

ENGINEERING AND MINING JOURNAL

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Problem of Domestic Copper Consumption

By H. A. C. Jenison

Black Sand Deposits at Chiloe Island, Chile

By Fritz Mella

The Isthmian Oil Fields of Mexico

By Arthur H. Redfield

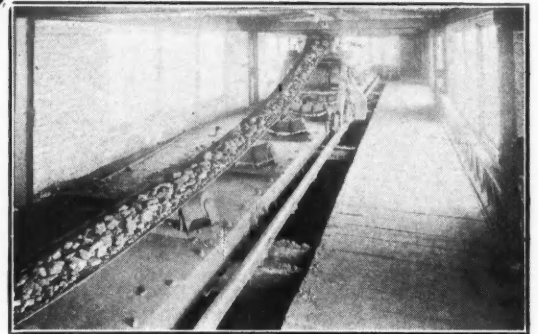
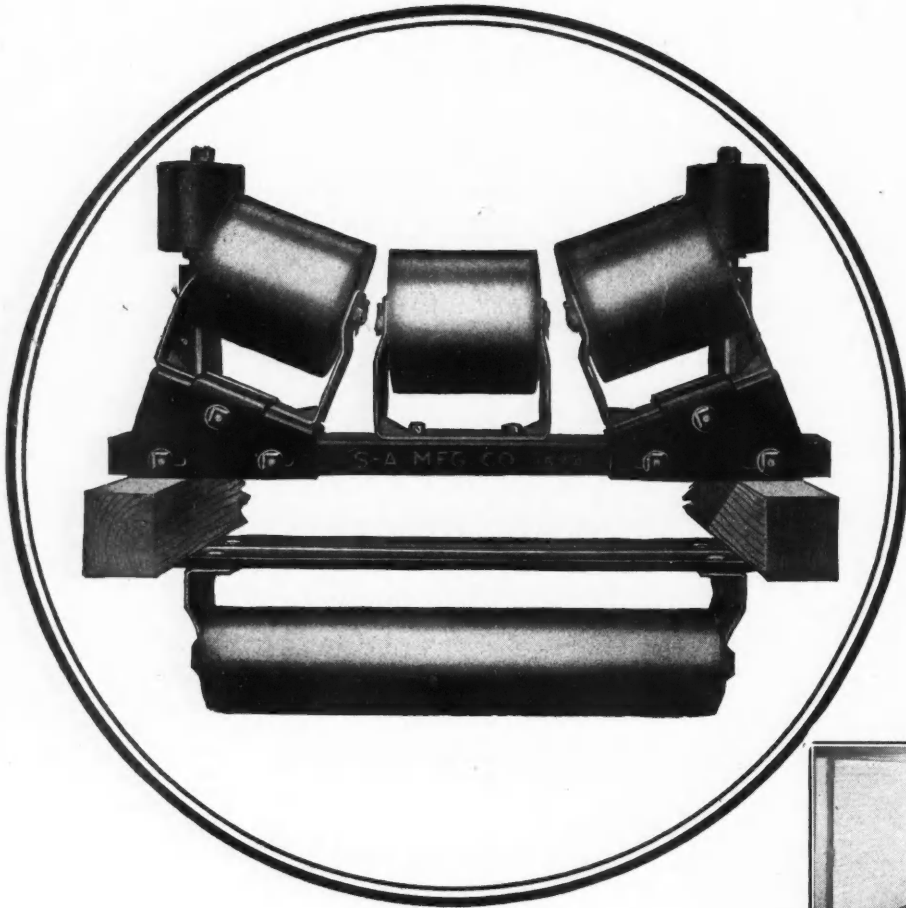
New Method for Copper Assaying

By George J. Hough



Starting a Stope
on "Conglomerate"
Copper Ore

in the
Calumet & Hecla Mine
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Hoover and Reorganization

THAT the position of Hoover in the Cabinet in Washington will further certain plans which have recently engaged the attention of engineers and of the mining industry is indicated by the tenor of recent dispatches. It is known that Hoover has studied very seriously the chaotic condition of the administrative organization of the Government at Washington, and has applied himself to a consideration of the remedy; and it is commonly understood and reported that Harding has listened sympathetically, and agreed to favor reorganization, and reassignment of the work of various bureaus, if not the bureaus themselves, in such a way as to improve efficiency and minimize duplication.

As president of the American Institute of Mining and Metallurgical Engineers and of the Federated American Engineering Societies (the order in which we mention these is designed), Hoover has been firm in his support of a Department of Public Works, and unquestionably he will further the movement now. The first changes which will take place, however, will be those which concern his own department. The Department of Commerce has hitherto been a subordinate affair, mostly a happy-go-lucky agglomeration of bureaus, without having charge of any powerful function of government. Hoover has secured from the President a promise that under him certain great powers over commerce now held by organizations without the department will be there concentrated.

Apart from domestic commerce and trade, there is the question of a foreign trade policy. The handling of this has long been a bone of contention between the departments of State and Commerce, and till now it has remained with the former, largely on account of its otherwise greater prominence and influence. This control centers in the organization of the Foreign Trade Adviser of the State Department, as the State Department has always maintained—and with considerable reason—that the foreign policy of the Government and the foreign trade policy could not be dissociated. However that may be, the supervision of foreign trade is now likely to be transferred to Hoover's administration, with the State Department in the capacity of adviser. This is a matter of importance to the mining industry, for during and after the war a conclave of representatives of various departments, called the Economic Liaison Committee, met under the chairmanship and at the call of the State Department to advise the latter concerning questions of commercial policy, especially foreign commercial policy, and there was in this organization a subcommittee on mineral industries, the chairmanship and leadership of which was in the Interior Department, through representatives of the Bureau of Mines and the Geological Survey. Through

this connection of knowledge and opinion, the Mining Bureau influenced powerfully the mineral policy of the Government, especially the foreign mineral policy. This liaison, of course, should be maintained, and, if transferred to the Commerce Department, will constitute a direct relation of Hoover to the mining industry.

Another point of contact is obtained through the Bureau of Foreign and Domestic Commerce of the Commerce Department. This bureau has been in the habit of sending abroad Foreign Trade Commissioners to investigate and report on industrial conditions in various parts of the world. All industry was included in this program, including the mining industry. Accordingly, certain mining engineers and geologists were appointed as commissioners, and were sent to investigate the mining industry in various selected localities, as in the Far East, or in Spain. No administrative tie-up existed between this work and the mining bureaus of the Government. The location of the latter in the Interior Department presupposed the conclusion that the mining industry and the mining policy of the Government was purely a domestic affair.

During the war it was brought home unmistakably that this was not even relatively so; that the mining industry had two almost equally important aspects, the domestic and the foreign side, which could not be dissociated; and the Interior Department bureaus boldly attacked, so far as powers and funds allowed, foreign problems.

Both the Bureau of Mines and the Geological Survey sent men abroad to study critical mineral problems; and the World Atlas of Commercial Geology, just published by the Geological Survey, is a testimony to its war and post-war activity in the world field. These Interior Department emissaries abroad overlapped in some cases with mining engineer commissioners sent out by the Commerce Department; and in communications which ensued the latter department suggested that foreign mining investigation be turned over to it, a request which was not pressed in view of the sound arguments to the contrary.

All the mining and mineral organizations of the Government should be centralized in one organization, and this will be one of the problems that we look to Hoover to solve.

The Slump in the Nickel Industry

NOT IN YEARS has the Canadian nickel industry been so depressed as at present. Upon the outbreak of the war, a curtailment comparable to that now in force was carried out, but it was of only short duration. The leading interest operating in the Sudbury district, the International Nickel Co., produced in 1913 about 3,700,000 lb. of nickel per month. In

September, 1914, this amount dropped to 1,200,000, but immediately the war demand began to be felt, and in 1918 production reached over 7,000,000 lb. per month. Now it has dropped back to but little over 1,500,000 lb.; the reverberatory department of the smelter is completely shut down, and only two of the eight furnaces are being operated.

The second largest interest, the Mond Nickel Co., has had only one furnace out of four in blast for the last two years, and is producing about 700 tons of bessemer matte per month, or around 600,000 lb. of nickel. Even during the war, the Mond production was never expanded in the same ratio as that of the International, for the reason that the product is shipped to Wales for refining, and ships were not available. The close of the war, therefore, found a large stock of bessemer matte at the smelter. Furthermore, government war stocks of nickel in Europe were sufficiently large to take care of peace-time demands for a year or so.

In view of the great demand for nickel during the war, a third company was organized, the British America Nickel Corporation, Ltd. This company was formed to mine and smelt ore from the Murray mine, the original discovery which was made when the main line of the Canadian Pacific Ry. was graded, in 1883. Several previous plans to work the property under various corporate names resulted in failure. Without doubt, both the International and Mond companies had the opportunity to acquire the property, but did not find it sufficiently attractive.

The birth of the present company was accompanied by more or less mystery, but it is generally understood that the British government financed in large part the development of the mine and the construction of the smelter and refinery. The government also agreed to take a certain amount of the product at the market price. About a year ago the smelter was blown in, and on Feb. 26, 1921, the operations were shut down completely, an event which was not unexpected.

From the first there was considerable doubt as to the successful outcome of this project. The ore was not as high grade as that of the International. Also, power costs were high, inasmuch as imported coal had to be used for fuel; whereas the International and Mond companies had developed cheap hydro-electric power. Production began just in time to meet the post-war slump in demand, and the contract with the British government proved a burden instead of an asset. We can imagine that operations were carried on at a loss, and we are told that the British government became very uneasy when the conditions of the loan were not being met. Apparently there was considerable agitation in Parliament over the matter. W. A. Carlyle, until recently managing director of the company, informs us, however, that the finances of the corporation have been put on a firm basis against the time of resumption. Recently the financiers had four experts from the United States, including Pope Yeatman, examine the mine, plant, and processes, and all of their reports are said to have been most satisfactory.

We suspect, however, that it will be a long time before operations are resumed, as there seems to be no necessity for a third company in the district. Both the International and Mond companies are capably managed low-cost producers, with facilities for over four times the present production. The selling policy of these companies has been eminently fair, and prices have been so adjusted as to return a reasonable profit to the stock-

holders over an extended period. Even at the height of the war demand, with the accompanying high cost, little or no increase was made in prices.

How long will the depression in nickel continue? Formerly nickel was largely used in the manufacture of nickel-steel for armor plate and in other munitions. Signs now point to a reduction in armament by the leading powers, and no more big wars are likely for twenty or thirty years: possibly not then, if civilization should learn some of the lessons of the last struggle, wherein the victors' losses were staggering. The future of nickel will, therefore, depend more upon peace-time uses than before. These are being actively pushed by the producing companies, and demand only awaits the resumption of general industrial activity.

Thomas and Tungsten

DURING THE CLOSING DAYS of the Sixty-sixth Congress, a Senator from a tungsten-producing state, Henderson, of Nevada, attempted to rush through the Senate the bill providing for a tariff on tungsten, so that the dormant tungsten industry of the country might be revived behind the kindly wall of protection, which might keep at a safe distance the product of cheap labor in China and Bolivia. A Senator from another tungsten-producing state, Thomas, of Colorado, announced that he would talk (filibuster) from then till the end of the session, if need be, to prevent the passage of the bill: and the Senator from Nevada discreetly desisted.

There is a series of gossamer-light cartoons running in a New York daily, "Wonder what a ——— thinks about," the blank being changed daily, and varying from a New President to a Discarded Golf Ball. Well, we "wonder what a Senator from a tungsten-producing state thinks about."

When the War Minerals Relief Bill, of fragrant memory, was being pushed in Congress, it provided for compensation for the producers of all so-called war minerals, from asbestos to zircon. The Secretary of the Interior refused to indorse this principle, for the minor reason that no Government stimulation whatever had been applied in the case of many of these minerals; and on being pressed to name those concerning which Government stimulation had actually been exerted, he named the immortal three—manganese, chrome, and pyrite. Whereupon, it was whispered, Senator Thomas, of Colorado, rose up and declared that if tungsten was not included he would kill the whole bill. Tungsten *was* promptly added, for the good and sufficient reason that the Colorado Senator had provided; and Thomas thereby put into the pocket of producers, or would-be producers, of war tungsten a lot of the real stuff which they had been unable to catch up to by the more hazardous route of mining.

Finally, we "wonder what a Colorado tungsten producer thinks about Thomas." Probably he will be willing to let the good deed cancel the naughty one, and withhold his further judgment of the able and down-right Colorado Senator. Certainly, if you wanted anything in the tungsten line, or didn't want it, Thomas has proved himself the critical factor. Incidentally, we believe that both Henderson, of Nevada, and Thomas, of Colorado, were in their last days in the Senate when the final incident occurred to which we referred in the beginning; and this may also be a factor in reading their respective thoughts.

Taking a "Long Shot"

A RECENT DISPATCH in the *New York Times* conveyed the startling information that a deal whereby the Shell and Royal Dutch oil interests had secured title to all properties in the Grosnaya district, in the Caucasus, had been consummated. At first we are likely to regard this in the same category as the Vanderlip concessions, but a more careful reading of the article shows that the bargain has been made with Russians who held title to the property under the Czar's régime, and that a time limit of ten years has been placed in the agreement. In other words, as the *Times* expressed it, the bargain "amounts to betting that the Bolshevik régime in Russia will fall within ten years."

There are many "ifs," "ands," and "buts" to such a contract, and to offer an opinion on the possible outcome of the venture would be largely guesswork. However, it may be assumed that considerably more judgment is being exercised than is shown by many purchasers of oil stock. At any rate, the oil is there in this instance, and the gamble concerns only the management, or, as we regard it, the mismanagement, of a country.

Eventually it must come about that the sorry plight of Russia will take a turn for the better and some semblance of a reasonable government be set up. With the establishment of such the rights of former Russian subjects will undoubtedly receive some degree of recognition, but whether this period will be reached in one, two, or ten years is an open question. However, we know the betting proclivities of Lloyds, and also take cognizance of the fact that the Englishman is a good loser. He is taking a "long shot," but the trophy is worth the chance.

The Change in the Secretaryship Of the Interior

THE SECRETARY OF THE INTERIOR is also at present the Secretary of Mines, although he does not always fully realize this dignity. Therefore, it is an important incident for the mining industry when there is a change in the Secretaryship, as there was on the fourth of March, due to a change in the administration, Judge J. B. Payne, on account of being a Democrat, stepping out, and Senator Albert B. Fall, on account of being a Republican, coming in. Judge Payne had had only a brief time of office, having succeeded, in a way, as a temporary appointee, the Hon. Franklin K. Lane, who not long after the close of the war gave up the political career to engage in business.

As Judge Payne's administration was under non-spectacular conditions, and, therefore, he had not much possibility of coming into the limelight as a Secretary, it is all the more fitting to record the ability with which he served. His assistants in the Interior Department came to value fully his keen mind, his trenchant fashion of getting to the bottom of problems, his faculty of making up his mind and announcing it, and his convincing manner of explaining the reason for his decision. We should have liked to see Judge Payne continue as Secretary.

Concerning Senator Fall's fitness to be Secretary of the Interior and of Mines, nothing can yet be said. He is a man of force and character. He comes from a great mining state. He has been conspicuous in calling attention to conditions in Mexico and demanding that the United States take steps to remedy them. This may or may not be a recommendation for a place in the

Cabinet. Along with certain pre-election utterances of the President, the general outlook would be toward a more vigorous foreign policy as regards Latin America, and a less vigorous one as regards the rest of the world; and although the Secretaryship of the Interior is far from that of State, our domestic problems, especially that of mining, are now bound together inextricably with certain foreign problems.

Cyanide Treatment

Of Amalgamation Tailings

IN THE BUREAU OF MINES January *Reports of Investigations* there appears a short article on the subject we have given this editorial. The article is a report upon concentration and cyanide tests on tailings obtained from a mill run upon ore from a mine in the Fairbanks district, Alaska. Percentage extractions are noted. An outline of a plant, with estimated costs; a flow sheet, cost estimate of operation, and the results of flotation tests upon slimes are given. In addition, the report states that "if the ore blocked out in the mine warrants the assumption that 3,000 tons of \$40 ore can be mined and milled, the question of treating the amalgamation tailing should be seriously considered." The report in both form and substance is suspiciously like many we have seen over the signatures of practicing metallurgists. In fact, it falls distinctly into the class of commercial reports.

Whatever the merit of the particular case may be, we feel that the U. S. Bureau of Mines is treading upon dangerous ground both in carrying out testing work which is distinctly an encroachment upon professional practice and in spreading a report which might lead others to believe that the Bureau's research work has descended into the category of the side room of an assayer's shop. Professional metallurgists and engineers take pride in the Bureau's accomplishments in the broader fields of research, but their support cannot be expected to continue if the Bureau fails to observe the twilight zone between clearly defined commercial work such as a consulting engineer or metallurgist might expect to get, and its own special field.

A Gram of Radium for Mme. Curie

THE MOVEMENT that is under way to raise funds for purchasing a gram of radium to be presented to Mme. Curie when she comes to this country in May is a bit of sentiment not without its practical lesson. So rare and valuable is this substance, whose mysteries are but half explored, that its very discoverer, when asked as to what she most desired, said that she wanted a gram of radium more than anything else in the world. The great value of radium and the minute quantities in which it is dealt are evidence of its scarcity. The visible supply of both the element and the ores that yield it is small, and at the present rate of consumption a scant half dozen years may see the known deposits practically exhausted. Blind optimism cannot discover new ones.

Doubtless Mme. Curie's great desire has been made more keen by the prodigal way in which she sees radium wasted in the manufacture of luminous dials and similar articles. It is safe to say that the greater part of the current production of the substance is being so consumed. Radium thus used is, of course, a total loss. It cannot be readily salvaged as can old gold and silver. A gram given to Mme. Curie will be a gram saved, and saved it should be until everything is known about it, or, at least, until its promise as a cure for cancer fades.

WHAT OTHERS THINK

The Swinging Pendulum

The editorial comment in *Engineering and Mining Journal* of March 5, on the recent annual report of the Subcommittee on Employment of the Committee on Industrial Relations, A. I. M. E., is obviously based on what is contained in a single paragraph. The statements quoted do not represent what was intended to be emphasized by the Subcommittee on Employment, nor do they represent the sentiments of the Industrial Relations Committee, nor the sentiments expressed during the sessions of the Institute held under the committee's auspices.

No blanket indictment of all employers was made or intended by the report. There is no doubt that the majority of employers are sincere in their purpose to deal fairly with their employees. It was felt, however, that attention should be called to conditions and tendencies known to exist in some industrial organizations, with a view to emphasizing how important it is that the present situation be dealt with in the right way. The sentences you quote were merely intended to lead up to what immediately follows, in which is stated, "*Let us hope they (employers) will remain wise and able and not abuse the power that is theirs. Never was there a bigger and better opportunity for management to show that it is broad-gaged,*" which statement is omitted in the editorial but which might well have been included.

The constructive features of the report may be summarized as follows:

1. In spite of handicaps of less assured permanency, instability of labor supply, accident hazards and comparatively unhealthful working conditions, the mining and metallurgical industry has done much work, and constant progress is being made, toward the solution of these industrial problems. It is recommended that the Institute committee undertake to secure information on the present status of industrial relations in the mining and metallurgical industries of the United States and Canada, and to summarize this in a report for the benefit of the Institute membership.

2. A special responsibility rests on engineers to devote their attention and energy, their engineering skill and ability, to a constructive consideration of these problems and to give assistance to both employer and employee in an effort to reduce waste and promote industrial co-operation, emphatically indorsing the views of Herbert Hoover in his address before the first meeting of the Federated American Engineering Societies. And, as the report concluded, "*Let the mining and metallurgical engineers accept his doctrine of the initiative on the part of the employer, increased production on the part of the employee, and emphasize his keynote of good-will.*"

The Committee on Industrial Relations hopes that its work will be of real service to the Institute members, by bringing to their attention what is being accomplished to promote increased confidence and respect between employers and employees. We hope that this communication may correct any wrong impression that may have been given through what was

evidently a misunderstanding of the Employment Subcommittee's report.

SIDNEY ROLLE,

Chairman Subcommittee on Employment,
Committee on Industrial Relations, A. I. M. E.
Chrome, N. J.

Selective Converting First Developed In France

In your issue of Feb. 5, J. Owen Ambler describes the practice of selective converting at Clifton, Ariz., and calls it an adaptation of the old Welsh "best-selecting" process. The practice of selective converting was, to my knowledge, first developed by Paul David at the Equilles works, in France, in a spherical converter, which he called "sélecteur" (French for selector). This converter is provided with a pocket on its side, in which are stored the "bottoms."

After the matte has been blown to white metal, blowing continues for a relatively short period, until the impurities are collected in the first copper blown, which flows in to the side pocket of the converter. By turning the converter into proper position, the "bottoms" can be tapped. Blowing then continues on the rest of the charge. By this process David not only removed all the impurities from the bulk of the copper, but collected also the silver and gold in the bottoms, and effected great economies in the succeeding electrolytic refining operations. Only the bottoms were subjected to electrolytic refining; the other converted copper could be refined directly in furnaces. David's Sélecteur is described in "Annales des Mines," Vol. XIII, 1898, on page 621.

HERBERT HAAS.

San Pedro, Cal.

The Crowe Process as Practiced at the Homestake Plant

I have read Alfred James' "Sidelights on the Cyanidation Process," in your issue of Jan. 15, with interest. This is an expression of an individual's opinion. As such, it merits respect. Were it not that certain figures are quoted in discussing the Crowe process, there would be no occasion for comment on the article. But as figures are cited to make the author's point, there is justification for examining these to see whether they are authentic, typical and fairly representative of the most recent practice.

I quote the article in question: "It is obvious from Crowe's results that the consumption of 0.407 lb. per ton of ore should never have been permitted. Ought not Crowe's figure of 0.191 lb. to be reduced to at least 0.17 lb. (African practice) or more accurately 0.07 lb. (Indian practice) by reversion to zinc shaving?"

Merely calling attention to the fact that Portland ore is generally of higher grade than African, and that any comparison of practice at the two places should be made with this fact in mind, I give herewith, for Mr. James' information, recent precipitation data from Homestake. The Crowe process was used here: Period covered, year 1920; tons of tailings treated, 1,255,419; pounds of zinc dust used, 50,133; pounds of zinc dust per ton tailings, 0.04.

Substituting these figures in the paragraph quoted, it is apparent that the argument is thereby rendered futile.

ALLAN J. CLARKE.

Lead, S. D.

Black-Sand Deposits of the Island of Chiloe

Seven Beaches on the West Side of the Island Off the Chilean Coast Are Washed for Gold- and Platinum-Bearing Sands, Principally by Means Of a Local Amalgamating Device—Value and Extent of Deposits Erratic

BY FRITZ MELLA

Written for *Engineering and Mining Journal*

THE Island of Chiloe, a Chilean possession, lies in longitude 74 deg. West, between latitudes 41 deg. 50 min. and 43 deg. 25 min. It is 100 miles in length along a north-south axis, averages 30 miles in width, and is separated from the Chilean mainland on the north by the Chacao Channel and on the east by the gulfs of Ancud and Corcovado, which form the northern extremity of the inside waterway to the Strait of

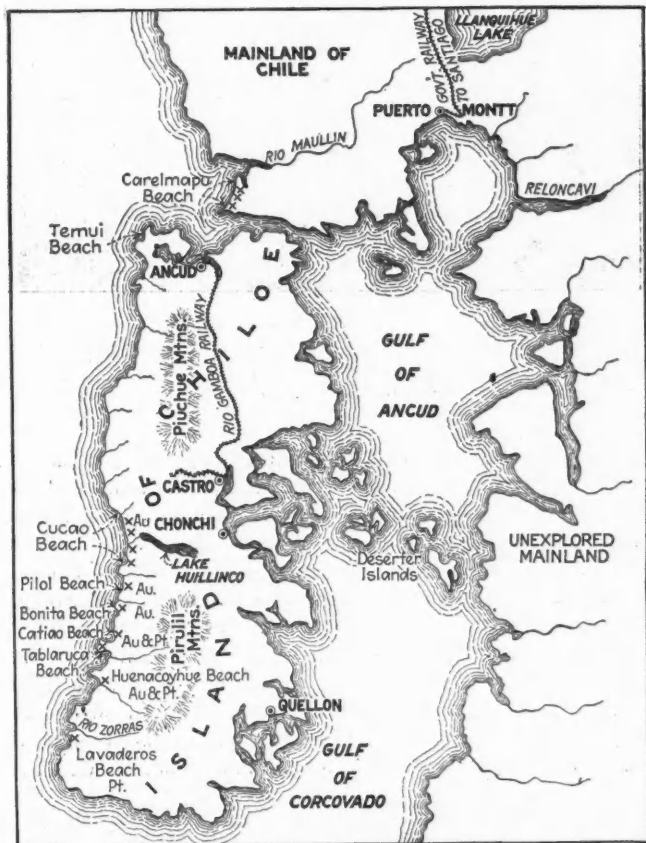
The climate, though disagreeable during the rainy season or winter months of June, July, and August, when the high north winds prevail, is not severe, as frosts are rare and snow is unknown. The annual rainfall, however, averages about two meters. Except for the beaches and small tracts cleared for agriculture, the island is still a virgin forest. The principal woods encountered are laurel and cypress and a species of oak, and dense hardwoods, locally called "luma" and "tepu," with high calorific values and used universally in that section of the country for fuel, are plentiful and cheap. The native "Chilotes," although small in stature, are strong and hardy, and make fairly good workmen. Because of their environment, they are skillful woodsmen, and at the same time natural and daring sailors. The inhabitants of the west coast occasionally engage in gold washing; but their chief occupation while at home is the raising of potatoes, for which the island is noted.

The Spaniards are credited with having worked the gold-bearing gravels of the Rio Gamboa, near Castro, on the east coast, more than a century ago, but the black sand beaches on the west coast did not attract attention until 1890. Most of the work done since that time has been of an individual nature. Several attempts by placer miners from the Punta Arenas fields to work on a larger scale are said to have resulted in failure.

The principal beaches exploited for their gold-bearing black sands are, beginning from the south, Huenacoyhue, Catiao, Tablaruca, Bonita, Cucao, Temui, and Carelmapu, the last named being situated on the mainland just across the channel from Ancud. Gold has also been reported on the Island of Cailin, across from Quellon, and on the Island of Ipun, about eighty miles south of Chiloe. Appreciable quantities of platinum are found from Tablaruca south. The auriferous- and platinum-bearing black sands consist of quartz, olivine, zircon, garnet, and other silicates, with magnetite, ilmenite, and hematite as the heavier constituents. The sands probably represent the erosion products of the basic igneous rocks of the higher cordilleras of the continent, from which they were transported to the sea by streams when the island was still a part of the mainland.

GOLD VALUES IN SANDS SHOW VARIATION

The present deposits are due to the concentrations of these sands by the sea as well as to the erosive action of the waves on the cemented sand bluffs jutting into the ocean at various points on the coast, some of which on panning yield the heavy black sands and colors of gold. The proportion of black sands on the various beaches varies from a trace to as high as 50 per cent of the deposit. As a rule, the highest gold values are found in banded layers of heavy black and garnetiferous sands, varying from thin knife-blade seams to as much as 20 cm. in thickness, and occurring between strata



MAP OF THE ISLAND OF CHILOE

Magellan. Owing to the absence of ports on the Pacific side, and the lack of means of communication by land because of the thickly wooded nature of the country, the western coast is sparsely settled, and all commerce with the island is through the channels and the ports along the eastern coast.

Small, wood-burning freight and passenger steamers of about fifty-ton register ply between the island and Puerto Montt, the southern terminal of the Chilean government railway. By through train the 600-mile journey from Santiago to Puerto Montt can be made in twenty-four hours, and from Puerto Montt to Ancud, the capital of Chiloe, requires eight or nine hours by channel boat. Points further south, such as Castro, Chonchi, and Quellon, require twenty-four to forty-eight hours. A 60-cm. gage railroad connects Ancud with Castro.

of lighter, gray sands. However, the presence of black sand does not always indicate the presence of gold, and although the deposits are extensive, the gold values appear to vary greatly within narrow limits. Elevated beds of shells on the east coast suggest that the island was subjected to at least two uplifts, so that the beaches investigated are probably all modern, and although high ancient concentrations may exist farther inland, their presence has not yet been disclosed. Owing to the thickly wooded nature of the interior, very little prospecting has been attempted there.

Generally, the concentrations of black sands are found close to the present high-tide mark, and between high and low tide, although a noticeable exception is Cucao, where the concentrated deposit lies from a hundred meters to one kilometer back from shore line. The same occurrence, but less marked, was observed on the Pilol and Bonita beaches, and it is possible that these concentrations, which are no longer subject to present wave influence, may be the results of an unusually heavy storm or a tidal wave, as they conform to the gently sloping contour of the present or modern beaches and differ from them only in their constituents. Similar conditions are reported on some of the beaches immediately north of Cucao, which, however, were not visited, as the gold contents of their sands were reported to be insignificant.

Both gold and platinum are encountered in the black sands, and, although little attention was paid to the platinum until recently, the Chilotes, who were aware of the latter's existence but not its value, termed it *oro blanco*, or white gold, and ignored it because of its failure to amalgamate. Platinum is found only in appreciable quantities from Tablaruca beach south, the richest samples coming from Lavaderos beach, the farthest south beach prospected. The gold, which occurs in fine thin scales, is unusually clean, running about 950 fine, and, unlike the gold in the Oregon deposits, amalgamates readily. It apparently occurs in a free state, as assays of the black sands from various beaches, after amalgamation, failed to disclose gold either chemically or mechanically combined. The coarsest gold is found on the southern beaches, pieces weighing up to 1½ milligrams not being uncommon, but the further north the beach the finer the gold, and at Carelmapu, the farthest north beach exploited, estimates show that 200,000 particles are required to make a gram, or about

3,000 colors to one cent. This is finer than the Snake River gold, which according to the U. S. Geological Survey, required 2,000 colors to make a cent.

NATIVE "APARATO" SUCCESSFULLY USED TO TREAT SANDS

Early attempts to save the gold in ordinary sluice boxes failed because of the tendency of the heavy black sands to clog the riffles, as a result of which the native amalgamating device locally termed *aparato* and sometimes *canaleta* was developed. The *aparato* is simply a wooden frame or box holding a series of



OPERATING A NATIVE APARATO

Note the corrugated amalgamating plates in the lower tray. Material in the right foreground is sand and pebbles which is being washed. In right background is oversize from the device. To the left are the tailings that have passed over the amalgamating plates.

inclined and sometimes staggered amalgamating plates and a tray with a screen for receiving the sands. The contrivance is set up near a source of water with a tub placed at one side and elevated so that water from a ¾-in. hole in the tub will flow into the tray in a continuous stream. The material to be washed is shoveled on the tray, from which, with the aid of the stream of water and a piece of board in the hands of the operator, it is moved over the screen, the undersize passing over the amalgamating plates and the oversize dropping at the back of the machine. As silver-plated plates are beyond native means, local custom decrees



THE GOLD DIGGERS. NATIVE CHILOES, WHOSE CHIEF OCCUPATION IS RAISING POTATOES

the use of a corrugated nickeled variety, but it is necessary to work these plates at a steep pitch to prevent the heavy black sands packing in the depressions of the corrugations. Notwithstanding the primitive arrangement of the apparatus, with well-dressed plates and in the hands of careful operators, the machine becomes a most efficient gold saver, although when it is crowded the gold losses are heavy.



WASHING BEACH SAND. SLUICES LINED WITH BURLAP

As the concentrated deposits are generally of a superficial nature, the enriched areas are prospected by means of shallow pits, and when the *manto* or rich strata is encountered it is stripped, carefully separated from the barren gray sands, and shoveled aside for subsequent treatment on the *aparato*. Gold pans are unknown, and, although a wooden batea is sometimes employed in the clean-up, an ordinary shovel is used for vanning and prospecting, the natives becoming very proficient in its use as a means of separating the fine gold from the heavy black sands.

The two principal beaches, from an acreage standpoint, are Carelmapu and Cucao, both of which were investigated in the expectation that the extensive yardages of sand would offer a promising field for operations on a large scale with modern appliances.

CARELMAPU BEACH FORMERLY SCENE OF ACTIVE WASHING

It is said that in the early 90's as many as two hundred *aparatos* were engaged in washing the Carelmapu beach, and although the remains of tailing mounds attest to considerable past activity, no authentic records of the gold produced exist. This beach is about 12 km. long by 2 km. wide, constituting one large, flat expanse of sand topped with a sandy soil that, in the rainy season and owing to insufficient drainage, becomes a vast swamp, but in the summer is transformed into a greasy meadow. Though the concentration of the auriferous black sands was apparently confined to the immediate shore line, subject to wave influence, pannings at almost any point on the meadow disclosed the presence of gold. In view of this fact, the entire area was located about two years ago by a group of Chileans in Ancud, and as samples taken by their representatives indicated possible values of $\frac{1}{2}$ to $\frac{3}{4}$ g. of gold per cubic meter, it was decided to investigate the meadow more thoroughly.

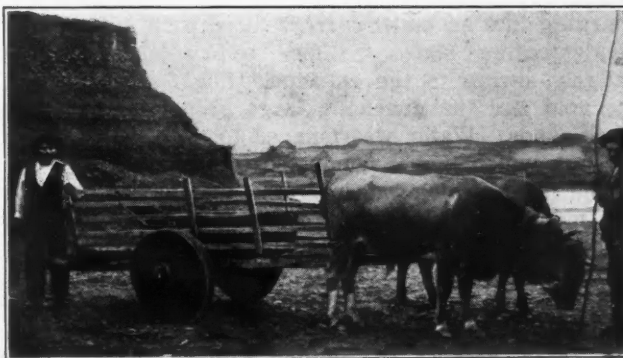
With considerable difficulty, owing to water and loose sand, eight test pits from three to four meters deep were sunk in a rectangle of 2 km. by $1\frac{1}{2}$ km. at the

southern extremity of the meadow and where the most promising surface prospects were obtained. The results were disappointing in that the average indicated gold value of the samples was under 4c. per cubic meter, although one hole returned an average of 30c. Subsequent investigation showed this pit to have been sunk at a point where some surface concentration had been effected in an area of less than one hundred square meters. The material exposed by the test pits was composed almost entirely of the lighter, gray, beach sands, the black sands probably not representing more than 1 or 2 per cent of the total material excavated.

ATTEMPTS AT PROSPECTING

In view of the low results obtained on the meadow, and to investigate the possibilities of the concentrated strip of beach at shore line, a series of shallow holes were sunk at 100 m. intervals, about 20 m. back from and parallel to the high-tide mark. Notwithstanding that estimates by the owners credited this portion of the beach with values in excess of one gram, or about 60c. per cubic meter, the average of the pits was less than 11c. Some concentration is taking place continually between high and low tide, but the occurrences are apparently too erratic to warrant even small-scale operations, as no attempts to exploit them have been made in recent years. At several points in this vicinity a thin streak of pure black sand showing from fifty to sixty colors to the pan was encountered, but owing to the changeable action of the waves no reliance can be placed on the permanency of the streak.

About ten years ago the Carelmapu meadow was drilled for oil, and, although none was found, the log of a drill hole that attained a depth of 600 m. shows that a false bedrock of sandstone about 3 m. thick was encountered at a depth of 15 m. Following this, successive layers of loose and cemented beach sands, sandstone, and occasional layers of clay and pebbles were passed through, and the hole was stopped in sandstone. The records of the oil company contain no reference to gold in the deposit; nevertheless it is of interest that samples of the last drilling from the hole mentioned, on



TRANSPORTATION AT CUCAO

being panned, disclosed the presence of the characteristic heavy black sand and a few very fine colors of the same flaky gold encountered on the beach.

Cucao beach, situated about half way down the coast of the island, is reached from the town of Chonchi over a 10-km. cart road to Huillinco, a settlement on the eastern shore of Lake Huillinco, and thence about 20 km. by boat across the lake, whose western extremity and outlet to the sea are on the Cucao beach. The road described is the only feasible overland communication

between the east and west coasts, for dense forests cover the island.

Like Carelmapu, Cucao is an open roadstead about 12 km. long, the beach averaging about 1½ km. wide. The concentrated black-sand deposit can be distinguished from the lighter, gray, beach sands by a slight iron stain and a heavy covering of rounded beach pebbles. By virtue of these markings, the deposit can be traced on surface for approximately 12 km. in a practically continuous line, the average indicated width being about 50 m. The middle of the deposit, which is only about 5 m. above sea level, lies about 1 km. back from the present shore line, the extremities approaching within 100 m. of high tide. The work done to date, which includes some haphazard drilling, indicates that a section through the deposit on an east and west line resembles a lens about 7 m. thick in its center. The deposit rests on gray beach sands of unknown depth, bedrock as yet not having been encountered, although one of the drill holes is said to have reached a depth of 20 m.

The deposit differs from the adjacent gray beach sands in that it contains a larger proportion of the heavy black sands and beach pebbles, the latter seldom exceeding fist size. The black sands constitute probably 10 to 15 per cent of the deposit and the pebbles 40 per cent. The gold, although somewhat coarser than that found at Carelmapu, is nevertheless exceedingly fine and flaky. It is disseminated throughout the deposit, but the concentrations of the metal are found in layers of pure black and garnetiferous sands, varying in thickness from ½ to 20 cm.

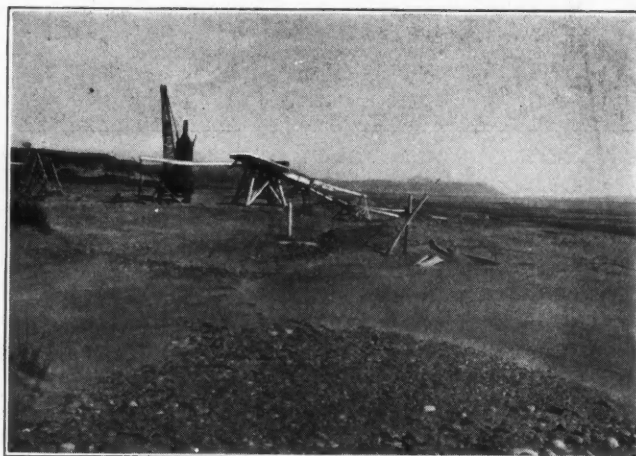
Although both native and foreign prospectors have been washing the richest sands of the Cucao beach with *aparatos* for the last twenty years, about two years ago a Chilean company, after acquiring practically the entire deposit by purchase and location, made an attempt to exploit the sands on a larger scale. Its installation consisted of a clamshell bucket and a 25-hp. steam-operated winch, mounted on a truck running on rails. The clamshell dumped into an elevated puddling box at the head of a sluice lined with sections of screen with 2-mm. holes, the undersize from the screen discharging into an under-current fitted with silver-plated amalgamating plates. Riffles were dispensed with entirely, owing to the extremely fine flaky nature of the gold and the unusually large proportion of heavy black sands. Water was pumped to an elevated flume, through which it was conducted to the puddling box.

The plant, which was operated intermittently for a few months only, proved a complete failure; first, because of the inability of the clamshell to dig the tightly packed black sands without the aid of hand labor; second, because of the difficulties encountered in the disposition of the tailings, due to the flatness of the beach, and, third, because the bullion returns for the time operated indicated a lower-grade material than originally anticipated. In the absence of any other records, measurements of the excavation compared to the bullion sold indicated a recovery of 30c. per cubic meter. Operations were discontinued at the beginning of 1919, but as the pits sunk on various parts of the deposit were said to have encountered good concentrations to a depth of 6 m., and as prospecting beyond the limits of the known black sand deposit showed the presence of gold and indicated a possible mineralized area of 1,000 acres, a preliminary examination of the property was planned on the assumption that modern dredges might profitably

exploit the deposit. A further incentive was the possibility of encountering commercially valuable quantities of platinum, as occasional colors are met in panning, and because an assay of some old mercury-trap concentrates was said to have shown several ounces of platinum per ton of concentrates.

It was realized that the nature of the deposit and the large proportion of black sands would present metallurgical difficulties hitherto not encountered in dredging practice. However, it was felt that attempts at their solution would have been justified in the event of confirming the expected yardage and values.

The investigation, which was undertaken in October, 1920, and for which test pits from 3 to 5 m. deep were sunk on both the known concentrated deposit and the adjoining ground, revealed the fact that the values were confined to erratic streaks of black and garnetiferous sand, generally within two meters of the surface, and never more than 20 cm. thick, two to three



UNSUCCESSFUL CLAMSHELL BUCKET PLANT ON CUCAO BEACH

centimeters being nearer the average. The entire contents of each test pit were run over an amalgamating device, and the results checked by 0.10- to 0.20-cu.m. samples cut down the sides of the pits, concentrated on burlap, and the concentrates assayed in the usual way. The gold values of the pits on the known deposit averaged less than 6c. per cubic meter, the highest value for any one shaft being 13c. No appreciable platinum was encountered, and the ground adjoining the known deposit, which it was hoped might augment the yardage possibilities, proved to contain only traces of gold, the majority of the shafts thereon showing only barren, gray beach sands. The depth of the pits was limited by the water level, slightly higher at that time of year than in midsummer. The discrepancy between the return of 30c. for the company's operations and the low results of the pits is probably due to the fact that the actual volume of material excavated by the clamshell was in excess of the estimated quantity; that, as subsequent pannings showed, the company's work had been initiated on one of the most promising sections of the deposit, and, finally, that the average depth of somewhat over two meters, attained in the operations, included only the richer superficial layers.

The beaches of Pilol and Bonita were also visited. A small portion of the latter, sometimes called "Tricolor," is said to have been worked with some success about fifteen years ago by Don Juan Cristie, but the occurrences of the auriferous black sands as judged by

panning tests are too erratic and limited in extent to interest other than individual operators. Samples taken from the beds lying about two hundred meters inland from the present shore line, though containing a large proportion of black sand, indicated insignificant gold values.

Samples from Tablaruca, Catiao, and Huenacoyhue show the presence of coarser gold and a larger proportion of platinum than the northern beaches, yet the southern beaches, because of their limited extent and inaccessibility, are exploited only in a desultory fashion, generally after winter storms. At best it appears to be a precarious business, even for the natives, to whom an equivalent of 75c. United States currency is a good daily wage.

PLATINUM AND IRIIDIUM AT LAVADEROS BEACH

Lavaderos beach, where the best platinum prospects have been found to date, is situated near the extreme southwestern point of the island, immediately south of Rio Zorras. The beach is small, about 250 m. long and 25 m. wide above high tide, although the best concentration is found in a width of about 25 m. between high and low tide. The platinum-bearing sand, averaging from 10 to 20 cm. thick, is encountered on a false bedrock of clay and below a capping of about 50 cm. of light gray beach sand. A second streak of platinum-bearing sand is said to exist below the false bedrock, but an excess of water has hindered proper prospecting. Random samples brought to my attention indicate that a value of $1\frac{1}{2}$ to 2 g. of platinum per cubic meter may be expected from the upper concentrated streak. The platinum occurs in thin, flaky scales, but tests conducted on 0.10- to 0.20-cu.m. samples show that it is easily saved on burlap, the proportion of heavy black sand in the beach probably not exceeding 2 or 3 per cent. The platinum is in a free state, as shown by assays of concentrates from which the platinum had been removed by amalgamation, and an analysis of the clean metal, which is of a light gray color, yielded 10 per cent of iridium.

An attempt is now being made by local operators to exploit the beach with a steam-operated dragline scraper with a daily capacity of about 20 cu.m., the sands after screening to be passed over amalgamating plates to remove the gold and thence concentrated on stationary canvas and burlap tables for the platinum. As the plant was placed in operation only a few weeks ago, no information as to results is available.

The investigations lead to the conclusion that though extensive deposits of black sand exist on the northern beaches, they contain only occasional traces of platinum and their gold values are both too erratic in distribution and too low in grade to permit of their profitable exploitation. It is possible that systematic prospecting on other southern beaches would disclose platinum-bearing sands that might be profitably exploited with high prices obtainable for the metal, but the limited extent of the beaches would indicate that no large deposits could be expected. Samples of sand in which monazite was suspected were tested qualitatively for thorium, but with negative results. It has also been suggested that the magnetite in the black sands might prove valuable as a source of iron ore. However, apart from the metallurgical considerations, the inaccessibility of the majority of the deposits and the wide distribution of the sands would discourage investigation in that direction.

Swedish Iron Industry in 1920

SPECIAL CORRESPONDENCE

AT THE MEETING of the Swedish Ironworks Association on Jan. 30, Manager Carl Sahlin presiding, the usual statement for the year 1920, and especially in its relation to the fourth quarter, was made. The export of iron ore had increased from 2,419,000 tons in 1919 to 3,737,000 tons in 1920, and the export of iron from 246,112 tons to 273,000 tons, of which the increase was entirely due to the pig iron. There was a heavy increase in the iron imports; viz., from 128,000 tons to 245,300 tons.

The number of blast furnaces in operation on Dec. 31, 1920, was 42, of 132 available; of bessemer furnaces 3, of 18 available, and 30 out of 80 available Martin furnaces. The output figures of all descriptions of iron in 1920 exhibit a falling off, and are the lowest during the last period of ten years.

The management states that the year 1920 has, for the Swedish industry, been a difficult one. The production has been unfavorably affected during the year by labor unrest and the introduction of the eight-hour day system. The revived inquiry during the spring and summer months, with resultant better prices, had, to some extent, balanced the unexampled increase in production costs, but despite this, the results for the year are, for the most of the steel and iron works, unsatisfactory, on account of the last quarter's depression, with prices that do not cover production costs.

The pig iron produced in 1920 amounted to only 452,300 tons, and is more than 200,000 tons under the average figures during the ten-year period. The cause of this low output is to be found in the minimum production during the first quarter. During the summer months a number of blast furnaces were put in operation, and during the year the average number operated was about sixty. In December, however, the figures fell to forty-two.

In addition, the industry has always had to contend with high freights, taxes and other disabilities, which the low production accentuated. The export figures show somewhat better totals for 1920 for the cast- and pig-iron group than the previous year, but the total is below the average for the last ten years. The chief cause of this is the general change over to peace requirements production, as also the unexpected exchange conditions, and last, but not least, the severe competition from Germany at prices which are far below the production costs of Swedish works.

The imports of iron, for the reasons given, show a distinct increase, viz., 110,000 tons more than during the previous year, the surplus being contributed by bars, with 33,000 tons, and rails, 25,000 tons; also thin and thick plates, 24,000 tons. The imports of malleable iron probably for the first time for a considerable period in the history of the Swedish iron industry exceeded the previous year's exports.

The association decided to resume the normal quotations for Swedish iron, which were inhibited during the war, and fixed the following: Export pig iron (maximum sulphur 0.015, phosphorus 0.025), 250 kronor;¹ billets (over 0.45 carbon), 500 kronor; wire (over 0.45 carbon), 570-600 kronor; Martin iron, base, 390 kronor, and Lancashire, ordinary, base, 500 kronor—all Swedish kronor, per 1,000 kg., f.o.b. works on thirty days' basis.

¹Swedish crowns are spelled "kronor"; Norwegian and Danish, "kroner."

The Problem of Domestic Copper Consumption

Developing New Outlets and Uses for the Metal Not More Important Than Combating Inferior Substitutes—Producers Should Form a Research And Publicity Organization, Instead of Following a Laissez Faire Policy

By H. A. C. JENISON*

IN CONSIDERING the present condition of the copper industry one naturally turns to new and recently developed or discovered uses of copper as a possible solution of the problem. Such uses have a considerable potential if not demonstrated value, but it is far simpler, and correspondingly more enlightening, to investigate the abandoned uses of copper. The tremendous substitution of other materials where copper has heretofore always been satisfactorily used is striking. Only brief attention will be given therefore to some of the more important of the new applications of this metal, and abandoned or neglected uses will be considered more at length.

During the war, many new and satisfactory military uses of copper were undoubtedly developed, but such applications, because of their nature and the conditions under which they were applied, are of little or no commercial consequence at the present time. Of the new uses of copper that have been developed in recent years, among the most important seems to be that of the production of copper-steel of high corrosion resistance. Although investigations covering the corrosion resistance of copper-steel have been carried on for many years, the lack of attention given to them is disappointing.

DEVELOPMENT OF COPPER-STEEL

In a recent paper, D. M. Buck¹ has reviewed the development of copper-steel, and in his review points to some interesting and important results. His investigations, covering a long period of years, show that normal open-hearth steel is corroded at a very much lower rate when it contains a small percentage (0.15 to 0.30 per cent) of copper. Mr. Story,² in his paper, "Corrosion of Fence Wire," investigated a great many samples of fence wire which had been subjected to field service for varying lengths of time, and from his analytical results, together with the history and length of life of wires, states, "It has been definitely established that the durability of old steel wire is due to the presence of copper." Hoyt,³ in 1919, from an extensive series of careful experiments, states: "The general conclusion which, it is believed, may be drawn from these exposure tests is that the so-called copper-bearing steel, in which the copper content is about 0.20 to 0.25 per cent, offers the greatest resistance to corrosion of the common sheathing materials."

INFLUENCE OF COPPER IN RETARDING CORROSION

The Railway Age for July 23, 1920, describes the series of tests conducted by the New York Central lines on the influence of copper in the reduction of the corrosion rate of steel tie plates. According to these tests, standard steel tie plates show approximately eight

to ten times the loss that the special copper-treated ones show. In this connection it is interesting and reassuring to know that the New York Central is reported to have placed an order for 4,000 tons of steel containing 0.25 per cent of copper, or enough for 650,000 tie plates. This is one of the few instances that have come to my knowledge where investigations covering a new use of copper promise to become of industrial and economic importance.

The following is a quotation from the American Society for Testing Materials: "At the inland industrial location, out of 146 sheets of 22-gage copper-bearing materials (0.15 per cent copper or over), forty-one sheets, or about 28 per cent, had failed after forty-one months' exposure, while out of eighty-four non-copper-bearing sheets, eighty-one, or 97 per cent, had failed after forty-one months' exposure. With this overwhelming mass of evidence we may consider it as proved that by alloying a small copper content (0.15 to 0.25 per cent) with the normal open-hearth bessemer steel, the corrosion rate is enormously reduced wherever the products are exposed to alternate attacks of air and moisture, which conditions prevail in practically all characters of atmosphere. It is certainly very conservative to estimate that the life of sheet metal is doubled by this treatment."

THE COPPER-STEEL CAR

The manufacture of copper-steel has heretofore been largely confined to sheet metal, and the product has been tremendously improved. The usefulness of the discovery may readily be broadened by the use of copper in other steel and iron sections, thereby very greatly increasing their life. Steel freight cars, for example, particularly those of the open type, undergo great damage and deterioration from corrosion. If the life of thousands of such cars that have passed out of the field of usefulness during the last few years could have been extended only 20 to 25 per cent, much would have been accomplished in relieving and preventing the recent severe car shortage.

According to *Chemical and Metallurgical Engineering* of Oct. 27, 1920, several copper-bottom gondola cars were made six years ago for the Bessemer & Lake Erie Ry., one-half of the sheathing of each being ordinary plates and the other half copper-bearing steel. A recent inspection shows much better paint adherence and less than half the loss due to corrosion and abrasion in the case of the steel containing copper. Here is a simple, easily controlled, and comparatively inexpensive method of improving many products that are called upon to resist the attack of air and moisture, thus greatly increasing the period of service. At the same time an immeasurably important step is taken in the conservation of our natural resources.

The preceding illustrations indicate one of the new uses of copper. This new industrial application constitutes, I believe, the most important that has been

*Published by permission of the Director of the U. S. Geological Survey and read at the January meeting of the New York Section of the A. I. M. E.

¹Buck, D. M., quoted in *Chem. and Met. Eng.*, Oct. 27, 1920.

²Story, *Chem. and Met. Eng.*, op. cit.

³Hoyt, *Chem. and Met. Eng.*, op. cit.

developed and gives the most promise. The prospective field for copper consumption in this way, however, is far less than might be expected, one of the reasons for which will appear later.

THE ERA OF SUBSTITUTES

Recent years have been marked with the continual growing substitution of other material for copper in many of its oldest and most dependable uses. Some substitutes have been satisfactory, but I believe by far the majority are unsatisfactory and ultimately more expensive than copper or its alloys. Among these substitutions is that of unsatisfactory alloys in the building industry and in household use. The building industry formerly consumed great quantities of copper and copper alloys, but present consumption has fallen off tremendously.

Despite the apparently unanimous opinion of architects and building contractors as to the superiority of copper and brass over all other materials and alloys used for roofing, plumbing, and hardware, the substitution of other metals and other materials for copper has been constantly growing for years. Galvanized iron and plastic materials have almost entirely displaced roofing copper, because the investors in buildings lack the knowledge of the ultimate economy in the use of copper or even copper-steel. Brass pipe has, to a very large and disturbing extent, been replaced by iron pipe, which is of marked inferiority. Recent investigations and inquiries show that a few years ago the quantity of brass sold and consumed as screws, hinges, nuts, knurls and similar parts was double what it is today. Such products, which were formerly made entirely of brass, are now made of brass-plated steel, and consequently lack, to a great extent, the principal value of brass—its resistance to corrosion.

DISCOURAGING DOMESTIC USES

In the Jan. 8 issue of the *Engineering and Mining Journal* attention is called to the fact that the old household copper hot-water tank has been displaced almost entirely by the galvanized iron tank. The following quotation is from that journal: "What, we asked our plumber, 'is the difference in price between a thirty-gallon hot-water tank made of copper and of galvanized iron?' 'Well, there is some difference,' replied the plumber. 'Copper tanks are so expensive we don't try to sell them and advise our customers against them. A galvanized iron tank will cost about \$13 and a copper tank will cost about \$40.' The difference in the value of the material in the two is five or six dollars."

It may well be asked why the five or six dollars difference in cost of material should result in a \$27 difference in the dealer's prices.

In many, many other instances unsatisfactory substitutes have replaced copper, as, for example, in the manufacture of pins, which is a small item, but illustrates the situation. In 1914, about 1,840,000 lb. of copper was reported to have been used in the making of pins, 640,000 lb. going into steel pins and 1,200,000 lb. into brass pins. The consumption of pins has increased since then, but the gain has been made in steel. Today probably not more than half of the pins made are of brass. Incidentally, the inferior, quickly rusting steel pin is sold at brass-pin prices.

Another instance of the substitution of other materials for copper is found in the automobile industry, which has been and should be one of the great copper-

consuming industries of America. It would appear that since the war there has been a steady tendency toward the replacement of copper and brass by iron in the manufacture of automobiles. According to Robert Mountsier⁴, the total amount of copper and brass now used in the average automobile is only about thirty-six pounds.

It is common knowledge that automobile repair business has increased out of proportion to the additional number of cars in use in the last few years, and investigations on this subject would indicate that this is due largely to the substitution in the structural and movable parts of inferior materials in place of copper and copper alloys. In the coast cities it is particularly noticeable that not only the working parts but all other parts of an automobile which are made of materials not immune to rust are constantly breaking down when exposed to the weather. One motor car is on the market today which is famous for its durability and excellent performance; it contains about two hundred pounds of copper. The durability and dependability of this car is in striking contrast to other large, high-priced cars, one of which contains only about thirty pounds of copper and all the others of which contain relatively small amounts.

SUBSTITUTION OF ALUMINUM FOR COPPER IN THE ELECTRICAL FIELD

In the electrical field copper has been considered supreme, so it is with considerable alarm that we are forced to realize the increasing substitution of aluminum for copper. This fact is particularly true in high-tension transmission lines. The first aluminum cables which were produced for high-tension transmission lines were unsatisfactory, on account of sag, breaking of joints, and low fusion point. Recently a steel-reinforced aluminum cable has been developed which has, to a great extent, eliminated the sag and breaking of joints and so becomes a very dangerous competitor of copper in the field of high-tension transmission.

The advantage of the aluminum cable appears to be in its relatively low corona losses. An aluminum cable capable of transmitting 220,000 volts is about one inch in diameter, whereas a copper cable capable of the transmission of the same voltage is considerably smaller. It appears that to avoid high corona losses at that voltage the transmission line must be at least one inch in diameter. The present copper cable—one inch in diameter—is so much more expensive that the aluminum cable is displacing it. It would appear that if the copper cable is to compete in the field of 220,000-volt transmission, a cable must be developed that will be at least one inch in diameter and contain only about the same quantity of copper as the present smaller cable made for the transmission of that voltage. In the lower voltage lines the corona losses are so much smaller that copper does not appear to be in any immediate danger. In view of the tremendous development of electric power, with increasing high-tension transmission, it is important that the copper producer and manufacturer undertake research work which will make copper as suitable and inexpensive as aluminum for such purposes.

It may well be asked why the use of copper-steel in materials which are required to stand exposure has not come into more general use. Why, when copper and copper alloys have demonstrated a marked superiority and ultimate economy in the building and hardware

⁴The *Annalist*, Dec. 27, 1920.

industries, have they been displaced by inferior substitutes? Why has the automobile manufacturer come to use so little copper and copper alloys despite their definite superiority and ultimate great economy to the owner? Why has aluminum developed into an active competitor in certain electrical uses? Why have not new and broader uses of copper been developed?

NO EFFORT MADE TO PUSH COPPER

Both the reasons and the remedy appear simple. Of the reasons which have contributed to the present conditions, the attitude of copper producers and of their competitors is the most important. Until the end of the war the market for copper had always been so great that the copper producer experienced little difficulty in disposing of his product. The electrical industry and the industrial brasses and bronzes, together with the export market, consumed all the copper produced. These great industries maintained, to a great extent, staffs of engineers to determine the relative values and costs of materials used. Under such conditions copper was used where it was determined to be the most suitable. In other words, those industries kept themselves technically informed as to the relative values and costs of all materials.

In other industries, such as the building, hardware, and automobile, the small ultimate consumer who really determines, to a large extent, what material shall be used, is largely, if not entirely, ignorant of the relative durability and initial and ultimate costs of various materials, and is dependent upon the dealer, the contractor, and others through whose hands the product passes, for his information. He is also much concerned with costs, and in his ignorance does not know that the relatively small initial cost of the inferior substitute is ultimately, after replacements, a much greater cost than the higher initial cost of copper and copper alloys.

PRODUCERS IGNORE ULTIMATE CONSUMER

The copper producers have entirely disregarded the small ultimate consumer. They have made no effort to keep the general public informed as to the relative merits and the initial and ultimate costs of copper, copper alloys, and their substitutes. They have made no effort to conduct researches and investigations for the purpose of developing new uses, and successfully competing with the improved products of their competitors. In this field the producers of substitutes have far outstripped the copper producer. They have carried on a successful campaign of publicity and research. Their advertisements and publicity matter transmitted through dealers have been attended by such success that copper and copper alloys have, to an alarming extent, been crowded out of building, household, and automobile consumption. By means of their carefully and thoroughly conducted research and investigation work they have been continually improving their product, until now they are competing with copper in those fields where copper has long been considered supreme. The copper producer, on the other hand, has done little or nothing to improve his manufactured product, little or nothing to maintain the supremacy which belongs to copper. He appears to have failed more or less completely in his public relations.

The remedy for these unfortunate conditions appears to be as simple as the reason for them. The marked superiority and ultimate economy of copper and copper alloys in the building, hardware, and automobile indus-

tries has been demonstrated. With the inherent superiority of copper over its substitutes in other fields, it seems certain that only a little intelligent effort is necessary for it to regain and maintain its supremacy.

The producer must bestir himself. An organization for the purpose of research investigation and public education should be created and maintained. Such an organization should study and determine the relative merit and initial and ultimate costs of copper, copper alloys, and substitutes, and keep the public informed of the results of its research. The organization should also determine new appropriate uses for copper and conduct research work to improve the copper products. With such an organization properly conducted, the domestic consumption would inevitably in a short time be greatly increased, and competition by the substitutes would become very difficult. All that is necessary seems to be public education and some constructive effort to improve present copper products.

The domestic building and hardware industries must inevitably soon assume greater proportions. The consumption of metals and alloys in these industries must accordingly be tremendous, and greater than ever before. Obviously, it lies almost entirely in the hands of the copper producer whether he will supply those metals and alloys or whether the public will continue to use increasing amounts of unsatisfactory substitutes. There is no doubt that the copper producer can do it, but if he does he must educate the consuming public to the desirability and economy of copper and copper alloys. Such an education cannot fail to increase quickly and vastly the present domestic consumption.

WAYS OF ENLARGING THE DOMESTIC MARKET

Although it is inevitable that the electrification of railways must be undertaken on a great scale, and that such projects as the super-power scheme must one day be a reality, the undertakings are vast, and by their very nature and magnitude must be slow of realization and in effect on the copper market. Furthermore, Europe must sometime consume much more copper than at present, but when that will be is uncertain.

However, the domestic building, hardware, automobile, and similar industries can undoubtedly furnish a very much greater domestic market than at present exists or has existed in the past, and one that will be almost, if not entirely, independent both of European uncertainties and of the great time involved in the realization of such projects as electrification of railways and the super-power plan.

Only a few of the many fields for domestic copper consumption have been suggested here. Systematic investigation and proper organization would develop many more, and would soon create a greatly increased domestic copper demand, which would, to a very great extent, at least, solve the present problem.

Phosphate Mining Wasteful

The present practice of mining phosphate rock for treatment with sulphuric acid to produce acid phosphate entails a loss estimated at around 68 per cent of the phosphate that is mined, according to the U. S. Department of Agriculture. The department is working upon a method that promises to be cheaper and much more conserving of the phosphate-rock deposits. The department feels that this investigation should be pushed with the object of ultimately cheapening the cost of production and conserving the deposits.

A New Method for Copper Assaying

Modification of the Fleitmann Procedure Found More Convenient Than Iodide or Cyanide Processes

BY GEORGE J. HOUGH

Written for *Engineering and Mining Journal*

THE volumetric determination of copper by solution of freshly precipitated metallic copper in ferric chloride, and titration of the reduced iron by standard potassium permanganate, has long been known as Fleitmann's method, but, owing to incomplete data for the method as published, it has not to my knowledge met with favor among technical chemists, although it really deserves more attention, as it has some advantages over other methods of copper determination.

The method as found in Sutton's "Volumetric Analysis" directs that the copper be precipitated by metallic zinc and afterward washed with dilute hydrochloric acid to remove any zinc, before solution in ferric chloride. In this process it is not well to use zinc for the reduction of copper, as minute particles of zinc may remain with the copper, and these particles will afterward react with the ferric chloride; also, the washing of the metallic copper with dilute hydrochloric acid is risky, as the nascent copper is easily redissolved. Furthermore, and most important of all, no mention is made of the fact that certain other metals, if present in the copper solution, are precipitated by the zinc and react with ferric chloride.

In the analysis of ores, about the only metals which will interfere are silver, antimony, and bismuth, all of which occur frequently in copper ores.

In the usual procedure of converting the copper to the sulphate, any or all of these interfering metals will be at least in part changed to the soluble sulphate, and consequently contaminate the copper precipitate. Silver, which is almost invariably present in copper ores, gives the least trouble; I have found that if there is not over 0.09 per cent, or 29 oz. per ton, it does not interfere. Antimony, however, interferes seriously, and a modified method must be used. When it is present, proceed as follows: Fuse 0.5 gram of ore with sulphur mixture (equal parts of sodium carbonate and sulphur), extract with hot water, filter off the copper sulphide, wash well, redissolve in a little nitric acid (1 to 2), fume with sulphuric acid, and proceed as directed later.

In the presence of bismuth, dissolve the ore in nitric and hydrochloric acids, evaporate nearly dry, dilute warm, and add an excess of ammonium carbonate solution (1 part ammonium carbonate to 4 parts of water and 1 part ammonia), filter and wash well, acidulate the filtrate with sulphuric acid, add 10 c.c. excess, evaporate, fume, and proceed as directed later.

The modified Fleitmann method that I used for two years for ores free from antimony and bismuth is as follows: Dissolve a suitable amount of sample, usually 0.5 gm., in nitric and hydrochloric acids; add 10 c.c. sulphuric acid and fume; cool, dilute, add one drop dilute hydrochloric acid to remove any silver (if ore is low in silver, no hydrochloric acid is needed), filter through a close filter and wash; precipitate the copper by aluminum foil, boiling gently until all the copper is separated from the foil, and the aluminum is clean and white; remove and wash the foil, and let the solu-

tion settle a moment or two. Decant the supernatant solution through a small filter and wash twice by decantation with hot water. If care is used, all the copper will remain in the beaker.

Now add to the copper about 10 c.c. of saturated ferric chloride, stir to dissolve, warm gently a moment or two to be sure all copper is dissolved, dilute at once with about 200 c.c. of cold water, add 5 c.c. of syrupy phosphoric acid to decolorize, and titrate by standard permanganate. The iron factor of the permanganate multiplied by 0.567 equals the weight of copper. This factor has been determined by experiment, and, as will be noticed, is slightly higher than the theoretical factor 0.5625; 1 c.c. N/10 permanganate equals 0.00316 gm. copper.

To prepare the ferric-chloride solution, dissolve one part of the salt in two parts of water, and add a very little hydrochloric acid to clear it. When a sample is very high in copper, it may be necessary to use 15 c.c. ferric-chloric solution. The aluminum foil should be in the form of a cylinder two inches long by one and one-half inches in diameter and with a projecting strip about one and one-half inches long for a handle. Such a cylinder of $\frac{3}{16}$ -in. foil will last for more than seventy-five determinations. To standardize the permanganate solution dissolve c.p. copper foil in ferric-chloride solution and titrate as above. Very thin foil has been ascertained to be the best.

I have found the method to give good results, and can recommend it as neat and more convenient to work with than either the iodide or KCNS method. However, owing to the tedious modifications required in the presence of antimony or bismuth, I believe it will find its greatest usefulness in the analysis of clean ores.

COMPARISON OF RESULTS BY VARIOUS METHODS

Kind of Ore	Per Cent Copper by Permanganate Method	Per Cent Copper by Iodide Method	Per Cent Copper by Cyanide Method
Carbonate	35.6	35.8	.....
Tetrahedrite	34.6	34.6	.....
Carbonate	4.1	4.11	.....
Carbonate	2.9	3.04	.....
Carbonate	6.5	6.6	.....
Bornite	53.6	54.0	.....
Sulphide	35.8	35.8	.....
Mill concentrates	15.64	.....	15.66
Sulphide ore	31.35	.....	31.4
Siliceous	10.0	.....	10.0

The above examples will illustrate the accuracy of the method on various kinds of ore.

Federated Malay States Tin Exports

The total tin ore exported from the Malay Peninsula in 1919 amounted to 741,970 piculs (1 picul = 133½ lb.), valued at \$32,247,444, compared with 768,157 piculs in 1918, valued at \$41,623,383, according to Consul H. J. Dickinson in *Commerce Reports*. The following table indicates the movements of Straits tin shipments since 1910, quantities being expressed in tons of 2,240 lb.

Years	United Kingdom, Tons	United States, Tons	Continental Europe, Tons	Total Tons
1910	35,047	12,915	6,643	54,605
1911	33,505	15,375	6,288	55,168
1912	33,482	18,238	7,230	58,950
1913	35,158	18,107	9,105	62,370
1914	35,652	19,240	8,306	63,198
1915	22,753	32,240	11,006	65,999
1916	25,011	28,108	8,481	61,600
1917	16,304	13,457	6,190	(a) 35,951
1918	(b)	(b)	(b)	(b)
1919	19,592	27,135	4,111	50,838

(a) January to June, inclusive.
 (b) No official records available, owing to government restrictions on publications of trade returns.

BY THE WAY

The Penalty of Ingenuity

"Back long we in tha h'early days, m'son," said Cap'n Dick, "afor' tha time o' these 'ere machine drills, there wuz some h'art an' science to tha swingin' o' a 'ammer an' tha twistin' o' a drill. Some rivalry there wuz, too, 'mong 'ammersmen. Settin' to one side h'all h'argument, 't wuz h'admitted that they chaps from daown St. Just way 'ad a pretty way with a single jack. Mus' be h'admitted, though, that most o' they St. Justers wuz such dreadful small chaps that they scarely h'appeared to be grawed h'up men. W'en twistin' a drill they never took a full 'and 'old but passed tha steel 'twixt third an' fourth fingers. This 'abit formed a callous, m'son. Cap'n Tredinnick, at Leadville, h'always 'ad a geek for tha callous 'pon a man's lef' 'and afoor 'irin' 'e. An' h'only once did 'e make a mistake; that wuz tha time 'e 'ired a teamster 'ose fingers wuz calloused from 'anging' fast o' tha lines o' a freight team. But some Cambourne an' Redruth chaps, Tom Penglase 'mongst 'em, 'ad never a good word for tha boys from St. Just. 'Dam-me,' sez Tom, 'saw one o' they little St. Just chaps back h'in Colorado kill 'isself tryin' to do man's work. This chap wuz so bloody short 'e mus' 'ave 'ad a hard time reachin' 'igh enough to wash 'is h'own face an' h'eyes. 'E wuz workin' h'on a stull one day h'in a 'igh stope tryin' for to gad daown a loose piece from tha 'angin'. Wuzn't strong h'enough nor 'andy h'enough to 'old tha gad w'ile strikin', so h'after 'e 'ad dropped un scores o' times, 'e took bit 'o string an' tied fas' to tha gad, makin' tha h'other h'end fas' to 'is nuddick. Nex' time 'e swung tha 'ammer 'is foot slipped. Gad fell one side o' tha stull, an', dam-me, St. Just chap fell h'on tha h'other side an' 'anged 'isself to death. W'ot's think o' that naow?"

The Birth of a Nugget

"There was recently unearthed at Mount Leyshon, some sixteen miles from Charters Towers goldfield," writes our Brisbane correspondent, "what has been described as a nugget in the making, which is regarded as interesting and important as a link in the evidence as to the origin of gold nuggets. Quite unlike any of the nuggets with which most miners are familiar, it is a flattish piece of metal, like a broad, thin wedge from which the pointed end had been cut off. Its sides showed irregular, angular markings, with cavities sharply defined and with small pieces of quartz adhering plentifully to them. Only one or two spots were at all rounded; in fact, the mass of metal had the same appearance as it would have had if it were a cast made from a mold whose sharp corners it had once well filled, but which had suffered just a little from rough handling since.

A correspondent of the *Queensland Government Mining Journal*, who may be regarded as an authority on such subjects, namely, Mr. Edgar Hall, manager of the Silver Spur mine, in the south of Queensland, has expressed the opinion that this so-called nugget probably came from a vug in a lode, which vug it did not quite fill originally, the rest of it being occupied by pyrite, calcite, or other soluble mineral. In the process of weathering, the calcite and the rest have dissolved

away, and finally the shattered rock has fallen apart, leaving the gold free. It was not long free before it became covered by sand, gravel, and detritus from the lode, which have protected it from the bumps, blows, and poundings it would have received if it had traveled far from its native place, and which would eventually have made it a nugget. It was born to be a nugget, but it never grew up, and it is still a nugget in the making. Probably it is also young in measurement of time, compared with most of the famous nuggets. Its birthday may have been only a few hundred years ago, or even less, and it may have been formed when its quartz womb was to be found not far below the present surface."

Again But Nevermore

M. W. Venable, a mining engineer of Charleston, W. Va., has contributed his mite to the bauxite literature of the day, but says that the whole question is much too complicated for him, concluding that, after all, it is largely a matter of taste how the word bauxite is pronounced. We feel equally philosophical about it, especially since the *Bauxite News* has so definitely settled the controversy. "Boxite" or "bawxite" it is from henceforth even for evermore. "Bozite" is taboo, and from now on it will be just as *gauche* to use this pronunciation as it will be to wear a tux at anything except a stag.

The Map That Disappeared

The present condition of hydraulic mining in California is well illustrated in the following incident which occurred in one of the old camps that in its prime added many millions to the output of the Golden State. A surveyor was desirous of locating a section corner near the town, and on inquiry was referred to the oldest inhabitant. Said o. i. pondered the question and then had an idea. Many years before a survey had been made of the townsite and a large wall map drawn which should show the location of the nearest corner. But what had become of the map? To his wife: "Amy, do you know whatever became of that old map of the town that Ed Uren made way back in the seventies?" A sweet-faced old lady, whom one could easily imagine a belle of the camp in the days when it was a live one, appeared at the door to the next room. "Why, let me see, Amos; you know that hung in the town hall for a long time until the hall fell down. Then they took it over to the saloon and kept it there awhile, but they were afraid that was going to fall down too, so they took it away from there, and I'm blessed if I know where they put it then."

Love's Labor Lost

A certain firm of Milwaukee that manufactures magnetic separators and pulleys recently received the following letter from Streetman, in the Lone Star State:

Please send me your catalogue containing articles of magnetic power that can be used in the mines and on mineral fields and that will locate minerals at a distance in the earth, such as "mineral rods" and etc. I found your firm address in the _____ So I would be glad to get your catalogue and price on the articles named above.

All this makes us very sad. Apparently there are some who remain untouched by our campaign to convince others how jackasinine it is to expect to push the prospector off the map with a divining rod. But we shall continue our efforts nevertheless.

CONSULTATION

The Occurrence of Diamonds

"What is the mode of occurrence of diamonds, and what are the surface indications? In what kinds of formations are they found? Are they mined in the United States?"

"How are they recovered? Do they appear in quartz matrix or alluvial formation?"

"Where may I procure the best illustrated literature dealing with diamantiferous formations and prospecting for the same?"

"Where is the best place to send them for a test?"

"I am an old prospector and have found some crystals that puzzle me, so that any information you may give me will be a great help."

Diamonds have been found and are at present being recovered in several localities in the United States, but the domestic diamond-mining industry is very small, particularly when contrasted to the heavy imports of diamonds into this country—the greatest diamond-consuming country in the world.

Thus, in 1919, about \$86,800,000 worth of diamonds, in various forms, such as rough or uncut, dust, carbonados and glazier's stones, was imported, compared with a domestic production of a few thousand dollars.

Occasionally diamonds have been found in Wisconsin, Indiana, Michigan, California, Georgia, and North Carolina, but the most important diamond activities in the United States center around Little Rock, Ark. The Arkansas Diamond Co. operates a property described in the *Engineering and Mining Journal* of April 24, 1920, in an article entitled "Diamonds in Arkansas," and has erected a test mill for the purpose of treating the mineral found. The diamond area covers sixty acres, and the diamonds occur in peridotite similar in geologic characteristics to the diamond-bearing rock in South Africa. The diamonds which have been recovered are in many instances of the finest quality, and the few that have been cut made beautiful gems. Their weight has averaged a little less than half a carat. A few other mineral properties are in the same general district, but have been worked only intermittently.

The U. S. Geological Survey estimates that about 5,000 diamonds have been found in Arkansas from the properties mentioned above, between the time of discovery in August, 1906, and the end of 1919. These included white, brown, and yellow stones, and their average weight was between 0.3 and 0.4 carats. The largest diamond yet discovered in the state was found in the Arkansas mine in May, 1917, and was a canary-colored octahedron weighing 17.85 carats.

The most important diamond deposits in the world, those of South Africa, are associated with altered basic igneous rocks. Intrusive "pipes" of Kimberlite, as the formation is termed, have been extensively worked and have yielded an immense number of diamonds. This Kimberlite, or "blue ground," as it is often called, is a complex rock consisting largely of serpentine derived from the hydration of olivine. It may be designated as an altered peridotite. The pipes vary widely in their dimensions; usually they are not more than two or three hundred yards wide—frequently less. The depth of the workings also varies considerably. The

famous Kimberley pipe has been mined to a depth of over 1,100 ft. The pipe-rock is considered good if it carries on the average of one carat of diamond per ton, and, from indications furnished by exploration, the deposit promises to be diamond bearing down to the greatest depths at which mining can be done.

Although the world's greatest diamond deposits are associated with basic igneous rocks, many occurrences are found with other geological relations. Thus, in India, the gem stone occurs in the Bundelkhand region of Central India in a bed of conglomerate that lies between shales and sandstones. The conglomerate is not more than two feet thick, and the diamond is associated with pebbles of jasper.

In the State of Minas Geraes, in Brazil, near Diamantina, surface gravels and earthy deposits, in part cemented with iron oxide, yield diamonds. The rocks of the area consist chiefly of geologically ancient micaceous sandstones, and it is held that the diamond-bearing gravels, being found only in the localities where this sandstone occurs, have been formed by its disintegration. Brazil furnishes, particularly in the Bahia districts, the diamond known as the carbonado, popular among diamond drill bit manufacturers.

Although a deposit of minor importance, an occurrence of diamonds found at Olivine Mountain, on the Tula-meen River, British Columbia, is interesting for the association of the diamonds with chromite in peridotite. Reverting to South Africa, important sources of diamonds are the alluvial deposits in the Vaal River basin, and the Great Namaqualand coast of Southwest Africa, whose parent rock has not been discovered, although it is assumed that the diamonds have been derived from intrusive peridotites similar to those in the region.

Diamonds are recovered in South Africa from the hard blue ground by allowing the mineral matter to be exposed to the air in open fields. In due time it softens and crushes easily, and can be readily washed and concentrated. The concentrates are passed over oscillating tables covered with grease. It has been found that diamonds stick readily to the grease, from which they are recovered periodically. The article "Diamonds in Arkansas," referred to above, contains a flow sheet that indicates the steps that must be taken in the recovery of diamonds from this type of occurrence. In Brazilian alluvial formations, panning by natives is the rule.

The diamond can be distinguished from other minerals and from imitations by its extreme hardness, high refractive index, and certain optical characteristics, such as its isotropism. Diamonds can readily be distinguished from quartz and zircon by their great hardness. Optical tests quickly indicate the genuineness of stones. Reputable jewelers, state geological surveys, the U. S. Bureau of Mines and the U. S. Geological Survey are in a position to make authoritative tests on gem stones.

An extensive literature has been published regarding diamonds, some of it popular and in part technical. The paper "Gems and Precious Stones," published yearly by the U. S. Geological Survey, contains valuable statistical information, and similar data are included in the papers published in the volumes of *Mineral Industry*.

HANDY KNOWLEDGE

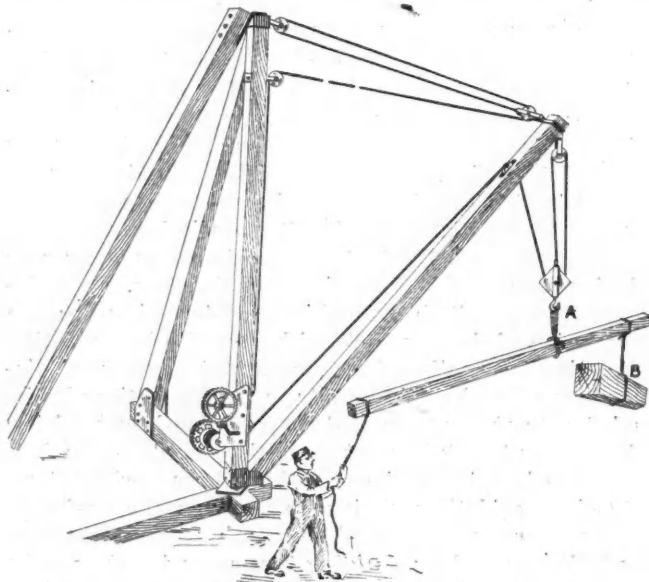
Extending a Derrick Boom's Reach

BY GEORGE J. YOUNG

Written for *Engineering and Mining Journal*

The boom derrick, so essential for general erection purposes, also has its uses around mine surface plants for unloading cars and handling material generally. The reach of the boom determines its radius of action. This radius can be increased by a simple expedient so that material can be handled in corners that would otherwise be difficult to reach. Steel or other material can also be shifted and put into place more readily by its use than by raising and lowering the main boom.

The device consists of a timber, usually a spare derrick boom, *A*, about which a sling is placed in such po-



DEVICE TO FACILITATE HANDLING OF MATERIAL BY DERRICK

sition as to almost balance the load, *B*. The overbalance is left on the free end of boom *A*, to which a rope is attached. When the load *B* is approximately in position, it may be easily maneuvered into place by pulling down on the rope to elevate it and from side to side to shift to position. Too great an overbalance on the free end of boom *A* would make the arrangement awkward to handle.

Method of Sampling Mine Dust

In seeking a method of determining the amount of dust in mine air, Dr. J. A. McCrae, of the South African Bureau for Medical Research, found that all the dust present could be caught in a tube containing 40 g. of pure cane sugar in a column about 9 cm. long by 8.5 cm. in diameter. An air suction pump was designed having 3.5 liters' capacity, and the required quantity of air was aspirated through the sugar column by means of this pump. The weight of dust was determined in milligrams per cubic meter of air. This "sugar-tube" method was adopted by the committee on dust sampling

of the Transvaal Chamber of Mines. The routine for taking samples is described in the committee's report as follows:

Each dust inspector is provided with a pump of known capacity, a box containing ten sugar tubes, and a 6-ft. piece of rubber tubing to connect the sugar tube to the pump. Surprise visits are paid to the mines when possible. In any case the actual places of sampling are not decided on until the arrival at the mine. The dust inspector arrives at the mine between 8 and 9 a.m., sees the manager or mine captain and consults with him as to the places to be sampled, taking care to choose places where, from experience, it is known that dust is likely to be made.

The actual process of taking each sample by the sugar-tube method occupies from ten to fifteen minutes. The air sampled is in the immediate neighborhood of that actually being breathed by the men at work. The sugar tube is held in the hand at the height of the mouth, and is moved slowly round so as to sample the air at that height in the particular place under examination. In stopes, the sample is usually taken at the upcast side, and in ore bins to the leeward side.

The sampling being completed, the dust inspector makes the following notes: Mine, section, date, number of tube, place of sampling, time, nature of work in progress, number and type of machines, state of water supply and how applied, number of men (whites and natives), appearance of the working place (*i.e.*, wet, dry, or dusty), appearance of the air, and so on.

The dust inspector then proceeds to the next place to be investigated and repeats his sampling until he has completed his work. In the course of his journey through the mine, he is expected to note the general appearance of the workings as regards dust, and to report any deficiencies which he may observe in dust-allaying apparatus. The visit of inspection occupies half a day, and on its conclusion the dust inspector returns to the Chamber's laboratory, hands his samples over to the analyst, and enters a report of his visit on the record.

Jacks Used To Replace Derailed Steam Shovel

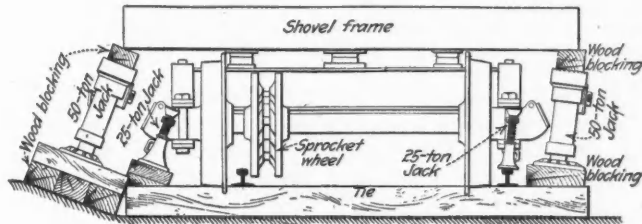
BY H. H. HUNNER

Written for *Engineering and Mining Journal*

In moving a 100-ton shovel backward around a sharp curve, the last pair of wheels dropped off on the inside of the curve. Several attempts were made to replace the two wheels, using "A" frogs, switch needles, dipper bases, and similar material, but the ordinary methods that usually suffice for a locomotive or stripping truck all failed. The great weight on this pair of wheels owing to the overhang of the boom and dipper stick makes them very resistant to climbing any description of replacing frog. One frog or the other is invariably pinched out of place.

On this particular shovel the sprocket wheel for the chain drive was on this axle and would engage the frog on the inside rail, shoving it out of place before the wheel could engage it.

The method that finished the job in less than half an hour on first trial was the one indicated in the sketch. The jack arms were not used. Blocking the other truck to prevent the shovel moving either forward or back, the dipper was rested on the ground just on the outside of the outer rail. Two fifty-ton jacks were started, one on either corner of the shovel frame, canted to draw the whole body of the shovel toward the center of the



MANNER OF EMPLOYING JACKS IN REPLACING DERAILED STEAM SHOVEL

track. As soon as the body was free of the boulder, two twenty-five-ton jacks were started at the corners of the journal boxes. As soon as the wheels were clear of the rails, the frame gradually settled, dropping the wheels in place.

Plan of Pumping Station

High-head stage centrifugal pumps are either arranged with their lengths parallel with the width of the pumping station or parallel with its length. In rock that stands well the former arrangement is preferable, but where heavy support is necessary, the latter arrangement is more favorable, as it allows the minimum span of roof. An example of recent practice is given in the illustration, which shows in plan and cross-section the pumping station of the Randfontein Central Gold Mining Co., Ltd., in South Africa.

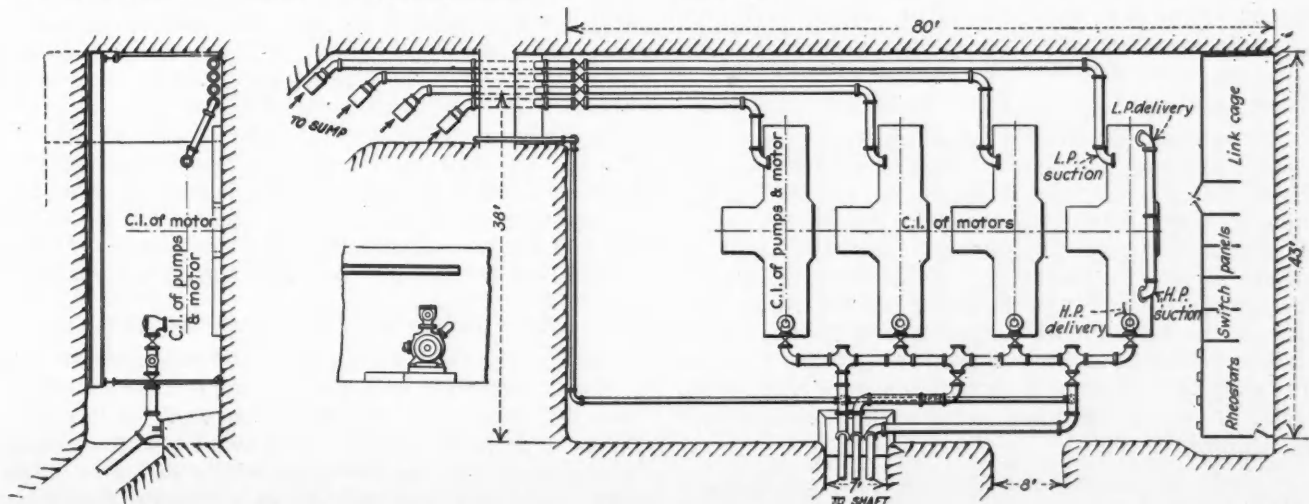
The description is taken from a paper by G. H. Beatty in the November, 1920, issue of the *Journal of the South African Institution of Engineers*. There are four units, each a thirteen-stage Sulzer pump of 1,400-gal. capacity per minute against a 2,500-ft. head. The unit consists of a five-stage right-hand suction pump and an eight-stage left-hand pressure pump. The two pumps are coupled in series and are on either side of a 1,750-hp. motor, which is on the base plate common to both pumps. The motor operates at 1,470 r.p.m. All four pumps discharge into a common header, which in turn is connected to three 10-in. pump columns.

The total capacity of the four pumps is 5,600 gal. per minute, equivalent to 748.8 cu.ft. per minute, or 46,800 lb. water per minute. The theoretical horsepower per pump is 886. Assuming a friction head of 52.25 ft., 18.5 hp. would theoretically be required to overcome this head. The combined theoretical head is 904.5 hp. The over-all efficiency is 51.7 per cent, as figured on the basis of 1,750 hp. input to the motor. The actual efficiency would exceed this amount. The velocity in 10-in. columns is equivalent to 22.8 ft. per second for maximum capacity.

Repair of a Broken Jaw Crusher

The repair of a broken jaw crusher described in *Engineering and Mining Journal's* issue of Jan. 29 last, is very interesting to the oxy-acetylene welder as indicating that there is yet considerable latitude for spreading the usefulness of his trade. The method described, though undeniably ingenious, is involved and roundabout. One side frame casting of a 36 in. x 42 in. jaw-type crusher was broken along the line of bolts that held in place the back end of the frame. Material used in the repair consisted of six sections of 2½ in. shafting, each 14 ft. long; twenty-four drop-forged 3-in. nuts; six drop-forged 8 x 4-in. steel stays, each 7 ft. long; and four cast-iron pillar blocks, two being 34 x 6 x 10 in., and two 34 x 4 x 6 in. Four days were required to assemble the material, twenty-four hours for threading the six rods, twenty-one hours for drilling holes in the stays, besides the time for setting up. One lathe and one drill had to be relieved from production twenty-four hours and twenty hours, respectively, during the preparation of material for the repair. When the job was completed, the crusher, though capable of functioning, was nevertheless a broken machine tied together with an iron and steel crating.

By the method of re-making broken machinery by oxy-acetylene welding, the repaired crusher might have been restored to its original compact structural form, and, assuming the necessity of temporarily dismantling the fractured casting and redrilling of the bolt ports, the repair would very likely have been made in less time and at lower cost than it was by the method described. It is not intended to give the impression that this would have been a simple repair as compared to some welding operations, but it would certainly be within the range of the competent oxy-acetylene process, and is of a type that is often handled by repairmen in many industrial centers.



PLAN AND CROSS-SECTION OF PUMPING STATION OF RANDFONTEIN CENTRAL GOLD MINING CO., SOUTH AFRICA

THE PETROLEUM INDUSTRY

The Isthmian Oil Fields of Mexico

BY ARTHUR H. REDFIELD*

THE ISTHMIAN oil-producing district of Mexico extends between 91 and 95 deg. longitude west of Greenwich, between 17 deg. 35 min. north latitude and the shores of the Gulf of Mexico. It includes the Tehuantepec and the Tabasco-Chiapas fields, and corresponds to the officially designated zone of Minatitlán.

In the early days of Mexican oil production the Isthmian district gave promise of a considerable output—so much so that the Pearson interests established a refinery at Minatitlán. The Isthmian oil fields, however, have been a disappointment. They have at no time produced enough to supply the refinery at Minatitlán, which has been operated on crude oil shipped from the northern fields. Development of the Isthmian fields languished when the Potrero del Llano, owned by the Mexican Eagle Co., in the Tampico-Tuxpam region, began its spectacular output. This soon eclipsed the modest production of the Isthmian district, and the latter was left to play a part of diminishing importance. Political disturbances have also checked the development of the Tehuantepec oil fields. In recent years their contribution to the oil supply of Mexico has been negligible. Whether the Isthmian region will ever be a large producer of petroleum remains open to question.

A comparison between the production in recent years of the zone of Minatitlán, which corresponds to the Isthmian district, and that of all of Mexico is afforded by the following table:

PRODUCTION OF CRUDE OIL IN THE ZONE OF MINATITLÁN AND IN MEXICO, 1914-1919
(In Barrels of 42 Gallons)

	Zone of Minatitlán	Mexico
1914.....	228,761	26,235,403
1915.....	226,163	32,910,508
1916.....	160,950	40,545,712
1917.....	23,549	55,292,770
1918.....	321	63,828,326
1919.....	904	87,072,954

The world-wide demand, however, for petroleum and petroleum products has awakened interest in fields previously considered negligible. The Isthmian district has accordingly had its share of the interest and the active attention of the oil men in recent months.

LOCATION AND EXTENT OF THE TEHUANTEPEC FIELD

The Tehuantepec oil field comprises the southern and eastern parts of the State of Vera Cruz, between latitudes 17 deg. 35 min. and 18 deg. 5 min. north and longitudes 95 and 94 deg. 10 min. west of Greenwich; and includes the San Cristóbal, Jáltipan, Ixhuatlán, and Tecuanapa pools. The oil-bearing area proper extends from the Chapopote ranch, southward to Medias Aguas station on the Tehuantepec railroad; from Sayula on the west to the border of the states of Tabasco and Chiapas. The extent of this area is about 100 square miles. Only about fifteen square miles, however, have been proved by drilling.

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The thick residual soil and the dense tropical vegetation make geologic investigation of the region difficult. It can be seen, however, that the horizontal strata of Quaternary quartz gravels, reddish sands, and white to cream-colored clays, which extend forty miles southward to Minatitlán, lie unconformably upon blue argillaceous and micaceous sandstones, as well as unconsolidated sands, gravels, and conglomerates of Pliocene age, to a total thickness of 2,000 to 2,500 ft. These are underlain in turn by Upper Miocene blue marls and shales outcropping over an area 100 miles wide. The Tertiary beds are unconformably underlain by a Cretaceous dolomitic limestone, which is the oil-bearing formation of the region.

A journey along the Tehuantepec railroad from Puerto México to Santa Lucrecia discloses the Quaternary gravels, sands, and clays as far as Chinameca (22.99 miles from Puerto México), followed by Pliocene sands and conglomerates to Jáltipan and continuing to the 69 kilometer (42.87 mile) post. Here the Upper Miocene shales begin, continuing, though masked for wide stretches by Pliocene sands and gravels, to Medias Aguas (60.27 miles), where Cretaceous limestone outcrops. Beyond this, Pliocene deposits hide the underlying formations, but at Tortugas (65.86 miles) Upper Miocene marls are visible, continuing to Santa Lucrecia.

SAN CRISTÓBAL ANTICLINE IS PRINCIPAL STRUCTURE

The Cretaceous and Tertiary strata are considerably folded, forming close anticlines and synclines, of which the bearing varies between N. 45 deg. and N. 80 deg. W.

The principal structure of the region is the San Cristóbal anticline, which extends forty-four miles along an axis passing a little south of San Cristóbal and a little north of Sayula, bearing N. 75 deg. W. to N. 80 deg. W. The strata of the crest are slightly inclined; the flanks descend in a gentle slope. On the eroded crest of this asymmetric anticline is the San Cristóbal pool; on the north flank occur the Ixhuatlán and Jáltipan pools; and on the south flank are the Medias Aguas and Coapitolya pools. The Tertiary strata are fissured in various directions, both along the axis and down the flanks of the anticline.

A second asymmetric anticline, very close, occurs south of Santa Lucrecia, near Cardenas station on the Tehuantepec railroad. From this point southward the Miocene marls continue in gentle undulations to the point where the Middle Cretaceous limestones outcrop.

SALT DOMES FREQUENT AND GROUPED

The occurrence of petroleum in the Tehuantepec field is closely connected with the salt domes that have been observed, principally on the north flank of the San Cristóbal anticline. These are of two types, true domes or quaquaversals, and anticlines with a salt core in the apex. The Isthmian salt domes are quite numerous,

and in places they are closely grouped. The principal domes of this area are those of Ixhuatlán, Filisola, Palmitota, Cascajal, Tecuanapa, and La Concepción.

The Ixhuatlán salt dome has the general form of a northeast-southwest anticline, surrounded by bluffs of blue Pliocene sandstone, rising 200 ft. above the floor of the valley. The wells after penetrating the Quaternary detritus enter the Miocene marl. This formation has a number of intercalated sands, some of which produce oil. The dolomite which is found just above the salt plug is hard and compact and carries no oil. The Palmitota dome, though differing in form, is similar in its main characteristic geologic structure to that of Ixhuatlán.

The Tecuanapa salt dome is elongate, with its major

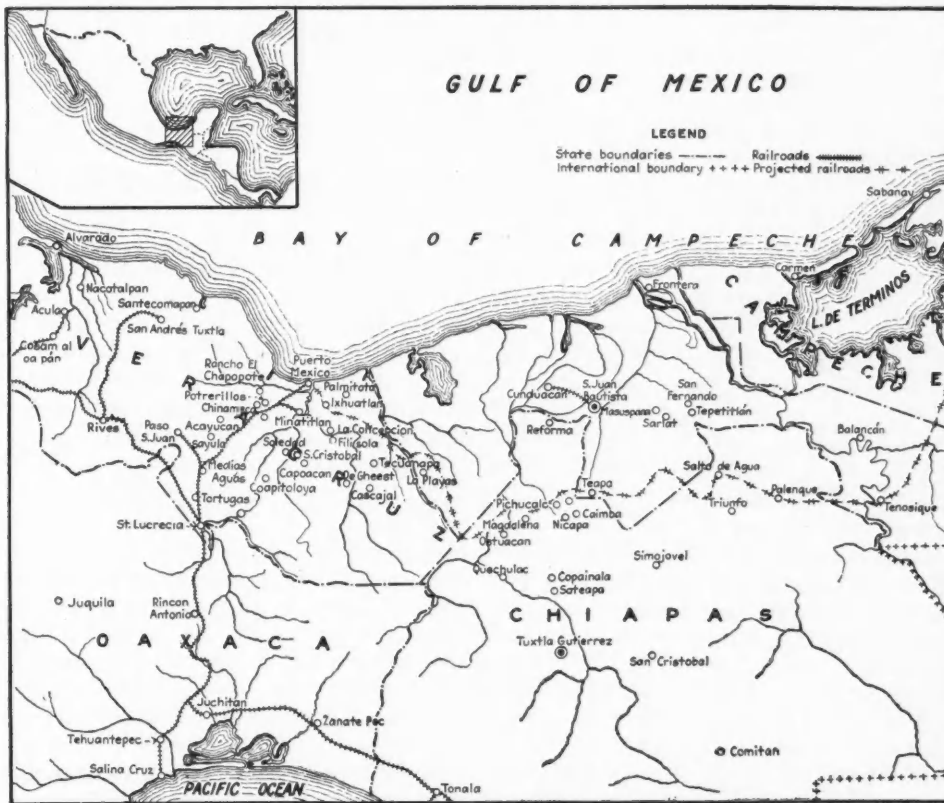
The elongated dome at La Concepción is a duplicate of the Tecuanapa dome, save that its major axis runs more nearly north-south.

The Cascajal salt dome, structurally almost a perfect dome, shows a dissolution of the outer portion of the salt core similar to that of the Filisola dome, and a partial replacement of the salt by Pliocene detritus.

According to Hartley, the domes of the Tehuantepec area may be grouped along two well-defined axes which may have a connection with lines of structural weakness. The trend of one axis, along which the Tecuanapa, Filisola, and Concepción salt domes are aligned, is northwest-southeast and generally parallel to the mountain front. A parallel axis to the south would take in the Cascajal, De Gheest, and San Cristóbal domes.

The second of two principal axes runs northeast-southwest. Along it may be aligned the Palmitota, Ixhuatlán, and San Cristóbal domes. The intersection of the two hypothetical "lines of weakness" at San Cristóbal may account for the double dome which characterizes the San Cristóbal-Capoacán field.

This alignment is given by Hartley as tentative only. It is not possible at the present state of knowledge concerning the geology of the Tehuantepec oil fields to determine whether these lines, if they are proved to be lines of weakness, are folds or faults. De Golyer, however, believes that no general alignment of the salt domes of the Tehuantepec region similar to that reported in the Texas-Louisiana region can be traced. The structures produced by the salt masses generally resemble folds rather than symmetrical domes occurring at the intersection of faults. These folds may be traced from one



GEOGRAPHIC SITUATION OF THE ISTHMIAN OIL FIELDS OF MEXICO

axis running northwest-southeast. The Miocene formations occur quite close to the surface. The few Miocene sands occurring in this dome are water-bearing; the oil is contained in the Cretaceous dolomitic limestone. The salt mass has been abruptly cut off on the south side by a northwest-southeast fault.

The dolomite cap of the San Cristóbal-Capoacán salt dome shows a symmetrical double dome upon the San Cristóbal anticline, similar to the domes of the Texas-Louisiana region. The Soledad dome is also of this type.

The Filisola dome is formed at the intersection of two nearly equal axes, three miles long, running respectively northwest-southeast and northeast-southwest. A central surface depression surrounded by bluffs of Miocene marl dipping steeply away from the central core shows that the salt mass must have originally reached the surface and have been dissolved out, leaving a basin to become partly filled with débris. Drilling has revealed that the salt extends a considerable distance to the northwest.

dome to another, as the surface geology of the region is better exposed than in the Gulf-Coast areas of the United States.

ASPHALT AND OIL SEEPAGES

Surface indications of petroleum in the Tehuantepec region are confined to the Miocene and Pliocene rocks on the flanks of the San Cristóbal anticline. These consist of seepages of asphalt (*chapopote*), by which the principal pools were originally located. Oil seeps out in the Pliocene sands at Potrerillos, near Jáltipan.

The oil of the San Cristóbal pool is asphaltic, with a specific gravity of 0.892, (26.8 deg. Bé.) and a viscosity of 500 Saybolt, at 38 deg. C. (100.4 deg. F.). The oil contains 2.34 per cent of sulphur, and has a heating power of 10,107 calories. Analysis by the Engler method of a sample from a surface seepage gave the results indicated in the table entitled "Laboratory Distillation of Crude Oil From San Cristóbal," which appears at the top of the first column of the page immediately following this.

LABORATORY DISTILLATION OF CRUDE OIL FROM SAN CRISTÓBAL

Fractions	Per Cent by Weight	Specific Gravity
Between 20 and 150° C. (gasoline)	16.59	0.834
150 and 250° (illuminating oils)	10.66	0.906
250 and 300° (illuminating oils)	17.73	0.913
300 and 389° (heavy oils)	23.71	0.936
Residuum, asphalt	28.64	1.124
Water	1.29	1.000
Loss	1.38	.....
Total	100.00	.....

Commercial distillation of crude petroleum from San Cristóbal at the Minatitlán refinery gave the following proportions:

REFINERY DISTILLATION OF CRUDE OIL FROM SAN CRISTÓBAL

	Temperature of Distillation	Per Cent	Specific Gravity
Naphtha	170 to 302° F.	12.0	0.717
Illuminating oil	302 to 572° F.	30.0	0.812
Gas oil	572 to 684° F.	20.4	0.892
Intermediate oil	684 to 732° F.	19.4	0.930
Water		0.3	.....
Liquid products		82.1	.....
Coke by weight		13.5	.....
Loss		4.4	.....
		100.0	.....

Crude oil from Jáltipan is asphaltic, with a specific gravity of 0.983 (12.4 deg. Bé.). The sulphur content averages 1.87 per cent. Analysis by the Engler method gave the following percentages:

FRACTIONAL DISTILLATION OF CRUDE OIL FROM JÁLTIPAN

Fractions	Per Cent	Specific Gravity
Between 20 and 150° C. (gasoline)	9.87	0.862
150 and 200° (illuminating oils)	19.41	0.908
200 and 250° (illuminating oils)	3.92	0.916
250 and 300° (illuminating oils)	25.20	0.924
300 and 389° (heavy oils)	23.44	0.934
Residuum (asphalt)	26.14	1.128
Loss	1.02	.....
Total	100.00	.....

From the Tecuanapa pool was extracted a dark-brown oil, with phosphorescent properties, and with an odor of hydrogen sulphide. Its specific gravity was 0.856 (33.50 Bé.), and its viscosity at 70 deg. F. was 57 seconds by the Redwood scale. The flash-point occurred at 50 deg. F. and the point of ignition at 95 deg. F. Its heating power was calculated at 10,590 calories.

Distillation of crude oil from Tecuanapa by the Engler method gave the following fractions:

FRACTIONAL DISTILLATION OF CRUDE OIL FROM TECUANAPA

	Per Cent by Volume	Specific Gravity
Between 80 and 150° C. (gasoline)	13.0	0.730
150 and 200° (illuminating oils)	13.0	0.785
200 and 250° (illuminating oils)	11.0	0.822
250 and 300° (illuminating oils)	11.9	0.852
300 and 350° (heavy oils)	44.0	0.871
Residuum (asphalt)	4.0	.....
Loss	3.1	.....
Total	100.0	.....

In refinery practice 13 per cent of gasoline of 0.730 specific gravity was obtained; 36 per cent of illuminating oils of 0.810 specific gravity; 12 per cent of gas oil of 0.860 specific gravity; 30 per cent of paraffine oils of 0.875 specific gravity; and 4 per cent of asphalt.

Distillation of crude petroleum from the wells of Nanchital, in the Tecuanapa pool, by the Engler method, gave 10 per cent of gasoline; 40 per cent of kerosene; 0.9 per cent of sulphur; and no asphalt. In refinery practice 8 per cent of naphtha was obtained; 39 per cent of illuminating oil; 10 per cent of gas oil; 34 per cent of heavy oils; 4 per cent of asphalt; and 1 per cent of sulphur, with a loss of 4 per cent.

Crude oil from Ixhuatlán has a specific gravity of 0.913 (23.3 deg. Bé.); that of Capoacán a specific gravity of 0.885 (28.2 deg. Bé.). Both of these oils are asphaltic.

The production of crude oil in the Tehuantepec field in recent years is illustrated by the following table:

PRODUCTION OF CRUDE PETROLEUM IN THE TEHUANTEPEC FIELD, MEXICO, 1914-1917

	(In Barrels of 42 Gallons)			
	1914	1915	1916	1917
San Cristóbal	13,393	14,640	8,183	2,412
Tecuanapa	96,688	98,803	24,143	.....
Ixhuatlán	100,459	94,990	110,980	18,529
Soledad	9,101	9,154	6,480	.....
Capoacán	9,120	10,567	10,868	2,252
Total	228,761	228,154	160,654	23,193

DRILLING RECORDS INCOMPLETE

Drilling records for the wells of the Tehuantepec field are not available with any degree of completeness or detail. The following table illustrated the progress of drilling in the Tecuanapa and the Ixhuatlán pools down to the closing of the former in August, 1916, and of the latter in April, 1917.

	Wells Drilled	Range in Depth	Average Producing Depth, Ft.	Dry Wells	Abandoned Wells
Tecuanapa	11	439-2,013	732	3	8
Ixhuatlán	16	311-2,497	1,049	10	3

The output of the Ixhuatlán wells ranged between 2½ and 60 bbl. a day, with an average production of 30 bbl. per day.

During 1919, five wells were located on the Hacienda de Cuyucuenda, near Cocuite, in the Municipality of Tlalixcoyan, State of Vera Cruz, by Alejandro P. Wiechers. Drilling, however, was not started.

The Mexican Eagle Co. located five wells in the Ixhuatlán pool and three in the Tecuanapa pool, but drilling was not started. One well near Ixhuatlán was carried to 513 ft., when work was suspended.

TRANSPORTATION AND REFINING

A pipe line conveys the oil of the Ixhuatlán pool to the River Coatzacoalcos, navigable by vessels of deep draught and leading to Puerto México, on the Gulf Coast, and another pipe line connects the Tecuanapa pool with the River Uxpanapa, a tributary of the Coatzacoalcos. The Capoacán and Soledad pools are situated along the River Coachapán, another tributary of the Coatzacoalcos.

A refinery was built in 1908 by the Mexican Eagle Co. at Minatitlán, on a branch of the Tehuantepec railroad. Though intended originally to serve the Isthmian district, it has for years received its main supply of crude oil from the company's wells in the Tampico-Tuxpam region. This refinery was almost totally destroyed by a fire on July 27, 1920. The intentions of the Mexican Eagle Co. with regard to rebuilding have not been made public.

The Minatitlán refinery was situated on the left bank of the River Coatzacoalcos, about eighteen miles north-east of the city of Minatitlán, between two marshes and upon a group of hills ranging from 66 to 98 ft. in altitude. Because of the local conditions of drainage, the buildings of the refinery were located upon the hills, despite the difficulty and expense of pumping up all the water that was needed. The refinery had a capacity of 12,000 bbl. daily.

The crude petroleum was shipped to the refinery up the River Coatzacoalcos in tank steamers. The refined products were shipped down the river in native dug-outs and in tank boats to Puerto México. Formerly a pipe line led to the port; but as this had been laid over marshes and under bad conditions generally, it was useless at the end of five years.

The capacity and the activity of the Minatitlán refinery may be gaged by the exports of refined oil from Puerto México. It must be remembered, however, that practically all of the crude petroleum consumed in the preparation of these products came from the northern oil fields.

EXPORTS OF MINERAL OILS FROM PUERTO MÉXICO, 1913-1916
(In Metric Tons)

	1913	1914	1915	1916
Crude petroleum.....	21	7	.....	7,000
Refined petroleum				
Benzine.....	1,442	.....	.....	.....
Gasoline.....	4,742	7,151	8,521	4,327
Naphtholine.....	5	1,641	2	11,239
Kerosene.....	20,978	19,100	.....	.....
Illuminating oil.....	4,664	23,649	37,110	32,142
Gas oil.....	4	23	2,438	.....
Fuel oil.....	69,828	184,802	118,536	134,618
Lubricating oil.....	.....	1,052	4,633	8,396
Asphalt.....	50,811	33,689	19,269	26,242
Other derivatives.....	833	26	.....	3,846
Totals.....	153,328	271,140	190,509	227,810

Exports of refined oil from Puerto México equaled 207,712 metric tons in 1917; 149,555 tons in 1918; and 283,262 tons in 1919.

The producing area of the Tehuantepec field is controlled entirely by the Mexican Eagle Oil Co., (Compañía Mexicana de Petróleo "El Aguila," S. A.), founded by the Pearson interests with British capital. The sale of a controlling interest in this company to the Royal Dutch-Shell group was announced in April, 1919.

LOCATION AND EXTENT OF THE TABASCO-CHIAPAS FIELD

The Tabasco-Chiapas oil field includes the south-central portion of the State of Tabasco and part of northern Chiapas State. It may be defined by a line extending from the El Triunfo ranch, on the Mexcalapa River, to Ostuacán, in Chiapas; thence to the historic ruins of Palenque, to Balancán, in Tabasco, and to the Gulf of Campeche. The probable oil-bearing area was calculated by Arnold in 1917 at twenty square miles. Only one-fourth square mile has been proved by the drill.

The surface of the Tabasco oil region is covered with horizontal Quaternary deposits of sand and clay. Below the Quaternary occur the marine Tertiary formations, which outcrop on the border between the states of Tabasco and Chiapas, bearing generally N. 80 deg. E. These consist of calcareous sandstones, alternating with shales, marls, and conglomerates. Oil horizons occur in the loose sandstones and conglomerates of the Tertiary. The finer-grained rocks of this series are found between Quechulac and Las Palmas, on the Mexcalapa River, in Chiapas; and the coarser grained in the sub-soil of Tabasco. The Pliocene is represented by strata of chalk, sandy clay, and conglomerate. The Miocene formations, consisting of marls, shales, blue clays, and coarse limestones, rest unconformably upon nummulitic limestones belonging to the Eocene, which outcrop at Copainalá and Soteapa.

The Tertiary formations of Tabasco rest upon coralliferous dolomites and dolomitic limestones of the Upper Cretaceous which outcrop in Chiapas. These rocks, with their numerous cavities, are the principal reservoirs of oil in this area. They occur generally in thick beds, some of which present a brecciated structure. Below the Upper Cretaceous limestones and dolomitic limestones occur coarse beds of limestones containing *Rudistæ*, ascribed by Villarello to Middle Cretaceous.

Eruptive rocks are not plentiful in this region. They occur sporadically in the center of Tabasco, consisting chiefly of quartz-bearing micaceous diorites

near Santa Fé, and andesites of Miocene and Pliocene age in the valley of Chiapas River. Miocene diorite and andesite, partly covered by marine Pliocene sediments, outcrop south and southeast of Pichucalco, principally along the axis of the Pichucalco-Salto de Agua anticline.

GEOLOGIC STRUCTURE

The Tertiary strata of the region are folded into two series of anticlines and synclines. The principal anticlines of the region are the Triunfo-Palenque, the Pichucalco-Salto de Agua, and the Reforma-Macuspana. The last named is considered an eastward extension of the San Cristóbal-Tecuanapa anticline, in the Tehuantepec region. All three are open anticlines, with broad arches, bearing N. 80 deg. E., the axial planes of the folds dipping steeply to the south. A second series of minor folds runs at right angles to the first, bearing N. 10 deg. W. The chief of these are the Pichucalco-Reforma and the Salto de Agua-Tepetitlán anticlines. Elongated domes occur near Ostuacán, Pichucalco, Reforma, east of Macuspana, and near Salto de Agua. Parallel to the two principal lines of folding run two systems of faults.

SURFACE INDICATIONS OF PETROLEUM

Surface manifestations of oil, gas, and asphalt are abundant in the Tabasco-Chiapas region. *Chapopoteras* (seeps of asphalt) occur in the northeast of Tabasco at Tlachontalpa, near Santa Ana and along the lagoon of Santa Ana; in the north of the state, from San Fernando through Macuspana to La Reforma; and in the south from Salto de Agua to Tacotalpa, Teapa, Pichucalco, Ostuacán, and Sayula. Along the crest of the Pichucalco-Salto de Agua anticline oil of good quality seeps out at the Hacienda de Guadalupe and along the Arroyo de Chapopote.

Gas, oil, and asphalt (*chapopote*) exude along the Ostuacán or Sayula River, on the crest of the Triunfo-Palenque anticline to the north of Pueblo la Magdalena. The limestone at Primavera, to the east of Magdalena, is impregnated with *chapopote*.

CHARACTER OF OIL

The oil from the well of Sarlat, northeast of Macuspana, is of a deep red color, with a specific gravity of 0.830 and a viscosity of 25 deg. Saybolt at a temperature of 38 deg. C. The flash-point ranges from 14.5 deg. to 17.8 deg. C.

The abandoned wells of the Anglo-Mexican Oil Fields, Ltd., at Caimba, southwest of Pichucalco, produced formerly a black oil with little fluorescence which showed dark red in transmitted light. Its specific gravity was 0.8712 (30.69 deg. Bé.), and its viscosity at 20 deg C. by the Engler scale was 106 seconds. Distillation of this oil by the Engler method gave the following results:

Fractions	Per Cent by Volume	Specific Gravity 15.5° C.
50 to 150° C. (gasoline).....	16.0	0.7215
150 to 250° (illuminating oils).....	16.0	0.814
250 to 300° (illuminating oils).....	9.0	0.880
300 to 350° (heavy oils).....	11.5	0.9805
Residuum.....	47.0	.....
Loss.....	0.5	.....
Total.....	100.0	.....

In refinery practice, 15 per cent of gasoline was obtained from this oil; 25 per cent of illuminating oil; 20 per cent of solar oil, and 35 per cent of lubricants, with a loss of 5 per cent.

In the Sarlat pool of the Tabasco oil field the Mexican Eagle Co. carried one well 48.22 ft. during 1919, or to a

total depth of 157.44 ft., but abandoned it in May as unproductive. A second well started in July had reached 156.46 ft. at the close of the year. No drilling was done by the Mexican Eagle Co. in the Reforma pool, Department of Pichucalco, Chiapas, but four wells were located.¹

The pool of Caimba abandoned by the Anglo-Mexican Oil Fields, Ltd., in 1910, was reopened in 1919 by the Mexican federal government. Nine wells were drilled. The first upon reaching a depth of 2,132 ft. proved a gusher. According to reports, three others, after reaching respectively 656 ft., 508.4 ft., and 115.04 ft., yielded oil by pumping. The remaining wells were carried to depths ranging from 55 ft. to 2,744.05 ft. Three were abandoned and two proved unproductive. No statement has yet been made public regarding the output of the Caimba field under government operation.

The output of the wells of Sarlat from 1915, when production began, is illustrated by the following table:

CRUDE PETROLEUM PRODUCED AT SARLAT, 1915-1919		
Years	Barrels of 42 Gallons	Metric Tons
1915.....	9	1.17
1916.....	296	39
1917.....	366	48
1918.....	321	42
1919.....	904	119

The only producing wells in the Tabasco-Chiapas district, those of Sarlat, are owned by the Mexican Eagle Oil Co. (Compañía Mexicana de Petróleo "El Aguila," S. A.), founded originally by S. Pearson & Sons, Ltd., with British capital, but sold in the spring of 1919 to the Royal Dutch-Shell group. Its principal holdings are in the Macuspana and Pichucalco oil fields.

In 1919, as has been stated, the Mexican federal government entered the field by beginning the exploitation of the Caimba pool, near Pichucalco, abandoned in 1910 by the Anglo-Mexican Oil Fields, Ltd.

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The Exploitation of Petroleum by Means of Pits and Galleries

M. COURAU, ex-engineer of the Corps des Mines and a former member of the French General Committee on Petroleum, calls attention to the exploitation of petroleum by means of pits and galleries in *Technique des Petroles*, according to *L'Echo des Mines et de la Metallurgie*. "The complete exploitation of a deposit," says M. Courau, "should logically pass through three distinct phases, whose abilities of extraction should correspond, approximately, to the following proportions of the total volume of oil originally contained by the sandstone: Drilling, 10 to 20 per cent; drainage by means of subterranean galleries, 30 to 40 per cent, and mining of the sandstones and washing with boiling water, 30 to 40 per cent."

These figures, given by Paul de Chambrier, director general of the Péchelbronn mines, are not absolute and may vary from one deposit to another, but at least they give an idea of the order of magnitude of the phenomena involved. It is certainly true that the quantity of oil discharged through a boring that taps a petroleum deposit represents but a small fraction of the crude oil saturating it.

De Chambrier's method, which is described in a small publication,¹ offers the following advantages over ordinary well drilling: It permits the recovery of two or three times as much oil as that already secured from the same deposit by means of borings; it increases, to the above extent, the value of a concession by permitting one to at least estimate with sufficient accuracy, if not to calculate precisely, the oil reserves still held in the ground; from the economic point of view it offers possibilities in countries where oil deposits appear to have reached the limits of their yield; from the scientific standpoint, it is destined to solve a multitude of problems that have remained obscure heretofore, involving the origin of crude oil, its migration, its concentration in the lower strata, the behavior of the natural gas associated with the petroleum, and the stratification of the porous rocks.

New Oil Field Expected in Fresno County, Cal.

SPECIAL CORRESPONDENCE

A new and extensive field of petroleum in close proximity to Fresno is to be brought in, according to a report made by T. A. Piper, geologist to the board of directors of two oil companies which have been drilling in the western part of Fresno County, Cal.

The field is described as being twenty-eight miles long and about five miles wide. It is stated that the drills have penetrated three oil-bearing sands and have encountered a series of hard cappings, and that quantities of gas and indications of oil have been found. Two wells are being drilled, eight miles from each other, but in the same geological formation.

¹"Exploitation du Petrole par des Puits et Galeries," by Paul de Chambrier.

Technical Papers

Virginia Clays and Shales—Bulletin No. 20 of the Virginia Geological Survey (obtainable upon request to the Survey at Charlottesville, Va.) is a 118-page book entitled "The Clays and Shales of Virginia West of the Blue Ridge." The region covered by this report is shown to contain vast clay and shale resources desirable for the manufacture of certain clay products, for which there is a large and increasing demand. A map of the state, 21 x 33 in., is included.

Goodnews Bay, Alaska—The U. S. Geological Survey has issued a twenty-one-page bulletin (No. 714-E) on the Mineral Resources of the Goodnews Bay region, Alaska, which may be obtained on request. The pamphlet contains the results of investigational work done in 1919. The claims are largely of placer gold.

Canadian Mineral Production—The "Annual Report on the Mineral Production of Canada" for 1919 has been issued and may be had on request to the Department of Mines at Ottawa. The total value for the year was approximately \$177,000,000.

Ceramic Industry—U. S. Bureau of Mines *Reports of Investigations*, No. 2,212 (obtainable on request) describes the work of the ceramic station of the Bureau, at Columbus, Ohio. The suitability of domestic clays and other materials for the following purposes is being studied: graphite crucibles, dolomite refractories, white pottery clays, and Ohio fire clays. The bulletin contains five pages and suggests possibilities of widening present demands.

Willow Creek, Alaska—Five mines were operated in the Willow Creek district in 1919, according to Bulletin 714-D of the U. S. Geological Survey, describing lode developments in that district in 1919.

Talc—"The Talc Industry in 1920" forms the subject of a five-page bulletin issued by the U. S. Bureau of Mines in its series of *Reports of Investigations*, No. 2,204. Conditions in the various domestic producing states are discussed and the foreign situation is summarized. The bulletin is free on request to the Bureau at Washington, D. C.

Colorado Resources—The annual review number of the "Railroad Red Book," January, 1921 (price 30c., 2,019 Stout St., Denver, Col.), contains a large amount of matter relating to the resources and attractions of Colorado, and, to a lesser extent, of Utah and New Mexico.

Tin Ore Dressing—In the February number of *The Mining Magazine* (price 1s. 6d., Salisbury House, London Wall, London, E. C. 2, England) appears a twelve-page article by R. T. Hancock entitled "The Physical Bases of Tin-Dressing."

Mine Ventilation—The U. S. Bureau of Mines has issued a preliminary report of forty-four pages entitled "Ventilation in Metal Mines," which may be obtained from the Bureau free of charge for a limited time, or from the Superintendent of Documents, Washington, D. C., for 10c. This paper discusses the conditions affecting the temperature, relative humidity, and composition of mine air; the effect of dust, and the influence of velocity. The necessity for efficient control of ventilation is emphasized and methods for securing it are suggested. The cost of efficient ventilation is approximately 5c. per ton of ore produced for large mines and 10c. for small ones, but, compared with possible savings, costs are said to be negligible.

Phosphate in Canada—The latest publication of the Canadian Department of Mines, Mines Branch, Ottawa (obtainable upon request), is an illustrated book of 156 pages entitled "Phosphate in Canada." Of late years the Canadian production has been small—less than 1,000 tons per year—but in the late '80s the industry was more important, most of the production coming from Quebec. In addition to describing the Canadian occurrences of apatite in considerable detail, a chapter is included devoted to associated minerals. Several pages are also devoted to general information and to the manufacture of phosphorus products, thus making the book one which will prove valuable to all those interested in this subject, even though in other lands.

Power Transmission—A new method of transmitting power by wave motion, the invention of a Rumanian, G. Constantinesco, is described in principle in *The Mining Magazine* for February. (Price 1s. 6d., Salisbury House, London Wall, London, E. C. 2, England). Another article descriptive of the various applications of the idea to rock drills and other machines will appear in the March issue.

Safety—Bulletin No. 8 of the Bureau of Safety, Sanitation and Welfare, United States Steel Corporation, is an attractive book of 97 pages which shows pictorially the several activities of this company at the various subsidiary plants. Over five hundred illustrations with suitable captions are included, and demonstrate the splendid manner in which the Corporation has provided for the well-being of its employees.

Chitina Valley, Alaska—The status of mining in this district in September, 1919, is covered in an eight-page pamphlet just issued by the U. S. Geological Survey, Washington, D. C., as Bulletin 714-C, obtainable on request.

Sand Filling in Stopes—A short sketch of the method used at the No. 3 mine of the Ray Consolidated is given in U. S. Bureau of Mines *Reports of Investigations*, No. 2,208, obtainable on request.

Book Reviews

Economic Mineralogy. A Practical Guide to the Study of Useful Minerals. By Thomas Crook. Cloth; 5½ x 8½; pp. 492. Longmans, Green & Co., London and New York; 1921. Price, \$8.

Although this book is a compilation, the wisdom of the plan and the energy and accuracy of treatment plainly give it a prominent place among textbooks. "The aim of this book," say the publishers, "is to deal with the subject of mineralogy in such a way as to meet the needs of those who wish to restrict their attention to the utilitarian side of the subject." In other words, it is a study of minerals with special reference to the interests and purposes of the general student and the engineer. As such, it is a welcome and timely publication. We have heard on various sides the intention of preparing such a book: Mr. Crook has been the first to do it, and has done it in a remarkably thorough and satisfactory manner. We recommend it to the consideration of students in mining schools, and to mining engineers in general. Admirable judgment has been shown in the balance and selection of the technical characteristics of minerals—their uses, origin, and distribution. Of the twelve chapters, the first eight are general in their character, but altogether constitute only about a quarter of the book. They treat of the symmetry of crystals, their physical characteristics, the elements of crystal optics, their chemical examination, the physical analysis of crushed rocks, the geology of economic mineral deposits (23 pages), and the economic classification of useful minerals. Chapter IX (118 pages) is devoted to the description of the different ore-minerals; Chapter X (54 pages) to the individual gem minerals; Chapter XI (115 pages) to the "Miscellaneous Economic Minerals," including the abrasives, asbestos, asphalt, borates, building and decorative stones, carbonates, cement materials, clays, fertilizers, micas, graphite, and in general the whole group of what it has become the custom to conveniently term "the non-metallic minerals." There is added, at the end of the book, a set of determinative tables of mineralogy of more or less the usual type, which occupies 32 pages.

The idea of popularizing or vitalizing the study of mineralogy has occurred to many, and numerous attempts have been made in that direction. Unless we mistake, no one has done this so thoroughly, accurately, and in general so successfully as the author of this book. The description of the physical characteristics, the distribution, and the geological occurrence of each mineral is admirably epitomized. A drawback is the price of the book, which is plainly a war price, of the kind which we hope soon to see disappear, along with the deflation of other commodities.

J. E. S.

COURT DECISIONS IN MINING CASES

By Wellington Gustin

War Clause Held to Excuse Carrier

N. Y. Appellate Division Decides Excess Freight Paid on Shipment to Genoa Not Recoverable

Appealing from a judgment of the Supreme Court of New York for \$167,428 as damages for a breach of contract, whereby the France & Canada Steamship Co., Ltd., had agreed to carry 3,000 tons of copper from New York to Genoa upon its steamships during December, 1916, and January, 1917, for the Compagnie de Trefileries & Laminiers du Havre, the Appellate Division has reversed same and dismissed the complaint of the shipper.

The contract was subject to the usual war claims. The defendant was not a common carrier, but was privately operating seven vessels, one a British vessel, which it had been forbidden to take into the Mediterranean. There were six American vessels, two of which were torpedoed. On Dec. 8 one sailed for Genoa, and the shipper was informed that the vessel would carry whatever copper it desired to ship thereon. The shipping company was informed that the shipper had no copper then which it wished to ship. The only vessel thereafter sailing before May 15, 1917, was the "Missourian," which sailed for Genoa on March 19. Upon that vessel 750 tons of the copper was sent to Genoa. On May 15 the shipper notified the shipping company that as it could not take the shipments it would ship on other lines, and did thereafter ship on an Italian line, for which it paid freight rates in excess of the freight rates provided for in the contract between the parties in suit. The judgment represents the difference in freight rates charged to the shipper.

The court said the record showed the good faith of the shipping firm could not be questioned, and the shipper was given every opportunity for shipping that was possible, in view of the dangers of the service to Genoa. The firm offered to take the copper to France, but this was refused by the shipper. There was no claim of preference given other shippers, and under the contract the court said the firm had a right to discontinue its service, in view of the perils of transportation to Genoa, and especially in view of the fact that one of its ships had been torpedoed. The charter on the American vessels expired before the cancellation of the contract, and the owners would not renew the same. The court's conclusion was that the shipping company's offer to take the copper upon the first steamer bound to Genoa was a full compliance with its contract to make the shipment subject to the war clauses contained therein.

Therefore the judgment was reversed and the complaint dismissed, the court holding that, under the war clause in the contract, giving the company an option to cancel any contract when hostilities should make it improvident for vessels to sail, and the company, after losing vessels in the Mediterranean, declined to make further voyages, there can be no recovery for breach, where it carried some of the copper which it had agreed to carry, and offered to transport copper on the vessel last sailing for the Mediterranean port.

Status of Optionee Who Acts as Broker

Nevada Packard Mines Co. Wins Controversy Over Mines — Not Responsible for Officer Acting Wholly for Himself

In the action brought by W. A. Keyworth to recover an undivided one-fourth interest in the Packard No. 1, Packard No. 2, and Packard Fraction mining claims, situated in Rochester mining district, Humboldt County, Nev., from the Nevada Packard Mines Co., the Supreme Court of Nevada has affirmed judgment in favor of the Packard company.

In disposing of his claims, Keyworth and others gave R. L. Ray an option on them, and simultaneously agreed with Ray that if he should make a sale he should receive a commission of 20 per cent. The subsequent purchasers of the mines thought they were dealing with Ray as optionee, though the facts were that they were dealing with him as agent of the plaintiff and his associates.

The court said that plaintiff could not recover because he made it possible for Ray to represent himself only as an option holder, when, in fact, he was getting a commission for selling the mines.

Ray sold his interest in the option in consideration that the purchasers should make the initial payment on the option and organize a company to take title to the claims and divide with him the promotion stock. The court ruled that such did not create a partnership between the parties, any more than if the whole consideration had been paid in cash; and that such purchasers could not be charged as partners with the optionee's knowledge of the facts at issue.

Later Ray became director and officer of the company formed to operate the mines under the option. The court said this did not charge the corporation with knowledge of the officer's fraud on the owner of the claims; he having acted, in the matter under consideration, wholly for himself.

Must Plug Abandoned Wells

Supreme Court of Kansas Upholds Statute Making Land Owner Responsible for Compliance With Law

The Kansas statute requiring plugging of abandoned oil wells applies only to the owner, and not to the operator, declares the Supreme Court of Kansas in the state's criminal action against H. V. Foster and E. K. Clark. Both Foster and Clark were charged with drawing the casing from an abandoned well without plugging it, as the law prescribes. Clark was convicted in the Greenwood County District Court, and he appealed on the ground that he did not come within the application of the statute. Foster was the owner of the well and Clark was the operator, who had charge of the drilling and operations in exploring for oil. Foster was not apprehended, and the prosecution proceeded against Clark alone.

The well was abandoned, the casing was drawn, and it was not plugged by anyone. The validity of Clark's conviction depended upon the interpretation of the act, said the court. It found no penalty to be prescribed by the statute for the failure of an operator to plug an abandoned well. For failing to case out the water before drilling into the oil or gas-bearing rock, both operator and owner may be punished, but the Legislature chose to hold the owner alone responsible for failure to plug an abandoned well. It was declared that a court cannot extend a criminal statute beyond the natural meaning of the words employed by the Legislature.

Idaho Supreme Court Finds Against St. James Mining Co.

The Supreme Court of Idaho has affirmed judgment in favor of Peter B. Grant against the St. James Mining Co., Ltd., in Shoshone County. Grant brought this action to foreclose a lien claim of \$2,693. He received a judgment for \$525 plus an attorney's fee of \$125 and costs.

The Mining company appealed from this judgment, contending that dynamite valued at \$330 had been wrongfully charged to it, though sold to the Guelph company, in that Grant had purchased this dynamite for the St. James company without its authority and had converted it to his own use by sale to the Guelph company, and had never accounted therefor. The court found this purchase authorized and the sale to the Guelph company ratified by the St. James Mining Co. and denied the claim.

Another claim that Grant had appropriated certain payments received from the C. & R. Mining Co. was denied and judgment affirmed.

ECHOES FROM THE FRATERNITY

SOCIETIES, ADDRESSES, AND REPORTS

Copper Miners Must Fabricate Their Own Product

Calumet & Hecla's Manager Discusses Logical Cure for Rising Cost of Mining Operations

The relation between the copper producer, the manufactured product, and the profits from the latter was the subject of a recent talk before a large number of business and professional men, by James MacNaughton, general manager of the Calumet & Hecla Mining Co. He believes that the time will come when that company will be forced to manufacture its own copper products. This cannot be done at present, nor will it become practicable until the company can handle its total production. The market at present does not warrant manufacture of its copper products by the company, but he asserted that there is no question that the time will arrive when such a step will be logical.

Mr. MacNaughton outlined briefly mining conditions in the copper country. He said that the present production of copper ranges from 30 to 50 per cent of normal, and the fact that there is such a large surplus on hand, with such a low consumption, easily explains the condition of the copper industry. The average mine, he ventured, is hardly making enough to pay for depreciation. No betterment in the market can be expected, he said, until Europe can afford to buy copper as well as other commodities.

Outlining the trend of the copper market during the past few years, Mr. MacNaughton said:

"Copper before the war was a luxury, and during flush times people have used the metal in a luxurious sense. During the war, however, there was a noticeable shortage, and, as a result, steel, zinc, and other metals supplanted copper. Whether copper will return to its former use depends on whether the people can be re-educated to purchase such articles as copper tacks, which a few years ago were purchasable at any hardware store, and many other products formerly composed of copper."

Manufacturers of copper products make more profit than the producer, according to Mr. MacNaughton. He explained that they take no risk with respect to raw material, and can conduct their business so long as they can buy copper.

Northern Minnesota Engineers Hold Annual Banquet

The seventh annual banquet of the Engineers' Club of Northern Minnesota was held at Eveleth on Feb. 26, in the City Auditorium, over 350 members and guests attending.

Charles Grabowsky officiated as

toastmaster. The principal address of the evening was delivered by F. W. McNair, president of the Michigan College of Mines, who related his experiences with the Pacific fleet shortly after the end of the Great War. The work undertaken by Mr. McNair and several associates was the perfecting of a new method of fire control for battleships. This was done during the war and was only completed when the war ended. The tested and approved method has been adopted by the Navy Department.

Tulsa Section of A. I. M. E. Urges Oklahoma Legislature To Help the State University

Mounting costs in every department at the University of Oklahoma, with a great increase in the student enrollment, and particularly the very rapid growth of its engineering department, which is inadequately housed and equipped, are seriously hampering the work of that institution. The local press has commented editorially on the danger of a complete shut-down of the university after March 15, through lack of funds, and the following resolutions were adopted by the Tulsa Section of the A. I. M. E. at its annual meeting on Feb. 25, 1921:

Be it resolved that the Tulsa, Okla., Section of the American Institute of Mining and Metallurgical Engineers urge upon the members of the State Legislature of Oklahoma non-partisan and non-political consideration of the deficiency appropriation bill, and further urge its prompt passage, so that no discredit may be brought upon Oklahoma or its legislative bodies.

Be it further resolved to urge upon the members of the State Legislature the importance of and necessity for increasing the appropriation for maintenance of the university, both as to current expenses and additional buildings, during the ensuing year, in proportion to the increase in enrollment, so that the progress of the university may not be impeded and that it may not lose its prestige and standing among the universities of this country.

At the same meeting the section elected officers.

Mining and Metallurgical Society Defines Anew Its Purpose

The council of the Mining and Metallurgical Society of America, to make clear its purpose and its field, has adopted the following

DECLARATION OF PURPOSE

The purpose of the Mining and Metallurgical Society of America is, primarily, to discuss, digest, and take formal action by referendum of all its members upon those broad principles and questions which affect the mining industry, and which cannot be, or are not, covered by other organizations; and then to put into operation, so far as possible, its conclusions.

It excludes from consideration technology, methods, detail, and special interests, in order the more effectively to concentrate its attention upon the fundamental principles and problems affecting the industry, such as labor relations, legislation, economics, and education, with which it may be competent to deal.

Committee on Elimination of Waste States Its Purpose and Methods

A recent statement from L. W. Wallace, executive secretary of the American Engineering Council, explains the origin, purposes, and plans of the council's "Committee on the Elimination of Waste From Industry," suggested and appointed by Herbert Hoover last month. Mr. Hoover, with the approval of the council, picked the following as members of the committee: J. Parke Channing, of New York City; Ira N. Hollis, of Worcester, Mass.; L. W. Wallace, of Baltimore, Md.; H. R. V. Scheel, of Passaic, N. J.; L. P. Alford, of New York City; George D. Babcock, of Peoria, Ill.; F. G. Coburn, of the Bethlehem Shipbuilding Co.; Morris L. Cooke, of Philadelphia, Pa.; Harrington Emerson, of New York City; E. E. Hunt, former labor investigator for the Clothing Manufacturers' Association; C. E. Knoeppel, of New York City; Robert Linton, of Montana; Fred J. Miller, J. H. Williams, Robert B. Wolf, and Mr. Hoover himself. His aim was to secure men of broad experience, of clear concepts, of unbiased attitude toward labor problems, and representative of managerial, consultant, educational, and editorial activities, as well as having widely distributed and varied industrial contacts.

At its organization meeting in January this committee outlined its purpose as being (1) to determine the causes of labor, material, and equipment waste in industry, (2) to determine as far as possible the extent of the waste arising through each major cause, (3) to suggest means of removing the cause for such waste.

It is the object of the committee to attain this purpose by studying the organization, the engineering features, the production control and cost control, the physical factors characteristic of ten representative industries mentioned in a previous issue of the *Journal*. From three to ten plants of each industry are being visited by an experienced engineer. By the aid of a carefully prepared list of questions with which he has been provided, the field worker will secure the information desired by the committee. This will be supplemented by authoritative data in existing reports from reliable sources.

A small headquarters staff plans and directs the field investigations, which are to be conducted by selected engineering firms. The latter are doing the work at actual cost. The headquarters staff will ultimately compile all the data and write the final report, which is to be reviewed by the committee as a whole. Every care will be taken to secure authentic quantitative data and to avoid a biased report.

MEN YOU SHOULD KNOW ABOUT

J. B. Tyrrell, of Toronto, Ont., is doing professional work in the vicinity of Calgary, Alberta.

F. W. McNair, president of the Michigan College of Mines, was a recent visitor on the Mesabi Range.

Walter E. Gaby, geologist, is with the Santa Gertrudis Co., Ltd., at Pachuca, Hidalgo, Mexico.

Frank M. Warren, mining engineer, of the Pine Land Co., Minneapolis, Minn., spent the week in New York City.

F. R. Wadleigh has been appointed assistant to the president of the Tuttle Corporation, 15 Broad St., New York City.

H. B. Lee, of the Mutual Chemical Co., has left Quebec for Florida, where he will conduct operations for his own company.

William T. Curley, formerly with the Oliver Iron Mining Co., sailed for Rio Janeiro, Brazil, the last week in February.

B. M. Conklin, of Hibbing, Minn., chief engineer of the Great Northern Iron Ore Properties, has returned from a trip to New Orleans, La.

Ralph Arnold, consulting geologist, sailed for London on March 12. He expects to return to the United States before the end of the month.

Charles Dubuc has resigned his position as engineer of the Consolidated Asbestos Co., in Quebec, to take up private practice at Sherbrooke, Que.

Sherwood Aldrich, president of the Ray Consolidated Copper Co., is traveling in Japan. He will visit China and the Philippines before returning to the United States.

W. P. Chinn, assistant general manager for Pickands, Mather & Co., Duluth, Minn., went to Birmingham, Ala., on March 2. He will visit New Orleans and other Southern points before returning.

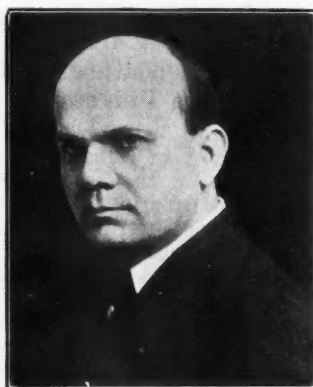
Vernon Claypool, mining engineer for the Oliver Iron Mining Co., in the Coleraine, Minn., district, has been promoted to succeed **William Curley** as assistant superintendent in the Chisholm district for the Oliver Iron Mining Co.

Edward Thornton, who was for many years with the American Smelting & Refining Co., first in the exploration department and later in the operating branch, was in New York City recently. He is opening a consulting office in Los Angeles, Cal., and will specialize in operating problems.

W. H. Crago, in charge of mining engineering and exploration for the Union Minière du Haut Katanga, is visiting in Duluth, Minn., after an absence of three years in the Belgian Congo, Africa. Mr. Crago was formerly assistant to **John Uno Sebenius**, general mining engineer for the Oliver Iron Mining Co.

R. A. Cattell, petroleum engineer, will investigate and report to Louisiana the actual conditions in the gas fields of that state. The work is being done by the U. S. Bureau of Mines at the request of Governor John M. Parker, and under the direction of **H. W. Bell**, engineer in charge of the bureau's field office at Dallas, Tex.

Carl I. Lausen, geologist with the Moctezuma Copper Co., Nacozari, Mexico, has resigned to accept the position of geologist with the Arizona Bureau of Mines at Tucson, Ariz. Mr. Lausen, who is a graduate of the University of California, was with the Old Dominion Co., Globe, Ariz., for nearly three years before going to Nacozari.



L. W. WALLACE

L. W. Wallace, executive secretary of American Engineering Council, was in Washington recently on matters concerning the work of the Committee on the Elimination of Waste in Industries.

Henry C. Morris, mining engineer, was in New York City for a brief visit the middle of last week. Mr. Morris was on the staff of the U. S. Bureau of Mines during the Great War, being detailed for special service with the Economic Liaison Committee of the State Department. He also acted as chairman of the subcommittee on mineral industries.

Arthur Clark Terrill, mining engineer and geologist, formerly with the Kansas State Geological Survey, Baxter Springs, Kan., and head of the department of mining engineering at the University of Kansas from 1915 to 1919, is now in Tientsin, China, where he is serving as professor of mining in Pei Yang University. Professor Terrill became superintendent of the Doctor Jack Pot mine at Cripple Creek, Col., soon after he was graduated from the Colorado School of Mines, in 1905, and in 1906 went from that position to the University of Oregon, where he was in charge of the department of mining from 1906 to 1908. The next year he held a similar position at the University of Idaho. After some years spent in private practice, Professor Terrill enrolled as a student at Columbia University, which gave him the degree

of A.M. in geology in 1914. In 1915 he helped prepare and was in charge of the New York State mining exhibit in the Palace of Mines of the Panama-Pacific Exposition at San Francisco. Professor Terrill is a member of A. I. M. E. and of several other societies.

SOCIETY MEETINGS ANNOUNCED

The National Petroleum Congress meets at Kansas City, Mo., March 22 to 25.

The Tulsa, Okla., Section of the American Institute of Mining and Metallurgical Engineers holds its next monthly meeting on March 25.

New York Section of Mining and Metallurgical Society of America will hold its next meeting the evening of March 24 at Columbia University Club. Following an informal dinner, **R. C. Allen** will talk on "Mine Taxation."

OBITUARY

Theodore M. Daulton, formerly in charge of hydraulic placer operations at Atlin, B. C., died at Seattle, Wash., on March 6, at the age of sixty. He was a member of the Canadian Institute of Mining Engineers and at one time was a member of the City Council of Seattle.

John Westerdahl, superintendent of the Tintic Standard mine at Eureka, Utah, was shot and killed on the night of March 9 by Mexicans who were robbing the Tintic Standard store. Mr. Westerdahl entered the store just as the hold-up was being staged, and thought the whole matter a joke. When told to stand against the wall and hold his hands up he advanced laughingly toward the bandits, of whom there were four, and was shot dead. Mr. Westerdahl had been interested in mining in this section for many years, rising gradually from the position of a common miner to that of superintendent. Another man was killed at the same time and the proprietor of the store and a miner were severely wounded.

Dwight B. Huntley died in Oakland, Cal., on March 7, 1921. He was one of the older graduates of the University of California, class of 1875, and a member of the American Institute of Mining and Metallurgical Engineers since 1892. Mr. Huntley was a man of broad acquaintance, best known to many of the older members of the Institute. He carried out his professional work in the Western states and in Mexico and other foreign countries. From 1903 to 1906 he was in Rhodesia in charge of gold properties. In 1909 and 1910 he was professor of mining engineering at the University of Nevada, and a few years later again served in the same capacity at that university.

THE MINING NEWS

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

LEADING EVENTS

High Royalties Restrain Operators in Joplin District

Question Comes Up in Considering Extension of Leases for Indian-Owned Land

Renewal of interest in the question as to the extension of leases for Indian-owned lands in the Joplin-Miami district has been recorded recently as the result of consideration of the question at Washington. Two of the larger companies in this field are asking for an extension of the leases for twenty-five years, or "so long as zinc and lead are found in paying quantities." It is understood they are asking renewal at the former royalty charge, which netted the incompetent Indian owners 5 per cent, with the tacit understanding that they are to renew subleases to actual operators at 15 per cent. Although there is little open opposition to this proposal, general opposition is rumored, and a few companies have come out openly and are asking that the Department of the Interior establish a maximum royalty on the lands of 10 per cent. They argue this will be better for the Indian land owners, and that it will particularly be a help to the zinc mining industry in this field, which just now is at a low ebb. It is declared that some mines now shut down could be operating and be giving employment to hundreds of miners now out of work if a maximum royalty of 10 per cent were established. As it is, royalties in some cases are as high as 25 per cent, and the average probably is around 17 per cent. Several of the holders of original leases have made hundreds of thousands of dollars of "velvet" out of the pyramided royalties.

I. C. C. Freight Rate Hearing Postponed Indefinitely

The hearing before the Interstate Commerce Commission on Lake Superior ore freights, set for March 12 at Chicago, has been indefinitely postponed by the commission. Eighty-seven iron mining companies in Michigan, Minnesota and Wisconsin have requested the commission to investigate the rate schedules from June 25, 1918, to date, and to fix such a new rate as will net the carriers 6 per cent upon the value of the property utilized in ore hauling.

The commission has declined to suspend the increase of 10c. per ton for mine-to-dock haul and 5c. per ton dock

WEEKLY RÉSUMÉ

A report has been made on smelter smoke conditions in the Salt Lake Valley by the commission headed by Prof. R. E. Swain, under whose supervision operations have been conducted at the Murray and Midvale plants ever since Judge Johnson rendered his decision a year ago. Wage cuts have recently been announced by the two plants mentioned. From the iron ranges of Michigan and Minnesota reports of either curtailment or suspension by iron ore operators continue to be received. The Oliver Iron Mining Co. continues its wage schedule unchanged. The freight rate hearing affecting Lake Superior ore carriers and shippers, that was to have been held by the Interstate Commerce Commission at Chicago on March 15, has been indefinitely postponed. At Spokane the Talbot suit against the Northwest Magnesite Co. has been settled out of court. At Wallace, Idaho, the Hecla Mining Co. has made its annual report, incidentally giving the terms of the settlement of the suit brought against it by the Federal Mining & Smelting Co. In Ontario numerous events are chronicled: The Moore Filter Co. has sued the Nipissing company for filter patent infringement. The Mining Corporation of Canada has shut down at Cobalt, and the Hollinger, at Porcupine, is suing a power company for damages.

In Washington it is said that an effort may be made to revive the Payne-Aldrich tariff act at the extra session. The war-time explosives regulation act is declared to be inoperative and all licenses are declared cancelled. H. Foster Bain is to be renominated as Director of the U. S. Bureau of Mines.

charge put into effect by six of the railroads handling ore from the Michigan and Wisconsin ranges, despite the appeal of thirty-six independent ore producers in these districts.

Murray and Midvale Smelters Announce Wage Cut

The smelter of the A. S. & R. Co. at Murray, Utah, and the United States company's plant at Midvale have announced a wage reduction of 25c. per day for unskilled labor and 50c. for skilled on account of decreased living costs and lessened ore receipts. Neither smelters are operating at capacity, and it is possible that working forces may be reduced. The new wage scale became effective March 15.

Swain Reports on Smelter Smoke in Salt Lake Valley

Field Conditions About Murray and Midvale Plants Described — Safe Operating Conditions Discussed

The smelter-smoke commission headed by Prof. R. E. Swain, of Leland Stanford University, under whose observation operations at the Murray and Midvale smelters in the Salt Lake Valley, Utah, have been conducted ever since Federal Judge Johnson decided a smoke suit against the A. S. & R. and U. S. Smelting, Refining & Mining companies in February, 1920, has presented an exhaustive report after its year of research. Under the decision the two smelters were allowed to continue operations under certain conditions and under the observation of Prof. Swain's staff.

Prof. Swain, as commissioner, was to report his findings to the judge after one year. On this report was to be based a permanent stipulation as to methods of smelter operation that would avoid nuisance or damage in the neighboring districts. A brief summary of the conclusions in this report follows:

The evidence appears to be conclusive that the plant of the A. S. & R. Co. at Murray was not at any time during the period of investigation an agent of injury to crops or vegetation of any kind, or the cause of personal discomfort or ill-health to the residents of the district. No determination made on the air of this district showed an hourly average of more than one part of sulphur dioxide per million. Furthermore out of 5,923 single determinations only nineteen represented a concentration of three parts or more per million and only one a concentration of six per million. The highest concentration ever found in this district was 7.6 parts per million. These higher readings evidently represent momentary "puffs" of smoke. The contamination of the air in the immediate neighborhood of the plant through leakage of SO₂ from furnaces and flue systems is relatively light. Both plants employ the Dwight-Lloyd and the Wedge type of roasting furnaces. The amount of leakage from these furnaces is small, owing to their construction and to the good draft maintained, and the products of combustion are swept away under induced draft into the main flue system. The blast-furnace building at each plant is well ventilated, and points where objectionable waste products may escape are hooded and the emanations are swept out into the ventilating flue.

The results of the filtration tests at the Murray plant point to an average

daily loss from roasting operations through the 455-ft. stack of approximately 90 lb. of lead and 120 lb. of arsenic. These figures are probably fairly representative of the efficiency of the Cottrell process of electrical precipitation, with only two units in operation at one time. There is no evidence that the above losses of lead and arsenic are objectionable.

CONDITIONS AT MIDVALE

The results of the investigation lead to the unavoidable judgment that the Midvale plant has been at times during the past season, and under present conditions and methods of operation may continue to be, an agent of injury to the vegetation of the neighboring district. The conclusions reached by Dr. Pool are clear on this point. The "burns" reported by him in the Christensen, Lemich, Turner and Norvich cases were called to my attention by Dr. Pool and gone over carefully by us together. Thus in these cases my confidence in his judgment is supplemented by my own observations.

The work done by the chemists on the Midvale smoke stream also is indicative of a dangerous condition. Out of the 4,311 single determinations of sulphur dioxide made during the growing season, there was an average concentration of 0.49 part per million. There were twenty-eight determinations of 6 parts or more per million, the highest single determination made being 19.4 parts. There were four determinations over 10 parts per million; 153 over 3 parts per million; and 438 over 1 part per million. The highest hourly average recorded was 2.78 parts per million, there being thirty-four hourly averages over 1 part per million.

It cannot be denied that the more sensitive crops cannot, under weather conditions favorable to sulphur dioxide action, endure such concentrations as have been found in this field. On the other hand, the results hardly justify the finding that the sulphur dioxide in the gas stream from the Midvale plant is the cause of actual discomfort to the residents of the district. There were momentary concentrations sufficient to cause coughing and local irritation, but only four determinations, in all the time spent in the gas stream making tests were above 10 parts.

All results on filtration tests at the Midvale plant point to the efficient operation of the baghouse units through which all flue gases are passed. The average daily loss in lead and arsenic is certainly too small to be a source of any possible injury to the animal life of the district.

REMEDIAL STEPS

It is my belief that steps should be taken by the United States Smelting, Refining & Mining Co. as soon as possible to improve the situation in regard to atmospheric concentrations of sulphur dioxide during the season of plant growth. The best means for accomplishing this end, in my opinion, lies in increasing the temperature of the roaster gases before their discharge into the air. No measure approaches this one in relieving an unfavorable field condition. I believe that a solution of the matter at the Midvale plant may be found without going to the expense of the suggested erection of a 450-ft. stack in addition to heating the gases.

It is my firm opinion that if the Murray plant is continued under skillful management, if attention is paid to

keeping the baghouse and the Cottrell plant at their highest practical efficiency, and if the general operating conditions which prevailed during 1920 are maintained, the plant will be able to operate hereafter without being an agent of injury to its neighbors. But the fact should not be overlooked that the very favorable record of the past year is in all probability due to a number of important contributing factors, most of which fortunately involve no more than the continued intelligent and consistent use of operative measures which are already at hand and a part of the routine normal operation of the plant. These are:

1. The bag-filtration of the blast-furnace gases.
2. The electrical precipitation of roaster dusts and other suspended solids by means of the Cottrell installation, two of the three units of which have been in regular operation.
3. The discharge of the roaster gases, which carry the highest concentrations of sulphur dioxide, at a temperature high above that of the outside air. During the dormant season for plants the temperature of these roaster gases was increased, and incidentally their volume as well, by the delivery of the boiler gases from a neighboring power house directly into the main exit stack. During the season of plant growth the gases were heated by means of coal furnaces near the base of the stack.
4. The discharge of the gases from roasting operations from a high stack at a point approximately 455 ft. above the ground level.
5. A maximum daily elimination of sulphur from roasting operations amounting to about 100 tons. It can scarcely be denied that this plant is a potential agent of injury. Allow the filtration bags to deteriorate, reduce the voltage in the Cottrell plant, neglect the measures which have to do with maintaining a relatively high temperature in the exit gases, and a discharge of lead and arsenic in objectionable amounts or of sulphur dioxide under conditions of concentration and temperature which could give rise to serious injury to crops might easily result.

At once the question arises of what reasonable guarantees should be exacted, or what operating restrictions or other stipulations imposed to insure the indefinite continuance of safe operation. At first thought it would not appear unreasonable, with a plan of plant operation of proved safety before us, to make this the basis of future operation. This should at once give adequate protection to the residents of this community, but it has several serious objections. In the first place, as has been pointed out, there are many phases of plant operation involved as contributing factors to the present conditions of immunity from damage. These are not so much independent as they are interdependent.

Thus it is no longer wholly logical, as a single measure of protection, to place a restriction on the amount of sulphur eliminated or the tonnage of ore roasted when it is known that by a suitable change in one or more other factors, such as the temperature of the exit gases, double that amount might be eliminated with even greater assurance of immunity from trouble. Accordingly, if stipulations are drawn up along the line of plant operation, they must deal not with one but with a number of factors and to that extent be

more or less complicated. There is another objection to this proposal which is more serious. These are days of industrial progress based largely upon a new relation between science and industry. Rule-of-thumb methods are yielding to more intelligent and progressive direction. A set of stipulations dealing with plant operation, such as mentioned above, are at once a barrier to progress. Until changed, they may be just as effective in preventing the introduction of improved methods of operation as they are in preventing a relapse into a condition which makes it a menace to the community.

Federal-Hecla Settlement Terms Given in Annual Report

In his annual report for the year 1920 James F. McCarthy, of Wallace, Idaho, general manager of the Hecla Mining Co., states regarding the apex litigation involving the east orebody: "We have made a settlement with the Federal Mining & Smelting Co. of the suit for possession of our east orebody. This settlement provided for the purchase by Hecla Mining Co. of the Tiger-Poorman property of the Federal company, which adjoins the Hecla company's ground, including the Russell lode mining claim, which claim the Federal company asserted contained the apex of our east orebody. It also includes a valuable water right at Burke, which is being used at present for the generation of electric power. The purchase of this property is subject to a lease held by Marsh Mines Consolidated, which expires in July, 1926. Included in this lease is the Russell claim. The settlement provides for the payment by Hecla Mining Co. to Federal company of the sum of \$750,000, part of which is paid, the balance to be paid when the Federal procures from the Marsh company a cancellation of the lease and a release from all claims for alleged trespass, or when the Hecla company prevails in the suit which the Marsh company still maintains as an intervenor in the suit brought by the Federal company. Negotiations between Federal and Marsh for settlement of Marsh company's claim are now in progress."

Oglebay, Norton & Co. To Manage Richardson Fleet

The largest and most important transaction effecting the Lake shipping was transacted when the Richardson fleet of boats was purchased by the Columbia Steamship Co. The Richardson fleet consists of eleven steel steamers being operated by ten steamship companies. Under the new ownership the fleet will be managed by Oglebay, Norton & Co., of Cleveland, with John T. Kelly as fleet manager.

The officers of the new company are as follows: Crispin Oglebay, president; D. Z. Norton, vice-president; R. N. Case, secretary; John T. Kelly, fleet manager. The directors are E. W. Oglebay, D. Z. Norton, Crispin Oglebay, Garreston Wade, Isaac Scott, J. H. Frantz, Tracy Paine, W. W. White and John T. Kelly.

**Homestake Mining Co. Breaks
Ground for New Mill at Lead
Cyanide and Amalgamation Plant Will
Have 120 Stamps and 1,800
Tons Capacity**

The Homestake Mining Co., of Lead, S. D., has started work on a new mill which will be situated east of the Ellison hoist and on the south slope, immediately above cyanide mill No. 1. A large force of men is employed on the excavation work and it is expected that the new plant will be completed early this fall.

The general dimensions of the main building of this, the South Mill, as planned, are 150 by 160 ft.; the classification annex will be 70 by 70 ft. and the slime settling annex 100 by 40 ft. The general metallurgical scheme involves stage reduction, amalgamation after

For separating the slimes from the sand, two batteries of cones, eight of them 10 ft. in diameter and eight 7 ft. in diameter, will be installed. The slimes overflowing the cones will pass to two tanks 32 ft. in diameter and 20 ft. deep and equipped with three-compartment Dorr thickeners, for slime thickening and water reclamation.

The capacity of the new plant will be 1,800 tons daily and it has been so designed that additional units can be added from time to time to make it possible to increase the daily tonnage.

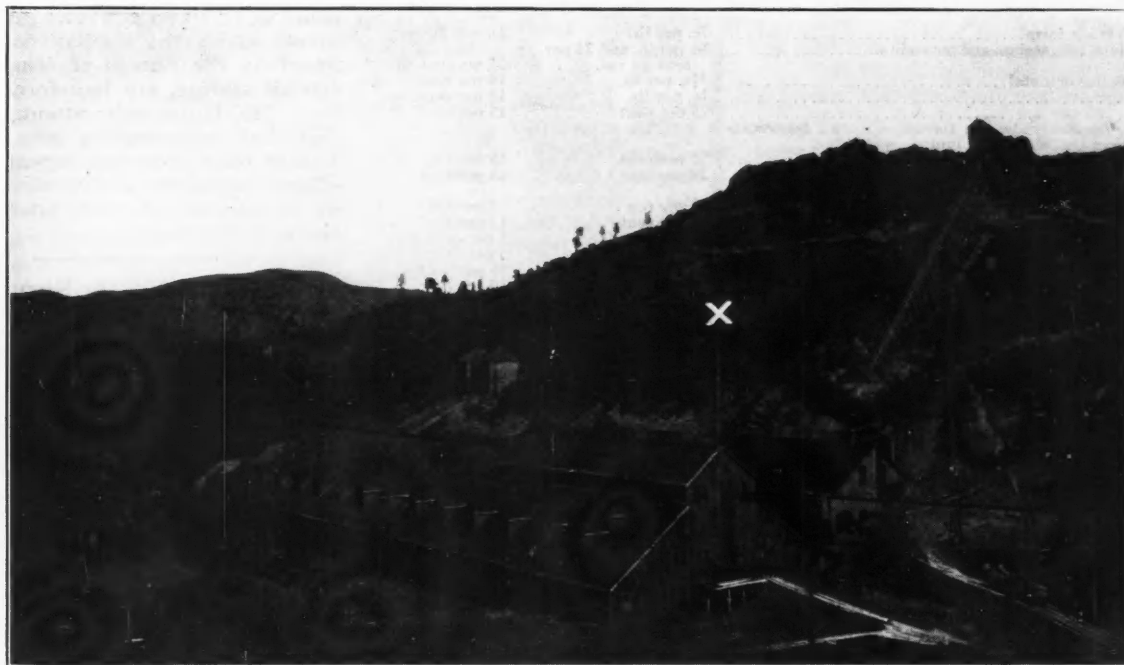
**Talbot's Suit Against Northwest
Magnesite Co. Dropped**

Litigation in which R. S. Talbot, a minority stockholder of the Northwest Magnesite Co., of Chewelah, Wash., sued to force a distribution of dividends by the Northwest company, was dropped

**Can't Reopen Compensation Case
After Release Is Signed**

**Utah State Industrial Commission So
Decides in Power Company
Employee's Action**

In regard to the working of the Workmen's Compensation Act in Utah, when an employee receiving injury signs a release upon receiving payment in settlement, the case, according to a recent decision of the state industrial commission, cannot be reopened. This decision was made in answer to the petition of R. S. Gardner, a former employee of the Cedar Electric Co. and the Dixie Power Co. Gardner, who was totally incapacitated from Nov. 15, 1918, to March 15, 1919, by injury to his hands from burns, signed a release March 31, 1919, upon the receipt of \$150.



CYANIDE MILL NO. 1 OF HOMESTAKE MINING CO., LEAD, S. D. CROSS MARKS
SITE OF NEW PLANT FOR WHICH GROUND HAS JUST BEEN BROKEN

each reduction and the separation of sand from slime with cyanide treatment of each product in existing plants.

Preliminary to treatment, the ore will be run through the crushers and over a tramway to the mill bins. It will be crushed by 120 stamps weighing 1,550 lb. each and then discharged through 2-mesh screens. The oversize from the stamps will then pass to six 5 by 10-ft. Allis Chalmers rod mills with individual motor drive and in closed circuit with Dorr classifiers. The fine sand and slime from the stamps will by-pass these machines and unite with the classifier overflow.

At this stage the ore will go through an amalgamation process, four 4½ by 12-ft. silver-plated copper plates being provided for each grinding unit. Suitable classifiers and two 5 by 14-ft. tube mills will be used to control the final sizing of the tailings passing from the plant.

by the Superior Court at Spokane, when it was announced that the question had been satisfactorily settled out of court. Mr. Talbot was the original operator in the Washington magnesite area and later sold a portion of his holdings to San Francisco interests who organized the Northwest company.

**Mining Convention for Portland
in April**

The third annual International Mining Convention will be held at Portland, Ore., April 5 to 9 inclusive. The Municipal Auditorium has been secured for the occasion and will provide extensive floor space for the various exhibits. A large number of mining men from Canada and from the Western states are expected to be present. The first session of the International Mining Convention was held at Vancouver, B. C., in 1919.

**Seek To Dissolve Section 30
Mining Co.**

Five of the principal stockholders representing a majority of the stock of the Section Thirty Mining Co. on the Vermillion Range in Minnesota have petitioned the district court for an order dissolving the corporation. The company was incorporated in 1909 for almost a million dollars but became insolvent in 1920 and ceased to do business after turning over its assets and obligations to the Section Thirty Mine, Inc. The men who have petitioned the court include George A. Sinclair, president of the old company; Alfred Merritt; A. W. Highfield and George H. Sinclair.

Rand's Gold Production

The gold output of the Rand, in South Africa, in February was 558,000 oz., against 651,000 in January.

NEWS FROM WASHINGTON

By PAUL WOOTON
Special Correspondent

May Re-enact Payne-Aldrich Tariff as Emergency

Advocates of Greater Protection for
Ores and Metals View Prospect
with Alarm; Duties Too Low

With the increasing probability that stop-gap tariff legislation will be enacted early in the extra session of Congress, much apprehension is felt on the part of those favoring higher tariffs on metals and ores that these items will not be given the amount of protection

To Renominate Bain as Director of Bureau of Mines

H. Foster Bain is to be renominated as Director of the bureau of Mines. As this is written, the nomination has not gone to the Senate, but it is understood that it has been approved and will go to the Senate at once. Mr. Bain was nominated by the outgoing administration, but his nomination was not confirmed by the Senate. President Harding is following the precedent of

Explosives Regulation Act Inoperative

Superseded by Transportation Act
Recently Passed—Penalties Still
in Force

Notice has been given by F. J. Bailey, in charge of explosives regulations for the Bureau of Mines, that the recent explosives transportation act supersedes the war-time explosives regulation act. The Bureau was charged with the administration of that act. As a result of the new legislation, all existing explosives licenses are cancelled as of March 3, 1921. All requirements under the regulations promulgated by the Bureau of Mines, under the old statute, are therefore inoperative. Mr. Bailey calls attention to the fact that no exemption from prosecution or relief from punishment for any offense committed in violation of the old act is granted by the enactment of the new statute.

COMPARISON OF DUTIES ON ORES AND METALS IN ACTS OF 1909 AND 1913

Metals and Ores	Act of 1909	Act of 1913
Aluminum in crude form.....	7c. per lb.	2c. per lb.
Barium, calcium, magnesium and potassium.....	3c. per lb. and 25 per cent ad val.	25 per cent ad val.
Antimony, regulus or metal.....	1½c. per lb.	10 per cent
As matte.....	1c. per lb.	10 per cent
Chrome.....	25 per cent	15 per cent
Ferrocrome, ferromolybdenum, ferrophosphorus, ferrotitanium, ferrotungsten, ferrovanadium:		
Valued at \$200 per ton or less.....	25 per cent	15 per cent
Valued at more than \$200 per ton.....	20 per cent	15 per cent
Ferrosilicon:		
Containing not more than 15 per cent of silicon.....	\$5 per ton	15 per cent
Containing more than 15 per cent of silicon.....	20 per cent	15 per cent
Copper, plates and sheets.....	2½c. per ton	5 per cent
In strips.....	45 per cent	5 per cent
Gold leaf.....	35c. per 100 leaves	35 per cent
Silver leaf.....	10c. per 100 leaves	30 per cent
Lead-bearing ore of all kinds.....	1½c. per lb.	1½c. per lb.
Lead-bearing ores containing more than 3 per cent lead.....		
Lead:		
Bullion.....	2½c. per lb.	25 per cent
Pigs and bars.....	2½c. per lb.	25 per cent
In sheets.....	2½c. per lb.	25 per cent
Metallic mineral substances in crude state.....	20 per cent	10 per cent
Molybdenum.....	25 per cent	15 per cent
Monazite sand and thorite.....	4c. per lb.	25 per cent
Thorium.....	40 per cent	25 per cent
Titanium.....	25 per cent	25 per cent
Tungsten.....	25 per cent	15 per cent
Nickel.....	6c. per lb.	10 per cent
Quicksilver.....	7c. per lb.	10 per cent
Zinc ores:		
Containing less than 10 per cent of zinc.....	Free	10 per cent
Containing 10 and less than 20 per cent of zinc.....	½c. per lb.	10 per cent
Containing 20 and less than 25 per cent of zinc.....	¾c. per lb.	10 per cent
Containing 25 per cent or more of zinc.....	1c. per lb.	10 per cent
Zinc:		
In blocks or pigs.....	1½c. per lb.	15 per cent
In sheets.....	1½c. per lb.	15 per cent
Manganese ore.....	Free	Free
Pyrites.....	Free	Free
Potash.....	Free	Free
Chromic ore.....	Free	Free
Graphite.....	Free	Free
Spiegeleisen.....	\$2.50 per ton	Free
Cyanide of potash.....	25 per cent	Free
Cyanide of soda.....	25 per cent	Free
Arsenic.....	Free	Free
Asbestos.....	Free	Free
Bauxite, crude.....	\$1 per ton	Free
Iron ore.....	15c. per ton	Free
Magnesite, crude.....	Free	Free
Uranium.....	Free	Free

that they desire. The probabilities seem to favor the re-enactment, with some revision, of the tariff act of 1909, commonly known as the Payne-Aldrich Act. That act does not carry sufficiently high duties on metals and ores to meet the present situation, it is asserted. An effort will be made to secure the revision of many of the schedules of the Payne-Aldrich Act, in case it should be decided to re-enact that statute. Owing to the interest in this question, a comparison is made of the duty on the principal metals and ores under the act of 1909 (Payne-Aldrich) and the act of 1913 (Underwood) in the table given above. Forty-five metals and ores are included in this comparison.

several former administrations in keeping the technical bureaus of the Government out of politics.

War Mineral Awards

Awards totaling \$59,967.47 were recommended by the War Minerals Relief Commission during the week ended March 5. An award of \$52,226.85 was recommended in the manganese claim of the Gloria Mining Co. This was 40 per cent of the amount claimed. An award of \$6,324.86 was recommended in the chrome claim of Frank Carson. This was 69 per cent of the amount claimed. In the light of additional evidence, an award of \$1,416.76 was recommended in A. W. Patton's claim.

Over \$3,000,000 for Survey and Bureau Next Year

As finally approved in conference, the U. S. Geological Survey will receive \$1,614,340 for its work during the next fiscal year. The Bureau of Mines appropriations total \$1,439,300. The principal subdivisions of the appropriation of the Geological Survey are as follows: Topographic surveys, \$330,000; geologic surveys, \$352,000; potash research, \$40,000; mineral resources, \$125,000; Alaskan mineral resources, \$75,000; water supply work, \$180,000; geologic maps (printing), \$140,000; classification of lands, \$300,000; administrative salaries \$29,900.

The principal subdivisions of the appropriation of the Bureau of Mines are as follows: Mine accident work, \$409,065; mineral fuels, \$142,510; mineral technology, \$125,000; petroleum work, \$135,000; mining experiment stations, \$200,000; and leasing operations, \$132,000.

Protection Sought for Arsenic To Aid Nevada Project

The Ways and Means Committee is being urged to place a duty on arsenic. This is being advocated particularly by those interested in the success of new developments in Nevada. Extensive arsenic deposits have been opened at Battle Mountain and at Beowall. Centrally located between these two mines, a 2,000-ton mill has been erected at Toulon, on the Union Pacific railroad. This mill has been erected at a cost of \$200,000 and is one of the largest of its kind in the world. There will be no product other than arsenic. The output will be used for making insecticides.

NEWS BY MINING DISTRICTS

CANADA

Ontario

Mining Corporation, at Cobalt, Shuts Down — Labor Arbitration Board Granted — Flin Flon Option Expires This Month

Toronto—Regarding the option held on the Flin Flon property, in northern Manitoba, it is said that the Mining Corporation of Canada is ready to go ahead with the deal, but that the Thompson interests are asking for changes in view of the condition of the metal market. The option expires on the last of this month. As far as the Flin Flon owners are concerned, it is reported that if a substantial payment were made, they would give satisfactory terms for the balance of the money. According to the original option, the whole amount is payable this month.

Cobalt—The Minister of Labor has granted a Board of Conciliation and Arbitration which is expected to begin sittings in Cobalt immediately. The opinion has been expressed that no matter what the decision of the board may be, the operators will put the reduced wages into effect as soon as the board has reported its decision.

Nipissing's February production was valued at \$124,391, taking silver at 54½c. per oz., and bullion from Nipissing and customs ore was shipped of an estimated value of \$234,374. The low-grade mill treated 6,289 tons and the refinery shipped 401,111 oz. of bullion.

The Moore Filter Co. has entered an action at Ottawa against the Nipissing Mines for \$600,000, alleging infringement of filter patents.

Owing to the low price of silver and the impossibility of operating at a profit under present conditions, the Mining Corporation has shut down its mine and mill. It is understood that the capacity of the mill will be enlarged to 300 tons per day, and that when this is completed, in about three months' time, operations will be resumed. In the meantime, about 200 men are thrown out of employment. Production during the last year was about 1,800,000 oz.

Porcupine—The Hollinger Consolidated has started an action against the Northern Canada Power, Ltd., for damages in connection with the power shortage, but it is unlikely that this step will be followed by the other companies in Porcupine. The Hollinger's suit is based on an original agreement dating back to the time when the Hollinger sold the Sandy Falls plant to the Northern Canada Power, Ltd., but retained certain rights and privileges exclusively to themselves. It is expected that the extremely open winter throughout northern Ontario will supply a sufficient volume of water to provide a full power load about April 1.

The management of the Beaumont

Gold Mines, Ltd., formerly the North Davidson, has succeeded in having the company's stock listed in Paris, London, and Amsterdam. The managers of this company cannot be classed among the conservative operators of the camp, as they claim that this non-producing property, with only a limited amount of underground development, ranks fourth among the gold mines of Ontario. This property may be a prospect of merit, but it still has a long way to go before being classed as a mine.

It is understood that plans are being made to reopen the Murray-Mogridge. The completion of the payment on the property and the acquiring of adjoining claims practically exhausted the treasury, but it is understood that money is being raised.

Kirkland Lake—It is officially stated that the time for starting operations at the Wright-Hargreaves has been fixed for May 1. The mill is in readiness and power is available, but the management is waiting until a steady supply of the latter can be assured.

Quebec

Asbestos Operations Slowing Down Following Recent Boom—Likewise Chrome

BY W. J. WOOLSEY

Thetford Mines West—The asbestos industry appears to relax after the maximum of effort during the last year. No apparent change has occurred in prices, but shipments are holding off and a restriction in production is evident in several quarters. The Bennett-Martin mines, at Thetford and Coleraine, have been closed since Dec. 24. The Fraser & Asbestos Mines, Ltd., at East Broughton, have likewise shut down until spring. The newly built plants of the Harris company and the Pare & Thivierge, at Coleraine, and the Berlin plant, at Robertsonville, will not start operation until spring. The Maple Leaf Asbestos Corporation has begun operation of its new plant on the old Reed property, Thetford Mines.

Considerable speculative interest is manifest over the new control of the Black Lake Asbestos & Chrome Co. by the J. A. Jacobs interests, formerly of the Jacobs Asbestos Co.

The labor contentions of last fall have become quite settled, resulting in improved organization and greater efficiency.

Chrome operations have been suspended in the Coleraine-Caribou district, owing to the slump in prices of that mineral.

British Columbia

May Double Capacity of Silversmith Mill

Sandon—Plans for doubling the capacity of the Silversmith mill during 1921 are being considered by the di-

rectors. After paying a \$25,000 dividend about Jan. 1 to shareholders of record in December, 1920, the company has an estimated cash surplus of about \$100,000, it is stated, which includes an accumulation of silver-zinc concentrates at a conservative valuation. Official reports are optimistic as to the future outlook for the property, ore reserves being estimated at ten years' supply at the rate of production prevailing during 1920. Since the mill was closed, about Jan. 15, 1921, about forty men have been kept on development underground. Outstanding features of the work done recently are: completion of the raises from the 10th or adit tunnel level to the 8th level and from the 8th to the 5th, with several hundred feet of drifting and crosscutting on the 8th and 5th, and connection with the old workings on the latter. A shaft has been put down from the 10th to the 11th level. Drifting on the latter level has opened up promising ground. Indications for marketing the 1921 output are somewhat improved over those of a month ago.

Three Forks—A contractors' crew is working two shifts on the 7th level of the Rambler-Caribou, and is driving into Jennie ground, which was acquired a year and a half ago from the Alexander interests. Lack of water has made it necessary to work with hand drills, and progress is slow. Small bodies of milling ore are found at times. The labor situation is good.

Ainsworth—Several groups of lessees at the Florence mine have found themselves unable to market their output, owing to the value of their ore being chiefly in lead, with only a small amount of silver, which makes it difficult to dispose of profitably to American smelters, on account of increased freight rates. Such material could be shipped to the Trail smelters, but payment would be made only in "warehouse receipts," which are not accepted as negotiable paper by Canadian banks.

Slocan City—L. H. Bigger and L. McPhee, who have a lease and bond on Ottawa mine, expect to complete during 1921 the concentrator begun last year.

Trail—Ingot cake copper is being produced by the Consolidated. The rod mill is nearing completion, but it is stated that the company will not enter the wire production field. Unfavorable markets have resulted in an accumulation of metal. Unofficial estimates are that the value of the quantity on hand exceeds \$1,000,000.

Penticton—At the annual meeting of the Associated Board of Trade of Eastern British Columbia held here during the last week in February, a resolution was adopted asking the federal government to purchase Canadian produced silver for two years at 80c. per ounce, and the minting of silver dollars.

MEXICO

Coahuila

Silver Currency Gradually Replacing Gold

Torreón—The gold coin which up to a few weeks past has been used almost exclusively as the circulating medium in Mexico is being gradually retired and supplanted by silver. Quite recently silver for small change was at a premium; some of the mining companies and haciendas were obliged to pay 5 or 6 per cent for silver money as small change in paying their help. Conditions are now being rapidly reversed and there is no doubt that there will be a big premium on gold within the very near future.

The Tres Estados Mining Company, operating in Coahuila, at a recent stockholders' meeting decided to levy an assessment of 50c. per share to defray current expenses for the ensuing year. Considerable development has been planned.

Pablo Neave has denounced several pertenencias in the San Lorenzo Mountains in the mining district of San Pedro.

Saltillo—The San Marcos Mining Co. at a recent meeting of stockholders in this city voted to increase its capitalization by issuing a third series of stock certificates to be sold at 25 pesos each. Ten pesos are to be paid down and the balance in three monthly installments of five pesos. The present holders of stock will be given preference in subscribing for the new issue.

Zacatecas

Zacatecas—The mines and machinery of the Cartagena y Anexas company are to be sold at public auction for indebtedness. The holdings of this company consist of two groups of mining properties, steam hoist, boilers, tools, cable, houses, etc.

CALIFORNIA

Activity in Plumas Copper Belt—Argonaut Mine Expected To Resume Production Soon

Engelmine—In spite of the low copper market, considerable activity prevails in this district. The Engels Copper Mining Co. is averaging 875 tons per day in its flotation mill. According to a recently issued report preliminary to the annual report, increased ore reserves have resulted from the development work and diamond drilling of 1920. In the underground ore-breaking there is a constant gain in efficiency, this having registered over 100 per cent gain during the last five months as compared with the preceding seven months. At the Walker Mining Co. development continues, and it is reported that production may be resumed soon. The Mason Valley Mines & Smelter Co. is completing arrangements for work on its properties in the Plumas copper belt.

Sutter Creek—Local reports are that results of recent operations on the Old Eureka group by the Old Eureka Min-

ing Co. are disappointing, and diamond-drill prospecting has now been started by the company in the hope of picking up an orebody. The Central Eureka has bonded the South Eureka.

Jackson—The Argonaut Mining Co., is making rapid progress toward rehabilitating its lower workings, and production, it is expected, will be resumed within a few weeks. The Kennedy has been unwatered to below its 3,600 level.

Grass Valley—Sinking of the main shaft of the Empire mines continues steadily. The 80-stamp mill is running to capacity, with ore from the lower levels of the Empire and Pennsylvania mines. The South Star mine, near Rough and Ready, has opened up an ore shoot recently, and preparations for further development are being made. Near Downieville, a rich gravel discovery has been made in the Mount Alta drift mine.

NEVADA

C. A. Heller Elected To Succeed Wingfield on Tonopah-Divide Directorship

Tonopah—In the Tonopah district no new discoveries are reported, with regular and satisfactory development performed. Practically all mines in the camp are operating full handed, which means production at the rate of about 35,000 tons of ore, with a gross value of over \$600,000 per month. There is some activity in near-by districts, and prospectors are busy, but new finds of importance appear to be lacking. Lessees are operating the Cornforth and Sweet mine at Bellehelen, about 50 miles east of Tonopah, with fair results.

Divide—The regular annual meeting of the Tonopah Divide Mining Co. was held in Tonopah March 2. The only change in the directorate was the election of Clyde A. Heller, president of the Tonopah Belmont, to fill the vacancy caused by the resignation of George Wingfield. The officers of the company remained the same. No official report of mine conditions was made at this meeting.

Pioche—Ore shipments from Pioche for the week ended March 3 totaled 1,535 tons, the decrease being due to the temporary cessation of shipments by the Prince Consolidated. Virginia Louise shipped 715 tons, Bristol 365, Black Metals 205, Combined Metals 200, and Prince Con. only 50.

UTAH

Bingham Galena Mining Co. Organized—Utah Copper To Cut Dividend

Bingham Canyon—Directors of the Utah Copper Co. have decided to reduce the quarterly dividend to \$1 a share.

Ground in Bingham lying between the Utah Copper and the United States companies' holdings, and covered by the Silver Shield, New York Bingham, and United Bingham, will probably be merged in a new company just incorporated, to be known as the Bingham Galena Mining Co. G. N. Lawrence is president of this new company.

ARIZONA

Developments at Kay Copper Property, 49 Miles North of Phoenix, Described by Company Engineer

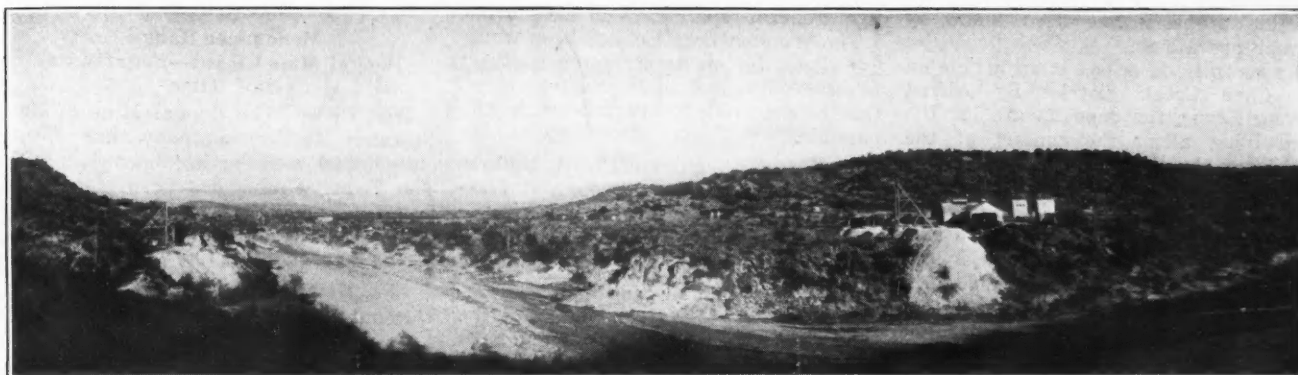
Canon—Work of installing electric power has recently been resumed at the property of the Kay Copper Co., in Yavapai County. J. R. Poss, engineer for the company, has prepared a résumé of the development work so far done by the company, the substance of which is given as follows:

The property is in Yavapai County, on the Agua Fria River, two miles north of the Yavapai-Maricopa county line. Canon, a mile distant, is the nearest post office, and Turkey, twenty-two miles northward, the nearest shipping point. The Phoenix-Prescott main highway passes within half a mile of the property, which is forty-nine miles north of Phoenix, or nearly half way between Phoenix and Prescott.

Low-lying hills of pre-Cambrian schist nestled against the massive granite of the Bradshaw Range a few miles to the west, and a broad fertile valley formed by the Agua Fria River to the east, furnish the setting for the property of the company. The elevation at the new shaft is approximately 1,900 ft.

The same broad belt of pre-Cambrian schist that has received its mineralization from the Bradshaws and its outlying phases at Jerome and also Mayer extends southward and likewise has been mineralized at Kay. Replacement has taken place chiefly in a quartz-sericite schist, believed to have been originally a quartz porphyry. A diorite mass, probably a part of the old pre-Cambrian complex, but less disturbed and inclined to be more massive, has intruded this and formed a structural basin. This diorite-schist contact strikes at an angle of 30 deg. oblique to the strike of the schist, and dips 74 deg. S.E., the schist dipping at about the same angle to the northwest. The diorite has thus formed a dam in the path of circulation of both ascending and lateral solutions, resulting in a roughly elliptical-shaped mineralized area, chiefly of iron pyrites, in which the copper orebodies occur in the form of lenses. The replacement, not being so complete in the main area as to have formed massive sulphides, resulted instead in a thorough dissemination.

A microscopic study of the various types of mineralization discloses the fact that the copper minerals, mainly chalcopyrite, have been introduced later than the iron pyrites. Erosion has followed faster than the processes of oxidation, leaching, and secondary enrichment. The ore is primary throughout and extends downward practically from the grass roots. Chalcopyrite forms the chief ore mineral associated with an appreciable percentage of tetrahedrite, in a gangue composed mainly of pyrite, quartz, and sericite, with calcite, barite, dolomite, and siderite. No high-temperature minerals are evident, which, together with the presence of the above gangue minerals, is rather indicative of the present develop-



VALLEY OF AGUA FRIA RIVER, FORTY-NINE MILES NORTH OF PHOENIX, ARIZ., SHOWING SHAFTS NOS. 1 AND 4 OF KAY COPPER CO. ON WEST (LEFT) AND EAST BANKS RESPECTIVELY

ment workings being in the upper or intermediate zones of deposition.

A typical cross-section of the orebodies shows solid bands of mixed chalcopyrite and pyrite from a fraction of an inch to 2 or 3 ft. in width, alternating with zones of impregnated schist. The sulphite bands themselves vary from being chiefly iron pyrites to those containing 24 per cent copper, the average probably being around 10 per cent copper. The average cross-section of the No. 1 orebody is, however, of slightly over 4 per cent grade. Post-mineral faulting has in places displaced the orebodies, and in the early days caused some confusion in the development of the property.

Prior to the organization of the present company, development work had been centered mainly on what is known as No. 1 shaft, located in the western portion of the main mineral area that lies adjacent to the diorite mass. The shaft had been sunk to the 350 level, and levels driven at the 85, 200, 250, 300, and 350-ft. points. Number three shaft, 2,100 ft. north of No. 1 shaft, had been sunk 180 ft., but was put aside for the more promising work at No. 1.

The work had been handicapped by the lack of the knowledge of existing geological conditions, especially the importance of the structural basin and its accompanying mineralized area, as well as the post-mineral faulting. With geological conditions and the systems of thrust faulting, which in the past had caused confusion, better understood, the present organization has been in a better position to carry on exploratory work.

Under the new management, No. 1 shaft was sunk to the 500 level, at which point considerable work was done. The orebody south of the shaft was drifted to as on the levels above. Upon reaching the fault, crosscutting into the foot wall revealed another ore lens (No. 2) 15 ft. wide, and subsequent drifting across the fault picked up the displaced portion of the No. 1 orebody. Exploratory work on the north side of the shaft on the 500 level opened another lens 12 ft. wide, averaging 2.9 per cent copper, but has not been as yet satisfactorily developed elsewhere. The gold plus silver content of the ore averages close to \$3; the silver \$1.

The 600 level was selected as the place to concentrate further development and exploratory work. Here, as above, the No. 1 orebody was drifted to, the fault crossed, and the displaced portion picked up. The width on this level was 32 ft., widening to 40 ft. south of the fault. Considerable work was also done on the north side of the shaft, but revealed less promising ground than that south of the shaft.

Thirteen diamond drill holes, varying from 180 to 450 ft. in length, were drilled from the 600 level. Two of these holes were depressed to 45 deg., picking up the continuation of No. 1 and No. 2 orebodies, 120 ft. below the level. The rest were horizontal crosscut holes. Two such holes into the foot wall were drilled into the main mineral area, which lies mainly to the east of the No. 1 orebody, from which the holes were drilled, and showed promising mineralization for the entire distance of 450 ft. It is expected, from surface showing, that the mineralization continues on some distance further. Several interesting lenses were passed through within the area, one having a width of 40 ft.

The percentage of ore obtained was very low, averaging not over 18 per cent, due to the fissile, broken character of the schist, which also contained numerous faults resulting in caving in the hole. Sludge samples were taken every 5 ft., the slimes being collected alternately in large settling tanks. Owing to the numerous faults and caving in spots in the holes, a large number of the sludge samples were diluted with cave material, which resulted in much uncertainty in regard to correct assay figures. It is also a question as to whether the ragged edges of the schist might not have produced riffles, causing some loss in the return of the sulphide. The sharp contrast in cutting the black sulphide bands against the light color obtained from the schist was of assistance in determining the nature of the ground cut. Drilling costs were low, for 3,000 ft. averaging \$1.95 per ft., including the items of labor, carbon, power, supplies, and depreciation.

After considerable work had been done on the 600 level, increasing amounts of water and a plant unable to handle it, together with the disad-

vantages of the old prospect shaft, and the desire to explore the main area from a more advantageous point through a new and up-to-date shaft, led to the sinking of the new three-compartment vertical shaft. Before abandoning the old shaft, 140 ft. of drifting was done along the No. 1 orebody south of the fault, which, together with the 50 ft. north of the fault, totals 190 ft. now exposed, the southern limit still being undetermined. No. 2 orebody was shown to be in place by four crosscuts at intervals into the foot wall. The new shaft, being in an advantageous position for exploration of the main mineral area, has also been located with regard to future production of the known orebodies and those expected to be developed. Operations were suspended at the new shaft last summer pending installation of a branch power line and a new electrical compressor and hoisting plant. The installation is now completed, and sinking has been resumed, the present depth being 280 ft. The first development work will be done on the 800 level.

No. 3 shaft was sunk from 180 ft. to the 530 level, where some work was done. Operations, however, were suspended there to concentrate efforts on the more promising area at No. 1 and No. 4 (new) shafts.

George W. Long, instrumental in the discovery and success of the United Eastern, is president of the company. Parker Woodman, at one time prominent in the organization of the Copper Queen, at Bisbee, as general superintendent, has recently been given direct charge of the property, in view of probable operations on a large scale in the near future. John R. Poss, formerly in charge, continues as in the past as the company's engineer and geologist.

Cave Creek District—The Phoenix mine, belonging to the Bully Cave Co., in the Cave Creek district, is a very extensive low-grade gold property, which has had just sufficient enriched stringers and ore pockets to encourage small-scale operations. Such operations were undertaken a number of years ago at considerable disadvantage as compared with present methods of reducing low-grade gold ores. It can therefore be stated that no real test of the value

of this property has been made by former operations.

As recently described in an article on the Cave Creek district by Alfred Strong Lewis, the deposits are in "the zone lying along the contact of the schist and the diorite and other igneous intrusions and in the western part of the mineralized section of the district, where there are several brecciated siliceous zones, from 50 to 300 ft. wide and of undetermined extent, which contain ore averaging \$2 to \$5 in gold per ton. Ore averaging as high as \$12 per ton has been taken from narrower enriched channels within the main low-grade orebodies."

Bisbee—The Night Hawk Leasing Co. has made connection on its 650 level with the workings of the Boras Leasing Co. The latter company is now developing on its 700 level. During the last sixty days the shaft has been sunk 100 ft. from the 600 to the 700 level and the drift on the 700 level has been extended toward the ore country a distance of 300 ft. The Wolverine & Arizona has put on a night shift and is pushing development work.

NEW MEXICO

Work in Steeple Rock District Almost Entirely Suspended

Steeple Rock—The Steeple Rock mining district, in western New Mexico is twelve miles east of Duncan, Ariz. Nearly all work in this district has been suspended. The Norman King property is being worked by lessees. The values in the ore are chiefly gold and silver. The Carlisle mill was shut down last November. A complex ore containing lead, zinc, copper, gold, and silver was treated by concentration and flotation. The mine was kept unwatered up until the middle of February. The main shaft is down to the 500 level and a winze goes 135 ft. below this level. All rails, pipe, and the winze hoist were taken out, and pumping was discontinued the middle of February. The Nugget mine was worked until last June by lessees. The Silver Reef has not been worked since October, 1919. The Twin Peaks, Mount Royal, and Jim Crow, owned by G. F. Utter, of Long Beach, Cal., are shut down.

Lordsburg—The Co-operative mine is shipping another car of lead-silver ore to the El Paso smelter. Returns upon the car shipped in February ran 68.5 oz. silver, 9 per cent lead and \$1.75 gold. A new 3½-ton truck has been purchased.

MINNESOTA

Mesabi Range

Alexandria at Chisholm Closed—Minnesota Steel Curtails—Mesabi Iron Co. Cuts Wages

Chisholm—The Alexandria mine has been closed. Curtailment of operation has been ordered at the Leonard No. 2, Leonard North Bank and Leonard South Bank.

Hibbing—The Mahoning Ore & Steel Co. has completed winter stripping at the Mahoning mine and has started

to do general repair work on the shovels.

The Winston-Dear Co. has been working all winter on its stripping contract at the Cleveland-Cliffs Boeing mine. Due to the mild winter this work was possible.

Marble—The equipment of A. Guthrie & Co. is rapidly being removed from the Danube mine and taken to the Hill-Trumbull mine, where the company have a large stripping contract.

Duluth—Curtailment has been inaugurated at the steel plant of the Minnesota Steel Co. Some men have been laid off and the plant put on a four-day-a-week basis.

Babbitt—The Mesabi Iron Co. has reduced wages. This reduction is in line with that made by all other operating companies on the various ranges of the Lake Superior district except the Oliver Iron Mining Co.

Eveleth—The Kingston Mining Co. has leased the Spring mine and the adjoining eighty acres to the north, known as the Silverton property. The Spring mine is partially developed as an open pit property and the present owners have explored and examined the properties to the extent that certain portions will be stripped and a washing plant erected. The properties lie near Mesabi station on the east end of the range.

Cuyuna Range

Kennedy Mine Cuts to Four Days Per Week

Crosby—The Rogers-Brown Ore Co. has suspended active mining operations at its Meacham mine, letting out from fifty to sixty men. A few mining crews were retained to continue development work on the 350 level.

The Armour No. 2 mine of the Inland Steel Co. has been closed indefinitely following a breakdown of hoisting engine equipment. This equipment will be thoroughly overhauled.

Robert M. Adams and associates of Duluth have taken a lease on the "Evergreen Forty," the SE¼ of SW¼ Sec. 2, 46-29. It is reported that a deal for sub-leasing the property is under way. This forty was drilled some years ago by the Roger Hill interests and a favorable tonnage of stripping ore developed.

Cuyuna—The Kennedy mine of the Rogers-Brown Ore Co., the only Cuyuna Range property now producing, has reduced its working schedule to four days per week.

Ironton—The George H. Crosby interests have three diamond drills operating on the NW¼ of SE¼ of Section 9, 46-29, check-drilling the Huntington mine orebody.

The new boiler plant of the Feigh mine, of M. A. Hanna & Co., was recently put in operation. The property is still idle, but steam is kept up for reserve pumping units.

Riverton—Foundations have been placed for a large machine and engine repair shop at the Sagamore mine, John A. Savage & Co. Construction will be of concrete and steel.

MICHIGAN

Menominee Range

Bengal Mine Closed—Fogarty on Half Time

Iron River—The Bengal Mine of the Pickands-Mather company has been closed, 300 men having been laid off. The Fogarty mine has been placed on half time and the Warner has stopped all work with the exception of the sinking of a shaft.

Marquette Range

Republic Mine Working Five Days Per Week

Republic—The Republic mine, the sole support of the village of Republic, is now working five days a week, with the men hoping this can be retained. The stockpiles are about filled and there is some apprehension that there may be a further decrease on this account before lake shipping starts. The Republic is working at the 20th level and is one of the deepest mines of this region.

The Michigan Verde Antique Marble Co. has added new channelers and is preparing for an active season. The product has credit for being the very finest in the verde antique list, surpassing that of Greece and Italy.

JOPLIN-MIAMI DISTRICT

Oklahoma-Kansas-Missouri

Central Relief Association Organized To Aid Unemployed Miners

Picher—With only about thirty-two mines operating where there were 125 six months ago, the problem of taking care of the unemployed miners in this district has been a difficult one this winter. Fortunately, mild weather has prevailed throughout. In the Picher camp the necessity for assistance has been greatest. It was taken care of by the local charity association until after Jan. 1, when help was asked. A Central Relief Association was thereupon organized, headed by F. C. Wallower, manager for the Golden Rod M. & S. Co., as chairman. This association, in the three weeks ended March 5, raised a total of \$2,758.50 in cash, of which amount \$1,010 was contributed by mining companies, \$1,004 by employed miners, paying 25c. a week; and the remainder by mine supply houses and individuals. Up to the date mentioned, not quite \$2,000 of the sum had been expended by way of payment for special road work in the field, the unemployed miners being given work at \$2 a day. It was eagerly sought, and the plan has resulted in easing the situation and incidentally in vastly improving the roads in the camp.

Joplin—Several thousand dollars, raised by subscription, have been expended in Joplin, at the old Bullfrog mine, in an effort to recover the body of Riverton Hutchinson, who was drowned in the mine early in February. The draining work has been under the direction of Charles Keith, deputy state mine inspector, but up to date has proved in vain. It is feared the body may have been buried under considerable earth, and may never be recovered.

THE MARKET REPORT

Daily Prices of Metals

March	Copper, N. Y. net refinery*	Tin		Lead		Zinc
	Electrolytic	99 Per Cent	Straits	N. Y.	St. L.	St. L.
10	11.75	26.00	28.25	4.00@4.10	3.95@4.05	4.80
11	11.75	27.00	28.50	4.00	3.95@4.05	4.80
12	11.75	27.00	28.50	4.00	3.95@4.00	4.80
14	11.75	27.75	29.00	4.00	3.95@4.00	4.80
15	11.75	27.25	28.25	4.00	3.95@4.00	4.75
16	11.75	27.00	28.00	4.00	3.95@4.00	4.75

*These prices correspond to the following quotations for copper, "delivered": 12c. for the week.

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

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

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

five sellers who are willing to accept 12c. for their metal. Wire-drawers are the chief factors in the market. Should the demand increase, the price would almost certainly rise to the 12½@13c. level of the large producers. As it is, copper for even second-quarter delivery can be obtained at the 12c. price. We have heard of one sale of a small quantity of copper for immediate delivery at 11½c. delivered, but as practically all of the business was done at the higher level we are not including it in our quotation. Foreign demand is poor, though some cash business has been done with Germany.

Lead

The official price of the American Smelting & Refining Co. continues at 4c., New York and St. Louis, and lead is being freely offered to responsible customers, for immediate shipment, at this figure.

The buying movement which took place during the first ten days of March is no more, and inquiries have been few. A local electrical company purchased a fair tonnage for forward delivery during the week, but most of the orders were only for carload lots. In general a small premium is being asked for April, May, and June lead; and some sellers are unwilling to go beyond April. Chemical lead continues to be quoted at 25@45 points premium. Cable manufacturers seem to be the most active consumers of lead at present. Quotations by metal-trade papers continue to be about 25 points above the market and are evidently made to assist dealers who laid in stocks around 4.75c.

A disposition exists in some quarters to allow foreign lead to come into the country and thus stabilize the world market as soon as possible. This would take place should the domestic price be much higher, as London parity is about equal to 4c., New York.

The statistical position of lead is none too good and seems to be getting worse, reliable figures indicating considerable stocks and current consumption less than production.

Zinc

The market both in London and St. Louis has become weaker, and the small rise reported last week has been almost entirely lost. Sales were light, as has been the case for months. It is reported that one sheet mill which has been in the market of late, on being asked why purchases were being made, replied that although it was shut down, the price looked attractive enough to warrant accumulating a stock. The present low prices of zinc are unquestionably bargains, and when industrial activity begins to appear it is likely that this metal will be one of the first to

London

March	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic	Spot	3 M	Spot	3 M	Spot	3 M
	Spot	3 M							
10	65½	66½	70	149½	153	19	19½	26	26½
11	65½	66½	70	155½	159½	18½	19½	26½	26½
12	66½	66½	70	159½	163½	19	19½	26½	26½
14	66½	66½	70	157	160	19	19½	26	26½
15	67	66½	70	153	156	18½	19½	25½	26½
16	67½	66½	70½						

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

Silver and Sterling Exchange

Mar.	Sterling Exchange	Silver			Mar.	Sterling Exchange	Silver		
		New York, Domestic Origin	New York, Foreign Origin	London			New York, Domestic Origin	New York, Foreign Origin	London
10	389½	99½	54½	31½	14	389	99½	57½	33½
11	389½	99½	54½	31½	15	389	99½	57	33½
12	389½	99½	56½	32½	16	389½	99½	55½	32½

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London quotations are in pence per troy ounce of sterling silver, 925 fine.

Metal Markets

New York, March 16, 1921

The market has again relapsed into its accustomed inactivity, the spurt in lead and tin which we mentioned last week having passed. Some small lots of all the metals have been sold to consumers, but buying has only been for immediate requirements, and no speculative activity has been in evidence. Reports from Washington state that thirty million pounds of cartridge cases have been sold to brass manufacturers in the Connecticut valley. This is the greater part of the scrap for which bids were recently asked, but which it was subsequently decided to sell privately. Settlement will be made on the basis of the market price of electrolytic copper in

New York and zinc in St. Louis. Some of the purchasers have had their requirements supplied from stocks of scrap for many months and have been almost entirely out of the market for virgin metal. It is encouraging to know that such scrap is gradually being consumed, but a fairly large amount is still said to be available in Europe. When these stocks are exhausted, and industrial activity begins to resume, the metal markets should be quick to respond, but when this will come cannot be predicted. Conditions are not yet at all encouraging.

Copper

The market is as dull as ever, and demand is just about sufficient to absorb the current production of the four or

strengthen. Zinc can today be obtained in St. Louis at 4.70@4.80c.; high-grade, 7c. delivered at Eastern points.

Tin

Demand for tin has fallen away, and no immediate resumption is expected, as consumers were tempted by the recent low prices to buy beyond their immediate requirements. Tin of the 99 per cent grade seems to have been a little oversold, and some sellers have not been anxious to book further business.

Straits tin for future delivery: March 10th, 28.50@29c.; 11th, 28.50@29.25c.; 12th, 28.50@29.25c.; 14th, 29.25@29.75c.; 15th, 28.25@28.75c.; 16th, 28.50@29c.

Arrivals of tin, in long tons: March 7th, Australia, 25; 11th, London, 75; 14th, Straits, 300; 15th, London, 75; Hongkong, 50.

Silver

Since our last report, continued buying on the part of the Indian bazaars and spasmodic buying for China account have advanced the London price to 33½d. At this higher level China again turned seller, with the result that spot silver in London broke sharply today to 32½d. In the absence of any special buying orders our local market has followed closely the London price, the New York quotation reaching a high of 57½c. on March 14. The Frisco market is a purely nominal one.

Mexican Dollars.—March 10th, 41½; 11th, 41½; 12th, 42½; 14th, 43½; 15th, 43½; 16th, 42½.

Gold

Gold in London: March 10th, 105s. 7d.; 11th, 105s. 3d.; 14th, 105s. 2d.; 15th, 105s. 6d.; 16th, 105s. 1d.

Foreign Exchange

Rates on China and India have shown an upward tendency, which should encourage silver producers. On Tuesday, March 15th, francs were 6.99c.; lire, 3.69c.; and marks, 1.59c. New York funds in Montreal, 14½ per cent premium. Canadian exchange continues to show no improvement.

Other Metals

Aluminum—List prices of 28@28.5c. are nominal. Outside market, 24@25c. per lb. Market quiet.

Antimony—Chinese and Japanese brands, 5½@5¼c.; market quiet. W.C.C. brand, 5½@6c. per lb. Cookson's "C" grade, spot, 9½c. Chinese needle antimony, lump, nominal at 4½c. per lb. Standard powdered needle antimony (200 mesh), 6½@6¾c. per lb. Demand light, with heavy supplies available.

White antimony oxide, Chinese, guaranteed 99 per cent Sb₂O₃, wholesale lots, 7c.

Bismuth—\$1.50@\$1.65 per lb., 500-lb. lots. London price reduced Feb. 12 from 12s. 6d. to 7s. 6d., accompanied by a decline here.

Cadmium—Nominal, \$1.10 per lb., in 1,000-lb. lots.

Cobalt—Metal, \$4.50 per lb.; black oxide, \$3@\$3.10 per lb. in bbls.; sulphate, \$1.35 per lb. in bbls.

Iridium—Nominal, \$250@\$300 per oz.

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

Nickel—Standard market, ingot, 41c.; shot, 41c.; electrolytic, 44c. Small tonnages, spot, 38@40c.

Monel Metal—Shot, 35c.; blocks, 35c., and ingots, 38c. per lb., f.o.b. Bayonne.

Osmium—Open market, \$70@\$80 per troy oz.

Palladium—\$65@\$70 per oz.

Platinum—\$72@\$75 per oz. Steady.

Quicksilver—Nominally, \$46@\$47 per 75-lb. flask. San Francisco wires \$45.50. Market dull.

Rhodium—\$200@\$225 per troy oz.

Ruthenium—\$175@\$200 per troy oz.

Selenium—Black powdered, amorphous, 99.5 per cent pure, \$2@\$2.25 per lb.

Thallium Metal—Ingot, 99 per cent pure, \$20 per lb.

Tungsten Metal—Wire, \$35@\$60 per kilogram, according to purity and gage.

Metallic Ores

Chrome Ore—Guaranteed 50 per cent Cr₂O₃, foreign ore with a maximum of 6 per cent silica, 45@50c. per long ton unit, f.o.b. Atlantic ports.

Iron Ore—Lake Superior ores, per ton, Lower Lake ports: Old Range bessemer, 55 per cent iron, \$7.45; Mesabi bessemer, 55 per cent iron, \$7.20; Old Range non-bessemer, 51½ per cent iron, \$6.70; Mesabi non-bessemer, 51½ per cent iron, \$6.55.

Magnetite Ore, f.o.b. Port Henry, N. Y.: Old bed 21 furnace, \$5.80; old bed concentrates, 63 per cent, \$6.70; Harmony, cobbled, 63 per cent, \$6.70; new bed low phosphorus, 65 per cent, \$9.50.

Manganese Ore—35@40c. per unit, seaport; chemical ore (MnO₂) \$60 per gross ton, lump; \$70@\$75 per net ton, powdered. Market dull.

Molybdenum Ore—85 per cent MoS₂, 55@60c. per lb. of contained sulphide, New York.

Tantalum Ore—Guaranteed minimum 60 per cent tantalic acid, 50c. per lb. in ton lots.

Titanium Ores—Ilmenite, 52 per cent TiO₂, 1¼@2c. per lb. for ore. Rutile, 95 per cent TiO₂, 12c. per lb. for ore, with concessions on large lots or contracts.

Tungsten Ore—Scheelite or wolframite, 60 per cent WO₃, and over, per unit of WO₃, \$3@\$3.25, f.o.b. Atlantic ports.

Uranium Ore (Carnotite)—Ore containing 1½ per cent U₃O₈ and 5 per cent V₂O₅ sells for \$1.50 per lb. of U₃O₈, and 75c. per lb. of V₂O₅; ore containing 2 per cent U₃O₈ and 5 per cent V₂O₅ sells for \$2.25 and 75c. per lb., respectively; higher U₃O₈ and V₂O₅ content commands proportionately higher prices.

¹Furnished by Foote Mineral Co., Philadelphia, Pa.

Vanadium Ore—\$1.50 per lb. of V₂O₅ (guaranteed minimum of 18 per cent V₂O₅), New York.

Zircon—Washed, iron free, 3c. per lb.

Zirkite—According to conditions, \$70@\$90 per ton, carload lots. Pure white oxide, 99 per cent, is quoted at \$1.15 per lb. in ton lots.

Zinc and Lead Ore Markets

Joplin, Mo., March 12—Zinc blende, per ton, high, \$24.95; basis 60 per cent zinc, premium, \$22.50; Prime Western, \$21; fines and slimes, \$20@\$17.50; average settling price, all grades of zinc, \$23.

Lead, high, \$43.45; basis 80 per cent lead, \$35 buying and \$45@\$35 settling; average price, all grades of lead, \$39 per ton.

Shipments for the week: Blende, 4,495; lead, 551 tons. Value, all ores the week, \$124,980.

Until Thursday noon \$21 basis was the highest offering, but that price was buying very little ore. Then 500 tons was purchased \$21.50, following which several thousand tons was purchased \$22.50 basis up to noon Saturday.

The Grasselli Chemical Co., out of the market since last August, is again purchasing. It is reported the smelter has not been restarted, but the ore was purchased for acid, following treatment for which it will be stocked at the smelter. Production of blende continues 2,000 to 2,500 tons larger than the average demand, but active buying this week advanced sales to a figure approximately 1,000 tons in excess of the week's output.

Platteville, Wis., March 12—No market for zinc or lead ore. Shipments for the week: Blende, 772 tons. Shipments for the year: Blende, 7,965; lead, 510 tons. Shipped during the week to separating plants, 308 tons blende.

Non-Metallic Minerals

Asbestos—Crude, No. 1, \$2,000@\$3,000; No. 2, \$1,400@\$2,000; spinning fibres, \$400@\$1,000; magnesia and compressed sheet fibres, \$325@\$500; shingle stock, \$110@\$150; paper stock, \$60@\$75; cement stock, \$17.50@\$30; floats, \$8.50@\$15, all per short ton, f.o.b. Thetford, Broughton, and Black Lake mines, Quebec, Canada; 5 per cent to be added as export sales tax.

Barytes—Crude, 88 to 94 per cent barium content, \$10@\$12 per net ton; ground (white) \$24@\$30 in bags, carload lots; (off-color) \$22@\$26 in bags, carload lots; all f.o.b. South Carolina points. Foreign barytes, prime white material, \$25 per net ton f.o.b. Atlantic seaports. Western grades, \$24.50. Demand is dull.

Chalk—English, extra light, 5@5½c. Domestic light, 4½@5c.; heavy, 4@4½c. per lb., all f.o.b. New York.

China Clay (Kaolin)—Crude, \$8@\$10; washed, \$10@\$12; powdered, \$15@\$20; bags extra, per net ton, f.o.b. mines, Georgia; powdered clay, \$15@\$20, f.o.b. Virginia points. Domestic lump, \$10@\$20; powdered, \$25@\$30;

imported lump, \$15@25, f.o.b. American ports; powdered, \$35@45, f.o.b. New York.

Feldspar—Crude, \$8@14 per gross ton, f.o.b. Maryland and North Carolina points; \$7.50@10, f.o.b. Maine; ground, \$27@30, car lots, f.o.b. Baltimore; ground, \$17@21, f.o.b. North Carolina points; \$17@21 per ton, No. 1 ground, f.o.b. New York State; \$21@23 per ton, ground, f.o.b. Maine.

Fluorspar—Gravel, guaranteed 85 per cent calcium fluoride and not over 6 per cent silica, \$25 per ton, f.o.b. Illinois mines, and \$25, f.o.b. Kentucky; ground, suitable for acid, chemical or enameling purposes, \$60; lump, \$17.50, f.o.b. Heathden, N. M. In Canada 85 per cent calcium fluoride sells for \$20 per ton, f.o.b. Madoc; output limited. Canadian price generally \$18 (Canadian currency) per ton, f.o.b. mines.

Fuller's Earth—\$16 per ton, carload lots, f.o.b. mines.

Graphite—Ceylon lump, first quality, 8@9c. per lb.; chip, 7c.; dust, 5½c. No. 1 flake, 7c.; high-grade amorphous crude, 3c.

Gypsum—Plaster of paris in carload lots sells for \$4.25 per 250-lb. bbl., alongside dock, New York. Raw crushed rock, \$3.50@4.50; calcined stucco, \$9; f.o.b. works, Illinois.

Kaolin—See China Clay.

Limestone—Crushed, New York State shipping points, ¾ in. size, \$1.40@2 per net ton; 1½ in., \$1.50@2. Prices for other sizes practically the same. Agricultural limestone, \$2.50@4.50 per net ton, f.o.b. eastern shipping points, depending upon analysis.

Magnesite, Calcined—High-grade caustic calcined, lump form, \$30@35 per ton, carload lots, f.o.b. California points. In Chicago district, \$57.70; Atlantic seaboard, \$60.

Dead-Burned—\$38 per net ton, Chewelah, Wash.; \$58@64, Chester, Pa. Austrian grade, \$55@60 per ton, f.o.b. Baltimore. (Magnesite brick—See Refractories.)

Mica—India block mica, slightly stained, per lb.: No. 6, 35c.; No. 5, \$1.20; No. 4, \$2.50@3; No. 3, \$3.50@4; No. 2, \$4.50@6; No. 1, \$5.50@6.50. Clear block: No. 6, 50c.; No. 5, \$1.75; No. 4, \$3.25; No. 3, \$5; No. 2, \$6.50; No. 1, \$8; A1, \$6.50@8.50; extra large, \$25; ground, wallpaper grade, \$90@160 per ton (depending upon quantity); all f.o.b. New York.

Monazite—Minimum of 6 per cent thorium oxide, quoted \$30 per unit, duty paid.

Phosphate Rock—Domestic demand weak; movements of stocks into consuming channels reported slow. Per long ton, Florida ports: 77 per cent tricalcium phosphate, \$12; 75 per cent, \$11.50; 75@74 per cent, \$11; 70 per cent, \$8.35; 68 per cent, \$7.85; 68@66 per cent, \$7.60.

Pumice Stone—Imported, lump, 4@50c. per lb.; domestic lump, 6c.; ground, 4@7c., all f.o.b. New York.

Pyrites—Spanish fines, per unit, 16c., c.i.f. Atlantic seaport; furnace size,

16½c.; Spanish lump, 14@15c.; domestic fines, f.o.b. mines, Georgia, 12@14c.

Quartz—(Acid tower) fist to head, \$10; 1½ to 2 in., \$14; rice, \$17; all net ton, f.o.b. Baltimore; lump, carload lots, \$5@7.50 net ton, f.o.b. North Carolina mines.

Sulphur—\$18 per ton for domestic; \$18@20 for export, f.o.b. Texas and Louisiana mines. Market quiet.

Talc—Paper making, \$11@20 per ton; roofing grades, \$8.50@13; rubber grades, \$11@18; all f.o.b. Vermont. California talc, \$18@40, talcum powder grade. Southern talc, powdered, carload lots, \$10@14 per ton; less than carload, \$25, f.o.b. cars; freight to New York \$5.25 per ton, carload lots; less than carload lots, \$9.25. Imported, \$35@40; Canadian, \$20@40 per ton.

Mineral Products

Arsenic—White arsenic, 9@10c. per lb. in carload lots. Usual spring demand is not being felt for insecticides. Supplies are plentiful and market is dull.

Sodium Nitrate—\$2.85@3 per cwt. ex vessel, Atlantic ports. Market quiet.

Sodium Sulphate—For 95 per cent material, \$20 per ton, f.o.b. mines, Idaho and Arizona, spot and six months' contract; \$30 per ton, New York.

Potassium Sulphate—Domestic, \$220@230 per net ton, basis 90 per cent, f.o.b. New York.

Ferro Alloys

Ferrotitanium—For 15 to 18 per cent material, \$200@225 per ton, f.o.b. Niagara Falls, N. Y.

Ferrocerium—Per lb., \$12@15.

Ferrochrome—Carload lots, spot and contract, 60 to 70 per cent chromium, 6 to 8 per cent carbon, 15c. per lb. of chromium contained; 4 to 6 per cent carbon, 14½c., f.o.b. works.

Ferromanganese—Domestic 76 to 80 per cent, \$90@95, f.o.b. furnace; resale, \$90, delivered; English, \$90@95, c.i.f. Atlantic seaports. Spiegeleisen, 18@20 per cent, \$35@40, f.o.b. furnace.

Ferromolybdenum—Standard grades, carrying from 50 to 60 per cent molybdenum metal, with low sulphur, phosphorus, and arsenic, \$2 per lb. of contained metal, f.o.b. works.

Ferrosilicon—For 10 to 15 per cent, per gross ton, f.o.b. works, \$55@60; 50 per cent, \$85@90; 75 per cent, \$145@150.

Ferrotungsten—Domestic, 70 to 80 per cent W, 50@55c. per lb. of contained tungsten, f.o.b. works. Foreign, 60c.

Ferro-uranium—35 to 50 per cent U, \$6 per lb. of U contained, f.o.b. works.

Ferrovandium—Basis 30 to 40 per cent, \$5 per lb. of V contained, plus 75c.@2 differentials and according to silicon content, f.o.b. works.

Metal Products

Copper Sheets—Current New York list price, 20½@20¾c. per lb.; wire, 15@15½c.

¹Furnished by Foote Mineral Co., Philadelphia, Pa.

Lead Sheets—Full lead sheets, 8c.; cut lead sheets, 8½c. in quantity, mill lots.

Nickel Silver—33½c. per lb. for 18 per cent nickel.

Yellow Metal—Dimension sheets—18½c.; sheathing, 17½c.; rods, ¾ to 3 in., 15½c.

Zinc Sheets—\$11 per 100 lb., less 8 per cent on carload lots, f.o.b. smelter; zinc plates, 10c. per lb.

Refractories

Bauxite Brick—56 per cent alumina, \$160 per 1,000, f.o.b. Pittsburgh.

Chrome Cement—40@45 per cent Cr₂O₃, \$45@50 per net ton, and \$55 in sacks, carload lots, f.o.b. eastern shipping points.

Chrome Brick—Straights, \$80 per net ton, shipping point; arches, keys, wedges, \$85; splits, soaps, \$100.

Fire Brick—First quality, 9-in. shapes, \$55@60 per 1,000, Pennsylvania, Ohio and Kentucky. Second quality, \$45@50.

Magnesite Brick—9-in. straights, \$90@100 per net ton; 9-in. arches, wedges and keys, \$105; soaps and splits, \$120.

Silica Brick—9-in., per 1,000: \$45@55 in carload lots, f.o.b. shipping points.

The Iron Trade

Pittsburgh, March 15, 1921

Production of steel continues to decline, the rate now being about 40 per cent of capacity, against about 80 per cent during the period of high pressure in 1920, when there was apparently demand for more than could be produced, output then being limited by transportation conditions and other influences. The Steel Corporation's rate has declined to about 60 per cent of capacity, and independent production shows little variation, being about 25 per cent of capacity.

The Steel Corporation has not reduced its prices and shows no intention of doing so in the near future. Extreme prices quoted by independents on the various finished steel products show hardly any further decline, except in sheets, which have declined, for ordinary orders, to 3c. for blue annealed, 4c. for black, and 5.10c. for galvanized. There is a slight improvement in the volume of buying of steel products.

Pig Iron—Foundry iron has declined another 50c., the Standard Sanitary Manufacturing Co. having bought 1,000 tons on the basis of \$26, Valley. At the same time the company bought for its Louisville plant 500 tons of Virginia iron at \$26, furnace, and 500 tons of Birmingham iron at \$25, furnace. Bessemer and basic remain nominally \$27 and \$25, Valley. A broker has sold 500 tons of basic at about \$23, Valley, but no regular supplies are offered at such a price.

Coke

Connellsville—Furnace, \$4.75@5.50; foundry, \$5.75@6.25.

The Copper Situation in Germany

Special Report From Our Vienna Correspondent

OF THE copper mined by the world during the period 1879 to 1913, Germany contributed about 4 per cent. Concerning the consumption of copper, the German brass and copper fabricators, and particularly the German electrical industry, although producing chiefly for home markets, always have manufactured a considerable quantity of copper for export. For example, 1913 statistics show that the copper exported in German wires and cables exceeded the imported copper by 27,118 tonnes. Naturally the major part of this was consumed by those German concerns manufacturing electrical goods—Allgemeine Elektrizitätsgesellschaft, the Siemens-Schückert, and the Lahmeyer-Felten-Guillaume companies. English electrical and other copper-fabricating industries were wholly unable to keep up with this German development.

Today general consumption of copper by Germany is down to barely more than half of that of the last ante-bellum year, because of the present production crisis, the coal shortage, and the continual labor difficulties.

In Germany at the outbreak of war copper cost about 114 marks per 100 kg., but during the war a maximum price was fixed. After this was removed on Nov. 1, 1919, official trade prices were reported, and the price of electrolytic copper rose to about 4,700 marks in the middle of February, 1920. Soon thereafter the demand for raw material changed into an offering of raw materials.

After the close of the Spa conference the world's markets waited in vain for large German buying orders for copper. As the freight from New York to Hamburg was not less than \$15 per tonne, and even from London to Hamburg was 30s., it was to be expected that German metal products containing considerable copper would be higher priced on the world market than American, at least by the amount of the heavy freight rate plus insurance and costs. This circumstance carried all the more weight, as the German price of copper was already considerably above the world-market par. Subsequently a very pleasing marked decrease in international freight rates occurred. Further-

more, the summer saw a decrease in the export business in most branches of industry, owing to the rise in German exchange. As a result of the market conditions mentioned, the German quotation on electrolytic was 2,655 marks in the middle of April, fell to 2,088 marks by the middle of May, and to 1,609 marks by the end of that month. Since then, within the limits of fluctuations in exchange, the quotations have remained at about 2,000 marks. Taking into account the risks necessarily associated with the purchase of copper and sales of fabrications, the present increased price of the electrical manufactures involved, as compared with pre-war prices, corresponds to the rise in the price of copper.

Naturally, the copper-producing countries suffer most from the fall in the price of copper, although because they have large export trade balances their exchange rate is high. Germany, however, could derive but a disproportionately small advantage from the fall in international prices, or none at all, by reason of the continued decline in the exchange rate. On the other hand, the copper-producing countries may have laid up sufficient reserves during their high-level period in the war to tide over this inevitable reaction, whereas low German exchange presents a not inconsiderable export premium for German export business.

Under the persisting inflation and existing economic situation, which precludes a fall in prices for the German consumer in the international markets, even the granting of American credits would scarcely put Germany in a position to import very much more copper. Therefore it seems that in view of America's dominant position in copper it would be more appropriate to make foreign loans in copper than in money, the copper to be manufactured and then re-exported, thus escaping the risk of exchange and transportation in the far from adequately traveled path of manufacturing credits. At present the world crisis seems to be increasing, so that it is likely we shall have to reckon with later effects on the copper market.

Metal, Mineral, and Ore Prices During 1920

	Place	Jan. 2	High	Low	Dec. 31
Aluminum, list price, 99 per cent, c. per lb.	New York	33	35.1	28.4	28.4
Antimony, Chinese ordinary, c. per lb.	New York	9.825	11.75	5.325	5.325
Bismuth, \$ per lb.	New York	2.65	2.85	2.40	2.40
Blende, average settling price, high, \$ per ton.	Joplin, Mo.	59.60	61.50	35.25	36.95
Blende, 60 per cent zinc, \$ per ton.	Platteville, Wis.	55.50	61.00	37.00	No mkt.
Cadmium, \$ per lb.	New York	1.45	1.45	1.40	1.40
Calamine, basis 40 per cent zinc, \$ per ton.	Joplin, Mo.	35.00	39.35	20.00	20.00
Copper, electrolytic, f.o.b. refinery, c. per lb.	New York	18.725	19.05	12.125	12.125
Copper, sheets, c. per lb.	New York	28.50	33.50	21.50	21.50
Copper, wire, c. per lb.	New York	22.75	32.50	16.50	16.50
Copper, spot, standard, £ per long ton.	London	116	122	71.75	71.75
Copper, 3 months, standard, £ per long ton.	London	118.25	124.5	72.25	72.875
Copper, spot, electrolytic, £ per long ton.	London	124	128	80	80
Ferromanganese, prompt, domestic, \$ per ton.	New York	145	250	122.50	122.50
Gold, s. and d. per troy oz.	London	109	127/4	102/7	116/1
Iridium, nominal, \$ per troy oz.	New York	300	425	300	325
Iron, basic, pig, \$ per ton.	Valley	35.50	48.50	30	30
Iron, bessemer, pig, \$ per ton.	Valley	36.50	48.50	32	32
Iron, foundry, pig, \$ per ton.	Valley	38.50	50	33	33
Lead, ordinary, c. per lb.	New York	8.25	9.375	4.50	4.75
Lead, ordinary, c. per lb.	St. Louis	8.00	9.0625	4.50	4.65
Lead, spot, £ per long ton.	London	45.75	52.375	21.50	23.50
Lead, 3 months, £ per long ton.	London	46.25	53.375	22.50	24.25
Lead, ore, high, \$ per ton.	Joplin, Mo.	93.65	115.60	58.05	58.05
Lead, ore, 80 per cent, \$ per ton.	Joplin, Mo.	92.50	111.25	51.25	51.25
Lead, ore, 80 per cent, \$ per ton.	Platteville, Wis.	87.00	110	75	No mkt.
Molybdenum, ore, 85 per cent MoS ₂ , c. per lb. of MoS ₂	New York	75	100	57.5	57.5
Nickel, list price, ingot, c. per lb.	New York	43	43	43	43
Nickel, list price, electrolytic, c. per lb.	New York	45	45	45	45
Nitrate, c. per lb.	New York	3.25	3.925	3	3
Platinum, \$ per troy oz.	New York	155	155	75	75
Pyrites, Spanish, fee. size, c. per long ton unit.	New York	17	17.50	15	16.5
Quicksilver, \$ per 75-lb. flask.	New York	85	104	45	45
Silver, 999 fine, domestic origin, c. per troy oz.	San Francisco	90	96.50	45	48.50
Silver, 999 fine, foreign origin, c. per troy oz.	New York	130.5	137	99.5	99.5
Silver, 925 fine, d. per troy oz.	New York	130.5	137	59.25	64.25
Spiegel Eisen, 18@20 per cent, \$ per ton.	London	75.875	89.50	40	40.875
Sterling Exchange, c. per £.	Furnace	45	83.75	45	60
Sulphur, \$ per ton.	New York	377.5	403.25	326	353
Tin, 99 per cent, c. per lb.	La. and Texas	18	18	18	18
Tin, standard, spot, £ per long ton.	New York	58.75	63.75	29	31.25
Tin, standard, 3 months, £ per long ton.	London	347.5	419	200	205 1/2
Tungsten ore, wolframite, 60% WO ₃ , \$ per unit WO ₃	London	349.5	421.5	205	210.25
Zinc, Prime Western, c. per lb.	New York	7	7	3.50	3.50
Zinc, spot, £ per long ton.	St. Louis	8.90	9.3625	5.55	5.70
Zinc, 3 months, £ per long ton.	London	58.5	63	22.50	26
Zinc, sheets, carload lots, c. per lb.	London	59.5	65.5	24.625	27.5
	New York	11.5	14.5	11.5	11.5

COMPANY REPORTS

Portland Gold Mining Co.'s Surplus Decreases

Gold; Colorado

The twenty-seventh annual report of the Portland Gold Mining Co. for the calendar year 1920 states that the gross value of the ore mined and shipped amounted to \$887,533.04, and that the values recovered by mills totaled an additional \$663,107.62. Net cost of mining and milling was \$1,474,100.35, leaving a net profit of \$76,540.31 from the operation of mines and mills.

Cash receipts totaled \$1,309,024.28, and disbursements, including a dividend of \$195,000, amounted to \$1,359,759.48. Surplus balance on Jan. 1, 1920, stood at \$103,087.85; on Jan. 1, 1921, at \$52,352.95.

Profit and loss account follows:

Debits	
Net profit from operation	\$76,540.31
Interest on bank balances	1,354.09
Interest on corporation bonds owned	300.00
Interest on bills receivable	2,380.00
Interest on open accounts	1,493.38
Interest on Liberty bonds	942.04
Discount	998.46
Registration fees	25.10
Net loss to surplus	442,094.72
Total	\$526,128.10
Credits	
Interest on notes payable	\$ 187.50
Discount on Liberty bonds sold	1,629.33
Depreciation:	
Permanent equipment	\$27,648.64
Independence mill	92,390.73
Furniture and fixtures	333.78
Depletion	120,373.15
Loss on sale of Colorado Springs mill	199,059.10
Loss on sale of Victor mill	119,362.86
Loss on sale of Victor mill	85,516.16
Total	\$526,128.10
Surplus balance, Jan. 1, 1920	\$819,531.97
Net loss for 1920	\$442,094.72
Dividends	195,000.00
Surplus balance, Jan. 1, 1921	\$182,437.25

Exploration Company Earns Substantial Profit

Gold; Mexico

A report of the Exploration Company, Ltd., for the year ending Dec. 31, 1920, shows a net realized profit of £57,162 2s. 5d., which, added to the balance of £87,384 10s. 4d., brought forward from the preceding year, makes a total of £144,546 12s. 9d. to the credit of profit and loss account. From this sum £20,000 has been deducted to provide for depreciation on the company's investments, and out of the remaining £124,546 12s. 9d. the directors have recommended the payment of a dividend—of 10 per cent—being 1s. per share, free of income tax, leaving a balance of £87,046 12s. 9d. to be carried forward.

The shares and interests of the company in various subsidiary and other companies stand in the balance sheet at £266,521 4s. 2d., being their value on Dec. 31, taken at market prices for quoted and the directors' valuation for unquoted securities. The appreciation in value of the American dollar early in the year enabled the directors to dispose of nearly all of the company's investments in the United States to advantage.

The subsidiary companies in the United States and Mexico have maintained operations without material change, but net results have been adversely affected by the increased cost of labor and supplies, increased taxation, and the fall in the prices of silver and lead. The Buena Tierra Mining Co. in November last made an issue of £66,000 five-year notes to provide funds for carrying out an extensive scheme of development, and this company underwrote the issue.

New Idria Quicksilver Has Large Deficit

The annual report of the New Idria Quicksilver Mining Co. for the year 1920 states that the company has passed through the most serious period since its incorporation. During the early part of the year the outlook was promising. On June 20, a fire destroyed a large portion of the plant, warehouse, supplies, and a large amount of quicksilver in process. The heavy expenses during reconstruction, with no production for several months, used up available cash assets, and with a stagnant market and the low price of quicksilver in the fall, the plant, which had been running at partial capacity in September and October, was closed down on Nov. 1, and all expenses were reduced to a minimum.

The low price of quicksilver prevailing since September was caused by the dumping of large quantities of foreign quicksilver from Europe, over 16,000 flasks having been imported in 1920, against a normal import of 6,000 flasks. Some of this imported quicksilver has been sold as low as \$35 per flask. These large importations, and low prices, which are much below the cost of American production, demoralized the home market, and resulted in closing down not only the company's mine but nearly every other quicksilver property in the United States.

It was deemed expedient to consent to the appointment of a receiver in order to preserve the assets and property of the company in behalf of the creditors and the stockholders and await a more favorable time to re-finance. James D. Colt, of Boston, was appointed receiver on Dec. 20, 1920.

The indebtedness of the company, as shown on the balance sheet, will have to be liquidated before the receivership can be terminated and the company placed in a position to operate. It will therefore be necessary to re-finance the company if it is to continue as an operating company.

The condensed balance sheet of Dec. 20, 1920, follows:

ASSETS	
Plant	\$685,470.60
Mineral deposits	3,381,108.00
Cash	11,903.08
Accounts receivable	2,073.47
Quicksilver and supplies	163,908.04
Deficit	299,363.07
	\$4,543,826.26
LIABILITIES	
Capital	\$500,000.00
Accounts payable	15,511.12
Notes payable	210,000.00
Reserve for mineral deposits	3,818,315.14
	\$4,543,826.26

Montana-Bingham Consolidated Mining Co. Copper, Lead; Utah

A report of operations of the Montana-Bingham Consolidated Mining Co. for the year ended Dec. 31, 1920, states that production amounted to 750,210 lb. copper, 16,278 lb. lead, 12,662.6 oz. silver, and 348.61 oz. gold, from a total shipment of 4,660.6 tons of copper and lead ore. Smelter returns amounted to \$79,382.77. Operating and profit and loss statement follows:

Total operating income	\$88,198.60
Total operating expenses	84,320.13
Profits from operations	\$3,878.47
Add interest earned	510.42
	\$4,388.89
Deduct bond interest and sundry adjustments	11,526.83
Net loss charged to surplus	\$7,137.94

Surplus balance on Dec. 31, 1919, was \$903,307.78, and on Dec. 31, 1920, \$809,296.36.

MINING STOCKS

Week Ended March 12, 1921

Stock	Exch.	High	Low	Last	Last Div.
COPPER					
Adventure.....	Boston	*70	*65	*65	
Ahmeek.....	Boston	48	47	47	Sept. '20, Q \$0.50
Alaska-Br. Col.....	N. Y. Curb				
Allouez.....	Boston	21	21	21	Mar. '19 1.00
Anaconda.....	New York	38	34	35	Nov. '20, Q 1.00
Arcadian Consol.....	Boston	2	2	2	
Ariz. Com'l.....	Boston	8	8	8	Oct. '18, .50
Big Ledge.....	N. Y. Curb				
Bingham Mines.....	Boston	8	8	8	Sept. '19, Q .25
Calumet & Arizona.....	Boston	47	45	45	Dec. '20, Q 1.00
Calumet & Hecla.....	Boston	237	225	227	June '20, Q 5.00
Canada Copper.....	N. Y. Curb			*13	
Centennial.....	Boston	9	9	9	Dec. '18, SA 1.00
Cerro de Pasco.....	New York	27	23	24	Mar. '21, Q .50
Chile Copper.....	New York	11	9	9	
Chino.....	New York	21	19	20	Sept. '20, Q .37
Columbus Rexall.....	Salt Lake	*30	*30	*30	
Con. Arizona.....	N. Y. Curb			1	Dec. '18, Q .05
Con. Copper M.....	N. Y. Curb	2	1	1	
Copper Range.....	Boston	34	31	32	Sept. '20, Q .50
Crystal Copper (new)	Boston Curb	*36	*30	*31	
Davis-Daly.....	Boston	6	5	5	Mar. '20, Q .25
East Butte.....	Boston	8	8	8	Dec. '19, A .50
First National.....	Boston Curb	*85	*75	*75	Feb. '19, SA .15
Franklin.....	Boston			2	
Gadsden Copper.....	N. Y. Curb			*25	
Granby Consol.....	New York	18	18	18	May '19, Q 1.25
Greene-Cananea.....	New York	21	18	18	Nov. '20, Q .50
Hancock.....	Boston	3	3	3	
Howe Sound.....	N. Y. Curb	2	2	2	Jan. '21, Q .05
Inspiration Consol.....	New York	33	29	30	Oct. '20, Q 1.00
Iron Cap.....	Boston Curb	6	6	6	Sept. '20, K .25
Ile Royale.....	Boston	20	20	20	Sept. '19, SA .50
Kennecott.....	New York	17	16	16	Dec. '20, Q .50
Keweenaw.....	Boston			1	
Lake Copper.....	Boston	3	2	2	
La Salle.....	Boston	2	2	2	
Magma Chief.....	N. Y. Curb			*21	
Magma Copper.....	N. Y. Curb	21	18	18	Jan. '19, Q .50
Majestic.....	Boston Curb			*10	
Mason Valley.....	Boston	1	1	1	
Mass Consolidated.....	Boston	2	1	1	Nov. '17, Q 1.00
Mayflower-Old Col.....	Boston	4	3	3	
Miami Copper.....	New York	18	16	16	Feb. '21, Q .50
Michigan.....	Boston	2	2	2	
Mohawk.....	Boston	48	45	46	Nov. '20, Q 1.00
Mother Lode (new).....	N. Y. Curb	5	5	5	
Nevada Consol.....	New York	10	9	9	Sept. '20, Q .25
New Baltic.....	Boston Curb			3	
New Cornelia.....	Boston	14	13	14	Aug. '20, K .25
Nixon Nevada.....	N. Y. Curb			*5	
North Butte.....	Boston	11	9	10	Oct. '18, Q .25
North Lake.....	Boston	*25	*25	*25	
Ohio Copper.....	N. Y. Curb			1	
Old Dominion.....	Boston	18	17	17	Dec. '18, Q 1.00
Oscoda.....	Boston	27	25	25	June '20, Q .50
Phelps Dodge.....	Open Mar.	†180			Jan. '21, Q 2.50
Quincy.....	Boston	40	38	38	Mar. '20, Q 1.00
Ray Consolidated.....	New York	12	11	11	Dec. '20, Q .25
Ray Hercules.....	Boston Curb	*50	*25	*25	
St. Mary's Min. Ld.....	Boston	30	28	30	June '20, K 2.00
Semeca Copper.....	Boston	15	12	13	
Shannon.....	Boston	1	1	1	Nov. '17, Q .25
Shattuck Arizona.....	New York	6	5	5	June '20, Q .25
South Lake.....	Boston	1	1	1	
Superior Copper.....	Boston			4	Apr. '17, 1.00
Superior & Boston.....	Boston	2	1	1	
Tenn. C. & C. cfs.....	New York	8	7	7	May '18, I 1.00
Toulumne.....	Boston	*50	*50	*50	May '13, .10
United Verde Ex.....	Boston Curb	27	24	25	Feb. '21, Q .50
Utah Consol.....	Boston	4	4	4	Sept. '18, .25
Utah Copper.....	New York	51	46	47	Dec. '20, Q 1.50
Utah M. & T.....	Boston	1	1	1	Dec. '17, .30
Victoria.....	Boston	1	1	1	
Winona.....	Boston	*50	*50	*50	
Wolverine.....	Boston	11	11	11	

Stock	Exch.	High	Low	Last	Last Div.
NICKEL-COPPER					
Internat. Nickel.....	New York	15	13	14	Mar. '19, .50
Internat. Nickel, pf.....	New York	80	80	80	Feb. '21, Q 1.50
LEAD					
National Lead.....	New York	72	70	71	Dec. '20, Q 1.50
National Lead, pf.....	New York			105	Dec. '20, Q 1.75
St. Joseph Lead.....	New York	11	11	11	Dec. '20, QX .50
Stewart Mining.....	Boston Curb			*6	Dec. '15, .05
ZINC					
Am. Z. L. & S.....	New York	8	8	8	May '20, 1.00
Am. Z. L. & S, pf.....	New York	28	26	26	Nov. '20, Q 1.50
Butte C. & Z.....	New York	5	4	4	June '18, .50
Butte & Superior.....	New York	12	10	10	Sept. '20, 1.25
Callahan Zn-Ld.....	New York	5	4	5	Dec. '20, Q .50
New Jersey Zn.....	N. Y. Curb	140	139	139	Feb. '21, Q 2.00
Success.....	N. Y. Curb	*4	*2	*4	July '16, .03
Yellow Pine.....	Los Angeles	*50	*40	*50	Sept. '20, Q .03

* Cents per share. † Bid or asked. ‡ Quotations missing. Q, Quarterly. SA, Semi-annually. BM, Bi-monthly. K, Irregular. I, Initial. X, Includes extra.

Stock	Exch.	High	Low	Last	Last Div.
GOLD					
Alaska Gold.....	New York	1	1	1	
Alaska Juneau.....	New York	1	1	1	
Carson Hill.....	N. Y. Curb			22	
Cresson Consol. G.....	N. Y. Curb	1	1	1	June '20, Q \$0.10
Dome Extension.....	Toronto	*53	*53	*53	
Dome Mines.....	New York	15	14	15	Jan. '21, Q .25
Golden Cycle.....	Colo. Sprgs.	†*66	†*64	*65	Dec. '20, Q .02
Goldfield Consol.....	N. Y. Curb	*9	*7	*8	Dec. '19, .05
Hollinger Consol.....	Toronto	6.65	6.65	6.65	Feb. '21, M .05
Homestake Mining.....	New York	50	50	50	Sept. '19, .50
Kirkland Lake.....	Toronto	*50	*49	*49	
Lake Shore.....	Toronto			1.16	Jan. '21, K .02
McIntyre-Porcupine	Toronto	1.99	1.99	1.99	Jan. '21, K .05
Porcupine Crown.....	Toronto			*21	July '17, .03
Portland.....	Colo. Sprgs.	*45	*44	*45	Oct. '20, Q .01
Reorgan. Booth.....	N. Y. Curb	*51	*4	*5	May '19, .05
Silver Pick.....	N. Y. Curb	*61	*5	*6	
Teck Hughes.....	Toronto	*10	*9	*10	
Tom Reed.....	Los Angeles	1.28	1.15	1.20	Dec. '19, .02
United Eastern.....	N. Y. Curb	2	2	2	Jan. '21, Q .15
Vindicator Consol.....	Colo. Sprgs.	†*20	†*18	*19	Jan. '20, Q .01
West Dome Consol.....	Toronto	*7	*6	*6	
White Caps Mining.....	N. Y. Curb	*10	*8	*8	
Yukon Gold.....	N. Y. Curb	1	1	1	June '18, .02

Stock	Exch.	High	Low	Last	Last Div.
SILVER					
Arizona Silver.....	Boston Curb	*17	*13	*14	Apr. '20, M .03
Batopilas Mining.....	New York	2	2	2	Dec. '07, I .12
Beaver Consol.....	Toronto	*39	*38	*38	May '20, K .03
Coniagas.....	Toronto	2.00	2.00	2.00	Nov. '20, Q .12
Crown Reserve.....	Toronto	*16	*16	*16	Jan. '17, .05
Kerr Lake.....	Boston	2	2	2	Jan. '21, Q .12
La Rose.....	Toronto	*24	*22	*23	Apr. '18, .02
McKinley-Dar-Sav.....	Toronto	6	6	6	Oct. '20, Q .03
Mining Corp. Can.....	Toronto	1.05	*95	*95	Sept. '20, Q .12
Nipissing.....	N. Y. Curb	8	7	7	Jan. '21, QX .50
Ontario Silver.....	New York	4	4	4	Jan. '19, Q .50
Ophir Silver.....	N. Y. Curb	1	1	1	Jan. '17, .10
Peterson Lake.....	Toronto	*9	*9	*9	Jan. '19, .01
Temiskaming.....	Toronto	*25	*25	*25	Jan. '20, K .04
Trethewey.....	Toronto	*16	*16	*16	Jan. '19, .05

Stock	Exch.	High	Low	Last	Last Div.
GOLD AND SILVER					
Atlanta.....	N. Y. Curb	*2	*1	*2	
Barnes-King.....	Butte	†	†	1.10	Aug. '20, Q .05
Boston & Montana.....	N. Y. Curb	*70	*64	*70	
Cashboy.....	N. Y. Curb	*8	*6	*7	
El Salvador.....	N. Y. Curb	1	1	1	
Jim Butler.....	N. Y. Curb	*16	*15	*16	Aug. '18, SA .07
Jumbo Extension.....	N. Y. Curb	*9	*7	*9	June '16, .05
Louisiana Con.....	N. Y. Curb			1	
MacNamara M. & M.....	N. Y. Curb	*15	*14	*14	May '10, .02
N. Y. Hond. Rosar.....	Open Mar.	†10	†9	†9	Jan. '21, Q .30
Tonopah-Belmont.....	N. Y. Curb	1	1	1	Jan. '21, Q .05
Tonopah-Divide.....	N. Y. Curb	1	1	1	
Tonopah-Extension.....	N. Y. Curb	1	1	1	Jan. '21, Q .05
Tonopah Mining.....	N. Y. Curb	1	1	1	Oct. '20, SA .05
West End Consol.....	N. Y. Curb	1	1	1	Dec. '19, SA .05

Stock	Exch.	High	Low	Last	Last Div.
SILVER-LEAD					
Caledonia.....	N. Y. Curb	*13	*11	*11	Jan. '21, M .01
Cardiff M. & M.....	Salt Lake	1.15	1.10	1.10	Dec. '20, .15
Chief Consolidated.....	Boston Curb	2	2	2	Feb. '21, Q .05
Consol. M. & S.....	Montreal	18	18	18	Oct. '20, Q .62
Daly Mining.....	Salt Lake			2.50	July '20, Q .10
Daly-West.....	Boston	3	2	2	Dec. '20, Q .25
Eagle & Blue Bell.....	Boston Curb			2	Dec. '20, K .25
Electric Point.....	Spokane	*7	*7	*7	May '20, SA .03
Federal M. & S.....	New York	6	5	5	Jan. '09, 1.50
Federal M. & S., pf.....	New York	25	24	24	Dec. '20, Q 1.75
Florence Silver.....	Spokane	*16	*15	*16	Apr. '19, .01
Grand Central.....	Salt Lake			*37	June '20, K .03
Hecla Mining.....	N. Y. Curb	4	3	3	Dec. '20, QX .15
Iron Blossom.....	N. Y. Curb	1	1	1	Apr. '20, Q .02
Judge M. & S.....	Salt Lake			3.00	Sept. '20, Q .12
Marsh Mines.....	N. Y. Curb	*8	*7	*8	
Prince Consol.....	N. Y. Curb	1	1	1	Nov. '17, .02
Rambler-Cariboo.....	Spokane	*7	*6	*6	Feb. '19, .01
Rex Consol.....	N. Y. Curb	*8	*7	*8	
South Hecla.....	Salt Lake	*63	*53	*53	Sept. '19, K .15
Standard Silver-Ld.....	N. Y. Curb	1	1	1	Oct. '17, .05
Tamarack-Custer.....	Spokane	1.80	1.50	1.75	Jan. '21, K .04
Tintio Standard.....	Salt Lake	3.22	3.20	3.22	June '20, Q .10
Utah Apex.....	Boston	2	2	2	Nov. '20, K .25
Wilbert Mining.....	N. Y. Curb	*4	*3	*3	Nov. '17, .01

Stock	Exch.	High	Low	Last	Last Div.
QUICKSILVER					
New Idria.....	Boston			*95	Jan. '19, .25
VANADIUM					
Vanadium Corp.....	New York	34	29	30	Jan. '21, Q 1.00

Stock	Exch.	High	Low	Last	Last Div.
ASBESTOS					
Asbestos Corp.....	Montreal	†76	73	80	Jan. '21, QX 3.50
Asbestos Corp., pf.....	Montreal	91	90	91	Jan. '21, QX 3.75

Stock	Exch.	High	Low	Last	Last Div.
MINING, SMELTING AND REFINING					
Amer. S. & Ref.....	New York	41	36	37	Dec. '20, Q 1.00
Amer. S. & Ref. pf.....	New York	79	73	74	Mar. '21, Q 1.75
Am. Sm. pf. A.....	New York	65	64	64	Jan. '21, Q 1.50

