 1918; 5,582 on Jan. 1, 1917; and 5,999 on Jan. 1, 1912.

Earnings per share have been as follows: $4.29 in 1912, $1.24 in 1913, $1.25 in 1914, $9.20 in 1915, $15.57 in 1916, $12.60 in 1917, $7.35 in 1918, $2.47 in 1919, loss of 1c. a share in 1920, profit $0.60 in 1921, $0.84 in 1922, loss of $1.44 a share in 1923.

The dividend record is as follows: $4 a share in 1905. $6 in 1906 and 1907, $4 in 1908 and 1910, $3.50 in 1911, $2 in 1912, $2.75 in 1913, none in 1914, $3 in 1915, $10 in 1916 and 1917, $6 in 1918, $2.50 in 1919, $1.50 in 1920, none in 1921, $1 in 1922, 1923, and 1924.

At the close of 1923, current assets were $6,556,239, compared with current liabilities of $1,540,790, leaving an excess of assets at $5,015,449, equivalent to about $12.72 a share.

The stock was quoted up to 105 in 1907. During the last few years the price range on the Boston Stock Exchange has been: High, 62 in 1919; low, 25 in 1920; closing price 28¾ on Jan. 27, 1925. INVESTIGATOR

Magma Increases Outstanding Stock and Retires Bonds

The capital stock of the Magma Copper Co. will be increased from 350,000 to 410,000 shares, of no par value, the stockholders have decided. The additional 60,000 shares of stock will be issued for a consideration of $36.50 per share. The company is planning to retire the greater part or all of its outstanding ten-year 7 per cent convertible gold bonds by June 1. Under the company's indenture approximately $360,000 must be turned over to the trustee to cover sinking-fund requirements of $1.50 a ton on the ore treated last year. The terms of the trust agreement securing the bonds provide that the trustee must apply this fund to the acquisition or redemption of the bonds at not exceeding $105 and accrued interest before June 1, 1925.

Higher Metal Prices Again Reflected in Increased Dividends for January

The following dividends were paid by mining and metallurgical companies operating in the Americas in January, 1925:

Companies in the United States	Situation	Per Share	Total
Arizona Commercial, c.	Ariz.	$0.50 SA	$132,500
Bingham Mines, s, l.	Utah	0.50 K	32,500
Cleveland Cliffs Iron	Mich., Minn.	0.75 A	298,722
Cresson Consolidated Gold	Colo.	0.10 Q	122,000
Homestake Mining, g.	S. D.	1.50 MX	376,740
Inland Steel pfd.	Minn.	1.75 Q	175,000
Kennecott Copper	Alaska	0.75 Q	3,197,823
Nichols Copper, pfd	N. Y.	1.75 Q	38,500
Park City, s,l,z.	Utah	0.15 Q	131,400
Phelps Dodge, c.	Ariz., Mex.	1.00 Q	500,000
Republic Iron & Steel, pfd.	Various	1.75 Q	437,500
Silver King Coalition, s,l.	Utah	0.20 Q	243,250
Sloss-Sheffield Steel & Iron, pfd	Ala.	1.75 Q	117,250
Tintic Standard, s,l,c.	Utah	0.30 Y	345,874
Tonopah Extension, s,g.	Nev.	0.05 Q	69,636
U. S. Smelting, Refining & Mining, pfd.	Various	0.875 Q	425,556
Utah Apex, l,c,s,g.	Utah	0.25 K	132,050
Virginia Iron, Coal & Coke, pfd.	Various	2.50 SA	125,000
Companies in other countries			
Ahumada Lead.	Chihuahua	$0.15 Q	$178,053
Asbestos Corporation, pfd.	Quebec	1.50 Q	60,000
Consolidated Mining & Smelting	B. C.	0.75 SA	320,167
Dome Mines, g.	Ont.	0.50 Q	500,000
Erupcion, l,s.	Chihuahua	0.15 Q	187,500
Frontino & Bolivia Gold	Colombia	1 sh. SA	£7,000
Frontino & Bolivia Gold, pfd.	Colombia	1 sh. SA	1,169
Hollinger Consolidated Gold.	Ont.	$0.05 4 wks.	$246,000
N. Y. & Honduras Rosario, g, s.	Honduras	0.25 Q	50,000
Nipissing Mines, s.	Ont.	0.30 Q	360,000
Premier Gold, s,g.	B. C.	0.10 QZ	500,000
San Francisco Mines, l,z,s,g.	Chihuahua	2 sh. K	£150,396
Silversmith, s,l,z.	B. C.	$0.02 Q	$50,000
Wright-Hargreaves, g.	Ont.	0.05 QW	137,500
			$9,490,521

Q, quarterly; M, monthly; SA, semi-annually; K, irregularly; A, annually; X, includes $1 extra; Y, extra dividend; Z, includes 2c. extra; W, includes 2½ c. extra; c, copper; s, silver; l, lead; g, gold; z, zinc.

Dividends paid in January show a pronounced increase over those paid for the two previous corresponding quarters, in October and July of 1924, being more than $2 000,000 greater than the October total. Bingham had not paid a dividend since 1919; in the meantime the capitalization has been reduced by buying up stock in the open market. Homestake reflected prosperous conditions at that property by declaring an extra dividend of $1 in addition to the regular monthly of 50c. Last year a similar extra was declared in April.

Nichols Copper has paid a dividend on its new preferred stock, 22,000 shares of a par value of $100 having been issued. Practically all of the old 8 per cent preferred stock has been redeemed, the new 7 per cent preferred being issued to take the place of this and $3,000,000 worth of debentures, which the company has been in process of retiring for some time. Silver King Coalition increased its quarterly dividend from 15 to 20c. per share. Tintic Standard paid 50 per cent more than its regular quarterly dividend, as an extra. The increased dividends paid by these Utah companies result from the present phenomenally high prices that are being realized for lead.

Utah Apex paid in January of this year the same dividend as was paid last September, that being the only one paid in 1924; the indications are that the shareholders will fare better this year. Premier Gold increased its regular 8c. dividend by 2c., and Silversmith paid double its usual disbursement.

A Correction

In our Annual Review Number and Year Book (Jan. 17), the ending of the article "Lead Breaks Records," by Mr. Irwin H. Cornell, reads: "The price during the new year will be determined by the world supply and demand. The world demand will apparently be large, and unless the production in the countries outside of the United States can be materially increased, the price is bound to show a decided advance as a result of these strong basic conditions."

What Mr. Cornell actually wrote was: "The price during the new year will be determined by the world supply and demand. The world demand will apparently be large, and unless the production in the countries outside of the United States can be materially increased, the price is bound to reflect these strong basic conditions."

Current Prices of Mine Materials and Supplies

RISE AND FALL OF THE MARKET

Principal among the items for which there is active current demand with consequent upward trend in prices, are: railroad materials and track supplies; sheet steel; lumber, particularly hemlock timbers; nails, wire and cut; red and white lead; litharge and rope. Some weakness is noted in steel pipe and c.-i. pipe, clay products and explosives.

SHEETS—Quotations are per 100 lb. in various cities from warehouse also the base quotations from mill:

Blue Annealed	Pittsburgh, Large Mill Lots	St. Louis	Chicago	San Francisco	New York
No. 10	$2.70	$3.90	$3.80	$3.95	$3.89
Black					
No. 28	3.60	4.65	4.50	5.00	4.60
Galvanized					
No. 28	4.75	5.65	5.50	6.05	5.60

STEEL RAILS—The following quotations are per ton f.o.b. Pittsburgh and Chicago for carload or larger lots:

	Pittsburgh Current	Pittsburgh One Year Ago	Birmingham	Chicago
Standard bessemer rails	$43.00	$43.00	$43.00	$43.00
Standard openhearth rails	43.00	43.00	43.00	43.00

TRACK SUPPLIES—The following prices are base per 100 lb. f.o.b. Pittsburgh for carload lots, together with the warehouse prices at the places named:

	Pittsburgh Current	Pittsburgh One Year Ago	Chicago	St. Louis	San Francisco	Birmingham
Standard spikes, ⅝-in. and larger	$2.90	3.00@3.15	$3.45	$3.55	$4.35	$2.80
Track bolts	3.75@4.00	4.00@4.25	4.45	4.55@4.90	5.85	4.00
Standard section angle bars	2.75	2.75	3.30	3.40	4.00	2.85

STRUCTURAL MATERIAL—Following are base prices f.o.b. mill, Pittsburgh and Birmingham together with quotations per 100 lb. from warehouses at places named:

	Pittsburgh, Mill	Birmingham Mill	New York	Dallas	St. Louis	Chicago	San Francisco
Beams, 3 to 15 in.	$2.00@2.10	$1.90@2.15	$3.34	$4.15	$3.25	$3.10	$3.00
Channel, 3 to 15 in.	2.00@2.10	1.90@2.15	3.34	4.15	3.25	3.10	3.00
Angles, 3 to 6 in., ¼ in. thick	2.00@2.10	1.90@2.15	3.34	4.15	3.25	3.10	3.00
Tees, 3 in. and larger	2.00@2.10	1.90@2.15	3.34	4.15	3.25	3.10	3.05
Plates	2.00@2.10	1.90@2.15	3.34	4.15	3.25	3.10	3.00

WIRE ROPE—Discounts from list price, f.o.b. New York and east of Missouri River, on regular grades of bright and galvanized are as follows:

Cast steel round strand rope	20%
Galvanized steel rigging and guy rope	7½%
Round strand iron and iron tiller	5%
Plow steel round strand rope	35%
Special steel round strand rope	30%
Galvanized iron rigging and guy rope	+12½%

	New York	Cleveland	Chicago
Drill Rod (from list)	60%	55%	50%

WROUGHT PIPE—The following discounts are to jobbers for carload lots on the latest Pittsburgh basing card:

	Inches	Steel Black	Steel Galv.	Iron Inches	Iron Black	Iron Galv.
BUTT WELD—	½ to 3	62	50½	⅛ to ⅜	30	13
LAP WELD—	2½ to 6	59	47½	3 to 6	28	13

STEEL PIPE—From warehouses at the places named the following discounts hold for steel pipe:

	Black New York	Black Chicago	Black St. Louis
3½ to 6 in. lap welded	48%	53%	46%

CAST-IRON PIPE—The following are prices per net ton for carload lots:

	New York Current	New York One Year Ago	Birmingham	Chicago	St. Louis	San Francisco
6 in. and over	$54.60@55.60	$62.10@63.60	$40.00	$47.20@48.20	$48.60	$55.00

NUTS—Semi-finished, ½x½-in., 2c. each. Discount 70% for ⅛-in. and smaller; 65% for ¼-in. and larger. Case hardened, 6c. each, less 50%.

HOLLOW TILE—Price per block in carload lots to contractor for hollow building tile.

	New York Current on Trucks	New York One Year Ago	Chicago	Philadelphia	St. Louis	San Francisco	Perth Amboy N. J., Factory
4x12x12	$0.1162	$0.1179	$0.06	$0.125	$0.072	$0.108	
6x12x12	.1743	.1769	.0825		.097	.156	$0.2388*
8x12x12	.2179	.2211	.1125	.215	.132	.244	.2956†

* 10x12x12; † 12x12x12.

MACHINE BOLTS—½x1½-in., per 100, $1.70. Discount at New York warehouses on all sizes up to 1x30-in., 45%.

LUMBER—Prices of rough Douglas Fir No. 1 common, in carload lots to dealers at yards in San Francisco. To contractors, $2 per M. ft. additional.

	6-8 and 12 Ft.	10-16-18 and 20 Ft.	22 and 24 Ft.	25 to 32 Ft.
3x3 and 4	$28.00	$29.00	$30.00	$33.00
3x6 and 8	28.00	29.00	30.00	33.00
4x4-6 and 8	28.00	29.00	30.00	33.00

Wholesale prices to dealers of long leaf yellow pine. To contractors in New York City, delivered from lighters or cars to job, $5 additional.

	New York 20 Ft. and Under	New York 22-24 Ft.	Chicago 20 Ft. and Under	Chicago 22-24 Ft.
3x4 to 8x8	$43.00	$44.00	$.....	$...
3x10 to 10x10	49.00	50.00	.....	.....
3x12 to 12x12	55.00	56.00	.....	.....

Other Cities	8 x 8-In. x 20 Ft. and Under Pine	Fir*	Hemlock	Spruce	12 x 12-In. 20 Ft. and Under Pine	Fir*
Boston	$54.00	$52.00†	$50.00	$50.00	$64.00	$62.00†
Cincinnati	40.00	74.00	74.00	88.00	44.00	78.00
Denver	.....	38.75	38.75	.....	.....	39.75
Minneapolis	42.00	39.75	39.00	.....	44.50	39.75
Kansas City	.....	.....	.....	.....	.....	.....
Birmingham	32.00	.....	.....	.....	32.00	.....

* Douglas fir. † Prime.

NAILS—The following quotations are per keg from warehouse:

	Pittsburgh, Mill	Chicago	San Francisco	Dallas	St. Louis	Montreal
Wire	$2.85	$3.25	$4.00	$4.25	$3.19	$4.95
Cut	2.90	....	5.25	....	3.44	5.00

PORTLAND CEMENT—Prices to contractors per bbl. in carload lots *without bags*. Cash discount not deducted.

	Current	One Month Ago	One Year Ago
NewYork, del. by truck	$2.50@2.60	$2.50@2.60	$2.50@2.60
Chicago, f.o.b.	2.20	2.10	2.10
Cleveland, f.o.b.	2.39	2.39	2.41

LIME—Warehouse prices:

	Hydrated, per Ton Finishing	Hydrated, per Ton Common	Lump, per Barrel Finishing	280-lb. net Common
New York	$18.20	$12.@13.10	$3.75	$2.50@$3.00
San Francisco	22.00	.....	.....	(180-lb. net) 1.60

LINSEED OIL—These prices are per gallon:

	New York Current	New York One Year Ago	Chicago Current	Chicago One Year Ago
Raw in barrel (5 bbl. lots)	$1.17	$0.95	$1.10	$0.94

WHITE AND RED LEAD—In 100-lb. kegs, base price in cents per pound:

	Dry Current	Dry 1 Yr. Ago	In Oil Current	In Oil 1 Yr. Ago
Red	16.75	14.00	18.25	15.50
White	16.75	14.00	16.75	14.00

HOSE—Quotations at New York warehouses:

Fire Protection — 50-Ft. Lengths

Underwriters' 2½-in. coupled, single jacket ..... 56c per ft.

Air—Best Grade

¾-in., per ft. ..... 3 ply $0.36 4 ply $0.44½

Steam—Discounts from List

First grade ..... 30–5% Second grade ..... 40–5% Third grade ... 50%

RUBBER BELTING—List price 6-in., 6 ply, $1.83 per lin.ft. for rubber transmission belting.

Best grade ..... 50% Second grade 50-10%

LEATHER BELTING—List price, 24c. per lin.ft. per inch of width for single ply at New York warehouses:

Grade	Discount from list
Medium	40–2½%
Heavy	30–5%

RAWHIDE LACING—For cut, best grade, 45–5%, 2nd grade, 55%. For laces in sides, best, 41c. per sq.ft.; 2nd, 37c. Semi-tanned: cut, 45–5%; sides, 41c. per sq.ft.

PACKING—Prices per pound:

Rubber and duck for low-pressure steam, ½ in.	$0.90
Rubber sheet	.45
Rubber sheet, wire insertion	.70

MANILA ROPE—Per lb., ¾-in. and larger, 1,200-ft. coils.

Atlanta	$0.21	New Orleans	$0.21½
New York	.22	Seattle	.17
Chicago	.21½	San Francisco	.21

EXPLOSIVES—Prices per pound of dynamite in small lots:

	Gelatin 40%	Gelatin 60%
New York	$0.27	$0.295
Minneapolis	.1917	.2123
Denver	.2025	.2275
Seattle	.165	.19
Cincinnati	.22	.245
New Orleans	.235	.26
San Francisco	.1625	.1925

FLOTATION OIL—

Pine tar, 50 gal. bbl., gross weight 500 lb., f.o.b. New York, carload lots, per gal.	$0.30

CHEMICALS—

Zinc dust, 550 lb. casks, f.o.b. Palmerton, Pa., per lb.	$0.08½
Litharge, f.o.b. New York, kegs, per 100 lb.	16.75
Sodium cyanide, 220 lb. single case lots, f.o.b. New York, per lb.	.19@.22

Mining Stocks

Week Ended January 24, 1925

Stock	Exch.	High	Low	Last		Last Div.
COPPER						
Alaska-Br. Col.	N. Y. Curb			*6		
Anaconda	New York	46½	44⅜	45	Ja.17, Fe.16,	0.75
Arcadian Consol.	Boston	2⅜	2⅛	2⅜		
Ariz. Com'l.	Boston	13½	12⅜	12⅜	Ja. 19, Ja. 31	0.50
Calaveras	N. Y. Curb	1⅜	1⅛	1⅜		
Calumet & Arizona	New York	55⅞	55	55	De.5, De.22 Q	0.50
Calumet & Hecla	Boston	18	17⅛	17⅜	Ja.30, Mh.4	0.50
Canario Copper	N. Y. Curb	4⅛	4⅛	4⅛		
Cerro de Pasco	New York	54½	53	54¼	Ja. 22, Fe. 2, Q	1.00
Chile Copper	New York	36⅞	35½	36¼	De.3, De.29, Q	0.62½
Chino	New York	25⅛	24½	25	Sept., 1920	0.37½
Con. Coppermines	N. Y. Curb	3 1/16	3	3⅛		
Copper Range	Boston	31½	30⅜	30½	May, 1924	1.00
Crystal Copper	Boston Curb	*59	*55	*57		
Davis-Daly	Boston	*68	*67	*67	Mar., 1920	0.25
East Butte	Boston	5½	5	5	Dec., 1919	0.50
First National	Boston Curb	*34	*30	*33	Feb., 1919	0.15
Franklin	Boston	*65	*40	*50		
Gadsden Copper	Boston Curb	*76	*75	*75		
Granby Consol.	New York	20⅜	19	19½	May, 1919	1.25
Greene-Cananea	New York	18	17	17	Nov., 1920	0.50
Hancock	Boston	†1½				
Howe Sound	N. Y. Curb	3½	3½	3½	April 1924	0.05
Inspiration Consl.	New York	30⅞	29⅝	30	De.20, Ja.7, Q	0.50
Iron Cap	Boston Curb	2	2	2	May, 1923	0.15
Isle Royale	Boston	19	18½	18½	Sept. 1923	0.50
Jerome Verde Dev.	N. Y. Curb	1 1/16	1 1/16	1 1/16		
Kennecott	New York	56⅜	54	55⅛	De.2, Ja.2,	Q 0.75
Keweenaw	Boston	*99	*80	*99		
Lake Copper	Boston	3	2⅞	2⅞		
Magma Copper	New York	37⅛	33⅜	35⅜	Jan., 1919	0.50
Mason Valley	N. Y. Curb	2⅜	2⅛	2⅛		
Mass Consolidated	Boston	1¼	1	1	Nov., 1917	1.00
Miami Copper	New York	24	23½	23⅜	Fe.2 Fe.16 Q	0.50
Mohawk	Boston	39½	36½	39	Ja. 13, Mh. 2	1.00
Mother Lode Coa.	New York	8⅝	8⅛	8⅝	De. 12, De. 31	0.37½
Nevada Consol.	New York	15⅞	14⅜	14⅞	Sept., 1920	0.25
New Cornelia	Boston	24	22½	22⅝	Fe. 6, Fe. 23	0.25
New Dominion	N. Y. Curb			2½		
North Butte	Boston	3½	3	3	Oct., 1918	0.25
Ohio Copper	N. Y. Curb	1 1/16	1 1/16	1⅛	No.14, De.2	0.05
Old Dominion	Boston	24¼	24	24⅛	Dec., 1918	1.00
Phelps Dodge	Open Mar.	†130	†125		De.2, Ja.2 Q	1.00
Quincy	Boston	34½	33⅛	33⅛	Mar., 1920	1.00
Ray Consolidated	New York	15½	14⅛	14⅜	Dec., 1920	0.25
Ray Hercules	N. Y. Curb			*14		
St. Mary's Min. Ld.	Boston	45½	43⅛	43⅛	May 1924	3.00
Seneca Copper	New York	1⅛		1		
Shannon	Boston	1⅛	1⅛	1⅛	Nov., 1917	0.25
Shattuck Arizona	New York	7⅞	7	7	Jan., 1920	0.25
Superior & Boston	Boston	1⅝	1⅛	1⅜		
Tenn. C. & C.	New York	8⅞	8⅝	8⅝	De.31, Ja.15,Q	0.25
United Verde Ex.	N. Y. Curb	28⅛	27⅛	28	Ja. 2, Fe. 2	0.50
Utah Copper	New York	91½	91	91⅛	De.12, De.31,Q	1.00
Utah Metal & T.	Boston	†*68			Dec., 1917	0.30
Victoria	Boston	*75	*75	*75		
Walker Mining	N. Y. Curb	3⅜	3⅛	3⅜		
Winona	Boston	*26	*26	*26		
NICKEL-COPPER						
Internat. Nickel	New York	27	25⅞	26⅛	March, 1919	0.50
Internat. Nickel pfd.	New York	97	96	96	Ja. 15, Fe. 2, Q	1.50
LEAD						
Carnegie Lead & Zinc	Pittsburgh	6	5¾	5⅞		
National Lead	New York	162	159	160⅜	De.12, De.31, Q	2.00
National Lead pfd.	New York	116½	116⅛	116⅛	Fe.2, Mh.14, Q	1.75
St. Joseph Lead	New York	46⅜	43⅞	44⅛	De. 9, De. 20	0.50
ZINC						
Am. Z. L. & S.	New York	11⅛	10⅜	10⅜	May, 1920	1.00
Am. Z. L. & S. pfd.	New York	35⅛	31	33	Nov., 1920	1.50
Butte C. & Z.	New York	8	7⅛	7⅛	De.10, De.24	0.50
Butte & Superior	New York	23⅛	20⅜	20⅜	June, 1923	0.50
Callahan Zn-Ld	New York	4⅞	3⅞	3⅞	Dec., 1920	0.50
New Jersey Zn.	N. Y. Curb	196⅜	190⅛	193⅝	Ja.20, Fe.10	2.00
United Zinc	N. Y. Curb			*15		
Yellow Pine	Los Angeles	*76½	*75	*75	De.10,De.15 Q	0.04
SILVER						
Alvarado	Boston Curb	1⅛	1⅛	1⅛	Oct. 1920	0.50
Beaver Consol.	Toronto	*32	*30½	*31	May, 1920	0.03
Castle-Trethewey	Toronto	*75	*73½	*74½		
Coniagas	Toronto	2.20	2.00	2.10	May, 1924	0.12½
Keeley	Toronto	2.16	2.13	2.14	Sept. 15, SA	0.12
Kerr Lake	N. Y. Curb	1⅛	1⅛	1⅛	Oc. 1, Oc. 15,	0.12½
La Rose	Toronto	*27	*14¾	*25	Apr., 1922	0.10½
Lorrain Trout Lake	Toronto	1.26	1.25	1.25		
McKinley-Dar.-Sav.	Toronto	*19½	*17	*19	Oct., 1920	0.03
Mining Corp. Can.	Toronto	2.90	2.85	2.88	Sept., 1919	0.12½
Nipissing	N. Y. Curb	6¼	6⅛	6⅛	Ja.18,Ja.20,QX	0.30
Ontario Silver	New York	5⅛	5	5⅛	Jan., 1919	0.50
Temiskaming	Toronto	*9⅜	*8⅝	*8⅝	Jan., 1920	0.40
GOLD						
Alaska Gold	New York			*25		
Alaska Juneau	New York	1	1	1		
Argonaut	Toronto	*34	*32½	*33⅜		
Carson Hill	Boston	*51	*50	*50		
Consol. W. Dome L.	Toronto	*19	*17	*18½		
Cresson Consol. G.	N. Y. Curb	3⅞	3⅝	3 13/16	De.31, Ja.10 Q	0.10
Crown Reserve	Toronto	*51½	*50	*50½	Jan. 1917	0.05
Dome Mines	New York	16½	15⅝	16	De.31, Ja.20, Q	0.50
Golden Cycle	Colo. Springs	1.46	1.46	1.46	Dec.11, 1924	0.03
Hollinger Consol.	Toronto	14.95	14.80	14.90	Ja.12, Ja. 28, M	0.05
Homestake Mining	New York	46½	46½	46½	Ja.20,Ja.25,MX	1.50
Jib. Consol.	N.Y. Curb	*53	*42	*43		
Kirkland Lake	Toronto	*41	*40	*40		
Lake Shore	Toronto	4.95	4.90	4.90	De.1, De.15,XQ,	0.10
McIntyre-Porcupine	New York	17	16⅞	16⅞	Fe.2, Mh.2,	0.25
Newray	Toronto	*27	*25	*25½		
Night Hawk Pen.	Toronto	*28	*25	*25		
Portland	Colo. Springs	*49	*49	*49	Oct., 1920	0.01
Rand Mines	New York	35⅞	35½	35⅞	Aug. 1924	1.71
Teck-Hughes	Toronto	1.36	1.35	1.35		
Tom Reed	Los Angeles	*43½	*38⅜	*43½	Dec., 1919	0.02
Tough-Oakes	Toronto	*41	*39½	*40		
United Eastern	N. Y. Curb	*56	*42	*52	July, 1924	0.05
Vipond Cons.	Toronto	1.35	1.33	1.33		
Wright-Hargreaves	Toronto	4.25	4.10	4.15	De.15, Ja.2,QX	0.05
GOLD AND SILVER						
Black Oak	N. Y. Curb			*81		
Con. Cortez	N. Y. Curb			*10		
Con. Virginia	San Francisco	6½	6½	6½		
Continental Mines	N. Y. Curb			1⅛		
Dolores Esperanza	N. Y. Curb			*26	July, 1923	0.05
Premier Gold	N. Y. Curb	2⅜	2⅛	2⅛	De.22, Ja.5,QX	0.10
Tonopah Belmont	N. Y. Curb	*57	*54	*54	Apr., 1923	0.05
Tonopah Divide	N. Y. Curb	*30	*27	*30	Se. 22, Oc. 10	0.10
Tonopah Extension	N. Y. Curb	3 1/16	2 1/8	2 1/8	De.11, Ja.1	0.05
Tonopah Mining	N. Y. Curb	1 1/8	1 1/8	1 1/8	Se.20, Oc.31	0.07½
Unity Gold	N. Y. Curb	*77	*75	*75		
West End Consol.	N. Y. Curb			*46	Mar., 1923	0.05
Yukon Gold	N. Y. Curb	*45	*45	*45	June, 1918	0.02
SILVER-LEAD						
Ahumada	Boston Curb	10⅛	9⅛	9⅛	De.15, Ja.2, X	0.15
Bingham Mines	Boston	34	32¾	33⅛	De.20, Ja.2	0.50
Cardiff M. & M.	Salt Lake	1.15	1.15	1.15	De.16, No.18	0.10
Chief Consol.	Boston Curb	3⅛	3⅛	3⅛	May, 1924	0.10
Columbus Rexall	Salt Lake	*23	*22	*23	Aug., 1923	0.05
Daly Mining	Salt Lake			1.50	July, 1920	0.10
Erupcion	Boston Curb	3⅜	3⅛	3⅛	De.15, Ja.2, X	0.15
Federal M. & S.	New York	25	23⅛	23⅛	Jan., 1909	1.50
Federal M. & S. pfd.	New York	63½	61½	61½	No.25, De.15,	1.75
Florence Silver	Spokane	*7⅞	*4⅛	*4⅛	Apr., 1919, QX	0.01
Hecla Mining	N. Y. Curb	14⅛	13⅛	14⅛	No.15, Dn.15	0.25
Iron Blossom Con.	N. Y. Curb	*29	*26	*29	Oc.25, 1924	0.02½
Marsh Mines	N. Y. Curb			*6	June, 1921	0.02½
Park City	Salt Lake	4.85	4.80	4.80	De. 15, Ja. 2	0.15
Park Utah	Salt Lake			3⅛	April, 1924	0.15
Prince Consol.	Salt Lake	*31⅛	*28⅛	*29⅜		
Silver King Coal	Salt Lake	5.90	5.75	5.75	De.20, Ja 2, Q	0.20
Silversmith	Spokane	*31½	*28	*31½	Ja. 1, Ja. 10	0.02
Tamarack-Custer	Spokane	*94	*90	*90	Se. 22, Se. 29	0.25
Tintic Standard	Salt Lake	9.40	9.05	9.30	Ja.2, QX	0.50
Utah-Apex	Boston	8⅜	5¾	7⅛	Ja.10, Ja.15,	0.25
IRON						
Bethlehem Steel	New York	52¼	50⅛	51⅞	Jn.1, Jy.1, Q	1.25
Char. Iron	Detroit			*20		
Char. Iron pfd.	Detroit			*74		
Colorado Fuel & Iron	New York	45⅞	42¼	43½	May, 1921	0.75
Gt. North'n Iron Ore	New York			108½	De.10, De.27	2.00
Inland Steel	New York	47	45½	47	De. 1924, Q	0.625
Mesabi Iron	N. Y. Curb	4⅛	4	4⅛		
Replogle Steel	New York	22	20½	20½		
Republic I. & S.	New York	61½	58¼	59⅜	May, 1921	1.50
Republic I. & S. pfd.	New York	94	93¼	93⅜	Mh.8, Ap.1, Q	1.75
Sloss-Sheffield S. & I.	New York	87⅞	83⅝	86½	Dec., 1924 Q	1.50
Sloss-Shef. S.&I. pfd.	New York	96½	96	96½	De.20, Ja.2, Q	1.75
U. S. Steel	New York	129⅜	124½	128½	No.29,De.3, QX	1.75
U. S. Steel pfd.	New York	125½	123½	125	No.4, No.29, Q	1.75
Virginia I. C. & C.	New York			43½	De.15, Ja.2	1.50
Virginia I.C.&C.pfd.	New York			79½	De. 13, Ja. 2, Q	2.50
VANADIUM						
Vanadium Corp.	New York	30⅜	28½	29¼	Jan., 1921	1.00
ARSENIC						
Western Utah Copper	N. Y. Curb	*20	*20	*20		
ASBESTOS						
Asbestos Corp.	Montreal	45	39	45	Oct., 1924 Q	1.00
Asbestos Corp. pfd.	Montreal	82	68⅜	80	Ja.2, Ja.15, Q	1.50
SULPHUR						
Freeport Texas	New York	10⅛	9⅞	10⅛	Nov., 1919	1.00
Texas Gulf	New York	109½	103	107½	De.1,De.15, QX	2.25
DIAMONDS						
De Beers Consol.	New York			23⅜	Ja.6, Fe.2	0.95
PLATINUM						
So. Am. Gold & P.	N. Y. Curb	3⅜	3⅛	3⅛		
MINING, SMELTING AND REFINING						
Amer. Metal	New York	52	50	50¾	No.19, De.1 Q	0.75
Amer. Metal pfd.	New York			116	No.20, De.1, Q	1.75
Amer. Sm. & Ref.	New York	100⅞	98	99⅛	Ja.16, Fe.2, Q	1.50
Amer.Sm.&Ref.pfd.	New York	110⅛	109	110	Fe.6, Mh.2 Q	1.75
Consol. M. & S.	Montreal	59½	56½	58½	De.11, Ja.15 SA	0.75
Federated Metals	N. Y. Curb			37½		
Southwest Metals	N. Y. Curb			2		
U. S. Sm. R. & M.	New York	38	36	36	Jan., 1921	0.50
U.S. Sm. R.&M.pfd.	New York	46	45½	46	Ja.8, Ja.15	0.87½

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

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