ENGINEERING & MINING JOURNAL-PRESS

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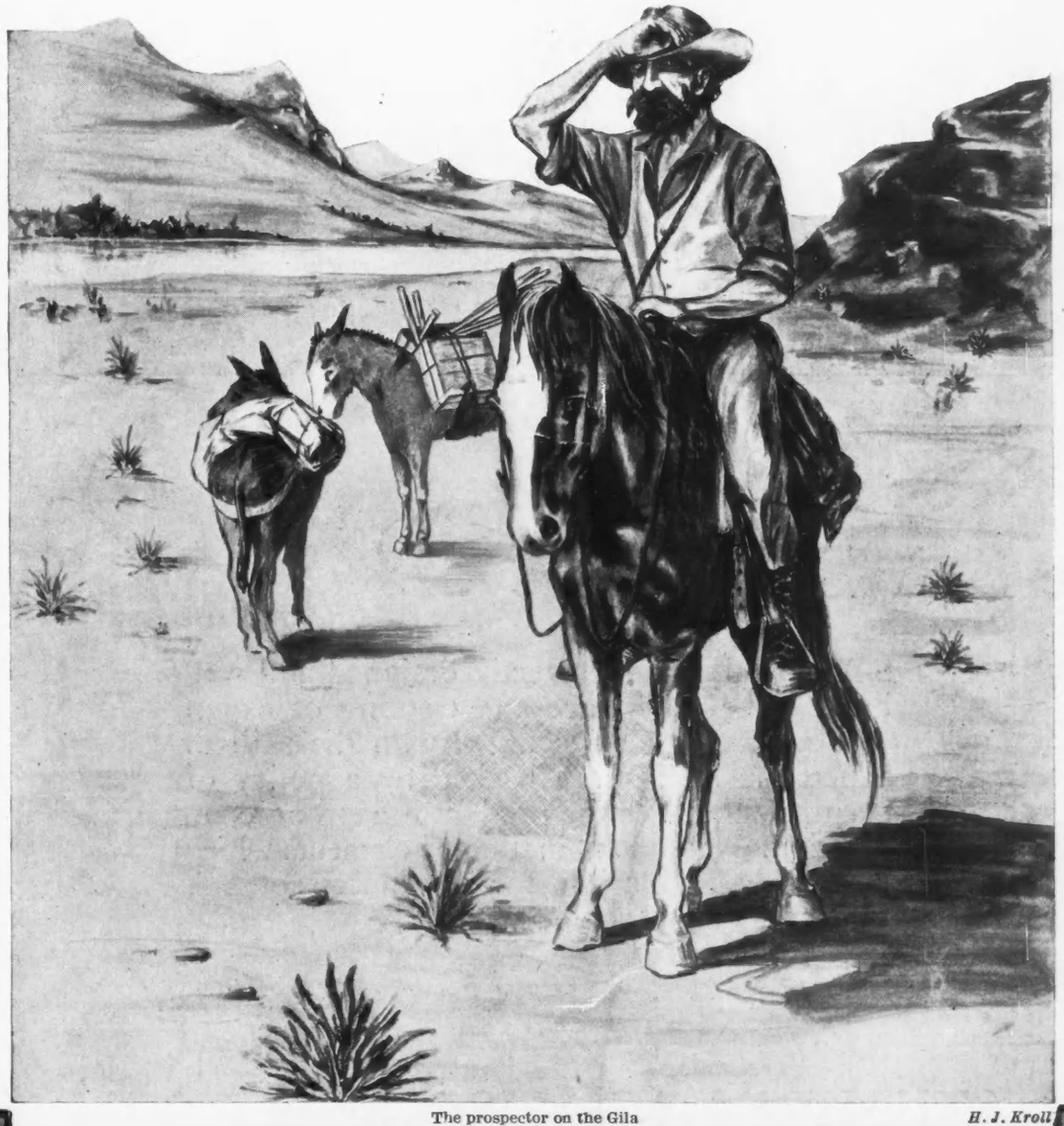

The prospector on the Gila — *H. J. Kroll*

A WEEKLY JOURNAL REPRESENTING THE WORLD'S MINING AND METAL INDUSTRIES

February 3, 1923

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JOSIAH EDWARD SPURR, Editor

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Fifty Years Ago

A GLANCE at the mining industry of fifty years ago as reflected in the pages of the *Engineering and Mining Journal* of 1873 shows various things of interest. Conscious of our present-day advance, we are apt to feel superior as we read these records of an earlier day, and occasionally we may condescend to be amused. But the times were virile; much was being done to improve machinery and methods, and crudities then were but the natural steps in the path of evolution to present-day refinements.

At that, the time was not so crude. The news reads often strikingly like that of today. Indeed, in places it is curiously parallel. The Civil War was eight years past; the need of a new mining law was agitated; there were strikes in Germany, England, and at home, and the workman was showing a desire to improve himself that no doubt was considered radical. Sargent's mining law bill passed the House Jan. 23, 1872, its purpose being to give owners of claims a fee simple of the surface, to secure description of claims, to regulate tenure of possessory title by requiring a certain amount of assessment work annually, and to simplify and cheapen the process of obtaining a patent.

Prospecting was active, but "little indicative of recent progress or good omen from Arizona" was reported. Many new and promising deposits of lead-silver ore were found in 1872, chiefly in eastern Nevada and in central Utah. Gold placers of limited extent were found in Oregon, Idaho, and Montana, those on the Rogue River paying "remarkably well." Everywhere one reads there were accounts of quartz lodes found and other minerals, especially cinnabar, which was being successfully sought on the coast range.

The year 1872 was reviewed as one of preparation and schooling. Much was done in promoting a more systematic exploitation of mines, and much practical information was gained as to formations and vein systems and as to the best methods for mining and treating ores. Invention was rife, and encouragement was given to every process or device promising a labor saving or greater efficiency. There were improved screens, the chronicles state, stamps and batteries, gears, pumps and nozzles, patent drilling machines, furnaces and amalgamators, concentrators for saving sulphides and new methods for their chlorination. There were improved tramways, more efficient plans of ventilating mines, valuable improvements to the safety cage, and a new means for laying "the nitrous fumes of giant powder," as well as other beneficent schemes for insuring "health, life and limb of underground employees." Many new mills and smelters were built, though some others were burned. Improvements in roasting had helped to treat intractable ores with less trouble and many refractory ores were being made to yield up to 80 per cent of the pulp assay.

As a result of these improvements and the advent of railroad transportation, lower-grade ores were being worked, it is said, without reducing wages. In California, gold ores running $8 to $10 per ton were being profitably treated and hydraulic washing of auriferous gravels yielding 5c. per cubic yard was under way.

Fifty years ago the A.I.M.E. was an infant, the *Engineering and Mining Journal* its father and likewise its official organ. Of members it boasted 167 in January, 1873, of whom sixty-five were associates. The *Journal's* readers were increasing rapidly. "Buy a copy; read the Department of Popular Science; see the general excellence of the paper and send your subscription to Willard P. Ward, manager, 37 Park Row."

Our advertising varied pleasingly then, the Columbia School of Mines rubbing elbows with the Tobacco Manufacturers' Association, the latter announcing a change of address. H. R. Worthington, of 59 Beekman St., New York, was turning out pumps and other engines at his manufactory in Brooklyn, and Cooper Hewitt & Co. was making bar iron, Cooper's glue and gelatine, and other things at 17 Burling Slip, this city.

Rothwell, then editor, and his staff had completed his "great map of the Wyoming and Lackawanna coal fields —a new mine of information opened in the coal regions," which was offered to companies and others at the modest price of $100 per copy. H. Sontag, of St. Louis, advertised boring apparatus that would drill shafts "1 to 18 ft. in diameter from 200 to 1,500 ft. deep in solid rock under water." Of Blake's crusher it was said: "The office of this machine is to break ores and minerals of every kind into small fragments preparatory to their further comminution by other machinery." An interesting society note was that of a lecture on Dec. 11, 1872, on the sinking of a proposed shaft at the Calcasieu sulphur mine in Louisiana.

Between then and now there was little that was essentially different. Today we make a better display and have a greater mass of detail at our command. Following the same path of industrial evolution and as rapidly, from what advanced position fifty years hence shall we look back to the present day!

China as a Mining Country

THE MINERAL RESOURCES of China are relatively well known and never were extensive, in the opinion of many American, European and Chinese engineers who have investigated this problem. The per-capita production of mineral wealth in the United States is 240 times that of China, a fact which has led to the belief that the great area of the latter was promising for development. But Mr. Chang Yu Wang, in a recent paper on the subject, is not of this opinion. Coal, as is well known, constitutes China's greatest mineral asset, and does occur in large quantities; but the supplies of iron ore are insufficient for a well-balanced and low-cost steel industry. The per-capita consumption of coal in the United States is eighty-seven times that of China.

Among the metallic ores, tin ore is important, worked

from alluvial deposits; antimony constitutes one of China's best-known products; and tungsten has been largely exported, especially to the United States. On the other hand, there are few important mines of lead, zinc, silver, copper, and gold. Gold is scarce, and of alluvial character; copper deposits are numerous, but not of any magnitude. The largest lead and silver mine in China—the Shui Kou Shan, in Hunan province—is connected with a syenite intrusion into limestone. The Chinese production of mercury has been important; and there are minor deposits of various other metals, and of the non-metallic minerals.

Mr. Wang points out, as a reason for the scarcity of important mineral deposits in China, that throughout most of the country the strata are nearly horizontal and have not been upheaved; that aside from granite and quartz porphyry there are relatively few igneous rocks, and of few varieties. The most favorable area is held to be a stretch of 40,000 square miles on the western border of the province of Szechuen, where many lodes occur in a geologically much disturbed country. Nevertheless, in general it is believed that the future of China depends upon agriculture and industrial development rather than on important mineral industries.

Two's Company, Three's a Crowd, in the Nickel Industry

THE MARKED SLUMP in the price of nickel, as mentioned in the market pages of our Jan. 27 issue, is noteworthy in view of the advances made by practically every other metal. The violent competition that has brought the price to its present unusually low level was not unexpected, however, and, in a way, was predicted in one of our editorials last fall. The condition is an interesting one for several reasons.

Before the World War the nickel market was always what the market reporter would call quiet. The International Nickel Co. produced about 60 per cent of the world's supply from ores mined and smelted in the Sudbury district of Ontario, and the Mond Nickel Co., operating a neighboring plant, about 20 per cent. The other 20 per cent was scattered between Norway, New Caledonia, and countries in which the metal was a by-product. The International company had practically a monopoly in this country, and the Mond company did not seem to be troubled much in Europe, though a part of the International product was also sold abroad. During the war, producers had all they could do to meet the demand; the International's smelting and refining facilities were greatly enlarged, and a new Ontario producer, the British America, entered the field. Owing to an ill-advised delay in curtailing operations at the end of the war, a surplus was soon piled up, as was also true with copper. Copper is, by the way, associated with the nickel in the ore, and therefore a good copper market adds materially to the prosperity of the nickel producers.

With the demand for nickel for armament purposes practically non-existent, large stocks on hand, and general business conditions dull, all of the producers began a campaign to extend their outlets. Both the Mond and British America companies opened sales offices in this country and began competing for American business. For a time the market was so dull that the International seemed to feel that little more nickel could be sold even were prices reduced to a considerable degree. But in the last month or two, business has been better, and the International was apparently startled into action by some desirable contracts with old customers going to competitors. Then prices began to drop until now they are 10c. a lb. below pre-war levels of 35 to 40c.

It is probable that this competition will be a good thing all around for both consumers and producers; that is, except for those producers who may be obliged to cease operations owing to high costs. Though costs of production are probably not quite down to pre-war levels, it is certain that marked economies in overhead and in certain phases of plant operation have been secured. Furthermore, more research is being done to extend the uses of nickel, and the nickel-copper alloy, monel metal.

A particularly attractive development is that of malleable sheet nickel. All three of the Ontario producers are working on this. The use of nickel steel in automobiles has been extended, and the use of nickel steel for structural purposes is being given attention. A big stumbling block in its application for structural work is the fact that, owing to the increased strength of nickel steel, much less will be required, and the steel companies are averse to making it on that account. One of the nickel companies is developing a cheap nickel-plating process which is expected to make nickel-plated sheets almost as cheap as ordinary black sheets and which should have wide application in the automobile and other industries where the increased durability, both of the metal and the painted or enameled finish, will be an attractive feature.

Kitchen utensils of nickel may come to be important competitors of those made of aluminum. The use of monel metal has not been altogether satisfactory for this purpose. The manufacture of nickel tubes and sheets is being improved greatly, and their uses are being extended. This only gives an idea of the large amount of work that is being done by all producers.

Will these new developments increase the demand sufficiently to absorb all of the latent production, or will one or more producers be forced out? That is the question. Present consumption is only about two-fifths of smelter capacity. If the weaker companies cannot stand the gaff of low-price competition, some readjustment of conditions among the producers may be expected. An amalgamation of the International and British America is not beyond the realms of possibility. The International has high-grade ore, cheap hydro-electric power, smelter capacity of around 40,000 tons of nickel a year, but refining capacity, according to last reports, of only about 8,000 tons, owing to the Bayonne, N. J., refinery having been abandoned. The Port Colborne refinery, however, could easily be enlarged. The British America has low-grade ore, high-cost power at the smelter, but a modern and probably more efficient refining process than the International. It would seem that the British America's Deschenes refinery would fit in well with the International's string of plants.

Dating the Past

MAN-MADE CALENDARS do not take us very far back, so that in our investigations of the even fairly remote past we have to study nature's records. A few of these are annual records, marking the years just as the human record does. The annual rings of trees afford a well-known one, though even

this is not as significant to the layman as it should be. By this we may prove the age of the redwoods of California as far antedating the Christian era or even of having sprouted when Pharaoh was a kid.

A Swedish geologist—Baron De Geer, a specialist in glaciology—has recently studied and applied a similar annual record, consisting of annual layers of clay deposited in fresh-water lakes which formed at the front of the great glaciers of the Ice Age. One of his pupils, Dr. Antevsahas, applied the criterion to the American glacial problem—and he is able to tell us, for example, that it took 4,000 years for the front of the great American continental glacier to retreat from Hartford, Conn., to St. Johnsbury, Vt.! Thus, science shall triumph more and more over the inertness of nature. A clew to a mystery more astonishing than those of Jules Verne or Sherlock Holmes lies ready for the scientist detective, in every clod and pebble.

Mono Lake in the Limelight

MONO LAKE occupies a saucer-like shelf projecting from the foot of the scarp of the Sierras and surrounded by mountains of lesser magnitude interrupted by broad sweeping plains on the east and south. A group of worn-out volcanic cones backgrounds the southern vista. On to the east are the brown-tinted ranges that fade into distant Nevada. Riotous mountain streams plunge down through the steep gorges of the Sierran wall and more soberly wend their way between lateral moraines of ancient vintage and out to the lake. The lake itself is almost circular. Several islands intrude its broad sweep of color that varies in tint from daylight to dark.

The lake is without outlet. Evaporation maintains the level between narrow limits. Alkaline salts, the accumulation of many centuries, render its waters undrinkable and unusable for most purposes. The scanty population in the neighborhood derives a livelihood by grazing stock on the meadow grasses and by raising alfalfa in the few fields near the lake. During the summer, gasoline, smoking tobacco, ice cream, and other necessities are supplied to the tourists who roam through the region. In Lundy Canyon and at Bodie, mining was once an important activity, but all the miners are either dead or have gone to other districts save for a few old-timers. The region is one of scenic splendor, but apparently holds little to attract either the home-seeker or the industrialist. It is a sleepy hollow, but well worth a trip through it in the summer.

How little we really know. Who would have even dreamed it? If the information we have just received is true the old miners who are permanently ensconced in the region will turn in their graves and chuckle. More, their ghosts will dance and sing and laugh at the simplicity and ignorance of mankind in general. We even venture to predict, if the information is true, we repeat, that Mono Lake will be the next great gold discovery. It will be the Mecca of the modern Argonauts. Villages will spring up. The glamor and the romance of rich gold camps will be repeated. Once more the mining industry will come into its own, and hungry promoters will desert their petroleum friends and hurl their toy derricks into oblivion. Panoramic pictures will reveal the scenic glories of the region to the get-rich-quick denizens of the cities. Bankers will sit up and rub their eyes and gasp. Desert Bill will slap his knee and say—I always knew that this was so. Mining engineers will make themselves as inconspicuous as possible out of shame that they have had another one put over on them. The citizens of the region will look upon Mono Lake more as a bank than as a liability.

Mono Lake, according to a prospectus which is typewritten and more or less privately circulated by the Universal Metals Recovery Syndicate, contains 5,000,000,000 tons of water. The details of length, breadth, and depth we will pass over, and we will accept the tonnage, although the prospectus states that the U. S. Geological Survey inventories the water of the lake at only 4,000,000,000 tons. Says the prospectus: "Assuming that it (the water in the lake) has an assay value of only 40c. per ton, one can readily see that the total amount of gold in the water is tremendous." It would be indeed, about $2,000,000,000 in all, if we have calculated correctly. There you have it. There is no sampling difficulty. Just tie a dead soldier on a string, row out into the lake, and lower it down and draw it up, and you have your sample. There is no necessity for mill runs or grooving or even grab sampling. Continuity is proved. The water is in sight. The situation is unprecedented in the annals of mining.

The prospectus continues: "The question of allowing the water from which the gold has been extracted to return to the lake will come to mind—in answer, attention is called to the fact that the laws of diffusion take care of this. What might be termed the 'tailings' are returned to the lake at a point not closer than 300 ft. from the 'intake,' and were it not for the decided currents and the surf in the lake the comparatively small amount returned would be as nothing. Prof. Parker has estimated that the law of diffusion would allow of the operation of 100 plants each taking out $1,000,000 a year and would require 50 years to weaken the water 10 per cent. . . . Mono Lake may be likened to an immense placer claim that has been prospected and covered with test pits to bedrock and found to contain placer gold in sufficient quantities to recover 65c. per yard." There is an obvious discrepancy between the assumed $2,000,000,000 content and the $5,000,000,000 product of the 100 plants.

As we understand the language, it is proposed to work the lake by a system of gradual impoverishment in which an electrochemical process is to be used. Prof. Herschel C. Parker is stated to be the discoverer of the process. Respecting ownership of this vast property, the prospectus states: "The waters of Mono Lake are under the control of the State of California and permits to extract metals and minerals from this lake can be secured and at no expense. No royalties are charged, no limit as to the amount of water treated and the permits run for a period of 15 years and are renewable for like periods." California is a generous state. The only fly in the promoter's dream appears to be the income tax and the corporation taxes of the state, neither of which were considered in the prospectus.

We do not know whether there is any gold in Mono Lake or not. We are as breathless as our readers in our repressed desire to get at the facts. However, we have not signed on the line, nor are we going to lose any sleep in building air castles with the imaginary gold of the lake. We hope that it is all true, but we are a little dubious. The prospectus is distinctly misleading, and the good intent of the projectors of it is open to serious question.

Alfred de Ropp: Metallurgist

By T. A. Rickard

ON ANOTHER PAGE we publish an interview with Alfred de Ropp, a Russian nobleman of whom it may be said that he got the best of the rabble, for his invention of the traveling rabble operated by a cable was the mechanical basis of a successful roasting-furnace. Indeed the Baron devised a method for cooling the rabble, which otherwise is easily overheated by the gases of combustion, even as the proletariat is heated by the fumes of soap-box oratory. He himself is always full of fun, so this introduction to a distinguished American metallurgist is not inappropriate. It is true he is not a citizen of the United States, but his career as a metallurgist has been spent in this country and his technical contributions to American progress in the metallurgic art have won for him the territorial designation that I venture to use. In any event he has given to the United States several fine native-born citizens. The two sons are over six feet—to be exact, 6 ft. 3 in., and 6 ft. 4½ in. He himself is 6 feet tall. His youngest brother was 6 ft. 6, and the shortest of the seven brothers was 5 ft. 10. They come of a tall stock—with no tendency to stoutness. He tells how he did not hesitate to claim the Belgian Jesuit at Los Angeles as a kinsman when he noted that he had the family nose—Roman—and the family figure—tall and spare, "no *embonpoint*". His daughter is the wife of Eric Fisher Wood, the author of 'The Notebook of An American Attaché', who rose to the rank of Lieutenant-Colonel during the War and is now an architect at Pittsburgh. It will be noted that the Baron answered the interviewer's questions frankly and fearlessly. That is characteristic. He comes of a family that traces its ancestry to the brother of the first bishop of Riga, now the capital of Latvia. His ancestor was one of the Knights of the Sword, who appear to have been lively gentlemen. He seems to have inherited some of their belligerent temperament. As a child he lived under feudal conditions and amid an environment strangely unlike, for example, Santa Barbara, California, where he resides now. A baronial hall and flocks of dependents constitute an old-world setting entirely unlike the mining towns and smelting centres in which he has passed his professional life. The social system to which he was born was beginning to disintegrate before his schooling was finished, and like others of his class he had to look around for a living and a career. He found them in the United States, thanks to an acquaintance made at Freiberg. In consequence of this he obtained an engagement at Pueblo, in Colorado, at a time when that town was an important and progressive smelting centre. At the smelter he came in contact with a number of men now honorably prominent as metallurgists, including Messrs. E. P. Mathewson and Arthur S. Dwight. To his early association with H. H. Schlapp, an American-born metallurgist, who became identified with the best practice at Broken Hill, he owed much—and he is quick to acknowledge the fact, as likewise, later in the interview, he refers in warm terms to the help and friendship of E. N. Engelhardt, with whom he was closely associated at the Selby smelter. It was at that plant that he won his reputation, and it was his success as a manager there that enabled him to speculate profitably in the shares of the company that owned the smelter. He was at Selby for seven years, and during that period brought the enterprise from failure and disrepute to profit and reputation. The furnace that he invented has been mentioned already; it was a clever device by which one of the chief difficulties in roasting was overcome; but his technical ingenuity would not have sufficed to save the Selby smelter from financial disaster; to do that he brought to bear a mind keenly alive to the essentials of good business and a personality that won the devoted loyalty of his staff—in return for the loyalty he gave to them. A lively sense of humor and a fondness for honest fun have marked him always; this characteristic has found expression in speech that is not according to the Boston standard; he has never completely conquered the English language and still finds scope for his descriptive powers in the use of words and phrases not yet sanctioned by the dictionary. He writes the language of America with greater facility and correctness than he speaks it, because he learned it from books—all except the decorative part, which he has acquired by residence in the West. His brother-in-law, Mr. Harry H. Webb, when they were working together for the Gold Fields people, would ask him how to spell this or that word. One day he launched a jocular remark at his colleague: "It's a damned shame you can't spell your mother tongue". To which Mr. Webb replied: "Yes; but you learned spelling by the eye, and I learned it by the ear". He learned many other things "by the eye", for he has the keen powers of observation that belong to a scientific man. Just now he is using them at Honolulu, whither he has gone for a change. Men of his type enrich the American melting-pot, even if they refuse to melt; they pass into the bullion, not the slag. The American nation gains by the addition of such men, who do their work skilfully and give the country children and grandchildren of the best type.

Alfred de Ropp

DISCUSSION

Trouble in the Melting Pot

THE EDITOR:

Sir—As a prospector I am naturally interested in the subject of ore deposition and occurrence. I like sound theoretical articles that are based on observed facts; these help to extend our knowledge. The editorial on the "Origin of Nitrate Deposits" is an example of what I mean. One of the most valuable in the curious collection of books on my "Two-Foot Book Shelf" is the "Data of Geochemistry," published by the U. S. Government, which only cost me six bits. This book, as you know, contains summaries of the different theories on the origin of mineral deposits. In reading this book one cannot help but be impressed with the infinite amount of work and patience and wide knowledge required in the compiling of it; and one wonders how the government can retain such men in its service, considering the meager pay that the politicians dole out to them. One gets the impression that they would rather starve a scientist than lose a voter.

I wish to relate to you an incident that happened to me recently, as it has a bearing on a recent editorial in the *Journal-Press* on immigration: I was coming into Ketchikan a few days ago. I had made quite a long run that day and was tired, so I thought I would run into a near-by bay and lie for the night, and come on into Ketchikan in the morning, which was only two or three miles, which I did. As I was anchoring the boat an elderly man came along in a row boat. He asked me where I had come from. I told him. Although he spoke good English, I noted that he was some kind of a foreigner. As it was late in the evening, I inquired if he lived around there. He said, "Yes; I have taken up a homestead here on this island (Gravina Island). My son has one farther up; I live with him." Then he asked almost abruptly, "What countryman are you?" I told him that I was an American. He laughed, and said, "I know, we are all Americans, but what country do you come from?" "Why," I said, "I come from the United States." He appeared to be incredulous. The next day as I was standing on a certain street corner in Ketchikan talking to an acquaintance, I happened to note the people who were passing; there within the space of a few minutes, this is what I saw: A Japanese, a Chinaman, a negro, an Hawaiian Islander, a Filipino, a Mexican, a Chileno, a Russian, a Greek, and an Italian. I remarked this to the man I was talking to, an old-timer, and inquired if there were any Hindus here. He said, "No, there's no Hindus, but there's some Turks." Some of these have interbred with the natives. The result is "Americans." It is no wonder the old man laughed. I know that labor unions are necessary, but the way I have seen unionism work out around some of these big mines has always made me feel antagonistic toward them; but if it is the labor unions that stand between us and more floods of these unassimilable aliens, I am for them, no matter what their motives may be.

Mining is dormant here just now. Editors and publishers of these high-grade technical journals are no doubt aware that it is only the relatively few that read them, and all the more credit is due them on that account. In the diminishing number of all classes of publications, which we witness today, I do not see any cause for regret. I think that it is a good thing. It is only one phase of a process that is going on all around us. We see the large crystal growing at the expense of the smaller one; the large system at the expense of the smaller systems, and for the same reason; the larger one contains more energy for a given volume and is therefore more stable. This must be the working out of universal law. Our Senators and Representatives at Washington evidently think that they can repeal this law; but so far they have not succeeded in doing it.

Ketchikan, Alaska. J. M. DODGE.

Sampling Spotty Gold Ores

THE EDITOR:

Sir—The following is a discussion of the article "Sampling Spotty Gold Ores" by Charles D. Demond and A. C. Halferdahl, in the *Journal-Press* of Nov. 25, 1922:

All experience in sampling contributes to the sum of our knowledge of the art. Too much cannot be known. The possible accuracies, the difficulties, and the dangers of error, all are elements of the undefined judgment that guides in sampling. There is, however, so much to be known, and so much that is known, in regard to sampling, that we feel the urgency of having efforts directed to ends that are most important. Experience with any particular ore fails in the highest usefulness unless the principles bear extension in application. The experimental results that are obtained in sampling the ore described in this paper will be useful in continuing the sampling of the same ore, if that be required, provided the ore remains true to form. When, however, anybody undertakes to apply this information to other ores that are "spotty," in varying degree, the case is different. Nothing is found here that seems to justify disturbing public tranquillity with this private matter.

Because each publication is an example for another, it is perhaps necessary to indicate two objections that appear in connection with this paper. The trifling quality necessary to elevate it from a description of the passing moment to an item of permanent use in fundamental understanding would require obviating these. There is no exact significance in the designation of "spotty" as descriptive of ore; and the formula upon which the calculations are based departs from current practice without justification and introduces confusion to no purpose. Engineering practice must revere work done before, and show wherein it is deficient or defective before superimposing upon it substitute material.

Most engineers, in their general reading, while committing a fault that they would condemn in others, skim from the current of passing scientific literature the substance of basic understanding upon which they rely.

Everyone knows that principles should be first established from the older and proved sources, and be the background against which new ideas stand and bear comparison. And so there is a responsibility to discriminate here between that which should contribute toward the upbuilding of the structure of proved knowledge and that which only breaks from accepted commonplaces. One of the items in the study of sampling, in years past, was a publication of D. W. Brunton.[1] The paper had faults, was long, involved, and difficult to understand. Yet it filled a place that had not been occupied before, and it has not been replaced by anything that has been done since. It set forth principles that were correct. It by-passed the mathematical exposition of probability, but employed a mechanical equivalent that reached the same end. It was complex only because the necessary items in the reasoning of sampling are many. It will last in its influence because it was sound, and because many of our best-trained engineers have based their practice upon the principles that it contained. An abstract of the paper of Brunton would be of service. A revision, possibly an abbreviation, a development and an adaptation of it to include all latest facts, would be a subject worthy of attention. It is a task for someone who desires to teach, but it would not be desirable to expand the simple ideas of Brunton's paper into mathematical exercises for beginners in engineering. A simple treatment of the substance of that paper would help us now. It contains information that should be before us all, and information of which some of us are deprived. Any new work, now, should be presented with some reference or relation to it.

Before we accept a substitute for Brunton's formula of relationships, we must see at least something that is found wanting and something that may be gained thereby. In the judgment of all practice, the cube of the dimension is taken as the indicator of the solid state. When modified by a suitable coefficient, the dimension raised to this third power is expressive of volume. Similarly, the square of the diameter is understood to be a function representing surface. No one can favor any mongrel condition of dimension that, taken seriously, is presumed to represent material substance otherwise. In the formula of Demond and Halferdahl, the exponent of the diameter of the particles of ore is made an independent variable, differing from the number three. In permitting this, we disturb the fundamental conception of a necessary relation that exists in material substance.

Any variable or constant which is to be used in representing these masses of ore in terms of diameter or screen dimensions belongs in the formula of a coefficient, not as an index. It was in such form that Brunton had it. The exponent is constant, and has the value 3. The representation of size, or volume, whatever the shape of particles, can be only by the third power of the dimension into a coefficient of shape. Any intermediate size of particles is a function of the cube of the intermediate diameter or significant dimension. The making of an exponent a variable factor, without finding that anything varies directly in terms of such a power, should suggest to us that we are dealing with something out of its true place. It seems like confining a bird that is meant to fly in a cage where we do not want it to fly. Such a variable, of course, should go in the coefficient, where it is expected to function in a direct way. So far as we make this exponential variable a true variable, and allow it to vary, we can do nothing with it, nor with our formula, except to assign values to it and hope that variation will not occur.

For these reasons I feel that this contribution lacks value that it should contain because it is not put in terms of usage that is standard. Had the authors turned to the earlier formula it would have suggested to them the fact that there were remaining judgments, moreover, to be made upon an ore, which they were omitting. It would have indicated that we are unable to judge the value of the richest minerals or the proportions from the data or description. We have, then, no systematic basis for passing judgment upon the ore as a member of any class of ores. The term "spotty" does not describe the ore.

When in sampling this ore we look to see what it is upon which we may be content, in having done the sampling well, we are dismayed to find that we do not know whether it was that our work was good or merely that the ore was favorable. There was a quality that Brunton would have handled, in his formula, that is not contained here. Until that is defined, there is no relation evident between this ore and any other to give basis for scientific judgment. Thus the interest is limited to the special case, and though the circumstance may appear perhaps as a record-breaker in the total of experience, or perhaps as a small item among many others, yet it is, in any event, only an unimportant item, deprived of the substance to make it of use to us.

Cambridge, Mass. ERNEST A. HERSAM.

[1] "The Theory and Practice of Ore Sampling," (1895). *Trans.* A.I.M.E., Vol. 25, p. 826.

Wanted: A Metallurgical Handbook

THE EDITOR:

Sir—This is not an appeal for a New Year's gift, but simply a suggestion—old perhaps, yet a reminder to publishers—that metallurgists have no real handbook like other professional engineers have. The recent appearance of a handbook on chemical engineering reminded me that metallurgists have been neglected. So too have chemists. By handbook I mean a volume of standard (6 by 9 in. or less) size, preferably bound in flexible cover, printed on say up to 2,000 pages of India or other thin paper, and written or compiled by a number of authorities—each his particular subject—and published under the name of the editor-in-chief.

Judging by the number of handbooks being published, which indicates popularity, the tendency is to concentrate a whole subject into handy compass, employing many engineers to do this. Of course, a handbook at best can only be considered as an authoritative and abbreviated reference work, yet of great practical value, but it constitutes the backbone of many an engineer's library. An important feature of such works is that nearly all contain good bibliographies, so that if more detail reference is required, the engineer can procure copies of articles or of complete textbooks. In the accompanying table I have tried to arrange a number of excellent handbooks and pocketbooks so as to show their scope, and think that one along these lines could be prepared for metallurgists; also one for chemists.

To this list might be added Weed's "Mines Handbook" and Skinner's "Mining Manual," which, although compilations, are really handbooks; and perhaps Fay's "Glossary of Mining Terms," compiled from 120 authorities. The "Mineral Industry" is an annual, but it con-

tains cumulative data. The "Practice of Medicine" is, of course, too big, but being on the loose-leaf system, a volume suitable for engineers may be made up from the others. I haven't held closely to the handbook in this table, such works as Liddell's, Bacon and Hamor, and Glazebrook having more than one volume and being bound in stiff cover, yet they indicate the handbook idea. Thorpe's "Dictionary of Applied Chemistry" and Watt's "Dictionary of Chemistry" are also more or less of the character of handbooks. In German there are many works written by a number of authorities, Biedermann's "Chemiker Kalender," Winklemann's "Handbuch der Physik," and Doelter's "Handbuch der Mineralchemie," for example; but all engineers cannot read German.

In conclusion, it is to be hoped that a "Metallurgical engineer's Handbook," covering all metals and processes, will be forthcoming from one of our publishing houses at a not far-distant date.

Pittsburgh, Pa. M. W. VON BERNEWITZ.

Technical Engineering Handbooks

Title	Editor-in-Chief	Publisher and Place
Van Nostrand's Chemical Annual	Olsen	D. Van Nostrand Co., New York
Gas Chemists' Handbook	.....	American Gas Association, New York
Chemists' Year Book	Atack	Sherratt & Hughes, London
Metallurigists and Chemists' Handbook	Liddell	McGraw-Hill Book Co., New York
Coal Catalog	Zern	Keystone Cons. Pub. Co., Pittsburgh
Coal Miners' Pocketbook	.....	McGraw-Hill Book Co., New York
Handbook for Electrical Engineers	Pender	John Wiley & Sons, New York
Electrical Engineers' Pocketbook	Foster	D. Van Nostrand Co., New York
Handbook of Cost Data	Gillette	McGraw-Hill Book Co., New York
Mechanical Engineers' Handbook	Marks	McGraw-Hill Book Co., New York
American Civil Engineers' Handbook	Merriman	John Wiley& Sons, New York
Civil Engineers' Pocketbook	Trautwine	Trautwine Co., Philadelphia
American Fuels	Bacon & Hamor	McGraw-Hill Book Co., New York
Ore Deposits	Emmons	A.I.M.E., New York
Engineers' Pocketbook	Kent	John Wiley & Sons, New York
Practice of Medicine	Tice	W. F. Prior Co., Hagerstown, Md.

Metullurgy Not Covered

Mineral Industry	Roush	McGraw-Hill Book Co., New York
Mining Engineers' Handbook	Peele	John Wiley & Sons, New York
Handbook of the Petroleum Industry	Day	JohnWiley & Sons,New York
Handbook of Petroleum, Asphalt and Gas	Cross	Kansas City (Mo.) Testing Laboratory
Dictionary of Applied Physics	Glazebrook	Macmillan & Co., London
Architects & Builders' Pocketbook	Kidder	John Wiley & Sons, New York

Better Facilities for Mineral Determination Wanted

THE EDITOR:

Sir—Why not a reliable spot determination bureau for minerals, for a suitable small fee? A mineral determination, in the hands of one fairly well trained with microscope, specific gravity apparatus, and complementary laboratory equipment, is but the matter of a few minutes. It is hardly worth while having a quantitative copper determination made on a specimen that shows no visible copper minerals or in which copper is not evident by a simple qualitative test. Radium may be indicated in a two-minute test. "White rock" that an assayer would not give attention to unless paid specifically for a lead or zinc test might be valuable. The character of most valuable ores, except gold, silver, platinum, or palladium, may be determined by a good mineralogist in a few minutes.

In this state, and I presume in other states, an unknown sent to the state mining department falls in the hands of one who makes an eye examination, and hastily reports, quite often inaccurately. The state and government bureaus do not identify mineral specimens unless they are unusual—in which case the samples often wait several months for analysis.

Such men as Mr. Peck, at Ann Arbor; E. T. Wherry, at the Bureau of Chemistry, or Mr. Gordon, at the Philadelphia Academy of Sciences, could identify 100 specimens a day, of the average submission, and recommend quantitative tests by assayers for final results. If the state, or government, or chambers of commerce, would employ men of this caliber—with proper equipment—to give spot answers to inquiries across the counter, prospecting would be encouraged and assayers' work speeded up. HOMER T. DARLINGTON.

Denver, Colo.

Mining on the Bolshevik Plan

THE EDITOR:

Sir—Your editorial comment in your issue of Dec. 30 on Arthur Brisbane's idea of burning hydrogen from the air, amused me, as did your criticism under the head of "Mining on the Bolshevik Plan" that appeared in the issue of the previous week. Both ideas have the common ground of all erroneous ones—namely, reasoning from insufficient facts. Believing that we cannot long ignore the facts of life, since they have an unpleasant way of compelling recognition, I have penned these lines, notwithstanding their most probable fate—their immediate discard into the editorial waste basket.

One of the most misunderstood forces that modern life presents—one of our own children; of our own "bone and flesh" (illegitimate if you prefer)—is the Bolshevik movement. There are many reasons for this, chief among which are the deductions from the appar-

ent, which, like so much other social phenomena, is quite often the opposite to the real; and our almost total inability to apply the inductive evolutionary interpretation by which alone true ideas of social movements are possible. This explains the origin of world errors which have impeded man in his struggle out of the jungle toward civilization. Current ideas on Bolshevism fall in the category of world errors. Now, it would create editorial surprise, if not anger, to be told that the mission of the *Journal-Press* and the Bolsheviki are identical. But it is true, since both strive for a maximum of production with a minimum of effort, the *Journal-Press* in relation to mineral products, the Bolsheviki in relation to everything. But what you gentlemen, who stand high in the world of mining, fail to see—thanks to the reasons mentioned—is that a social "system" that produces for profit and not for use, is, like all natural things, self-destructive. It must be adjusted so that it will be in keeping with the needs of the people, and we must stop trying to make the people fit into the system, else we shall all be whelmed in social ruin. As the system develops, the needs and desires of the people mount, but the possibility for their satisfaction diminishes even more rapidly than the super-institution becomes top-heavy. It is this ever-widening chasm between social desire and satisfaction that causes all our social ills; the World War, and the one that will be much greater than the World War, which seems destined to take place soon.

You seem quite pleased with the Associated Press dispatches concerning two of the disillusioned former members of the Kuzbas Industrial Colony who arrived in Riga from Kuzbas where "they found neither profits to share, decent food, or housing better than a tent." All this, we are told, is as you warned your readers in your issue of April 22, 1922.

This organization has great problems to solve, it is true, and no doubt many more men will join the "white feathers." However, in spite of the hardships, only twenty out of about 350 colonists have left. One of the chief difficulties of the organization is the getting of technical skill. Only those having fundamental ideas of society will support such an organization, and they are few.

To be an expert in production almost precludes such ideas. Technical men of the most efficient kind almost invariably identify themselves with the forces tending to perpetuate the things that are, and become negative forces of those tendencies striving to be. It is another of those many examples of progress defeating progress, showing that the Universe is planless. So if "Mining on the Bolshevik Plan" fails by virtue of this lack of skill, it will be more of a reflection on the understanding of technicians than on the plan.

That "the Radicals have wrecked Russia and brought it to the depths of misery through attempting to put into effect their ideals" is as false as it is apparent—to superficial observation. The general backwardness of the productive forces, the rottenness of the Czarist regime, the inhuman blockade of foodstuffs and materials needed for economic rehabilitation, the effects of the great war "for Democracy," the financing and assisting in every way possible of counter-revolutionary plots, causing years of civil war; the famine—all these factors are ignored by you, no doubt, because you charge the Bolsheviki as responsible for many of them.

"Prosperity, if it returns will do so because their methods are being ditched." If it "returns"! The great mass of humanity, much less the Russian masses, do not know what it is. And what is more, they never will until their economic institutions are transformed so as to be in keeping with their needs, so that they will supply their every want.

Paradoxical as it may seem to many, social stability is possible only in changes—in incessant transformations. Because we have failed to make incessant small changes, we will have to make large ones. It is inevitable. That is what the Bolsheviki did. To transform society and yet keep it stable is a task that is, perhaps, too great for our social intelligence; hence our social ills, and social chaos, inevitably. As a writer in the *American Journal of Sociology* has so ably pointed out, in a recent issue of that publication: "All aristocracies have gone out of existence"! This should make us all pause a moment in our struggle against ourselves, our social selves, and determine why so. To do so, we shall have to consider things in their true relations; as unavoidable effects of antecedent causes. Then "Mining on the Bolshevik Plan" will not seem bad, even to editorial imagination. R. HEGNER.

San Francisco, Calif.

The Engineer as Citizen

THE EDITOR:

Sir—Referring to your editorial, "The Engineer as Citizen—a Jeremiad," on p. 46 of your issue of Jan. 13, exhorting friend Caetani to tell us how to do it, you will get a mail-bag full from other friends. Here is my mite:

The engineer, whether home-made or college-made, can be told in a crowd. Observant, thoughtful, judicial, honest, he plods along. A few rise to heights and lead the others because of ability. Some, perhaps many, of ability "blush unseen." On the whole, they assert themselves, politically, about as much or as little as others.

If we dislike the present method of election, or nomination of Institute officers, change it. We have the same chance that, as citizens, we have of changing our methods of electing the man of our choice to the Presidency. We were out of luck, some of us, in 1920, if he did land in a Cabinet position of great importance. We are in luck, in 1923, that Hoover is Secretary of Commerce, because of his deeds. Why has Hoover towered above other engineers? He has gone beyond dreaming, balancing his thoughts, and has accurately achieved.

We Americans must learn from our foreign-born or foreign-blooded citizens, whom we call Wops, Irish, Kikes, English, and Dutch. Let us watch the career of New York City and learn how to govern. This city, as is well known, was discovered by the Dutch, is now run by the Irish, and owned by the Jews.

Why worry Caetani about our Institute troubles? Read the article about the Italians on p. 64 of the Jan 17 number of the *Nation*. Then we can wander off reading the other articles in that peculiar paper and wonder and wonder and—get nowhere. Is not that the way of the dreamer-engineer? As you say, Let George do it.

By the way, if I had a chance to cast the deciding vote for one candidate for president of the Institute I sincerely believe it would be the cut-and-dried candidate, E. P. Mathewson, as he "has the goods," is intensely human, and is a miner. DIOGENES II.

New York.

Mining and Washing Phosphate Rock in Tennessee

Industry Developed Since 1894—Geology of the Deposits—Brown and Blue Varieties Occur—Methods of Removing Overburden—Washing Has Become an Efficient Operation—Uses of Phosphate Rock

By Richard W. Smith
Assistant Geologist, Tennessee Geological Survey

Richard W. Smith

THE "BLUE" ROCK phosphate of Tennessee was discovered in December, 1893, and the "brown" rock in January, 1896. Before that time South Carolina and Florida had supplied most of the phosphate of the United States, South Carolina leading until 1894, and Florida from that date until the present time.

It had been known for some time that there was a layer of phosphatic nodules at the base of the Chattanooga "black" shale surrounding the Central Basin of Tennessee, but, wherever known, it was too thin to be of economic value. About 1892, Major Whitthorne,[1] Harry Arnold, and others started a search in Maury County to see if at some place this layer did not thicken to a workable deposit. They were informed by Dr. J. M. Safford, State Geologist, that the layer of phosphate nodules occurred above the limestone and below the shale. With this help, they found in October, 1893, a deposit about six miles northeast of Columbia where this layer was 18 in. thick. After analysis, two tons of the phosphate nodules were broken up and shipped to the National Fertilizer Co. at Nashville, this being the first shipment of phosphate rock ever made in Tennessee. The deposit, however, was considered unprofitable, and the search was continued.

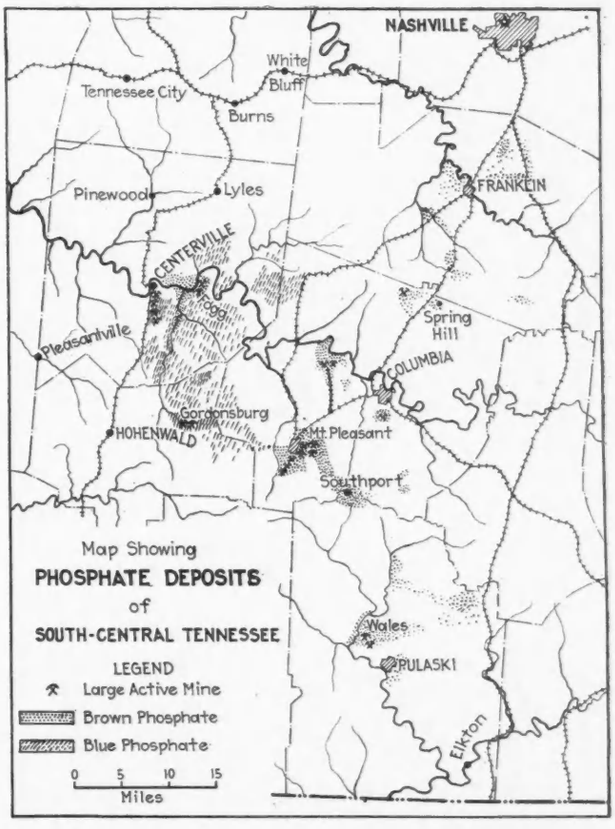
First Discovery in Lewis County in 1893

About Dec. 20, 1893, Major Whitthorne remembered a place on Swan Creek, in Lewis County, where there were immense bluffs of shale with limestone beneath, and decided to investigate this place. Here they found, instead of the nodules of phosphate, a 3-ft. layer of a solid, dark (almost black) rock. This they had analyzed; it was found to be a high-grade phosphate, and immediately they began leasing the land in the vicinity.

In January, 1894, while engaged in taking phosphate leases on Swan Creek, Major Whitthorne met two men who were also taking leases further down the creek. From them he learned that, some weeks earlier, George W. Harder, who lived at Palestine, on Swan Creek, had sent a piece of the blue phosphate to a Nashville chemist, thinking it to be a "bloom" of coal. On learning of its value as a phosphate rock, a company was formed to take leases and develop it. Thus the blue phosphate was discovered almost simultaneously by two independent parties; by one as the result of a careful and systematic search, and by the other through mistaking it for coal. Further prospecting disclosed other deposits in the region, and development progressed as rapidly as could be expected without railroad transportation.

In January, 1896, Judge S. Q. Weatherly, who was interested in the development of the blue phosphate, while riding along the road south of Mount Pleasant, noticed some slabs of brown rock in place above the limestone, and stopped to examine them. He took samples and had them analyzed, thus discovering the high-grade brown phosphate of this district.

This was kept quiet until July, 1896,[2] when mining was started at the village of Mount Pleasant. Development proceeded rapidly, many owners obtaining their capital by the sale of their rock fences, which were largely composed of slabs of high-grade brown phosphate.



The development of the brown rock, which is richer and more easily mined than the blue, caused Tennessee to advance from a poor third in production to second, surpassing the output of South Carolina, and being excelled only by Florida.

[1] Ruhm, H. D., Eng. Assn. of the South, *Trans.*, Vol. XIII, pp. 42-64.

[2] O'Neal, J. S., Eng. Assn. of the South, *Trans.*, Vol. IX, p. 58.

Phosphate mine, showing overburden and "horses" of limestone

The phosphate production of the United States in 1920 and 1921 was in long tons as follows:

State	1920	1921
Florida	3,255,720	2,088,251
Tennessee and Kentucky	627,677	332,962
South Carolina	42,709	....
Western States	48,895	4,961
Totals	3,975,001	2,426,174

There are three distinct varieties of phosphate rock in Tennessee, known commercially as: (a) brown rock; (b) blue rock, and (c) white rock. The brown rock is a product of the weathering and natural concentration of the phosphatic Ordovician limestones of the Central Basin or "blue-grass region" of Tennessee. Most of the phosphate produced is of this type. The blue phosphate is an unaltered phosphatic stratum of Devonian or Mississippian age, that outcrops at the edge of the Highland Rim, which surrounds the Central Basin. This furnishes a small part of the production. The white phosphate is a chemical replacement product from certain Silurian and Devonian limestones. It is not now being exploited, and will therefore not be further discussed.

Chemically, phosphate rock may be considered, aside from impurities, as the normal tricalcium phosphate of lime with the formula $Ca_3(PO_4)_2$, though it is probably a mixture of several phosphate minerals. It is contaminated with impurities such as iron oxide, clay, and calcium carbonate, which are eliminated as much as possible in preparing the rock for market.

Photo loaned by C. S. Chaffin

Hydraulic mining at the mine of the Ruhm Phosphate Co.

The Ordovician seas contained considerable dissolved phosphate, derived, according to Clarke,[3] from the mineral apatite, a flor- or chlor-calcium phosphate, and other phosphate minerals in igneous rocks. Some of this dissolved phosphate was deposited with the limestones, either as the phosphatic shells of certain animals, or possibly as a chemical precipitate, with later chemical replacement of the calcium carbonate of these shells by calcium phosphate.[4] In this manner some of the Ordovician limestones of the southwestern part of the Central Basin acquired a content of 25 to 50 per cent tricalcium phosphate.

The brown phosphate of the Mount Pleasant, Columbia, and Wales districts is derived from the Bigby (Ordovician) limestone. Here the Bigby limestone is a dense crystalline bluish limestone, usually banded with thin black layers, which are oölitic in texture, and sometimes plainly shelly and coarser grained than the rest of the limestone, and which produce the platy phosphate rock.

The brown phosphate of the Centerville and Gordonsburg districts is of the Leipers (also Ordovician) formation, which here greatly resembles the Bigby in lithological character.

The present brown phosphate deposits are the products of the weathering of such a phosphatic limestone. Acidulated surface waters, charged with carbon dioxide of the atmosphere and of decaying vegetable matter, as well as with organic acids of the soil, penetrating the pores of the rock and percolating downward through whatever channels may be present, dissolve and carry away the calcium carbonate in solution, leaving the more insoluble clay, silica, and chert. The extent to which such a weathering takes place depends upon the following factors:

1. Position of the phosphatic limestone strata relative to the surface topography.
2. Abundant jointing of the rocks, affording channels for the rapid circulation of underground waters.
3. Favorable surface drainage conditions.
4. Granularity of the rock.
5. Presence of interstratified clay beds.

Formation of "Rim" Deposits

The position of the phosphatic limestone bed in relation to the surface topography is of utmost importance. If the limestone is buried so deeply by overlying rocks that weathering does not take place, there is of course no further concentration of phosphate. If the phosphatic limestone lies in a bed too far from the tops of the outlying hills to be completely exposed to surface conditions, but outcrops around the sides of the hills, there is formed on this outcrop a more or less connected group of phosphate deposits encircling the hill. These are known as "hat-band," "rim," or less often "collar" deposits. But if erosion has carried away the overlying rock so that the phosphatic limestone itself forms the surface rock, the areal distribution of the phosphate deposit is not confined to a limited banded outcrop, but is determined more by other conditions. Such deposits are usually more extensive, and are known as "blanket" deposits.

Acidulated water, seeping through incipient fractures

[3]Clarke, F. W., U. S. Geol. Surv. Bull. 695, pp. 515-516.

[4]See discussion by L. P. Brown, of the brown and blue phosphate rock deposits of south-central Tennessee; by J. S. Hook: "Resources of Tennessee," Vol. IV, No. 2, p. 84.

and joints, gradually enlarges them by solution of the calcium carbonate of the limestone, until they become, in many instances, large underground waterways. In this way the so-called "cutters" are formed. These are long, narrow trenches filled with the commercially valuable residual calcium phosphate, or brown phosphate rock. If the phosphate left is platy, due to alternating bands of varying phosphatic content of the original limestone, the original structure is preserved in the brown phosphate filling the cutters, the layers sagging in the center because of the removal of the calcium carbonate portion of the original limestone. In the Mount Pleasant field these cutters are usually pronounced in their development. In almost any of the large pits where the phosphate has been mined there

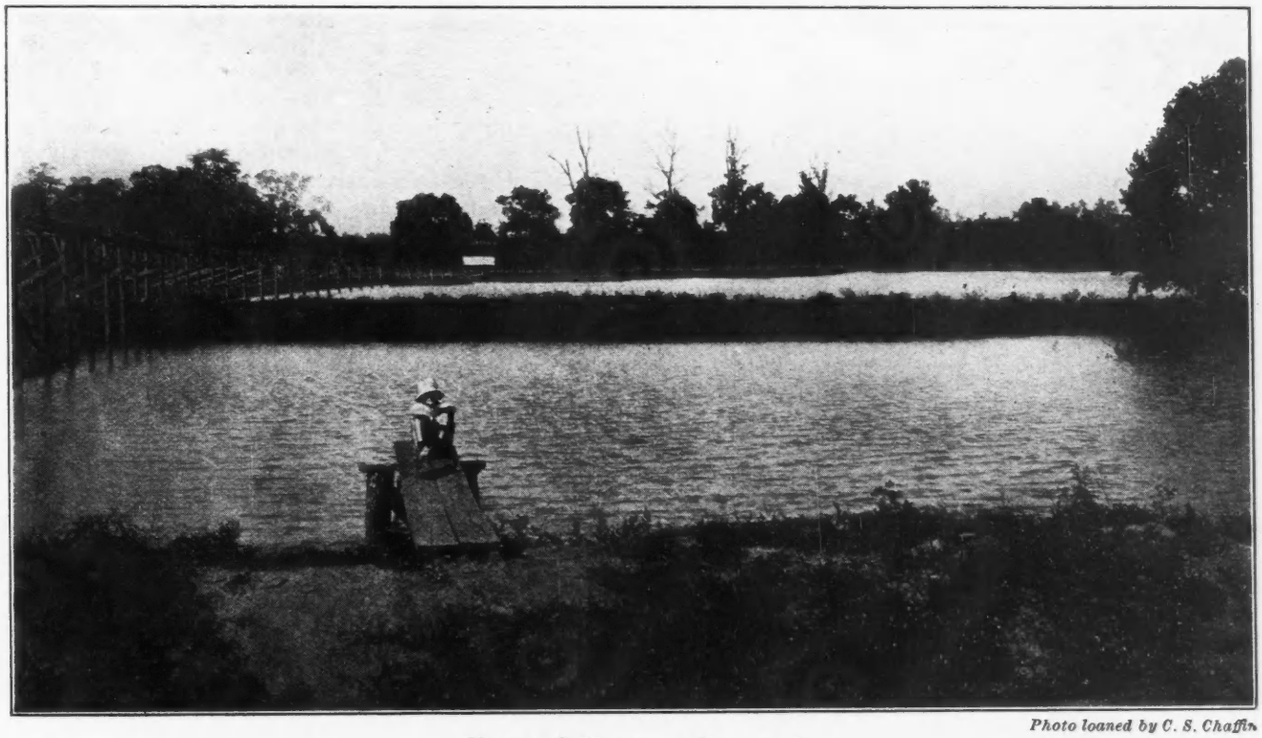


Photo loaned by C. S. Chaffin

Hoover & Mason settling pond

may be seen long, narrow trenches, separated by the intervening walls of the fresh limestone, which are irregularly traversed by smaller crosswise cuttings.

Clay seams are usually quite impervious to water, and tend locally to restrict its downward percolation, which limits the depth of the phosphate deposit.

Methods of Mining Brown Rock

Brown rock deposits lie near the surface of the ground, and are therefore easily worked in open pits. The overburden varies in thickness from almost nothing to such a thickness that its removal is unprofitable.

Removal of Overburden—Cleaning off the overburden is the first operation performed. The following methods are used:

1. The caving system. In this method the overburden is undermined, allowed to fall in on the worked ground, and shoveled back. This method is dangerous to life and is used only to a limited extent.

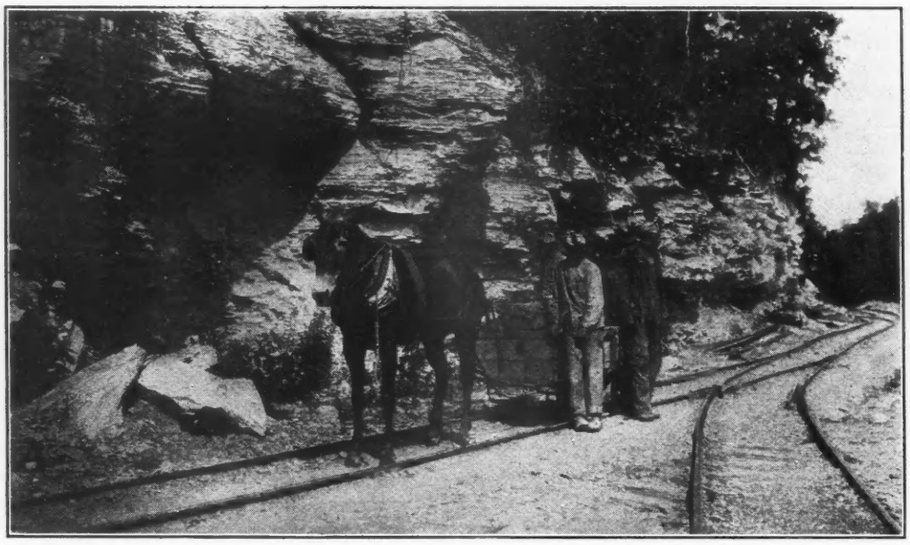
2. Removal by scrapers. This method is fairly rapid, yet lends itself with ease to the direction and manipulation of the operators, as the overburden being removed in comparatively small quantities at a time, the excavation can be made to conform more perfectly with the line of separation between the overburden and the phosphate. Its use is limited to the smaller mines.

3. Removal by steam shovel. This is rapid and is often used in the large mines where topographic conditions warrant.

4. Removal by drag line. For stripping overburden, this is usually a Bucyrus class 14, a Marion class 36 drag line, or equivalent in other makes, using a 1¼- or 2-yd. Page scraper bucket on a 40- to 80-ft. boom. The scraper is lowered to the ground at a distance from the machine, and hauled in toward the engine by a cable wound upon a revolving drum. The unloaded scraper is then raised and swung around to a position over the dump pits, where the load is released. This method is the most usual one adopted in the large mines.

5. Removal by hydraulicking. This is used in only one instance, where topographic conditions are favorable. In every case the overburden removed is placed on land already mined out. It is usually left in piles and not leveled off, leaving the land utterly unfit for future agricultural purposes.

Mining—The method of mining depends entirely upon the conditions involved. In the old days only the lump phosphate was removed by means of a "spall fork," and the rich phosphate sand was allowed to go to waste. This wasteful practice is still followed by a few of the smaller companies, but the larger ones have improved their washing plants until they are able to handle the entire thickness of the phosphate horizon—lump rock, muck, and all. Where the beds are thick enough, mechanical methods of removal are used, such as a drag line, steam shovel, and cantilever. The steam shovel can be used only where the phosphatic stratum is less than 20 ft. thick. The drag line can mine to a depth of 40 to 50 ft., and is generally used by the



Transporting "blue" rock near Gordonsburg

larger companies. The usual equipment is a Marion class 36 drag line or equivalent in other makes, using a 1¼-yd. Page scraper bucket on a 35- to 50-ft. boom. The cantilever is a machine designed by one phosphate company at Mount Pleasant and resembles a traveling crane. It is used to raise and lower buckets from deep or narrow cutters and dump them into the cars. In the narrow cutters, pick-and-shovel methods must be used. In two instances the mining is done by hydraulicking.

Transportation to Washer—The material is usually transported to the washers by tram haulage, using eighteen- to thirty-eight-ton locomotives on a 36-in. gage line. Either 3-yd. end-dump or 4-yd. side-dump cars are used. Where mining is done by hydraulicking, the muck is pumped from a sump at the pit through large pipes to the washer.

Washing—The washing processes whereby the mined rock is freed from clay, chert, and limestone are elaborate, and the mills in which the work is done, are, for the most part, large and modern. Though the details of manipulation vary at the different plants, the principles of the various washing processes are uniform throughout.

Flow Sheet of a Typical Washing Plant

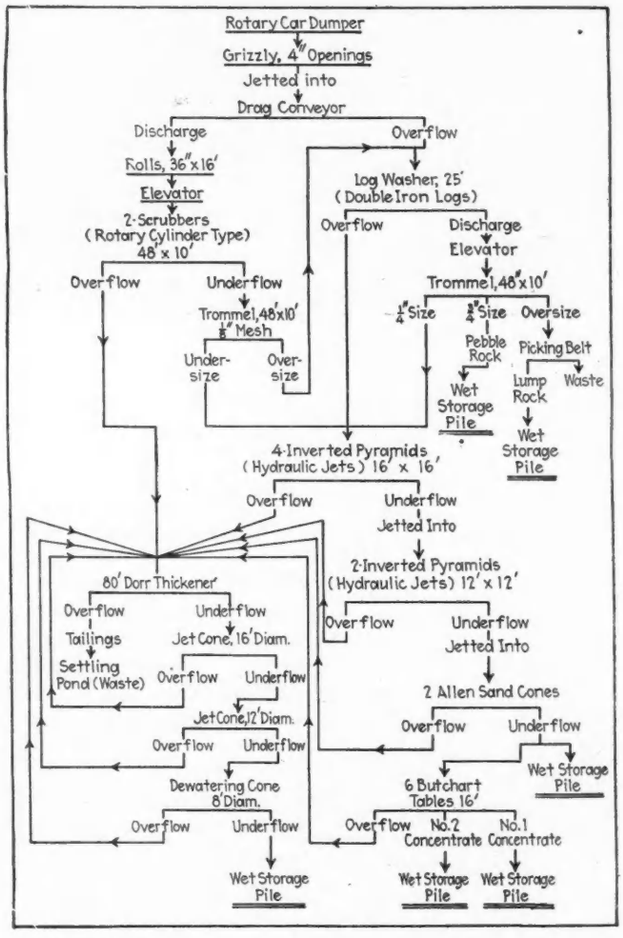
The following description of the general washing practice was prepared for me by James A. Barr, of Mount Pleasant:

"The crude rock is usually carried to a crusher at the top of the mill, where water is added, and the subsequent operations, for the most part, are conducted by gravity. From the crusher the material goes to a mixing department. This consists either of log washers or of rotating cylinders with shelves that lift the material and drop it back. The object is to break up the mud balls and agitate the material until the clay and fine sand are in suspension and separated from the coarse sand and lumps. The overflow goes to the fine-sand recovery department, the discharge to some form of classifier, usually a trommel. The oversize from this runs over a picking belt, where the remaining mud balls and pieces of chert and limestone are removed by hand, and the resulting lump rock goes to the wet-storage pile before drying. The undersize from the trommel goes to the sand-recovery department.

"The sand recovery equipment consists of a series of inverted pyramids, Allen sand cones, plain cylindrical jet washers, or a combination of two or all. The clay and finest sand are carried away by the overflow to the fine-sand recovery department. The heavier sand settles to the bottom, where a jet of fresh water carries it up through a pipe to the next tank, and finally to some dewatering device, such as Dorr classifiers, Allen dewatering cones, or a plain drag classifier. The underflow from this goes to the wet-storage pile.

"The equipment for fine-sand treatment consists of more Allen cones or Dorr thickeners. The overflow goes to the settling pond, where the tailings are caught so that the streams will not be choked with silt. The underflow goes to the dewatering devices, consisting of Allen dewatering cones, drag classifiers, or a Dorr bowl thickener. The underflow from the dewatering equipment goes to the storage pile, while the overflow either goes to the settling pond or back to the fine-sand recovery department.

"After draining on the wet storage pile, the washed



Typical flow sheet of phosphate washer in Tennessee The plants vary only in detail and elaboration

material is carried by cranes to the feed bins of the driers."

Drying—The drying is usually accomplished by rotary cylindrical driers, similar to rotary cement kilns. The rock is fed in at either the hot or the cold end. From the driers the finished product is conveyed to the storage bins, from which automatic loaders fill the freight cars.

Methods Differ Only in Detail

Such is the general process of washing the phosphate. The details vary, and the flow sheet of one company may be much more elaborate than that of another, but the principle is the same. The accompanying flow sheet shows the treatment in the washer of the Charleston (S. C.) Mining & Manufacturing Co. at Mount Pleasant. This is one of the most elaborate washers in the field. The flow sheets of the other companies differ from this in the omission of certain units. One company does not crush until after the mixing or agitating process and the separation of the lump from the fines. Several companies have recently installed Dorr bowl thickeners for the final scrubbing and dewatering of the finer material, replacing the Allen dewatering cones. These Dorr thickeners are said to accomplish a considerable saving of the finer material, and will probably be more generally adopted if justified by the results achieved by the operation of those now installed.

Bordering the part of the Central Basin containing the brown Ordovician phosphates, the overlying Devonian or Mississippian formation contains a phosphatic stratum, occurring just below the Chattanooga "black" shale, which is quite generally distributed. It varies in thickness from a few inches to 2 or 3 ft., and in composition from a highly phosphatic oölitic variety to an ordinary shale or sandstone. It is evidently a sediment that has not been altered since its formation. Unlike the Ordovician phosphatic limestones, it is not a direct concentration of phosphate by animal and chemical deposition. How, then, did it get its phosphate content? The principle clew to its origin is its position. It is present only where the underlying Ordovician limestone is phosphatic. Furthermore, in places where there is an intervening layer of Silurian limestone and the blue rock does not rest immediately upon the Ordovician, it is much less phosphatic. It was therefore suggested by Hayes and Ulrich,[5] that just before Devonian time there was an interval of erosion, during which brown phosphate deposits, similar to those in the Central Basin today, were formed by the leaching of the phosphatic Ordovician limestones. These leached areas, upon submergence in the sea, would furnish an abundant source of material for making up the new beds; and if so situated as to receive no additional sediments, would tend to produce a high-grade phosphate rock.

Geologic Section of Southwestern Part of Central Basin

Age	Name of Formation	Thickness, Ft.
Mississippian	Tullahoma-Fort Payne	40–100
	Maury green shale	0–5
Mississippian or Devonian (a)	Chattanooga "Black" shale	0–20
	Hardin sandstone	0–3
Silurian	Clifton limestone	0–60
Silurian or Ordovician	Fernvale	0–40
Ordovician	Leipers	0–100
	Catheys	0–100
	Cannon	0–100
	Bigby	30–100
	Hermitage	40–70

(a) Geologists disagree as to the age of the Chattanooga "Black" shale. E. O. Ulrich, R. S. Bassley and others now regard it as Mississippian, but this correlation has not been adopted by the U. S. Geological Survey.

Blue Rock Requires Underground Mining

The blue rock is workable where a minimum thickness of about 18 in. of high-grade rock is present. Such deposits occur at intervals over the whole area, and are usually connected with one another by the thinner unworkable portions. It is generally necessary to use underground methods of mining. Main tunnels are driven from the surface into the phosphate, and, at regular intervals, rooms about 25 ft. wide are turned off at right angles, leaving pillars of about the same width. Sometimes double rooms 50 ft. wide are used. After the rooms are completed, the pillars are drawn, allowing the roof of shale to cave. One blue-rock mine uses a No. 2 Radialax machine to put in an upper cut, and then the face is broken with Jackhamers. One-ton cars, loaded by hand, are hauled by mules to the mouth of the tunnel and then with dinky engines to the crusher.

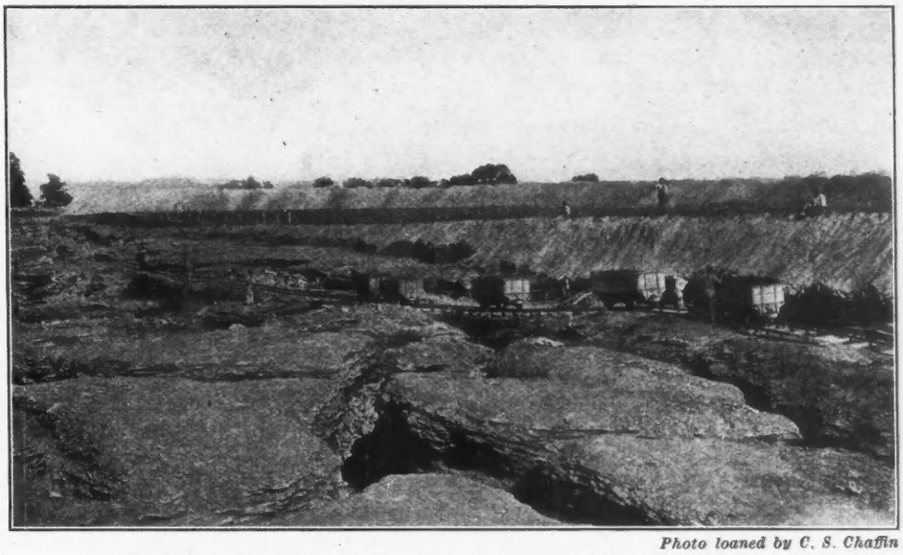


Photo loaned by C. S. Chaffin

Mining phosphate by hand at the mine of the International Agricultural Corporation

Where the Chattanooga "black" shale is thin or absent so that it is necessary to remove the kidney phosphate layer of the Maury green shale in mining the blue rock. it is sometimes possible to make use of these phosphatic nodules.

As the blue rock contains little clay and chert, it is not washed like the brown, but is simply crushed and dried in the rotary kiln driers.

At present about fifteen companies are mining phosphate in Tennessee, besides numerous independent owners that mine and sell lump rock phosphate on a small scale. and that have no washing plants. The

[5]Hayes, C. W., and Ulrich, E. O., U. S. Geol. Surv.; Geological Atlas, Columbia Folio (No. 95), p. 6.

industry centers around Mount Pleasant, Columbia, Wales, Centerville, and Gordonsburg. In the brown-rock districts, the grade of the finished product has fallen from 80 per cent bone phosphate of lime in the early days, to about 72 per cent at the present time. In a chemical analysis of phosphate rock, the phosphate content is first reported as P_2O_5. This is usually recalculated to $Ca_3(PO_4)_2$ which is called "bone phosphate of lime," and is often abbreviated to "B.P.L." As the cream of the deposits is gradually mined, the grade will fall still lower. Within and surrounding the present phosphate districts, and extending as far north as Nashville, are deposits averaging from 40 per cent to 65 per cent bone phosphate of lime. These are smaller in extent, lower in grade, and more irregular than the Mount Pleasant deposits, although some of them contain small areas of high-grade rock. These deposits are the reserve for the future, when the material of better grade is exhausted.

In the blue-rock area also are deposits now considered too thin or too low grade to mine, but which some day will be mined at a profit.

Principal Use of Phosphate Rock Is for Making Fertilizer

The greater part of the phosphate rock mined in Tennessee is treated with sulphuric acid to form a superphosphate of lime, in which condition a maximum amount of phosphorus is immediately available as plant food.

A recently patented process, called the A. L. Kreiss process, claims to produce a phosphorus-potash fertilizer by fusing phosphate rock with potash salts in a rotary cylindrical drier. The product is a soluble calcium-potassium phosphate that is said to have the further advantage of correcting rather than adding to the acidity of a soil.

It has been demonstrated in recent years that the phosphate rock, when finely ground and mixed with the soil, becomes available slowly, perhaps through the action of the weak acids formed there by the decomposition of organic matter. To meet this demand, some of the rock, both blue and brown, is finely pulverized and shipped direct to the agriculturist. At points to which freight rates are not too high, the phosphorus is much cheaper in this form, but the results of its application are not considered to be so immediate. There is the advantage, however, that the fertilizer does not have to be applied so frequently.

The Victor Chemical Co., of Nashville, is making monocalcium phosphate for use in self-rising flour, more of which is made in Nashville than at any other place in the country.

Chemical Industries Use Some Phosphate

A small amount of the best grade of Tennessee phosphate is made into chemically pure phosphoric acid for chemical use. A firm in northern Alabama produces chemically pure phosphoric acid from low-grade phosphate rock by an electrical process.

There has been an increasing demand in the last few years for high-grade lump phosphate for use by steel plants in the United States to raise the phosphorus content of their steel to the required limit. At Rockdale, six miles south of Mount Pleasant, there is a blast furnace using phosphate rock and phosphatic limestone to smelt Tennessee brown ore to produce ferrophosphorus, largely used by foundries and by basic open-hearth furnaces to obtain the correct phosphorus content in their products. The use of ferrophosphorus has the advantage that the phosphorus content can be easily adjusted without changing the grade of the product. For example, Bradley Stoughton tells me that the low phosphorus produced in the basic open hearth is a disadvantage in the manufacture of tin plate because the steel sticks together when rolled double. In this industry ferrophosphorus is therefore added to basic open-hearth steel.

Thus, besides shipping the crude phosphate to other states, Tennessee has a number of industries, centering around the phosphate district, that produce a variety of finished products made from phosphate.

Hoover & Mason mine, showing cantilever in foreground and drag-line in distance

Alfred de Ropp—Metallurgist

An Interview, by T. A. Rickard

You were born in Europe?

Yes; on one of my father's properties, near Libau in Russia.

In what year?

In 1858, May 1st.

Your family, however, is not of Russian origin—I infer from the name?

No, my family probably came from Belgium, where some de Ropps are still to be found. My ancestors came to Riga, Livonia, in 1189. They acquired large landholdings in Poland, Lithuania, and the Baltic provinces. Their main occupation, however, was fighting.

Were these estates handed down to the present generation?

Yes, but they had become subdivided among several generations of children. Very large families were the rule in those days. My grandfather had 11 sons and 7 daughters, and my father had 7 sons and 6 daughters. I was the ninth child. In consequence, the younger sons had to enter the professions in order to get a living. I was born at Fischroeden, about thirty miles from Libau, in what is now known as Courland.

What education did you have?

Up to my tenth year I had my schooling at home, partly in French, partly in Russian, partly in German. In my tenth year, I was sent to the Nicolai gymnasium at Libau, from which I graduated in 1878.

What was the character of your curriculum?

We were given a great deal of Latin and Greek. The Russian government had an idea that an overdose of classics would eradicate any revolutionary tendencies that we might have in our heads. I had 14 hours of Latin and 10 hours of Greek per week. Two-thirds of our time was taken up with the ancient classics.

After graduating from the gymnasium, where did you continue your studies?

At that time, my father, owing to bad harvests and other misfortunes, had lost most of his wealth, and, as I did not want to use any part of our family income, I appealed to my godfather, Baron Dietrich de Kleist, who generously offered to defray my expenses at the university. So I went to Germany and made a start as a medical student at Leipzig.

You did not continue long?

I discontinued the study of medicine in a very short time, because I could not stand the dissecting-room. From Leipzig I went to Freiberg in Saxony, where I entered the Royal Mining Academy for the purpose of studying metallurgy.

What made you choose metallurgy as your subject?

An older brother, who had graduated from the St. Petersburg University as a mining chemist, urged me to take up the same subject, and desired me to join him later in Siberia, where he had an important position with the Russian government.

What Americans did you meet while a student at Freiberg?

I met Waldemar Lindgren, now Professor of Economic Geology in the Massachusetts Institute of Technology; John Hays Hammond, who made his reputation in South Africa and is now one of the rich men of America; Harry H. Webb, who likewise made his reputation in South Africa; Wataru Watanabe, who became head of the mining school at Tokyo; and a great many others who became prominent in the profession of mining and metallurgy.

Cannot you recall the names of others?

Yes; C. R. Corning, Fred. Corning, John A. Allen, and Edgar P. Rathbone. Of the 160 students at Freiberg at that time about 60% were foreigners, the rest Germans. We foreigners had a good time, but the Germans worked hardest. For myself, I worked fairly hard, because I wanted to prove to my godfather that his funds had not been wasted.

Your training at Freiberg proved of immediate value to you?

Yes; but unfortunately I had to spend a great deal of my time on subjects that were of absolutely no use to me later on, such as German mining law and a lot of abstract science that I am glad I have forgotten.

When did you graduate from Freiberg?

In the fall of 1882, after which I spent several months at the local smelting works to familiarize myself with practical work; and while thus engaged I received a note from Clements Winkler, head of the Chemistry Department of the Academy, stating that he had received a letter from Pueblo, Colorado, from an old Freiberger named H. H. Schlapp, an American born in Iowa. This Mr. Schlapp was in charge of the works of the Pueblo Smelting & Refining Co., at that time one of the largest smelters in the United States. In his letter, Schlapp asked Professor Winkler to recommend a young graduate for the position of chemist, and he wanted one who had graduated in gas-analysis. It so happened that Freiberg was the first school to establish a special course in gas-analysis. Professor Winkler had given this course, and I had taken it. Mr. Schlapp offered a salary of $1000 per annum and my traveling expenses to Pueblo.

Did you proceed to Colorado at once?

First I went to Russia to take leave of my family, and after that I visited several smelting works in the Harz. Then I met my friend Lindgren by appointment at Aix la Chapelle. From there we went together to London and sailed from Liverpool on the 'Britannic.'

You must have enjoyed your first voyage.

I did, very much, and was surprised to find on board two of the most famous men of America—Cornelius Vanderbilt and J. P. Morgan. Vanderbilt was a rather rough-looking old man with bad manners, but Morgan was a fine gentleman in every sense of the word. He took a fancy to Lindgren and me, the two young immigrants, and especially to me because I did not speak English, but could speak French fluently, as he did. We spent many pleasant hours together walking up and down the deck, and playing games in the smoking-room. We used to meet there after dinner and fight like wildcats over a game of piquet, to see who should pay for the *demitasse* and *le petit cognac*. So here was I with $150 in my pocket and a job of $1000 per annum playing with this multimillionaire! But Morgan knew that I would rather pay for the refreshments than be treated by him. After a voyage of 11 days we landed at New York on June 11, 1883. Lindgren left me to go to Montana, where he had an appointment as geologist to the Northern Pacific Railroad Company. I

boarded a train for Pueblo. On June 15, 1883, I reported myself to Mr. Schlapp, and he put me to work at once on gas-analysis. When this work came to an end he gave me charge of the chemical laboratory, where I introduced several short methods for the quick determination of furnace products. After about eight months of this work, the manager, Alfred Geist, called for a volunteer to take over the night-shift at the desilverizing department. The work of desilverizing the lead bullion was being done on contract, and it was being done badly.

Please explain.

Our works were under contract with white-lead factories in St. Louis to deliver refined lead containing less than a tenth of an ounce of silver per ton, and a penalty was attached for an excess of silver over the stated amount. The workmen in the desilverizing plant handed in samples that came up to the specification, but in fact the refined lead was not properly desilverized, and contained often as high as half an ounce of silver per ton. The result was that whenever the white-lead factories produced a white-lead that was discolored through their own fault, they claimed this small amount of silver as the cause, and penalized our company. The manager called for a volunteer to investigate this discrepancy, but as I was the newest man on the chemical staff I did not offer my services at first, but when the other men hemmed and hawed and nobody volunteered for this uninviting job, the manager looked at me as much as to say, "How about you?". Whereupon I said I would tackle the job, but only if I was given control over the men, and if my report was to be considered final. Before the second night was over I discovered how the men were cheating.

And how was it done?

When the workmen turned in their samples, supposed to come from the batch of desilverized lead, I found that these samples were tarnished and did not look like fresh lead. This, of course, gave me a clue to the manipulations, and I proceeded at once to the lead refinery and asked the men where they had hidden the old samples taken from a batch of lead that came up to specifications. They at first denied any underhand work, but the evidence was too much for them and I soon found a big box full of samples that evidently had been taken a long while ago for the purpose of deceiving the company.

This episode must have improved your standing with the management?

Yes, it did; and also with the men, as I absolutely objected to having them discharged, because they were skillful and had received a good lesson that they would not forget. Also they had expessed regret and promised "to be good".

Were you promoted?

After I had been a year at Pueblo I was made assistant superintendent, and my salary was doubled. We were operating 13 blast-furnaces and 30 roasting-furnaces. Thus in one year I had acquired sufficient English to be able to take charge of 700 men. My job was a tough one and I was on duty from 14 to 16 hours out of the 24. I was often aroused from bed to straighten out all sorts of troubles. Early in 1886 Schlapp resigned and I succeeded him at a salary of $350 per month. This enabled me to assist my youngest brother and two nephews who were students at Freiberg. In October 1887 I resigned to join my friend Schlapp in running the Tomichi Valley smelter at Gunnison, Colorado. Eight months later Schlapp went to Broken Hill in Australia while I remained as superintendent.

This Tomichi Valley smelter never did much good, I believe?

During the year that Schlapp and I were in charge of the smelting works handsome profits were made for the first time in the company's existence, but as the management was desirous of paying dividends and would not furnish funds for the improvement of the plant, I considered it useless to remain any longer and accepted a position as superintendent at the Arkansas Valley smelter, near Leadville, Colorado. That was in January 1888.

From what mines did you get the ore that you smelted at the Tomichi Valley smelter?

The lead ore came largely from Sapinero in Gunnison county; and the dry ore from Ouray and other parts of the northern San Juan, as well as the Gunnison region.

Evidently you were not only rising in your profession, Baron, but you were also attaining a higher altitude, for you had progressed from Pueblo, which is about 4600 ft. above the sea, to Gunnison, which is about 7700 ft., and now to Leadville, which is two miles above sea-level. At that time, I know, Leadville was a lively community. Did you find it so?

In 1888 Leadville had a boom and was producing large quantities of ore from many mines, so that several smelters were actually at work. The town itself contained many times more men than women and was a very gay place. In those days the rough element in the Rocky Mountain mining camps was handy with a six-shooter and we used to have "a dead man for breakfast every morning". We had a queer mixture of people among our workmen. For instance, among the workers on our blast-furnaces I found a count and two barons, all of them lively youths and gay spendthrifts. Count Von der Ostensacken was a great drinker and would go on the bust after each pay-day, so I had to discharge him. Whereupon he dined with me and borrowed $200 before leaving for New York. He returned the money in due course and inherited a fortune in Russia. Baron Nolde was killed in a saloon brawl. Baron Rosenkranz, whose father was Danish ambassador to the court of Berlin, likewise did me the honor of borrowing money when pay-day seemed to be far off. He also repaid all my little loans to him, and I met him again in New York in 1892, by which time he was a member of a large coffee-importing firm, and doing very well. Strange as it may seem, I did not lose 5% of the loans I made at that time to comparative strangers.

How did you like your work at the Arkansas Valley smelter?

The plant had not been doing well when I took charge, but after a month it showed a profit and this increased from month to month. I enjoyed my work, but the manager, Charles Limberg, interfered with me too much, and undermined my authority. I warned him that I would not stand such interference and that I would resign if he did not cease it. Toward the end of 1888 he repeated his foolish activities, and I telephoned him that I would resign on January 1st. He begged me to remain and promised not to bother me in the future, but I wanted to leave Leadville, as the high altitude had begun to tell on my nerves and I wished to go to a lower level. Just as I was packing my belongings I received an offer from Marcus Daly,

manager for the Anaconda Copper Mining Co., at Butte, Montana. He offered me the position of superintendent of the Lower Works. I accepted the offer and reached Anaconda early in January 1889.

It seems to me that sooner or later nearly all the prominent American metallurgists have gone to the Anaconda. You must have been glad to go there yourself?

I was indeed, as the Anaconda smelting works was by far the largest institution of its kind, and the most progressive.

How did you like the "Marquis of Butte"?

Marcus Daly was a very peculiar man; he had many likeable traits, but he could do things that were simply horrid and cold-blooded. He would not hesitate a minute to shut-down the works in the midst of winter when the thermometer was about 30° below zero, in order to force his will on the workmen. This entailed, of course, great hardship to many a poor family. As I was single and had $4000 in the bank, I felt independent and did not knuckle down to Daly as so many did. This seemed to please the old fellow. He used to ask, "How is my independent Roosian friend getting along?" When I told him I had no complaints to make, he would use one of his pet remarks, "You men with a university eddication aint no good". To which I replied, "Why in blazes then do you pay us good fat salaries?" This took him aback, and he would say, "Nivir moind; will yez come to me quarters for dinner and have a bit of whiskey and a bottle of champagne?" His whiskey and champagne were excellent, so I never hesitated to accept his hospitality. Daly used to say, "Whiskey and champagne are the only two drinks fit for a jintleman".

Who was at Anaconda at that time?

Otto Stahlman was general superintendent; Harry H. Webb was chemist; the chief engineer was a fine old Scotchman by the name of James MacFarland. Sidney Jennings was assistant superintendent of the company's mines at Butte. I am sorry to say, however, that I found the atmosphere at Anaconda most unsympthatic.

Why? I am surprised to hear you say that.

Well, there was a constant fight between the Irish, who were more or less pushed forward by Marcus Daly, and people of other nationalities, who found the work very hard under the prevailing conditions.

Evidently the tone of the management must have been very different from what it was later under Mathewson?

Yes indeed; for Mathewson is a broad-gauge man; he treated the employees fairly and squarely, and changed living conditions in Anaconda very greatly for the better.

So you decided to resign?

Yes, I resigned in November 1889 and went to San Francisco with the idea of joining my friend Schlapp in Australia. He had offered me the charge of the Broken Hill Proprietary Co.'s lead refinery at Port Pirie. However, when about to leave San Francisco I received an offer from the Selby Smelting & Lead Co. to take charge of their plant at Selby, about 30 miles east of San Francisco and on the Bay of San Francisco. As I had fallen in love with California I did not hesitate to accept this position. On December 1, 1889, I took charge, with my old friend E. N. Englehardt as assistant, and I never had a better friend or a more loyal associate.

As I remember, the Selby plant was in a bad way at that time?

Yes, I found the works in a horrible condition, and the employees without discipline. They were without goodwill to the company, and without efficiency in their work. In consequence, the company was practically broke. It owed about two million dollars. So bad was the outlook and so poor were the prospects that the Bank of California had informed the management that it would take over the plant, sell everything, and liquidate the company, unless a competent man was put in control with a free hand to save the enterprise from utter ruin. The job was a tough one, but Englehardt and I were both young and in fine health, so we tackled the job with firm hands. After about a month I found that a lot of underhand work was being done by a group of bad men, and that the only way to get rid of them was to discharge the entire force. This was done, and as the men were paid off, I stood by the door of the pay-clerk's office, and picked out the men that I wanted to remain, telling them to come around the next day for duty. In this way I weeded out about 50 anarchists —mostly Irish, including three men by the name of McCoy, the ringleaders of a tough gang. These fellows hung around the works after they were discharged and threatened to blow up my house—that is, the house that my assistant and other members of the staff shared with me. It happened in those days that I was a good shot with a rifle, and I had won many bets by hitting a dollar when thrown in the air. Englehardt knew about my fancy shooting and suggested that I should give a little exhibition of it as a hint to the McCoys that I could protect myself if necessary. So one day when near the company's store Englehardt asked one of our assayers whether he had a dollar in his pocket and when this man handed the dollar to Englehardt he threw it into the air, not spinning it, and I was lucky enough to make a clean hit at the first shot. The McCoys saw the shooting and made the remark, "Holy Moses, that fellow can shoot". Whereupon I turned to the gang, rifle in hand, saying, "Yes, I can shoot, and so can my companions; and I warn you there will be plenty of dead McCoys if you come near our house". I also informed them that the sheriff of the county was on his way to arrest them if they were found loitering on the company's premises. They took to their heels, and I never saw them again. All three McCoys died a violent death when holding up trains and robbing houses. After this I had no more trouble with the men at the smelter. Soon I had a most efficient crew and was able to do first-class metallurgical work. After six months I had reduced the company's indebtedness by $300,000 and was making a profit of $75,000 a month. The company's debts were being reduced rapidly, and the prospect of dividends was good. I had confidence in the future of the enterprise, so I invested all my liquid cash in the company's shares. The Bank of California loaned me further money so that I could buy a block of them at $80 per share. Soon the company was paying $15 per share per annum in dividends. I continued to buy shares as opportunity offered. The company was now earning handsomely, so that I was furnished funds to rebuild the plant on modern lines. It became an efficient and successful smelter.

You were competing with the American Smelting & Refining Company?

Yes, and we had a tough fight on hand.

In what way?

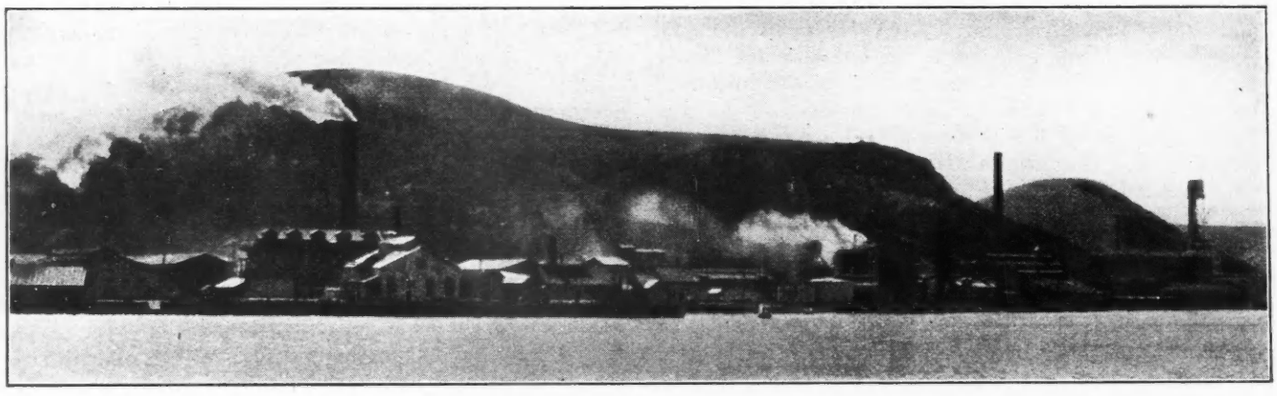
The Guggenheim interests did not like our competition on the open ore-market; and, among other things, tried to upset our business by contracting for the lead ores that we could obtain without paying the high freight charges.

Excuse me, so far you have only mentioned ordinary competition. What else did they do?

We produced a larger amount of lead than we could sell within a reasonable distance of our works and had to ship our surplus lead to the Atlantic coast. Of course, the A. S. & R. company knew whenever we shipped our lead around the Horn, and just about the time when this lead would reach the Atlantic seaboard, they would depress the price of lead, and on the falling market our lead was not salable—it had to be put in warehouses. All of this increased our expense considerably, and locked up the money we would have received if these manipulations had not taken place.

What did you produce at Selby?

We smelted lead, silver, gold, and copper ores. We refined our silver and gold for the U. S. Mint, and received large quantities of gold and silver in a crude state from California, Nevada, Oregon, Arizona, New Mexico, Mexico, and even from as far as Korea and China. Our production in some years ran up to $36,000,000 in gold, 18,000,000 ounces of fine silver, 12,000 tons of refined lead, and 3000 tons of copper sulphate. We turned our refined lead into white lead, sheet, pipe, solder, and shot. The shot was used in our shotgun factory, where we loaded as many as 42,000,000 cartridges per annum. Some of these were sent as far as Australia and South Africa. Our yearly output of metals and metallic products in some years exceeded $50,000,000 in value—an enormous sum for such a comparatively small plant. When our plant was bought by the Guggenheims they were very much surprised that our base bullion contained usually as high as 400 oz. of silver and 10 oz. in gold per ton.



The Selby smelter on San Francisco Bay

When was the Selby plant acquired by the A. S. & R. Company?

In 1905. They offered $420.40 per share. This seemed a big price, but I advised my directors to refuse the offer, as I felt sure that we could get a higher price a year or two later. However, most of my directors were old men and not willing to continue the fight with the A. S. & R. So the deal was closed and I received $140,000 for my block of stock. When the Guggenheims took over our works I had a contract with the Selby people for two years more, and I was entitled to 3% of the net earnings, besides my salary. I told the Guggenheims I would remain in charge for one year and then make them a present of my remaining one-year contract. I knew that I could not get along with them. So early in 1907 I took a six months' vacation and went to Europe. From London I wrote to the Guggenheims tendering my resignation, which was accepted. My family was with me.

When were you married?

In 1892 I was married to Miss Elizabeth Annesley Morton, whom I had met in San Francisco when she was on a visit to her sister, the wife of my friend Webb. When I went to Europe in 1907 I had a family of three children. While in California we lived most of the time in Oakland. In 1907 I put my children to school at Vevey in Switzerland, and lived there myself at intervals; but I soon became tired of an inactive life and wanted to get into harness again.

What was your next move?

In 1908 I received a telegram from Lord Harris, the chairman of the Consolidated Gold Fields of South Africa, asking me to meet him in London. When we met, he asked me to take charge of his company's affairs and investments in the United States as managing director. I accepted the offer and became the head of the American branch of this well-known British company. My headquarters were established in San Francisco. The American branch was known as the Gold Fields American Development Company, Ltd. It had a large interest in three Californian gold-dredging companies, a hydro-electric plant on the Truckee river, a power plant on the Mississippi river, oil interests in Mexico, and gold-dredging companies in the Yukon, besides potash and borax works in San Bernardino county, California.

The last of these I suppose is the Trona Corporation. I know that you have done some interesting work there, and I would like you to say something about this important enterprise.

The potash and borax deposit is in Searles lake, on the edge of the Panamint desert. It covers an area of about 25 square miles, of which over 12 square miles is a solid exposed salt deposit, snow-white, and permeated with a super-saturated brine. The rainfall in that district is slight, amounting to between two and three inches per annum. The summer months are ex-

cessively hot, the temperature rising as high as 128° in the shade. The evaporation in this very dry air is tremendous, so that the rain accumulating on the salt crust during the winter months to the depth of several inches disappears rapidly, and, in fact, even after the surface of the lake appears to be absolutely dry, the evaporation continues owing to capillary action. It would not take many years to evaporate all the water from the brine in this deposit. Our company put down over a thousand drill-holes, which passed through 50 to 75 ft. of a comparatively solid saline deposit, and at the bottom cut a constant flow of brine that became available for pumping. The brine contains a little over 34% solids, and about 5% potassium chloride, besides 3% borax figured as decahydrate.

You have had a good deal of difficulty in producing a marketable product, have you not?

Yes, the first attempts at producing potash were failures, until multiple evaporators were used to produce the marketable salts contained in the brine. During the World War, when no potash from Germany was available, we were urged to produce potash as fast and in as large quantities as possible. Our company spent a great deal of money during this period, when construction was extremely expensive, and erected large works at Trona, which in due time made a certain amount of potash for war purposes and for fertilizers. We also constructed 37 miles of standard railroad to connect with the Southern Pacific at Searles station.

How much have you produced in any one year?

Approximately 32,000 tons of salts were produced, containing from 20 to 40% potassium chloride, all of which was sent to the Atlantic seaboard.

Did you not refine it on the spot?

No, we did not refine the salt, because no water was available in the desert until much later. At present the potash delivered from Trona to the Eastern market contains over 98% potassium chloride, which is better than anything imported from Europe.

Did you have anything to do with the other enterprises of the Gold Fields in this country?

Not in a technical capacity, but only as chairman of the advisory committee, which had its headquarters in New York.

You found I suppose that there were many inconveniences in action for a company whose controllers lived so far from the scene of operations?

Yes indeed, especially during the War, when no English cash was allowed to leave the country, at a time when we needed it badly for improvements and equipment.

What impression did you receive of the manner in which large enterprises are managed from London.

While I found the directors most charming and the nicest people to deal with, it was often very cumbersome to keep in touch with them, and especially to obtain a quick decision when important questions had to be decided in a hurry. Before the War it was astonishing with what ease fresh funds could be obtained, but this, of course, was very much changed after warfare started in 1914.

You are no longer connected with the Gold Fields now?

No, I resigned in July 1919, as I found that indoor work had injured my nervous system so that I suffered from severe insomnia and other ailments due to overwork indoors. On the advice of my physician I resigned from every and all responsibilities, for which I am truly grateful, as I feel ten years younger now.

Reverting to your work as a lead metallurgist, what were the principal improvements made in that branch of metallurgy in your time?

In my opinion, they were made in the blast-furnace. To begin with, a better control over the smelting operations took place in the last forty years. I know of a great many smelting works that used to run their establishment without a chemist; now it would be considered suicidal. The blast-furnaces were changed from a crude apparatus to an efficient machine. The same holds good for a roasting-furnace.

By the way, you invented a roasting-furnace?

Yes, I did. The patent was taken out in 1895. The old style of furnace that we used at Selby was the so-called hand-roasting furnace, in which the ore was propelled from the coldest to the hottest part by means of rabbles worked by hand. This resulted in a large employment of laborers whom one had to trust to do the right thing, resulting in poor and expensive roasting operations. Mechanical rabbling was desirous, so I devised a furnace with an underground channel in which a four-wheeled carriage was propelled by a steel rope. The furnace was cut in two longitudinally. From the underground carriage, an arm projected through a slot into the furnace and to this arm were attached lateral arms, constituting the rabbles. The carriage traveled under the length of the furnace, and continued from its exit in an elliptical path, meanwhile being cooled before it entered the furnace again. Eventually my patent was beaten by Fraser & Chalmers, who had purchased the rights to the Brown horseshoe furnace. However, my invention helped to improve both roasting and my bank account. Another great improvement in lead metallurgy was the desilverizing of the crude bullion by means of the Parkes process, which is now in general use. The old hand-roasting furnaces had a capacity of seven to ten tons per day at the best, whereas a mechanical roasting-furnace, such, for instance, as I patented, would have a capacity of 30 to 50 tons per day and would deliver a much better and uniform product, using barely a tenth of the number of laborers required to treat an equal tonnage in the old hand-rabbled furnaces. One of the best improvements made in lead smelting was the introduction of bag-houses instead of long flue-chambers for the settling and collection of valuable metals carried from the furnace in the form of fume and ash.

You started the first bag-house?

No, the first bag-house was built at Joplin, Missouri, more than forty years ago.

You have not taken out papers of naturalization?

No, I have not, as I intended to join my brother in the Ural Mountains, but gave this up after I had made so many friends in America, and then took up my work again with the English company in looking after their interests on this continent. I am too old now to swap horses. Since the overthrow of the Czar in Russia I am practically a man "without a country," for far be it from me to recognize the Soviet. Still, I have received so many courtesies in America as a foreigner that I feel quite at home here. I find that even a man without a country can have a home. My three children are all native-born Americans, and so are my three grandchildren.

Carnotite in Southern Nevada

Deposits Small and Grade Too Low for Profitable Exploitation—Possibility of Discovering Larger Quantities—Deposition Associated with Action of Surface Waters

BY D. F. HEWETT
Geologist, U. S. Geological Survey

CARNOTITE was discovered in several localities in Clark County, Nev., during the winter of 1921-22. Although none of the existing openings shows material that can be worked profitably as a source of radium, the mode of occurrence is uncommon, and it is possible that further work may yield material of higher grade. Being engaged in field work in the region, I was able to examine most of the openings that have been made.

Three areas may be recognized in which carnotite has

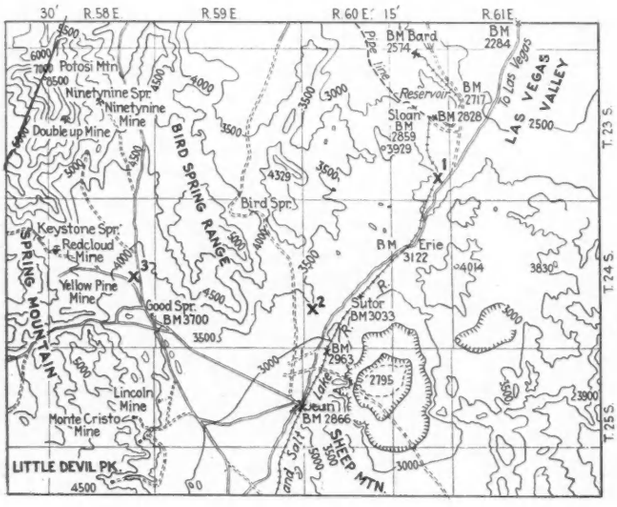


Fig. 1—Portion of Ivanpah quadrangle, showing location of the carnotite deposits near Sloan (1), Sutor (2), and Goodsprings (3)

been found (Fig. 1). The first lies along the Los Angeles & Salt Lake R.R., two miles south of Sloan. According to N. E. Williams, of Las Vegas, who brought it to my attention, several years ago he discovered yellow stains on the walls of the railroad cut in the north center of Sec. 32, T. 23 S., R. 60 E. Later samples were sent to an assayer in Los Angeles, who determined that the mineral was radioactive and probably carnotite. By further search, similar stains were found in another cut a mile south. Beyond drilling and blasting a hole near the outcrop, Mr. Williams has done no work on the deposit, and has not located the ground. The second area lies in Secs. 29 and 30, T. 24 S., R. 60 E., from one to two miles west of Sutor, also on the Los Angeles & Salt Lake R.R. This locality was discovered in November, 1921, by J. Isachsen, while he was prospecting for such minerals in the neighborhood. Four shallow pits were dug and four claims were located before work ceased in January, 1922. Later, A. J. Sieber found traces of the mineral a mile east of Isachsen's location and dug several shallow pits. The third area lies in Sec. 14, T. 23 S., R. 58 E., about two miles north of the town of Goodsprings, which is eight miles west of Jean, on the Los Angeles & Salt Lake R.R. Carnotite was discovered in two pits sunk by Nelson Nunn, several weeks after J. Isachsen had made his discoveries. No claims were located here, however.

The quantity of the mineral so far discovered is not sufficient for satisfactory chemical analyses, and the identification of the mineral is not completely satisfactory. Specimens from the Sloan area, examined under the microscope, possess most of the common properties of carnotite, but those from Sutor and Goodsprings are slightly different and may contain a new unidentified mineral. To facilitate description, all of the material will be considered here as carnotite.

DESERT CONDITIONS PREVAIL

Surface Features.—The dominant features of this part of Nevada are the mountain ranges that trend roughly north and rise to elevations that range from 6,000 to 11,000 ft. above sea level. The ranges are bordered by parallel minor ridges and groups of hills and are separated by broad stretches of wash, which commonly range from 2,500 to 4,000 ft. above sea level. The areas in which carnotite has been found lie in low hills adjacent to the broad washes east of Spring Mountain Range. Their elevation ranges from 3,000 to 4,000 ft. above the sea. As desert conditions prevail throughout southern Nevada, there is little water on the surface near by, and the only vegetation is a sparse growth of creosote bush, greasewood, yucca, and Joshua trees.

Local Geology.—Except for the report by Spurr,[1] based upon reconnaissance work by Spurr and Rowe in 1899 and 1901, and articles by Longwell[2] based on recent work in the Muddy Mountains, little has been published concerning the geology of this part of Nevada. From October, 1921, to May, 1922, I was engaged in the geologic mapping of the Goodsprings quadrangle, in which the third deposit lies. The geologic conclusions stated here are based on this work.

The upper Cambrian, Devonian, Mississippian, and Pennsylvanian are represented by about 5,000 ft. of dolomite and limestone. The upper part of the Pennsylvanian contains thin beds of shale and sandstone. The Permian section (Fig. 2), about 400 ft. thick, is made up of a lower bench of gray limestone about 160 ft. thick, which rests on yellowish shaly sandstone; a middle layer of reddish and yellowish shaly sandstone 30 ft. thick, and an upper bench of gray cherty limestone, about 210 ft. thick. Characteristic Permian fossils may be found in the lowermost bench, but are abundant in the upper half of the upper bench.

Overlying the Permian limestone there is 50 to 75 ft.

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[1]Spurr, J. E., "Descriptive Geology of Nevada South of the Fortieth Parallel," U. S. Geol. Survey Bull. 208, 1903.
[2]Longwell, C. R., "Geology of the Muddy Mountains," Amer. Jour. Sci., Vol. 50, pp. 39-62, 1921.

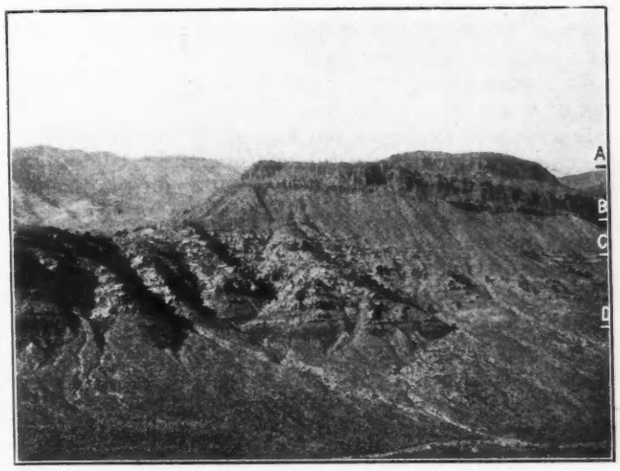


Fig. 2—View west toward escarpment in Sec. 18, T. 23 S., R. 59 E.

AB, 400 ft. Permian limestone; BC, 245 ft. red sandstone and gypsum; CD, 460 ft. buff sandstone on 220 ft. of red shaly sandstone; C marks horizon at which carnotite is found.

of red sandy shale, and this is overlain by about 300 ft. of thin-bedded buff limestone, which yields Triassic fossils. Elsewhere in the region there are higher red shales and red sandstones, which weather buff and which are tentatively considered as upper Triassic and Jurassic respectively.

After these beds were laid down, extensive thrust faults were developed, and later two groups of normal faults were formed before the region was greatly reduced by erosion.

In late Tertiary times, local volcanic vents were the source of andesite and rhyolite flows. In a broad way, the hills and ridges west of the Los Angeles and Salt Lake R.R. between Sloan and Jean (Fig. 1) are made up largely of Paleozoic limestones, much folded and faulted, whereas the mountains to the east are largely volcanic flows erupted from local centers, one of which lies two miles northeast of Erie. These flows may be faulted, but are nearly horizontal over a large area.

The carnotite south of Sloan occurs along the joints in a flow of rhyolite and is therefore Tertiary or later in age. Of the two groups of deposits near Sutor and Goodsprings, the first occurs in the shaly sandstone beds under the lower Permian limestone, and the second in similar beds over that limestone.

Sloan Occurrence.—Carnotite occurs along the Los Angeles & Salt Lake R.R. between telegraph poles 312 10 and 312 20, or about two miles south of Sloan. My attention was called to the occurrence by N. E. Williams, of Las Vegas, who also states that he has seen traces of a similar yellow stain along the railroad cut about one mile farther south. Mr. Williams states that he discovered the mineral in both localities about 1915 and that its identity was proved by an assayer to whom he sent specimens.

Relation of Flows to Topography

In the vicinity of Sloan, the road from Jean to Las Vegas approximately separates a gently rolling region on the west, underlain largely by Paleozoic limestone, from a slightly rougher region on the east, underlain by igneous tuffs and flows. A group of rugged hills four miles south of Sloan is made up of several confused flows and appears to mark the location of the volcanic crater that was the source of the near-by flows. Between Sloan and Erie the nearly horizontal flows extend locally northwest across the railroad, and clearly rest on a gently rolling surface cut in Pennslyvanian limestone. Where the railroad cuts through it, two miles south of Sloan, the flow is probably less than 100 ft. thick. The railroad cut is about 500 ft. long and attains a maximum depth in the middle of 15 ft. The showings of carnotite are confined to an area 20 ft. long along the east side of the south end of the cut.

Where the flow is exposed along the northern part of the cut, it appears to the unaided eye as a pale-brown rock with conspicuous crystals of orthoclase and biotite in a fine-grained groundmass. Here and there angular fragments of similar rock may also be distinguished in the groundmass. Under the microscope a thin section shows abundant fragments and crystals of orthoclase, with a few crystals of albite, biotite, and augite in a glassy groundmass that contains much iron oxide. Quartz is absent. Specimens collected a few feet below the surface are quite fresh and free from weathering. The rock, therefore, is a common variety of rhyolite. The southern 100 ft. of the cut is distinctly lighter in color and from casual inspection appears to be a tuff or fine breccia. A thin section of the rock taken near the carnotite shows, however, that it contains the same minerals as the darker flow and is almost as fresh. The feldspars are unaltered, but the augite shows a slight change. Small cavities are lined with a crust of minute needles of an undetermined mineral that may be celestite.

The outstanding difference between the two rocks lies in the abundance of minute vesicles in the lighter phase. As the darker phase shows a gradual transitior to the lighter phase, and as conspicuous alteration is lacking, it is concluded that the lighter of these represents the border, and the darker phase the inner part of the flow. The lighter and more porous phase in which carnotite is found is probably not produced by hydrothermal alteration, as one might readily assume.

Radioactive Substance Present

Carnotite is confined to several of the more conspicuous vertical joints in the flow that trend northeast (Fig. 3). To the unaided eye, it forms a thin canary-yellow coating sporadically distributed over the surface of both walls of the joints. Under the microscope the coating appears to be made up of many groups of

Fig. 3—Railroad cut in Sec. 32, T. 23 S., R. 60 E., showing location of joints that bear carnotite

minute radiating plates. Specimens tested in the chemical laboratory of the U. S. Geological Survey show the presence of vanadium and a radioactive substance, and absence of calcium and barium. Dr. E. S. Larsen has examined the optical properties of the crystal and has determined that the plates are pseudohexagonal, and the optical character is negative. The bi-refringence is strong, and although one index of refraction is not as high as the highest in carnotite, Dr. Larsen believes that these properties justify the conclusion that the mineral is carnotite.

Here and there in the fractures, a thin layer of calcite covers the walls, and in places this is coated by the film of carnotite; elsewhere, the outer portion of the layer of calcite is mixed with carnotite. In some places, minute crystals of celestite (sulphate of strontium) cover the walls, but the relations to the carnotite are obscure. There can be little doubt that the carnotite is more recent than the calcite, however. Near by the rhyolite is weathering by the splitting off of thin curved plates, which are commonly coated with a white efflorescence of sodium sulphate. Some faint black coatings on several of the principal joints were found to be manganese oxide.

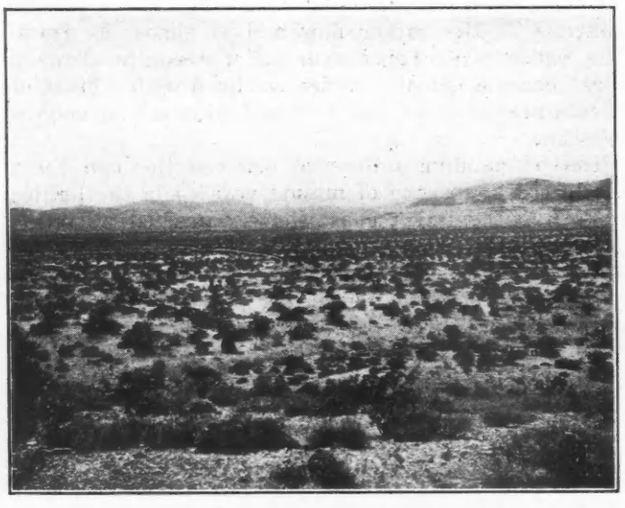


Fig. 4—View west near Sutor, toward low ridge in Sec. 30, T. 24 S., R. 60 E., in which carnotite is found. Openings on the Willabelle claim are in the middle distance

The minerals that are associated with the carnotite and their relations suggest that it has been recently deposited by downward percolation of surface waters. The source of the uranium and vanadium is obscure, for tests of both the dark and light phases of the rhyolite country rock show that they are not radioactive.

Comparison With Another Deposit

In connection with this occurrence of carnotite, attention should be called to its resemblance to that at the Atlanta mine, Atlanta district, Lincoln County, Nev. In describing this mine Hill stated[3]: "Specimens of rhyolite tuff and ore, said to have been found at a depth of 145 ft., in the main shaft, are coated on joint planes with canary-yellow, finely crystalline carnotite that contains both uranium and vanadium. It was apparently deposited in joints formed after the gold mineralization of the ore." In examining the Atlanta mine in April, 1922, I was unable to find any carnotite in place, but noted the resemblance of specimens showing carnotite with those from Sloan.

No analyses have been made to determine the quantities of uranium or vanadium in the material, because it is apparent by inspection that even though selected specimens weighing several ounces might contain as much as 1 per cent uranium, the total quantity of material of this grade in sight is represented by a few pounds rather than by tons. It is possible, however, that a small amount of exploration might yield results that would offer some hope for larger quantities.

Sutor Occurrences.—Explorations west of Sutor have shown (Fig. 1) the presence of traces of carnotite in several localities.

The first discoveries were made in November, 1921, by J. Isachsen, then living at Jean, who devoted considerable time to prospecting in Nevada and the southwest. His search for and discovery of carnotite in the region are a tribute to his persistence and keen observation. Mr. Isachsen first recognized yellow stains on red sandstone in a ravine in Sec. 30, T. 24 S., R. 60 E. The Willabelle claim was located to cover the discovery, and later, when the carnotite-bearing zone was traced southeast, the Humdinger, Lake View, and Lake View No. 1 claims were located. Later, Nelson Nunn, of Goodsprings, traced the zone a mile north and located a claim, and in April, 1922, A. J. Sieber, of Jean, made further discoveries along a lower zone in some low hills, a mile northeast. The first group of four claims is owned by Messrs. Isachsen and Sieber.

At each of these localities carnotite occurs in the sandstones that underlie the lowest Permian limestone. The Permian section is well shown along the east slope of the northward-trending group of low ridges that rises a mile west of Sutor (Fig. 4). Although it was not examined in detail, it apparently closely resembles in character and thickness that exposed at the north end of the Bird Spring Range, twelve miles northwest. On the Isachsen and Sieber claims and on the Nunn claim the zone within which carnotite has been found is about 50 ft. thick and immediately underlies the lowest Permian limestone. At the Sieber claim, a mile east, the zone is possibly 100 to 200 ft. below the base of that limestone. At each locality, the beds strike north and dip several degrees west.

The Results of Prospecting

In all, eight shallow trenches and shafts and four smaller pits have been dug on these claims and some carnotite has been found at each locality. The deepest shaft is 12 ft. deep, on the Sieber claim, and the largest trench is 5x8x15 ft. long, on the Lake View claim. Although the character of the country rock differs slightly from place to place, the associations of the carnotite are the same throughout all of the openings. At the openings on the Willabelle, Humdinger, and Sieber claims, the country rock is reddish-brown thin-bedded sandstone, although on the first claim some carnotite is found on fractures in thin beds of reddish sandy limestone. The sandstone is fine-grained, and, as the color is uniform, there appears to have been little if any reduction and leaching of iron.

No traces of fossils were found in the sandstone, although they are present in the limestone a few feet higher. Here and there, adjacent to fractures, minute films and grains of a black substance are found, which by test is shown to be manganese oxide. Elsewhere,

[3]Hill, J. M., "Notes on Mining Districts in Eastern Navada," U. S. Geol. Survey, Bull. 648, p. 119, 1916.

there are small cavities of irregular form, from which some unknown mineral has been leached.

On the Lake View and Lake View No. 1 claims the carnotite is found in buff sandstone which forms thin beds in the reddish sandstone. The sandstone has a uniform color and texture and is free from mottling or anything suggesting concretions. In some places, especially near the joint surfaces where carnotite is found, there are small dark areas due to the presence of a black cement between the sand grains. Tests show that this cement is manganese oxide.

The associations of the carnotite are the same throughout these explorations. In the buff sandstone, the film of carnotite is thinner, but forms larger patches than in the red sandstone. Most of the patches are less than half an inch in diameter, but here and there they exceed several square inches. In the larger patches, the film is commonly so thin that it merely gives a faint yellowish tint to the rock, and the texture is not discernible. The smaller patches are commonly sufficiently thick to be readily separable from the surface on which they lie. Under a glass, such films are not crystalline but clay-like, and they yield a powder when scratched. The examination of many specimens shows that carnotite and manganese oxide are commonly associated. In some specimens the film of carnotite is deposited upon sandstone impregnated with manganese oxide.

Not Rich Enough To Be Profitably Worked

More carnotite is exposed at the trench on the Lake View claim than at any other place in this region, but even at that place, there is not enough visible to be the basis of profitable exploitation. Although analyses show that uranium and vanadium are present, no quantitative determinations have been made. Probably there is not 100 lb. of rock in sight that would average 0.5 per cent uranium.

Goodsprings Occurrence.—After the discoveries were made in the Sutor area, Nelson Nunn explored outcrops of Permian beds near the town of Goodsprings, and was rewarded by discovering traces of the mineral in Sec. 14, T. 23 S., R. 58 E. About two miles north of Goodsprings, several outcrops of the Permian limestone beds form a low ridge, about 3,000 ft. long, which projects through the wash. The beds trend N. 20 deg. E. and dip 30 deg. NW. Even though the outcrops are small, they are sufficiently large to permit identification of the horizon. Two prospects are about 600 ft. apart in the saddle near the center of Sec. 14. The northern follows the dip of the beds and attains a maximum vertical depth of 10 ft.; the southern is vertical and only 8 ft. deep. The inclined prospect follows a bed of pale yellowish sandstone which overlies the top of the lower Permian limestone and, in turn, is overlain by 15 ft. of dark reddish-brown shaly sandstone and the upper Permian limestone. The vertical prospect starts in the red sandstone and the bottom is in yellowish sandstone.

Carnotite forms sporadic patches of thin film on both the reddish and yellowish sandstone, but less of the mineral occurs here than in the other areas. Of the material taken from the inclined prospect, it was estimated that only one lump in twenty-five showed a patch of carnotite. Especial interest is attached to the occurrence because the horizon is 200 to 300 ft. higher than those places at which the mineral is found near Sutor.

Specimens from each area have been tested in the chemical laboratory of the U. S. Geological Survey for radioactivity, with positive results. In order that the determinations might be confirmed, specimens from four claims in the Sutor area were submitted to the Experiment Station of the U. S. Bureau of Mines at Reno, Nev., which is especially well equipped to make tests for radioactivity. The report of Mr. C. W. Davis, of the Bureau of Mines, follows:

"All specimens coated with yellow are radioactive, while all other specimens (including some that were separated from pieces partially coated with yellow) are not noticeably radioactive by alpha ray electroscope. Although the natural leak was 1 D.P.M., the increased rate of fall of the leaf with the yellow coated specimens leaves no reason to doubt the presence of uranium.

"Willabelle Claim—caused the leaf to fall 4 D.P.M. (divisions per minute).

"Humdinger Claim—caused the leaf to fall 3 D.P.M.

"Lakeview No. 1 Claim—caused the leaf to fall 5 D.P.M.

"Lakeview Claim—caused the leaf to fall 5 D.P.M.

"Natural leak, 1 D.P.M.

"A lump which showed 5 D.P.M. was crushed and then showed about 1 D.P.M., showing that the uranium is in a coat on the surface.

"Chemical tests confirmed the presence of uranium in the yellow portion.

"Chemical tests showed the presence of vanadium in the yellow portion.

"Tests indicate that the uranium and vanadium are present as carnotite."

The feature of these occurrences of carnotite may be briefly summarized:

1. The yellow mineral near Sloan is probably carnotite, and even though that in the other deposits does not possess some of the crystalline properties of that mineral, it is probably carnotite also.

2. The only minerals associated with the carnotite except those that make up the sandstone, shale, and limestone of the country rock are manganese oxide, calcite, and celestite. Of these, only manganese oxide is persistently associated with the carnotite.

3. Carnotite has been identified on joint surfaces at three horizons that lie within a zone about 400 ft. thick in and under marine beds of Permian age. It also occurs on similar joints in a rhyolite flow, probably erupted in mid-Tertiary times.

Theory of Genesis

These relations suggest that in its present form and position the carnotite has been deposited by surface waters during recent geologic times. This examination yields no suggestion concerning the source of the uranium and vanadium that are a part of the carnotite.

The quantity of carnotite so far disclosed is small and the grade of material is too low to offer promise of profitable exploitation at present. There is a possibility that, with further search, deposits of commercial importance may be found.

Bauxite Available in Italy

Istria, Italy, is rich in bauxite, which only during the last few years has been estimated at its real value, says *Commerce Reports*. It is reported that there is every probability of a metallurgical plant being established in Istria for the extraction of aluminum from the ore. A comprehensive report on the deposits, giving analyses of the ores, has been made by Joseph E. Haven, U. S. Consul at Trieste, Italy. Copies of this report will be made available at the district offices of the Department of Commerce upon request, or will be sent to interested American firms upon application to the Iron and Steel Division, Bureau of Foreign and Domestic Commerce, Washington. Mention should be made of file No. 77,051.

Refining Gold Bullion With Chlorine at the Ottawa Mint

Introduction of the Gas Into the Molten Charge Removes Silver and Other Impurities as Chlorides, Which Float or Are Fumed Off, and Subsequently Recovered

By A. H. W. Cleave
Deputy Master, Royal Mint, Ottawa
AND
P. W. Bond
Refiner, Royal Mint

A. H. W. Cleave

P. W. Bond

THE REFINERY of the Ottawa branch of the Royal Mint was completed in 1911, the equipment being for the electrolytic deposition of gold and silver. In 1913 this process of refining the gold was suspended and the chlorine method was adopted in its place. The chlorination room is 76 ft. long x 27 ft. wide, and is fitted with sixteen chlorination, two tilter, and four melting furnaces, the chlorination and melting furnaces being on the south side, and the tilters on the north. The chlorine furnaces are fire-clay cylinders 21 in. high and 17 in. in diameter, incased in sheet iron. Near the bottom is an inlet 5 in. in length and 2 in. wide, and into this opening enters the atomized air and oil. The inside is circular, having a depth of 18 in. and a diameter of 9 in. Two inches from the top is a flue 2½x3½ in., connecting directly with the main flue which draws off the gases given off during chlorination. The main flue is a chamber 3 ft. wide x 3½ ft. high, which begins at the west end of the south wall, runs the entire length of the room, and is turned at an angle of 135 deg. to cross the east end of the room; then angled again to run up the north side. At intervals in this side of the chamber are four very fine water sprays, which wash and cool the fumes before they are finally ejected through the shaft. The latter is 54 ft. high, the inner lining being built of 30-in. earthenware pipe. Near the base is installed a 36-in. fan, with a direct drive from a 7.5-hp. motor running at 1,200 r.p.m., which draws air from the outside and forces it through a 12-in. pipe which enters the stack at an angle of 45 deg. Fitted on the 12-in. pipe, inside the stack, is a special ejector head, designed in the mint. The 15-in. intake pipe is provided with a sliding shutter, which is operated to decrease or increase the draft, according to the amount of base in the bullion being chlorinated.

The water through which the fumes have passed is carried by gravity through a series of filters and settling tanks. The filter tanks are built of concrete, and lined with pitch; having alternate layers of coke and charcoal. The settling tanks, which are also made of cement, have iron plates in them which precipitate any metal that may be in solution. The chlorine cylinders are placed in a brick closet in the chlorination room. This is fitted with a gas-proof door; also with an air-shaft, which is led outside, and with another shaft which leads into the fume chamber. These shafts carry away any leakage that may occur. A common header is connected to these cylinders, so that one, two, or three may be brought into use at one time; and, by distributing the load, there is less likelihood of their freezing. Each cylinder is under a pressure of 95 lb. per sq.in. at 20 deg. C. The chlorine is led through heavy lead pipes, which run along the top of the chamber; and above each furnace is a branch pipe fitted with a valve, so that the gas to each furnace can be operated as required.

The clay crucibles used for chlorination are 11¼ in. in height and 5¾ in. in diameter at the top, tapering to 3¼ in. at the bottom, the walls being ⅜ in. thick. The chlorine-crucible covers are made of clay, and are slotted halfway across the center, which allows the pipe stems to be inserted and withdrawn without taking off the covers.

The chlorine pipe stems are made of clay, and are 25 in. long, with an outside diameter of $\frac{7}{16}$ in. and an inside diameter of $\frac{3}{16}$ in. The center is cut out of one end, forming a notch, which allows the gas to flow more freely through the molten metal. A piece of heavy rubber tubing covers the other end, which, in turn, is connected with the branch line of lead pipe.

The chlorine test rods are made of clay, and are solid, having a diameter of $\frac{7}{16}$ in. They are used for taking the color which determines the finishing point of chlorination.

Guard pots are made of plumbago, and surround the chlorine crucibles during chlorination as a safeguard against pinholes or breakage. In the event of a leak, the bullion is caught and readily transferred to another crucible. For such emergencies a small number of these crucibles are kept at the desired temperature in one of the melting furnaces.

The chlorination-furnace covers are made of clay, in two halves, and bound with an iron ring having handles attached. One half has a ¾-in. circular opening which allows the inserting of the chlorine pipe stem without removing the cover.

A small triangular clay crucible is used for baling off the chlorides.

Rough gold bullion is accepted by the mint in all stages of fineness, varying from 1 to 99 per cent gold. Shipments are received by the mint office, and after being

weighed are forwarded to the refinery, where they are check-weighed, sent out to the rough gold-melting room, and melted under a cover of borax. The molten gold is then poured into one, two, three, or more ingots, according to weight and apparent fineness. Two assay cuts are taken from each ingot, and forwarded to the assay office, where they are assayed and, upon receipt of the assayer's report, the ingots are refined.

Method of Treating the Bullion

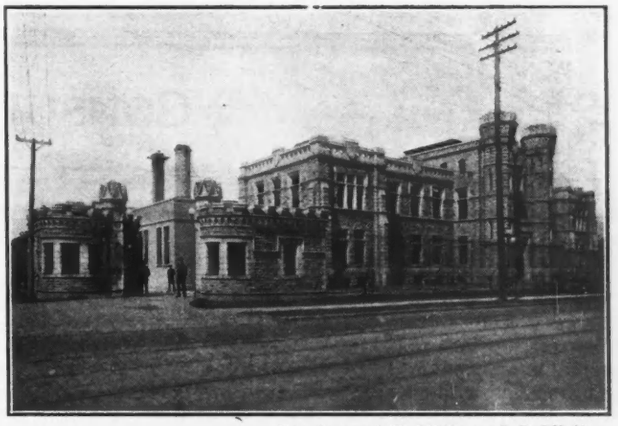
The bullion is then sent forward to the chlorination room, where 7,000 to 8,000 oz. are charged into the rough-gold tilter furnace, and melted. In the meantime, pipe stems, crucible guards, and chlorine crucibles (the latter containing sufficient borax to form a cover ¾ in. in thickness) have been placed in the furnaces, and brought to a red heat. They are then lifted, and molten bullion, weighing from 600 to 700 oz., is poured into each crucible, and placed in the furnace. The crucible and furnace covers are placed in position, the chlorine-pipe stem is put through the opening of the furnace cover, and the slot of the crucible cover is pushed to the bottom of the crucible, and held in position with a clamp. The rubber tube is then connected, and the gas turned on slowly. The amount of gas is gradually increased, until there is sufficient flow to work upon the base metals present without emitting free chlorine. The base metals are immediately attacked, causing base chloride fumes to arise in dense masses. The fumes are drawn through the furnace flues and thence into the chamber.

When the baser chlorides are practically exhausted, silver chloride is formed, which floats on the surface of the gold, below the borax cover. The finishing point is judged by the brown stain formed on a cold clay rod held in the fumes issuing from the crucible. When the chlorination is complete, the remaining silver chlorides and other impurities are baled off. A small amount of bone ash is then charged on top of the gold, which entirely cleans the surface of any remaining chlorides and borax. The crucible is then lifted, and the gold poured into an ingot mold. The chlorine pot then receives another charge of rough gold bullion, and the process is repeated.

Bullion containing 80 per cent gold, 15 per cent silver, and 5 per cent copper requires to be baled three times during chlorination; otherwise, the silver chloride would overflow. The time taken for the actual operation of chlorinating this type of bullion is 1¾ hours. Bullion containing more base takes longer, but by melting clean and dirty bullion together in the tilter, which expedites the process, a fair working bullion is obtained without difficulty.

Treatment of the Chlorides

The chlorides baled off during chlorination contain gold, which is extracted with sodium carbonate. Ten per cent of the weight of the chloride being treated is taken, the chlorides being placed in a No. 45 plumbago crucible, and melted. Sodium carbonate is then slowly charged on the top of the molten chloride. This converts some of the silver chloride into metallic silver (in form of minute beads which amalgamate with the gold), which sinks to the bottom. A second charge is made in the same manner, and it is then allowed to cool sufficiently to solidify the gold and silver. The chlorides, being still molten, are poured into an iron mold



Courtesy of Exhibits and Publicity

The Royal Mint, Ottawa

Bureau Department of Trade and Commerce, Ottawa

12x12 in., and the culôt of silver containing the gold is removed from the crucible.

The chloride cakes are placed on wooden trays, in layers, with a narrow strip of wood between each cake. The trays are placed in a wooden tank 4x2x2 ft. one end of which is separated from the rest by a perforated slide. In this compartment are placed iron plates. The cakes are covered with water, which is maintained at boiling point by a steam jet; thus the base chlorides are dissolved. The copper, together with traces of other metals, is reduced to the metallic state by the iron plates. After remaining in this tank for sixty hours, the cakes are taken out and washed, placed in another tank in alternate layers with iron plates, and reduced to metallic silver; then washed again, dried, and melted into 1,000-oz. ingots. The silver produced from reasonably clean chloride is very pure indeed, assaying 999 fine and over.

The silver culôts, which contain a small percentage of gold, are cast into anodes and treated in the ordinary Moebius cells for the recovery of the gold.

The fine-gold bars obtained from chlorination are charged into the fine-gold tilter furnace (6,000 to 7,000 oz. constituting a charge), melted, and cast into bars 8½ in. long, 4 in. wide, and 1¾ in. deep, and weighing about 500 oz., troy. The average fineness of these bars is 996.5, the difference between 996.5 and 1 000 being silver, with a trace of copper.

This chlorination plant has delivered, in one working day of eight hours, 42,000 oz. of fine gold, and in one week of 48 working hours, 205,000 oz.

Chlorination room. Chlorination furnaces on right; furnaces for rough gold and fine gold melting on left

CONSULTATION

Assessment Work Under the Law of 1921

"From the several articles which you published concerning assessment work, I gather that it was the purpose of Congress, by its act in connection therewith, to extend the annual assessment work period for a matter of six months, in connection with all mining claims located either before or since the passage of such assessment work time-extension act.

"It now appears that considerable confusion arises, as some well-informed attorneys claim that such assessment-work period was thus extended in connection with all mining-claim locations, and other equally capable attorneys contend that such is not the case."

On Aug. 24, 1921, a bill was passed making the assessment-work year coincide with the fiscal year instead of with the calendar year. It is to be noted that the law requiring performance of assessment work was completely suspended in 1917, 1918, and 1919, and that no work was necessary during those years to hold claims. But for the year 1920 the stipulated amount of work was required, and likewise for 1921, the time in which the work must be done for both of these periods merely having been extended (for the latter period incidentally by virtue of the new law) by six months.

Previous to the passage of the law of Aug. 24, 1921, the year within which work was to be performed was the calendar year beginning with the first day of January next succeeding the date of the location, and ending with the thirty-first day of December (See "Lindley on Mines," Sec. 632). According to Lindley, a location made on Jan. 1, 1903, need not have been represented until December, 1904, thus permitting the claim to be held practically two years, without the necessity of performing any work whatever, except such preliminary development as might have been required by the laws of the several states as an act of location.

The new law, however, which was signed on Aug. 24, 1921, is very definite in its amendment. It says:

"The period within which the work required to be done annually on all unpatented mineral claims located since May 10, 1872, including such claims in the Territory of Alaska, shall commence at 12 o'clock meridian on the first day of July succeeding the date of location of such claims: Provided further, that on all such valid existing claims the annual period ending Dec. 31, 1921, shall continue to 12 o'clock meridian July 1, 1922."

Suppose, therefore, that a claim was located March 30, 1921, the location work done in June, 1921, and the claim recorded June 15, 1921 (we are citing an actual case). The law at that time gave the locator until midnight of Dec. 31, 1922, to do his 1922 (or first-year) assessment work. On Aug. 24, 1921, the law quoted above was passed, and in view of its specific wording it will be seen that the locator's first-year assessment work had to be done by July 1, 1922, or six months earlier than under the old law. Thus he lost six months of the time that he would have had for doing his first year's work, had the new law not been passed. He had until noon, July 1, 1923, to do his second year's assessment work. It is confusing to call this his 1922 or 1923 assessment work, as the year now runs from July 1, noon, to July 1, noon. It is seen, though, that every claim holder whose assessment work was due under the old law to be done by Dec. 31, 1921, gained six months' grace by the enactment of the new law which changed the assessment work year to coincide with the fiscal year.

Nowhere is it stated in the new law of Aug. 24, 1921, that the assessment work period was extended six months for all mining claims. Some gained, others lost, in the change from calendar to fiscal year. Perhaps, as a matter of equity, no one should be made to lose, but the law certainly is not so worded. The intent of the lawmakers is another matter. The courts may construe the law as they see fit; but that, too, is another matter.

The Tariff on Lead Since 1883

"Will you please advise me what has been the duty on lead for the last thirty years, or notify me where I can get this information? I understand that the present duty is 2½c. per lb. on pig lead imports and 1¼c. per lb. on lead in ore. Also, before the present tariff went into effect I believe that there was a straight duty of ⅜c. per lb. on lead whether in pig or on ore."

The following table, which is partly taken from a report of the United States Tariff Commission, shows the rates of duty that have been placed by Congressional action on lead imports since 1883:

Lead Tariff Classification and Description

			Rate
1883	188	Lead ore and lead dross	1½c. per lb.
1883	189	Lead, in pigs and bars, molten and old refuse lead run into blocks and bars, and old scrap lead fit only to be remanufactured	2c. per lb.
1890	199	Lead ore and lead dross	1½c. per lb.
1890	200	Lead in pigs and bars, molten and old refuse lead run into blocks and bars, and old scrap lead fit only to be remanufactured	2c. per lb.
1894	165	Lead ore and lead dross	¾c. per lb.
1894	166	Lead in pigs and bars molten and old refuse lead run into blocks and bars, and old scrap lead fit only to be remanufactured. *Provided*, That in case any foreign country shall impose an export duty upon . . . lead dross . . . exported to the United States from such country, then the duty upon such . . . lead in pigs and bars, molten and old refuse lead run into blocks and bars, and old scrap lead fit only to be remanufactured, herein provided for, when imported from such country, shall remain the same as fixed by the law in force prior to the passage of this act.	1c. per lb.
1897	181	Lead bearing ores of all kinds, of the lead contained therein	1½c. per lb.
1897	182	Lead dross, lead bullion or base bullion, lead in pigs and bars, lead in any form not specially provided for in this act, old refuse lead run into blocks and bars, and old scrap lead fit only to be remanufactured; all the foregoing	2½c. per lb.
1909	181	Lead bearing ores of all kinds, on the lead contained therein	1½c. per lb.
1909	182	Lead dross, lead bullion or base bullion, lead in pigs and bars, lead in any form not specially provided for in this act, old refuse lead run into blocks and bars, and old scrap lead fit only to be remanufactured; all the foregoing	2½c. per lb.
1913	152	Lead bearing ores of all kinds containing more than 3 per cent of lead	¾c. per lb.
1913	153	Lead dross, lead bullion or base bullion, lead in pigs and bars, lead in any form not specially provided for in this section, old refuse lead run into blocks and bars, and old scrap lead fit only to be remanufactured; all the foregoing	25 per cent ad valorem
1922	392	Lead bearing ores and mattes of all kinds. (The duty would not apply to lead contained in copper mattes unless actually recovered)	1½c. per lb.
1922	393	Lead bullion or base bullion, lead in pigs and bars, lead dross, reclaimed lead, scrap lead, antimonial lead type metal, babbitt metal, solder, alloys, not specifically provided for	2½c. per lb.
1922	393	Lead in pipes, sheets, shot, glaziers' lead, lead wire	2½c. per lb.

THE PETROLEUM INDUSTRY

Daily Average Crude-Oil Production Estimated

An estimate that the daily average gross crude-oil production in the United States for the week ended Jan. 20 was 1,736,900 bbl. has been made by the American Petroleum Institute. This is compared with 1,751,350 bbl. for the preceding week, a decrease of 14,450 bbl. The daily average production east of the Rocky Mountains was 1,206,900 bbl., compared with 1,226,350 bbl., a decrease of 19,450 bbl. California production was 530,000 bbl., compared with 525,000 bbl., an increase of 5,000 barrels.

The following are estimates of daily average gross production for the weeks ended Jan. 20, Jan. 13, 1923, and Jan. 21, 1922:

Daily Average Petroleum Production in United States, in Barrels

	1923			1922
	Jan. 20	Jan. 13	Difference	Jan. 21
Oklahoma	407,850	401,950	Inc. 5,900	325,900
Kansas	83,200	84,150	Dec. 950	83,350
North Texas	57,400	58,550	Dec. 1,150	60,900
Central Texas	127,700	128,800	Dec. 1,100	214,250
North Louisiana	72,000	75,100	Dec. 3,100	94,450
Arkansas	118,000	121,150	Dec. 3,150	36,950
Gulf Coast	123,700	125,800	Dec. 2,100	107,400
Eastern	114,000	113,500	Inc. 500	115,500
Wyoming and Montana	103,050	117,350	Dec. 14,300	54,500
California	530,000	525,000	Inc. 5,000	325,000
(a) Totals	1,736,900	1,751,350	Dec. 14,450	1,418,200

(a) Daily average production.

The estimated daily average gross production of the Mid-Continent field for the week ended Jan. 20 was 866,150 bbl. as compared with 869,700 bbl. for the preceding week. Mid-Continent production, excluding Smackover, Ark., which is mostly heavy oil, was 769,450 bbl., against 770,500 bbl. The production of the Gulf Coast field was 123,700 bbl., as compared with 125,800 bbl. The combined production of the Southwest field was 989,850 bbl., as compared with 995,500 bbl. The production of the Wyoming and Montana field was 103,050 bbl., against 117,350 bbl. the preceding week.

Imports of petroleum (crude and refined oils) at the principal United States ports for the week ended Jan. 20 totaled 1,993,157 bbl. (of 42 gal.), a daily average of 284,737 bbl., compared with 1,777,901 bbl., a daily average of 253,985 bbl., the week ended Jan. 13.

Receipts at Atlantic Coast ports were 1,037,839 bbl., a daily average of 148,263 bbl., against 1,346,901 bbl., a daily average of 192,414 bbl., for the week ended Jan. 13.

Receipts at Gulf Coast ports were 955,318 bbl., a daily average of 136,474 bbl., against 431,000 bbl., a daily average of 61,571 bbl., for the week ended Jan. 13.

New Concession in Angola

The Companhia de Mozambique (Ltd.), in which British capital is said to be largely interested, has recently organized a subsidiary known as the Companhia Concessions de Petroleo de Angola to exploit its petroleum concession in Angola, Portuguese West Africa, which covers the whole of the province not previously conceded, according to *Commerce Reports*. The Companhia de Petroleo de Angola was granted a concession for exploitation of the northern part of the province by a decree published in April. The contract entered into by the Companhia de Mozambique provides that the operating company's initial capital must be at least 2,500,000 escudos, par value specified, and the life of the concession is five years, which may be followed by an additional five years if the company has carried on intensive exploitation during the first period. The company may exploit for an unlimited period all petroleum deposits which it may discover and legally register within five years, and is obliged to establish a refinery in Angola within two years from the beginning of exploitation.

Roma Hole, in Queensland, Dry

SPECIAL CORRESPONDENCE

In the course of a survey of the prospective oil fields of the Australian Commonwealth, Sir Edgeworth David, professor of geology in the Sydney University, stated that the great obstacle to obtaining payable oil at Roma, in Queensland, is the large volume and consequent pressure of artesian water, which holds down the oil and natural gas and prevents their egress to the surface. Another geologist confirms this opinion, and adds that it was clearly an initial mistake to put this bore down within 300 ft. of a "live" water bore. The latter adds that this site would never have been chosen had qualified oil geologists been consulted, strongly exculpates any of the drillers who have been connected with the bore from any blame for its failure, and expresses the opinion that the government was particularly fortunate in having obtained the services of W. H. Whaley, the driller who was engaged in California to start the bore. Up to the present nothing has come of the attempts to explore the country at 3,750 ft., where what was hoped were favorable indications of oil were found some months ago, and the government is now considering what is to be done in the future. Dr. Duncan Milsom, from Los Angeles, has described the Roma bore as "a forlorn hope," and the probability is that it will be abandoned.

Dr. Jensen, of the Queensland Geological Survey, has suggested that better chances of success for future oil prospecting operations lie further north of Roma, where the oil beds come nearer to the surface, and where, if prospecting proves succesful, the extent of the oil-bearing country will probably be considerable. Professor David, however, says it does not necessarily follow that any payable field will be found in this region, but points out that the greater part of it has shown not merely indications but definite proof that oil is locally present, and that there is every reasonable prospect that when geological structures are suitable pools of oil will occur. It is in this locality that Dr. Milsom has taken up leases, and he is positive he will find oil in commercial quantities within twelve months.

Societies, Addresses and Reports

Plan International Engineering Congress for Philadelphia

Representatives of National Societies Discuss Scope of Meeting That Is To Be Held in 1926

A conference on plan and scope for an International Engineering Congress to be held at the time of the Sesquicentennial Celebration in Philadelphia in 1926 was held in New York City on Jan. 9. Richard L. Humphrey occupied the chair. The movement to hold the conference was initiated by the Engineers' Club of Philadelphia in December, 1921, and an invitation was extended to the four Founder Societies and the American Society for Testing Materials. Each society appointed two representatives to meet with a committee of the club in Philadelphia to formulate plans.

At the conference the topics discussed included the scope of the meeting, finance, relation of meetings of engineering societies to the sessions of the congress, and publicity. Twenty-five or thirty leading engineers expressed their views. It was pointed out that the meeting represented another step toward bringing the engineers of the world together, taking up the threads of contact that had been broken by the war; that it was necessary to develop a program that would emphasize the broader relations of the engineer to the public rather than the development of a large number of technical papers, and that the opportunity exists to make engineers abroad acquainted with actual engineering achievements in this country and to work out in connection with the proposed congress a tour of the different industrial cities to give visitors an opportunity to see our engineering works.

Those taking part in the discussion included H. Foster Bain, Director of the U. S. Bureau of Mines; A. R. Ledoux, Charles F. Rand, and Fred M. Feiker, assistant to the president of the McGraw-Hill Co.

Refractories To Be Discussed by Ceramic Society

The American Ceramic Society will hold its "Silver Jubilee" convention in Pittsburgh, Pa., Feb. 12-16, at the Hotels William Penn and Fort Pitt. Thirty-six papers are included in the program of the Refractories Division. Some of these are: "Analysis of High Alumina Ores and Refractories," by C. A. Underwood; "Testing Refractories," by W. J. Rees, Sheffield, England; "Prospecting for Fire Clays," by E. W. Hess; and "Quartzite of the Baraboo Range," by W. O. Hotchkiss. There will also be a symposium on "Metallurgical Requirements of Refractories," led by Dorsey A. Lyon, chief metallurgist and supervisor of experiment stations U. S. Bureau of Mines.

Engineer Cohesion Between South and North America

One of the results most hoped for from the International Engineering Congress in Rio de Janeiro was the establishment of closer relations between the engineers of the Americas. A tangible proof that this has resulted is seen in the election of the following North American engineers to membership in the Club de Engenharia, an organization which would correspond to an amalgamation of the four national societies here in the United States of North America.

As corresponding members: J. E. Spurr (A.I.M.E.), editor, *Engineering and Mining Journal-Press;* Louis J. Hirt (A.S.M.E.), engineer, Pearson Engineering Corporation.

As honorary members: Verne L. Havens (A.S.C.E.), editor, *Ingeniería Internacional;* A. W. K. Billings (A.S.C.E.), Canadian & General Finance Co., Ltd. (Toronto); Edward Wegmann (A.S.C.E.), consulting engineer; Samuel M. Vauclain (A.S.C.E.), president, the Baldwin Locomotive Works; and Calvin W. Rice (A.S.M.E.), secretary of the A.S.M.E.

Ontario Engineers Choose Officers for Current Year

The recently organized Association of Professional Engineers of Ontario held its first annual meeting on Jan. 8, in Toronto. The report of the secretary showed a membership of 478, of which 296 were civil engineers, 50 mining, 38 mechanical, 16 chemical, and 90 electrical. Applications for membership had been received from 115 others. Officers were elected as follows (each of the five branches choosing two members to the council): President, Willis Chapman, Toronto; vice-president, F. P. Ewart, Toronto; registrar and secretary-treasurer, R. B. Wolsey, Toronto. Councilors elected for the mining branch were: J. A. Reid, of Cobalt, and D. E. Keeley, of Schumacher.

Colorado Mining Organizations Elect Officers

At the annual meeting of the Colorado Metal Mining Association, held in Denver, Jan. 16 and 17, George A. Stahl, assistant manager of the Metals Exploration Co., was elected president; Jesse F. McDonald, manager of the Down Town Mines Co., Leadville, first vice-president; R. M. Henderson, general manager of the Wellington Mines Co. at Breckenridge, second vice-president; Bulkeley Wells, third vice-president; A. M. Collins, treasurer, and M. B. Tomblin, secretary.

The Colorado Chapter of the American Mining Congress elected George E. Collins, general manager of the Mary Murphy mine, governor; J. F. Welborn, president of the Colorado Fuel & Iron Co., first vice-governor; Charles A. Chase, second vice-governor, George A. Stahl, third vice-governor, A. M. Collins, treasurer, and M. B. Tomblin, secretary.

Men You Should Know About

Frederic R. Weekes has gone to Nevada on professional business.

H. A. C. Jenison, geologist in charge of copper, U. S. Geological Survey, is in San Francisco.

D. M. Liddell, of Weld & Liddell, New York, was recently in Chicago on a short business trip.

L. W. Wickes, mining engineer of Los Angeles, has been in Reno, Nev., on professional business.

Elwood Wilson has become manager of the Black Lake Asbestos & Chrome Co., at Black Lake, Quebec.

Charles E. Knox, president and general manager of the Montana Tonopah Mines Co., is in Tonopah.

C. M. Weld, of New York, has returned from a professional visit to the soft-coal fields in West Virginia.

A. W. Newberry has returned to New York after an absence of six months in the West, and will remain in the East for the next year.

Louis D. Huntoon left last week for the Porcupine gold area of Ontario, where he will be engaged on professional work for about three weeks.

A. M. Sen, senior geologist of the State of Mysore, India, is visting Ottawa in the course of an American tour undertaken to study geological conditions and other matters here.

Walter B. Congdon, of the Iron Field Co., has left Duluth for a visit to the company's property on the Isle of Pines, West Indies, where extensive development work has been carried on.

George M. Humphrey and **R. S. Walker,** of Cleveland, a member of the firm and consulting engineer respectively of the M. A. Hanna Co., were recent visitors on the Mesabi iron range on a tour of inspection of the company's properties.

C. H. Macnutt has resigned as manager of the Vimy Ridge mine of the Bennett Martin Asbestos & Chrome Mines, Ltd., to become assistant general manager of the Asbestos Corporation of Canada, with headquarters at Thetford Mines, Quebec.

C. W. Goodale has retired from active service with the Bureau of Safety of the Anaconda Copper Mining Co., and **John L. Boardman** has been appointed chairman in his place. Mr. Goodale will continue his connection with the department in an advisory capacity.

O. D. Street, well known for the last ten years as general manager of distribution of the Western Electric Co., has been elected vice-president of the McGraw-Hill Co., in executive charge of the *Electrical World, Electrical Merchandising, Journal of Electricity and Western Industry, Industrial Engineer, Electric Railway Journal,* and *Bus Transportation.*

Dr. Bailey Willis, professor emeritus of geology of Stanford University, and president of the Seismological Society of America, sailed on Jan. 11 for Chile and Peru. He is going to the scene of the recent Chilean earthquake under the auspices of the Carnegie Institution, of Washington, to study the effects of the great quake and to ascertain the conditions which caused it.

Edward Loye, of the Oliver Iron Mining Co., has been elected president of the Engineers' Club of Northern Minnesota. **L. C. Moore** and **C. J. Calvin,** both of Hibbing, were named vice-president and secretary-treasurer, respectively. Directors of the club named are: **R. J. Moore,** of Hibbing; **W. E. Bates,** of Chisholm; **F. R. Mott,** of Virginia, and **W. J. Kaiser,** of Eveleth.

Mining and metallurgical engineers visiting New York City last week included: **L. A. Harris,** of Eureka, Nev.; **R. S. Ord,** of Spokane; **Oliver Bowles,** of Washington, D. C.; and **Charles Janin,** of San Francisco.

OBITUARY

Walter Scott Grether, for six years assistant mine superintendent for the Butte & Superior Mining Co. at Butte, Mont., died on Jan. 11, after a brief illness. He was born in Bunker Hill, Ill., in 1882. "Scotty" Grether was highly regarded both for his ability as an engineer and for his engaging personal qualities by officials of the Butte & Superior company; he was also unusually popular among the men whose work he directed for many years. He was a graduate of the Missouri School of Mines, at Rolla, and had most of his experience in the West. He was a Mason and a member of the A.I.M.E. He is survived by his wife, Irene Browning Grether, and two children, a boy twelve and a daughter three.

Robert D. Jackson, mining and oil engineer, who was recently injured in an automobile accident near Corpus Christi, Tex., died in a hospital in that city on Jan. 15. Mr. Jackson was president of Gray Ridge Oil Co., of San Francisco. He had just finished boring a well on the West Ridge lease near San Diego, Tex., and was on his way to the property for the purpose of making a final test when his car overturned.

Mr. Jackson was a native of Brooklyn, N. Y. He went to Berkeley when he was sixteen years old and was graduated from the School of Mines of the University of California with the class of 1882. The same year he went to Mexico to take charge of a silver mine at Parral, where he remained for twelve years. He later was engaged in mining in Nevada, and at one time was president of the university of that state. He also served as State Senator in Nevada.

Jim Butler, Discoverer of Tonopah

Jim Butler passed out—"went over the Range"—at Sacramento on Jan. 22. He was sixty-seven. Jim had been a prospector, and was the discoverer of Tonopah. The story of the discovery is somewhat garbled in the newspapers—not that it matters much to Jim. But the facts are these. He had left his headquarters in Austin to go to a little camp, the Southern Klondike, which never became prominent. He camped, with his burros, on the "wash" below where now is Tonopah. Of course he turned out his burros to nibble desert plants, as burros will consent to do. In the morning, according to custom, Jim had to ramble over the low hills above his camp to get his burros, and in picking up stones to herd the burros back, as the custom is, he chanced upon quartz and likely outcrops. The specimens were not "rich in virgin silver," as the newspapers have it, nor were they located "on the hill known as Mount Oddie," nor did Mrs. Butler knock them off. There are no veins on Mount Oddie. Quartz is quartz to a prospector, however, and Jim took the samples to an assayer in the Southern Klondike camp, who soon pitched them out of the window. On his way back to Austin, Butler collected other samples. There was an assayer in Austin, but Jim's credit was no firmer there than in the Southern Klondike camp.

In spite of the absence of "virgin silver," the quartz looked "live" to Jim. He had a friend in Austin, one Tasker L. Oddie, a young man who was trying to break into mining by the single-jack route. To him he went and promised an eighth interest for the price of an assay. Oddie's finances were hardly more plethoric than Butler's, but having been trained as a lawyer, he persuaded the assayer to make an assay for one-half of his eighth—viz., one-sixteenth. The assay ran very high; whereupon Butler determined to make another trip to formally locate claims on his find. Before he got under way, however, the assayer at the Southern Klondike, hearing rumors, recovered his samples, and assayed them, finding them rich. Recalling Butler's description of the locality whence they came, he set out to find the source and locate claims for himself, but he could not find the place, and returned. Finally, Mrs. Butler, an energetic woman, roused Jim to make the trip and locate the claims.

Their richness was at once apparent, and "experts" came to inspect—perchance to buy. One such visited Butler when he was five feet deep in a location hole. Jim squinted up at the "expert" standing against the glaring desert sky. "Well, what d' ye think about her," asked he. "She won't go down." answered the faint-hearted emissary of "capital." Jim spat on his hands and raised his pick for another blow. "Well," quoth he, philosophically, "I'm damned sure she won't go up!"

He was a kindly man, and a just, who inspired kindliness and justice. Men came, eager to get in on the find. Neither Jim nor his partners had any money, so Butler leased his ledges in sections, for the ore was rich "shipping ore," well worth hauling a hundred miles by wagon to Sodaville, and shipping thence to San Francisco or Salt Lake. Jim allotted these leases verbally, as to terms and space. "You take so many feet here," he would say, "and pay me so much royalty"; and that was all there was to the transaction.

When it soon turned out that these leasers were putting in great crews, were running feverishly during the time allotted, were making fortunes for themselves, and threatening to gut the mine, Jim remained tranquilly firm to his word and to his friendships. When he sold his property, as he soon did, he safeguarded in the deal each man with whom he had ever had a verbal understanding or had passed a binding word.

He later bought a fine ranch in Fish Lake Valley, west of Tonopah—a desert oasis—and went there to enjoy life. Yet he loved Tonopah and liked to visit there, and to gather great groups of friends and take them into a saloon for a drink—happy and proud to spend good gold pieces. He loved the prospector and the miner and dreamed of doing great things for them—but he loved others equally. As to his partners whom we mentioned: while Butler got his ranch, Oddie—another just and kindly man—did not keep his Tonopah-earned fortune, but is now in the United States Senate, having before been a Governor of Nevada. He campaigned the state for Governor in a flivver, and his funds were not sufficient to pay for gasoline, which was contributed by his friends, from camp to camp. These were his campaign expenses—easily accounted for. He has filled these positions, speaking simply and without flourish, because he was loved and trusted in Nevada. The assayer at Austin received $32,000 in cash for his assay—his sixteenth casually promised him. And thus goes a fine clean story, which I know to be true, since I knew these men personally and long.

Jim Butler made a trip East once, after his prosperity. He even penetrated as far as New York. His friends steered him around, and finally asked what he thought of it. "Well," observed Jim, judicially, "looks like she'd make a permanent camp."

J. E. SPURR.

Ellsworth Daggett, of Salt Lake City, died Jan. 6 at New Haven, Conn.

Santiago G. Purcell, director of La Compañia Minera "La Constancia" S. A., died in New York on Dec. 31.

Peter Ruppe, treasurer of the Calumet & Arizona Mining Co. and of the New Cornelia Copper Co., died on Jan. 26, in Calumet, Mich. He had been associated with these companies as a director since their organization.

THE MINING NEWS

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Leading Events

THE "Coolbaugh Process" plant at Durango, Colo., is nearing completion. It is expected that many zinky ores hitherto unprofitable will be amenable to the process. Ultimately, custom ores will be accepted.

Judge Bourquin signs an order restraining both the Davis-Daly and Anaconda companies from mining in area involved in litigation just started.

Construction work on the Sullivan concentrator at Kimberley, B. C., progresses rapidly.

Misleading publicity apropos of the Teck-Hughes Orr deal draws unfavorable comment.

Large orders for heavy ore-handling equipment indicate busy season on the Mesabi iron range.

Large British corporations acquire control of company planning to exploit old Comstock Lode mines in Nevada. A project similar to the United Comstock is planned.

In Nevada, three new mills are in course of construction.

The Nevada Consolidated company expects to produce at the rate of 6,000,000 lb. of copper per month.

Canadian bankers acknowledge the wisdom of financing legitimate mining ventures. Industry of great importance to the Dominion.

Reasonable "blue-sky" legislation in Colorado is being advocated by the Colorado Metal Mining Association.

"Coolbaugh Process" Plant Nears Completion

Applicable to Many Complex Ores—Arrangement Will Be Made to Purchase on Custom Basis—Outline of the Process

Special Denver Correspondence

THE new plant at Durango, Colo., that will treat complex ores by the Coolbaugh process, should be completed and in operation by May 1, according to a statement made at the annual meeting of the Colorado Metal Mining Association in Denver by Howard H. Fields of the American Smelting & Refining Co.'s staff.

He related how Mr. Coolbaugh and associates had developed the sulphating idea to a point where they interested Bulkeley Wells and associates, who carried it to a semi-commercial stage. At this point the A. S. & R. Co. was asked to investigate it, and did so, thoroughly. Its engineers and metallurgists were convinced of the value of the process, and today the Complex Ores Recoveries Co.—composed of the inventors, Mr. Wells and associates, and the A. S. & R. Co.—is building the first 40-ton unit of a plant, at Durango, Colo., at a cost of over a quarter of a million dollars, to try the process on a commercial scale.

The process itself is simple. The finely crushed ore or concentrate is roasted in a Skinner multiple-hearth furnace, with the roast so controlled that the metals are converted to sulphates. The hot calcine from the furnace is then leached with water and agitated. Zinc and copper sulphates are soluble in water, whereas other sulphates, and other elements of the ore, are not. Lime or zinc oxide is added to the agitated solution, and the soluble copper is precipitated as copper oxide, with the rest of the residue.

The zinc sulphate, which is the only soluble compound left, is filtered off, and the residue, containing all the gold, silver, lead, and copper, with a little zinc, is ready to be agglomerated on the Dwight-Lloyd sintering machines. The resulting product is then smelted in the regulation lead blast furnace.

The solution containing the zinc sulphate is treated in a Spray drier, where the zinc sulphate crystallizes. This method of crystallizing zinc sulphate produces a sulphate containing only two molecules of water of crystallization, in place of the normal seven, which is a saving of 10 to 20 per cent, when the shipment of the zinc sulphate is considered. Present plans assume that this zinc sulphate will be marketed as such, but, of course, tests now being carried on may determine other forms of zinc which can be produced and sold.

"Naturally," said Mr. Fields, "the average miner wants to know first of all how the process will affect his own individual ore. I am not able to make any blanket statements on its universal application; but, about the middle of this year, we will be ready to look into its applicability to other ores and concentrates. The probable procedure will be for the interested miner to send a small sample to the testing laboratories, where preliminary tests on his ore will be made. If these are successful, a trial shipment of 50 or 100 tons will be arranged. This will be sent to Durango, to be purchased on a basis to be determined later. The plant will be put on this ore exclusively, so as to determine the recoveries and costs as a basis for future purchase, if the treatment is successful. Eventually, as enough ores are found, the plant will be enlarged to accommodate them.

"It is impossible to predict the financial basis on which ores will be purchased for treatment under this sulphating process, until cost figures from actual operations are available. However, we hope to be able to place zinc in the credit class, wherever the ore is adaptable for treatment by the sulphating process. This is a step in the right direction, and should make available many complex ores which cannot now be mined and smelted."

Curtailment of Women's "Rights" Proposed in India

The report of the Joint Committee submitted at Delhi, India, on the bill to amend the existing mining laws, proposes much wider definition of the word "mine" to include shallow open cuts, according to Reuters. The committee is of the opinion that the absolute prohibition of women from working underground is merely a question of time, and recommends that local governments consider this matter with a view to making such provision within five years. The minimum age of children working above ground is maintained at thirteen years, but children are prohibited from working below ground altogether.

British Interests Buy Control of Comstock Properties

Middle Mines Group and Other Claims Included in Deal—Exploitation on Large Scale

Formal announcement has been made that the Gold Fields American Development Company, Ltd., and the National Mining Corporation, Ltd., both of London, have entered into a contract for the purchase of a controlling interest in the Comstock Merger Mines, Inc., recently created by Charles V. Bob, a mining engineer of New York, to take over and re-work by present day large-scale mining and milling methods fifteen properties controlling about 10,000 ft. along the famous Comstock Lode, at Virginia City, Nev., adjacent to the property now being exploited by the Metals Exploration Co.

Under the old methods of mining and milling, it was impossible profitably to extract ore that had a value less than $20 a ton, but with the present day methods, the orebodies can probably be re-worked at a profit.

Thomas F. Cole, formerly of the Cole-Ryan Syndicate; Charles M. Schwab, Dr. H. R. Ward, president of the Tonopath Extension Mining Co., and others, are said to have spent $150,000 in preliminary work on a part of the property. It was after this work had been completed that the Gold Fields American Development Co., Ltd. and the National Mining Corporation, Ltd., became interested in acquiring control and finally entered into an arrangement whereby they will manage and develop them. Frederic R. Weekes, engineer for the Gold Fields American Development Co., Ltd., has gone to Nevada to direct operations on behalf of the Gold Fields American Development Co., Ltd. The properties in the merger include fifteen claims, namely: the Bullion Mining claim to the Sutro Tunnel level, the Best & Belcher, the Savage and the Gould & Curry claims to the 1,000 levels, the Caledonia, the Caledonia Annex, the Front Lode and the Chollar, Hale & Norcross, the Potosi, and the Lady Washington and Alta group of claims.

Largest High-Pressure Pumps Go to Bisbee

The Calumet & Arizona Mining Co. has purchased three Prescott pumps for installation in the Junction shaft at Bisbee. One of the pumps will deliver 1,500 gal. per minute, and other two units will each have a capacity of 1,000 gal. per minute, against a vertical head of 2,300 ft. They will be placed on the new 2,300-ft. station and will pump the water direct to the surface in one lift. The water ends of the pumps will be made of steel forgings in order to insure safety in pumping against such tremendous pressure. This pressure, including static and friction, will be practically 1,200 lb. per sq.in. It will require a 1,000-hp. motor to drive the large pump and motors of 750 hp. for each of the other two. They will be synchronous motors, and the power will be applied to the pumps through single reduction, herringbone, helical gears. These pumps are an inovation in mining practice in that they are larger, considering the pressure against which they are going to pump, than any pumping equipment that has ever been installed in any mine. A large proportion of the water in the Bisbee district finds its way into the Junction, there being practically no water to handle in the other mines, but the pumping cost is borne by both the Calumet & Arizona and Copper Queen companies, which together own most of the properties that are being operated.

Blue-Sky Law Likely to Pass Colorado Legislature

Measure Provides for Filing of Sworn Statement of Facts—No Commission To Pass Upon Worth of Shares

During the last decade there has regularly been at each session of the Colorado Legislature a more or less insistent demand for blue-sky legislation. Various measures have been proposed, but conflicting opinions regarding the primary purposes of such legislation, or of the principles on which it should be based, have prevented agreement. Practically all of the proposed legislation of this nature in the past was based upon the creation of an agency, or commission, to pass upon or authorize the issue of securities. Opposed to these measures were those who believed that no commission can be created that could justly say whether the average promotion at its inception was good or bad, and that blue-sky legislation should comprise nothing more than rigid laws against fraud and misrepresentation, with proper and adequate penalties for violation, and the filing of a declaratory statement containing essential facts regarding a promotion, before its securities could be offered to the public.

Responding to the demand for such legislation, the Legislative Committee of the Colorado Metal Mining Association has prepared a bill, which has been introduced at this session of the Assembly. It is believed that this measure will not prove burdensome to the honest promoter, and will, on the other hand, facilitate the apprehension and conviction of the rogue or peddler of fake promotions. Its provisions are in line with the ideas of those who opposed a commission or agency for authorizing the sale of securities, and provide only that the promoter shall lay his cards upon the table, face up, leaving the investor to form his own opinion as to whether the security is desirable or not. A declaratory statement must be filed, which becomes the basis for prosecution in case of fraud or misrepresentation. Much thought and care has been given in the preparation of the bill, and it is believed that it will secure sufficient support at this session of the Legislature to become a law.

Brokers Will Get $255,000 Cash for Orr Shares

Fact Not Included in Original Announcement—Tech-Hughes Orr Deal Subject to Criticism

Further details regarding the purchase of the Orr property by the Teck-Hughes Gold Mines, of Kirkland Lake, Ontario, does not show the transaction in quite as favorable a light as the original announcement, which came from one of the interested parties. It was stated that the Teck-Hughes capital was to be increased from 4,000,000 shares of $1 par to 5,000,000 shares and that the consideration for the Orr was to be 600,000 shares. It is now learned, however, that the 600,000 shares of Teck-Hughes is to purchase only the stock of Conrad E. Wettlaufer, of Buffalo, who owns 1,050,000 shares of the Orr Gold Mines, which has a capital of $2,000,000 in $1 shares. Arthur E. Moysey & Co., who own 730,000 shares, are to receive $255,000 cash, and considerable criticism is being directed against the Teck-Hughes for not having made a public announcement of these facts.

In addition to the two large holders mentioned, there are about 93,000 shares in the treasury. The Teck-Hughes owns 66,000 shares, and this leaves 61,000 shares in the hands of the public, and these will also have to be purchased, unless the Teck-Hughes carries the Orr as a separate company. The Teck-Hughes still has bonds outstanding, and if $255,000 cash, in addition to the 600,000 shares of stock, has to be paid for the Orr, the question of dividends for Teck-Hughes will have to be shelved for a further considerable period.

Reserves on the Orr property are stated to be $2,000,000, and as the main vein of the Teck-Hughes passes through the corner of the Orr, the property will be a valuable acquisition to the operating company. Teck-Hughes production for December was $83,000, and a substantial profit is being made on current operations.

Indications of Platinum Deposits in Spain

By Cable from Reuters to "Engineering and Mining Journal-Press"

Madrid, Jan. 20.—According to news received in mining circles, borings in the Serrania de Ronda, in the Province of Malaga, in search of platinum have given satisfactory results, demonstrating the existence of the metal in appreciable quantities.

U. V. X. Finds Good Shoot of Gold-Silver Fluxing Ore

The United Verde Extension, at Jerome, Ariz., has cut a body of gold ore on the 900 level that is believed to extend down to the 1,500 level. The ore is high in both silica and iron, which is a product that has been badly needed for flux at the company's smelter, and is said to contain an average gold and silver value of $15 per ton.

Sullivan Concentrator Nears Completion

Plant at Kimberley, B. C., Will Be Model for Permanent Construction —Economies of Transportation—Preferential Flotation Used

By Robert Dunn

THE construction of a cencentrator at Kimberley, B. C., to treat the ores of the Sullivan mine is the outstanding new work of the Consolidated Mining & Smelting Co., of Canada. This plant will have a capacity of between 1,500 and 2,500 tons a day. It will be of steel construction throughout, and will have the most modern equipment. Sometime during the early part of this year it will be ready for operation. It will contribute largely to the economical handling of the ores of the Sullivan, one of the largest lead-zinc properties on the continent.

One great objective is the saving of transportation costs. At present the ore as mined is shipped for treatment to the Trail smelter. When the new plant starts concentrates only will be shipped and the 1,000-ton mill at Trail will be available for handling ore from the Rossland mines, owned by the company.

In looking at the lay-out on the map, "hill," "tunnel," and "concentrator" would be at three points of a triangle. The "hill" is the old portion of the mine, with its own connections and shipping facilities. The "tunnel' is the portion of the mine worked through the big crosscut that was driven about three years ago, on the 3,900 level. A raise from the tunnel broke through into the "hill" about twenty months ago, and the bulk of the ore will eventually come out through the lower level.

In preparation for the increased output, the movement of ore underground in the tunnel has been reorganized by increasing the gage of the electric railway to 3 ft., and installing 500-volt locomotives. These have to haul the ore from a point approximately two miles in. The mine has also been electrified throughout, and two new 3,000-cu.ft. d.c. air compressors have been installed, their location being at the tunnel.

The ore from the tunnel is dumped into a 900-ton receiving bin, from which it is fed into a 36x42-in. Buchanan jaw crusher, the product of which passes into two No. 8 Gates crushers. The product from this primary crushing is carried to a railway shipping bin holding 2,500 tons, just completed.

To get the crushed ore from this point to the receiving bins at the concentrator, which is about two miles beyond Kimberley, a railway three miles long has been built. A line has also been built from Kimberley to the receiving bins. There is a third railway link, which connects the C. P. R. at a point below the site of the Taylor mill, with the concentrator's shipping bins. This last line will be used both for shipping concentrate and for bringing up coal for the boiler plant.

The concentrator is over 700 ft. long, down the stope, and 110 ft. in width. Structural steel, gunited walls, concrete footings, concrete floors, and concrete bases are used, constituting the most permanent and indestructible type of structure. The roofs are as nearly fireproof as possible, with two-by-four lumber laid on edge, and a final covering of felt, tar, and gravel. This same type of construction is used in all the new buildings.

When the plant starts operation, the crushed ore, arriving at the millsite, will be weighed on 150-ton scales of the Fairbanks suspension type, and will then pass into a 1,000-ton receiving bin, which has been blasted out of the rock. Conveyors will feed it into two 72x20-in. Garfield Alaska type rolls, arranged in series.

By means of other conveyors, the product from the rolls will be elevated and distributed into a 2,500-ton receiving bin, which is a sort of cupola upon the concentrator. Pulley feeders will feed into 8x48 in. Hardinge conical ball mills.

Differential flotation will be employed with the use of alkaline solutions, as done at the experimental zinc mill at Trail, which for the last year or more has been successfully treating 1,000 tons per day of the Sullivan refractory ore. For refractory qualities, the Sullivan ore, which is composed of various iron, zinc, and lead sulphides, intimately mixed, with practically no rock gangue, is supposed to hold the world's championship. Flotation will be mechanical by an improved type of machine.

Some of the products will be dewatered in Genter thickeners. The Genter thickener has been largely developed at the Sullivan mill at Trail. It is compact, has a large capacity, and its initial cost is low. It is really a combination of thickener and filter. All the pulps from the thickeners will be filtered by the American disk filter. Storage will be provided for the stocking of several thousand tons of both zinc and lead cake from the filter.

The mill will be driven by electric power. With the exception of the motors and coarse crushing equipment, practically all the heavy machinery that will be used in the Sullivan concentrator is being made in the Trail shops of the Consolidated.

United States S. R. & M. Co. Buys Mexican Properties

One of the largest mining transactions that has taken place in southern Mexico for several years was the sale recently by George B. Houston, United States consular agent at Oaxaca, of his several properties to the U. S. Smelting, Refining & Mining Co., of Boston, Mass., for a reported consideration of several hundred thousand dollars. Included in the purchase are several gold and silver mines in a high state of development. It is also announced that the United States Smelting, Refining & Mining Co. has taken over the famous Leona and Soledad groups of Rickard brothers, their work on the property while under lease having developed that the vein on the Leona mine goes on down below the present workings. This mine produced silver ore so rich that the father of the Rickard brothers found it profitable to ship it from Oaxaca to Vera Cruz, before the days of railroads, by pack mules and from there to Swansea, Wales, for treatment. One of the Rickards is British consul at Mexico City and the other is a parish priest in Oaxaca.

Guanajuato Mine Operators Nervous Over Proposed Labor Laws

Division of Profits Among Workmen Object of New Measure—Much Official Inspection

By Keith A. Cunningham

The Guanajuato state government has named a commission, which is now in session, to draft a project of law having as its object the division among the workmen of a part of the profits accruing from mining and milling operations in the State of Guanajuato. The state government is acting under one of the clauses of Article No. 123 of the Mexican Constitution of 1917, which provides for the participation by workmen in profits from all industries. Each state in the Mexican Union legislates upon the clause in question in accordance with its own particular views, and it is probable that there will be wide differences in the spirit, wording, and application of the laws resulting in the various states. The government of the State of Guanajuato began upon the agricultural industry, and from what is now apparent, it intends to take each industry in turn. When the commission referred to has completed its draft, about which as yet circulate only the vaguest rumors, this will probably be submitted to representatives of the mining industry and of the workmen interested before discussion by the State Legislature, as was done in the case of the draft affecting the agricultural industry. Just what effect such legislation will have upon the local mining industry it is as yet impossible to forecast, but operators are naturally nervous.

There was a strike of the miners working for the Cubo Mining & Milling Co. at the beginning of the year. The men demanded an increase of 40 per cent, but gave in after a few days and returned to work at their old rate. But for this strike, labor conditions have remained quiet, and there seems to be no unrest. The local committee of conciliation and arbitration has rendered a few decisions, on the whole not unfair, though a few have been appealed to higher courts. There are now both federal and state inspectors of labor, and these pay periodical visits to all mines and mills.

Canadian Bankers Recognize Importance of Mining Industry

Change in Attitude Seen in Annual Meetings—Legitimate Mining Ventures Will Get Support

BY ALEXANDER GRAY

Without relaxing much if any of their hereditary or traditional vigilance toward mining ventures—over-the-counter business not being in favor—there is an undoubted change of sentiment in Canadian banking board rooms toward mineral industries. It is not to be inferred that speculation will be encouraged or ill-conceived promotions carried while the country has other internal problems. Finding, however, that the farming sections must have diversified domestic industries and their accompanying markets, confronted by the barbed wire tariff fence at the border, which prejudices so many of Canada's products, the banks have come to the realization that the mining industries bring working capital more expeditiously than the wheat areas.

That is why four of the leading banks in annual meeting have sounded the tocsin in behalf of Canada's natural resources and urged the necessity of their more rapid development. The Bank of Montreal, Royal, Commerce, and Union join in this refrain, presidential utterances being in the same strain. There is no indication of a change of heart as to loanable funds that are being husbanded against international eventualities. Leniency cannot be shown until readjustments are complete. The call-money market had been a negligible quantity until the New Year. Even now the bank rate is designedly inhibitive; the undoubted desire is to attract outside capital to mineral industries. For the first time there is banking unanimity that the mineral industries will and must expand —and, singularly enough, it is argued that developments justify this. No longer are mines "napoo."

Mineral resources, therefore, have won their way into the estimation if not the confidence of Canadian bankers —bankers say so without further committing themselves. For this remarkable admission the ability of the mineral industries to maintain themselves despite obstacles is responsible. It was thought the prairie provinces would obtain a fillip from oil developments, that would relieve the tension due to short crops. No aid from that source being forthcoming, the results from the mines of British Columbia and Ontario, the certainty that the precious-metal country extends into Quebec, the expectation that the Gaspe Peninsula will become productive of other commodities than pulpwood and fish, are what has brought about a revision of judgment on the part of the banks. So, modification of taxation is advocated, and participation in conservatively premised mining ventures need not be cause for closer scrutiny of customers' accounts. Without the increased gold, silver, and base-metal output, the grand aggregate of Canada's production from mines in 1922 would have been less than it was in 1921. The increase from $172,327,580 to about $181,000,000 is to be credited almost wholly to the gold and silver mines of Ontario and British Columbia. Disturbances in the coal trade, depression in the iron and steel division, liquidation of the nickel mining position left it for the precious-metal mines and the Consolidated Mining & Smelting Co.'s lead and zinc output and the Cranby Consolidated company's copper production at Anyox to preserve a measure of equilibrium.

15c. Copper Will Restart S. & A. Operations at Bisbee

The Shattuck & Arizona Copper Co. announces that it is the plan of the company to resume mining operations at Bisbee "as soon as the copper market reaches 15c." It is expected that this company will start with about 150 men on copper ore and about 50 men on high-grade lead ore. The mine has been shut down since December, 1920, with the exception of development work on the 1,000 and 1,100 levels, which was stopped in August, 1921.

Anaconda Draws First Blood in Davis-Daly Litigation

Judge Bourquin Stops All Mining in Disputed Area—Hard on Davis-Daly—Usual Array of Geological and Legal Talent

UNTIL the case is heard on its merits, neither the Davis-Daly Copper Co. nor the Anaconda Copper Mining Co. may mine ore from the ground involved in the suit brought by the latter company to recover about $2,500,000 damages for ore alleged to have been illegally extracted by its neighbor at Butte and to quiet title to certain orebodies. This decision was the substance of a temporary restraining order issued by Judge J. M. Bourquin on Jan. 20, after studying affidavits presented by both sides. Though this order has no effect on Anaconda's operations, it is a serious blow to Davis-Daly.

The orebodies involved lie beneath the surface of the property of the Davis-Daly Copper Co., the Davis-Daly Extension Copper Co. and the Smokehouse Copper Mining Co., all of which are believed to be closely related corporations. The affidavits filed on behalf of the defendant companies were also used in support of a counter-action filed by the Davis-Daly Copper Co. et al, against the Anaconda Copper Mining Co., which in turn applied for a restraining order, quieting of title, and accounting for ores extracted by the Anaconda company from the same vein.

The orebodies in dispute lie within the surface boundaries of the Davis-Daly, Smokehouse, and Davis-Daly Extension properties and extend through them in a northwest direction at a depth of from 2,000 to 2,700 ft. directly beneath the most active section of the Butte business district. A portion of the disputed vein and orebodies lies almost immediately beneath the Federal Building in which the case has been heard.

The Anaconda company alleges that this vein is a branch or spur of the Original vein, which is covered by the oldest location in the Butte district, the Original No. 39, located on Aug. 10, 1864, and that the vein departs as an obliquely striking flat dipping spur from the main Anaconda lode on its downward dip to the south beneath the Butte townsite. The defendant admits practically the same points of contact of the two veins, but denies that the Colorado No. 2 vein is a downward spur or branch of the Original, and asserts that it is an entirely independent vein, having an independent apex and being of later age than, and crossing through, the Original vein.

The reading of the affidavits filed on behalf of both parties and the arguments of counsel were concluded on Jan. 17, and the entire day on Jan. 18 was spent by Judge Bourquin, accompanied by one of the engineers to represent the plaintiff and one to represent the defendant, in making an inspection of the alleged points of junction.

The Anaconda company claims that it is spending $70,000 per month for the purpose of proving its contentions. Both parties are doing development work that will consume about six months, so that the hearing will be deferred till the expiration of that time.

L. O. Evans, chief counsel for the Anaconda company, and John P. Gray, of Coeur d'Alene, Idaho, especially well known in the Butte district since his engagement in the Elm Orlu-Butte & Superior apex suit, appeared for Anaconda. Affidavits by the following men were presented for the Anaconda company: John Gillie, manager of mines; C. L. Berrien, superintendent; Reno Sales, chief geologist; F. A. Linforth, assistant chief geologist; Horace V. Winchell, formerly chief geologist for the company; Walter Wiley, of Los Angeles, and Frederick Searls, Jr., of San Francisco.

The Davis-Daly was represented by J. Bruce Kremer and L. P. Sanders, of Butte; A. C. Ellis, Jr., of Salt Lake City, and John C. Higgins, of Seattle, as counsel. Affidavits were filed from J. L. Bruce, general manager; C. J. Hansen, geologist for Davis-Daly company; Albert Burch, mining engineer, of San Francisco; Oscar Hershey, geologist, of San Francisco; Dr. Walter Harvey Weed, of New York City; E. E. Chase, of Denver; Walter Lindgren, professor of geology at the Massachusetts Institute of Technology, and Samuel Barker, mining engineer, of Butte.

Equipment Orders Indicate Good Year on Mesabi Range

Activity in Minnesota Iron Mining Anticipated by Operating Officials

An order covering heavy equipment has been placed by the Oliver Iron Mining Co. for use at that company's mines on the Mesabi iron range in Minnesota. The order indicates that large operations are anticipated during the coming season. A No. 300 steam shovel which has been specially designed to meet the heavy duty that is required on the range has been ordered from the Bucyrus company; also three 50-ton revolving caterpillar type shovels, and two 50-ton air-operated spreader plows. After successful results from experiments with caterpillar mountings with the present railroad type steam shovel, an order has been placed for ten more mountings with slight modification in design. The body of the shovel is placed on three mountings, two forward on each side and the third in the center at the rear end. Motive power is supplied to each mounting, and only the rear mounting is deflected for the guidance of the shovel. In addition to the above equipment, one hundred 30-yd. dump cars have been ordered from the Western Wheeled Scraper Co.; two locomotive cranes from the Philip T. King Co.; twelve eight-wheel locomotives weighing 215,000 lb. on each driver with 23x28 in. cylinders and ten 50-ton flat cars from the Mount Vernon Car Manufacturing Co. This equipment is to be delivered in the early spring. Another order has been placed by the Mahoning Ore & Steel Co. which calls for a 100-ton Marion steam shovel and ten 30-yd. Clark dump cars.

Montana-Tonopah Company Will Resume Operations

Seeks To Exploit Tonopah Extension Veins That Extend Into Gypsy Queen Ground

The Montana-Tonopah Mines Co., which owns a large acreage in the north central portion of the Tonopah district, in Nevada, is about to resume mining operations at depth. This company has mined a large tonnage of high-grade ore and paid dividends up to 1912. In 1915 it was placed on a leasing basis and operations have been so profitable that the bonds and other debts of the Commonwealth Mining & Milling Co., which amounted to about $360,000 and were guaranteed by the Montana-Tonopah company, have been practically paid off. Present plans are to incorporate the Montana Tonopah Company Reorganized, capital 2,000,000 shares, 500,000 shares to be exchanged for the 1,000,000 shares of the original Montana-Tonopah company, and 500,000 shares to be sold at 20c. per share to provide $100,000 immediate working capital. The deepest working from the Montana shaft is at 765 ft. An agreement has been entered into with the Gipsy Queen Mining Co., which owns adjoining ground to the east, for the use of that company's 1,500-ft. shaft, and this shaft will be sunk to the 2,200 level. The Gipsy Queen has a lease on a portion of the Montana ground between the 850 and 1,650 levels, and the Montana company has a lease on the Gipsy Queen ground below the 1,650 level. The Montana expects to cut and develop the easterly extension of the rich and large Tonopah Extension veins, already proved to extend in that property to a depth of at least 2,000 ft. In fact, a vein system corresponding roughly with that of the Tonopah Extension was crosscut on the 1,300 level from the Gipsy Queen shaft in 1918, but fire destroyed surface equipment before lateral drifting could be accomplished, and no further work was done.

News from Washington

By PAUL WOOTON
Special Correspondent

Congressional Committee to Study Gold and Silver Situation

Outcome of Nicholson Investigation—Senator Pittman Sees Minimum Price for Silver Perpetuated

IN ALL PROBABILITY, the legislation which will come from the Senate Committee on Mines and Mining, as a result of its consideration of Senator Nicholson's bill, will suggest a Congressional committee, to be composed of three Senators and three Representatives, with powers to investigate the condition of the silver market; the condition of the gold-mining industry; the cost and availability of credit to silver producers; the currency status of both gold and silver, and such subjects as the influence of the exchange value of silver upon the agricultural industry and the export trade of the country.

Senator Pittman believes the bill which is to have the committee's approval should empower the Congressional committee to investigate all conditions affecting the production, reduction, refining, marketing, sale, and use of gold and silver. In addition, the committee should be charged, he thinks, with the duty of probing alleged discriminatory practices against the gold and silver mining industries.

In the opinion of Senator Pittman, American silver never again will go below a dollar an ounce. He bases that opinion on the fact that silver is limited in its occurrence in Nature, the production is small and the demand is great.

The demand, he believes, will greatly increase with the growth of commerce in China, India, and South America. As 90 per cent of the world's production comes from North America, and over 90 per cent of the North American production is controlled by American citizens and corporations, he thinks that the control of the world's marketing of silver by an American organization is entirely feasible.

Failure to perfect a marketing organization is laid at the door of the smelter companies by Senator Pittman. He says they should aid in the organization, maintenance, and operation of a credit and selling association for silver. One reason advanced in opposition to the formation of such an association is that the banks would oppose lending the necessary capital on silver bullion. With that objection, Senator Pittman does not agree. The necessary capital, he believes, could be raised if the collateral value of an ounce of silver were limited to 15c.

As Senator Nicholson introduced his bill more with the idea of its being the basis for discussion, he is more than willing to embody in it the constructive suggestions that have been made by various persons. Senator Oddie, the acting chairman of the Committee on Mines and Mining, is greatly interested in the legislation, as are most of the members of the committee. For those reasons, it is certain that a bill will be put on the Senate calendar at the earliest possible date, so that the Congressional committee can be appointed before the end of the present session of Congress.

Navy Department Asks for Bids for 3,800,000 Lb. of Zinc

The Navy has called for bids on 3,800,000 lb. of zinc. The bids are to be opened at 11 a.m., Feb. 23, at the Washington Navy Yard. The material is now at the Norfolk Navy Yard and is made up as follows: Rolled, sheet, 24 mils thick, 36 in. wide, and 84 in. long, 22,000 lb.; rolled, sheet, 24 mils thick, 36 in. wide, and 96 in. long, 115,000 lb.; rolled, sheet, 250 mils thick, 24 in. wide, and 48 in. long, 37,000 lb.; rolled, sheet, 375 mils thick, 24 in. wide, and 48 in. long, 132,000 lb.; rolled, sheet, 500 mils thick, 6 in. wide, and 12 in. long (hull zincs), with countersunk holes, 675,000 lb.; rolled, sheet, 500 mils thick, 6 in. wide, and 12 in. long, unfinished, 1,906,000 lb.; rolled, sheet, 500 mils thick, 24 in. wide, and 48 in. long, 576,500 lb.; rolled, sheet, 625 mils thick, 24 in. wide and 48 in. long, 36,350 lb.; rolled, sheet, 750 mils thick, 24 in. wide, and 48 in. long, 311,300 lb.

Pittman Act Purchases—54,000,000 Oz. More

Purchases of silver under the Pittman Act during the week ended Jan. 27 totaled 1,743,000 fine ounces. This brings the total amount purchased under the act to 153,272,912 fine ounces, and leaves about 54,000,000 to be purchased.

Tax Exempt Securities Bill Opposed in Senate

Unlikely That Advocates Can Get Sufficient Support to Submit Constitutional Amendment

Preliminary skirmishes on the floor of the Senate in preparation for the debate on the resolution to submit to the states a proposed constitutional amendment which would forbid issuance of tax-exempt securities indicates a fixed determination on the part of opponents of the resolution to kill it. Although a complete poll of the Senate membership has not been made, opponents express confidence that the resotion will fail through lack of a constitutional majority.

Not only would the amendment as proposed by the Ways and Means Committee make future issues of securities by states and minor political subdivisions subject to tax on their income after ratification, but it would be retroactive in the sense of subjecting to tax the income from those securities already in existence, according to the views of Representatives who opposed passage in the House. Removal of two commas from the punctuation of the proposed amendment does not sufficiently clear this point, according to the opponents. This phase of the matter has been taken up vigorously by Senators who are active in opposition to the resolution.

Passage in the House was by a comfortable margin of votes above the necessary two-thirds, with the full influence of the Administration behind the resolution. Party lines were split in the voting, the West and South, generally speaking, opposing, and the East and North supporting the measure.

Senators Fletcher, of Florida, and Caraway, of Arkansas, almost immediately launched a fight against the resolution on the floor of the Senate, taking advantage of debate on rural credits legislation to bring up the subject after Senator Lenroot, of Wisconsin, had made a strong plea for the proposed amendment.

News by Mining Districts

By Special Correspondents in the Field

London Letter

Labor Problem Still Limits Production in Burma—Selukwe Shares Are Basis of Merry Gamble

London, Jan. 19—Satisfactory as the report of the meeting of shareholders in the Burma Corporation held in Rangoon and published in London at the beginning of the week is, in general, there is still the labor problem to be solved. "Labor" intrudes itself everywhere. A favorable increase last season was reported, but the numbers available are still short of requirements. Yunnan is being scoured for workers, and the results are "very disappointing." Less than 25 per cent of the men obtained worked regularly. Recruits among agricultural laborers proved the most satisfactory. The difficulties in the province seem to be tribal unrest, making the Yunnanese unwilling to settle in Burma, and the fact that even the poorest laborer owns property in the form of fields, which is a greater attraction than working in the mine. India is now being tapped, though hopes of success are not great, while the cost of recruitment and transportation will be heavy.

Provided labor is forthcoming, there is nothing to prevent the company from carrying out its program, which looks forward to 1,000 tons of ore daily. The outlook is that, from the results of last year's working, there may be a modest distribution to the shareholders. The finance of the company is sound, debentures are being redeemed and other liabilities reduced.

Another company in which much interest is being taken at the moment is Akim (West Africa), whose £1 shares are quoted at about 30s. A powerful financial group—the same as took in hand the Cam & Motor (Rhodesia)—is said to have acquired a large block of shares with the intention of putting them to £4. The company is an amalgamation of an earlier company working alluvial gold, and another company producing diamonds. The output for December was 251 oz. of gold from 8,890 cu.yd. treated, and as regards diamonds, 593 carats were obtained from 1,074 loads. It seems to be mainly on the diamond output that the buying is based. The only recent indication as to the value of the diamonds is that in March last year 1,985 carats were sold for £2,109.

Tin winning in Nigeria is not at present a lucrative business, owing to heavy charges of operation and production, and the low price of the metal. During the period of adversity, however, companies have overhauled their expenditure and are now working, though on a reduced scale, more economically. The Jos Tin Area, for instance, last year lowered its costs by no less than £32 8s. 6d. per ton, and this year already a further £2 per ton is cut off returning charges. The bulk of the companies are awaiting a revival in trade, when they expect prosperity again.

A sensation has been caused on the Stock Exchange by the advance in Selukwe Gold Mining & Finance shares within two days or so from 8s. 3d. to 15s. 9d. and subsequently to 20s. 9d. As the denomination is only 2s. 6d., the premium is notably high. The company owns the B. C. Silver Mines, adjoining the Premier mine, the bonanza property of the Guggenheims, and tunneling from the former to the latter has been in progress for some months. A cable dispatch received on Tuesday from Vancouver announces the striking of a large orebody, "undoubtedly main Premier Gold Mining company's vein," and adds "future prospects are excellent." Gambling consequently is proceeding merrily on the chance of the vein turning out trumps. One dealer already claims to have made a fortune out of his speculation.

Victoria, B. C., Jan. 25—The tunnel at the B. C. Silver Mines property has cut a strong body of ore, which may be the extension of the main Premier vein, the objective of the tunnel. It will be remembered that the Premier Gold Mining Co. bought a one-third interest in B. C. Silver Mines for $100,000 about a year ago, and last summer it offered the Selukwe Gold Mining & Finance Co., which owns the other two-thirds in B. C. Silver Mines, $1,000,000 for its interest. This would seem to indicate that the management of the Premier expected that the extension of one of its veins passed into B. C. Silver territory. As yet, no announcement of the size and value of the lode has been made, but the manager has telegraphed the information to the head office of the Selukwe company, in London, and a telegraphic dispatch from that city states that the information has caused the shares of the company to jump from 8s. to around 27s.

Melbourne Letter

Sons of Gwalia Will Rebuild Gold Mill

Special Correspondence

Melbourne, Dec. 21—Heretofore only the larger mines of Broken Hill have been operating, but it is now announced that the Junction Mine intends to resume the raising of carbonate ore for shipment to the smelters. It is understood that a fair tonnage is available in the upper levels of the mine.

It will be remembered that in the early stages of the war the Broken Hill companies were compelled by the Prime Minister to enter into a 50-year contract with the Broken Hill Associated Smelters of Port Pirie for the treatment of their ores and concentrates. One of the companies—the British B. H. Co.—which was coerced in this way is now desirous of being relieved from the agreement, and threatens to start legal proceedings. Every effort has been made to adjust the matter, but without avail. It is now reported that an offer has been made to the British Broken Hill Co. for the purchase of their shares at the satisfactory figure of 35s. each, and that a new company will be formed with a capital of 750,000 £1 shares. One result of this will be to prevent the break up of the present smelting agreement, although it will not decide the question as to whether companies coerced into such an agreement during war time are legally bound thereby.

Several years ago the battery of the Sons of Gwalia gold mine, at Leonora, Western Australia, was destroyed by fire, and owing to the high cost of reinstating the plant, coupled with the

uncertainty of earning a profit, underground operations were discontinued, and attention was confined to the treatment of a large tonnage of tailings. Instructions have now been received by the general managers, Messrs. Bewick, Moreing & Co., from the board of directors in London, to proceed at once with the erection of a new 25-head battery. The directors claim that present conditions will not allow the treatment of run of mine ore, but that selective mining will have to be adopted in order to raise a grade which is payable. This is bad practice generally, but it is encouraging to see a company prepared to lay out capital on a gold-mining enterprise in view of the period of depression through which the industry has been passing, despite the fact that the gold premium has almost disappeared.

Montreal Letter

Deep Mining at Porcupine—Dome Mine Gossip

BY ALEXANDER GRAY

Montreal, Jan. 26—When Dr. MacLaren thirteen years ago went on record as to the deep-seated origin of Porcupine orebodies, not a few "eminent" geologists and engineers indulged in the merriest ha-ha's. The doctor was familiar with similar Westralian and Indian occurrences. However, certain of his principals did not possess the patience to await a larger profit than they realized in their haste. Now the McIntyre is mining below 2,100 ft. and is raising ore that promises increased profits with the larger mill that is approaching completion. Dome Mines, condemned at first as a structural monstrosity, has a better grade ore and more of it at the 1,600 level. Hollinger is drawing ore from its 1,250 level, and is sinking to 1,500. The offhand assumption is that the Hollinger will not hasten its deeper development. It has such an array of fissures in its upper levels that there is less immediate need of vertical penetrations. Keeping three years ahead of the mill is the program. So far as Porcupine is concerned, therefore, three of its companies have produced approximately $100,000,000 from sections above an estimated average depth of 1,200 ft., and their ore reserves above their 1,600 level will represent as much more in all probability. Only recently has Hollinger resumed development at 1,250 ft. The McIntyre deeper workings compare with those of a portion of the Acme area of the Hollinger. Dome has become, for the time being, the most agreeable surprise of the camp. At the moment, the objective in the Kirkland Lake is 1,000 ft., most of the companies having a limited crushing capacity and ample ore reserves. The Teck-Hughes is going to 1,100 ft. and will have a larger mill.

An unauthenticated story has started on its rounds that a New York firm is depressing the market in Dome shares for the purpose of accumulating 10,000 of them. The designing "firm" is said to also be giving options to a London group that contemplates getting control of the company, making an "international market" and then, directly or through subsidiaries, including enough other properties to make, "perhaps," the greatest "gold mine," singly or in combination, "in the world."

The understanding is that the present Dome administration is not a party to this ambitious program. On the contrary, it is intimated the sponsors for it are apt to "lose stock on balance": Dome control may have been concentrated since the late Captain de Lamar distributed the stock—but, all things considered, there was a great deal of wisdom in the classic enunciated by Theodore Harwood: "I confess I never had any ambition to be the permanent owner of an interest in a gold mine." If London became eager to have Domes on an advancing scale beyond the current market, "strong boxes might be opened," as the saying goes. The property is giving an excellent account of itself. President Bache is jealous of his mandate.

MEXICO

Cubo Company Will Overhaul Mine and Mill Plant

The Cubo Mining & Milling Co., of Guanajuato, has closed down its Tajo de Dolores mill and plant for about four months, during which time development work will be continued actively in the Villalpando, Cebolletas, and Capulin mines, as well as a certain amount of ore-breaking. In addition, many necessary repairs will be effected, both in mines and plant. The development work in the Cebolletas mine continues to show up ore of good milling grade. The cable-way formerly connecting the Villalpando mine with the Peregrina mill has been purchased from the Peregrina Mining & Milling Co., and will be re-erected to connect the Cebolletas mine with the Tajo de Delores mill. A bridge spanning the Cubo River has been built to connect the Capulin mine with the plant.

Treatment of Tailings Resumed in Remodeled Plant

The Mexican Reduction Co. has resumed treatment of old river tailings in its plant, which has been entirely remodeled. The company owns a concession on a long stretch of the Guanajuato River and its affluents, as well as the accumulations of patio process tailings in some half dozen of old haciendas, and can probably count on some hundreds of thousands of tons. It is planned to treat one hundred tons a day at the start.

New Mill in Pozos District

At the Carmen mine, in the Pozos district, M. D. Stacpoole, of San Luis Potosi, is erecting a 50-ton reduction and cyanide plant. The mine was a famous one in the past, and Stacpoole has secured it on a lease from its present owner, Pablo Parkman. The ore carries good values in chlorides and bromides of silver, and will be mined in an open-cut. The ore occurrence is interesting in that it is the shale parting between two veins, and not the veins themselves, that will be exploited.

Syndicate Plans Reopening of Old Santa Rosa Bonanzas

In the Santa Rosa district the old San Cayetano de Animas mine is being unwatered for examination by a syndicate of Mexican operators. If prospects warrant, the mine will be put into condition for proper working, and the 10-stamp mill and plant near by, now lying idle, will be leased. The same syndicate intends to examine the San Nicolas de Landa, the Conda and the Los Negros mines in the same district, all of them being within easy reach of the mill. All these mines were bonanzas in the past.

CALIFORNIA

Geysers May Be Harnessed in Sonoma County

Proposed diamond-drilling operations in the region contiguous to Oroville have evoked more or less local comment but little real interest. However, the latest spectacular incident that has started gossip is the proposal to utilize the Sonoma geysers for power purposes. It is stated, and apparently from reliable sources, that a test well has been drilled and develops an estimated 2,000 hp. It is said, also, that the Southern Pacific R.R. is interested in the possibilities of power from this source. There are undoubtedly possibilities of power development from terrestrial thermal belts, and the engineering of such development would be novel. There exists but few precedents, notably the one in Italy.

Public Supervision of Oil Doubtful

In the state Legislature, recently convened, an attempt is being made to throw the petroleum industry of the state into the control of the State Railroad Commission. The plan is not regarded seriously. A proposed investigation of production and marketing costs of gasoline by a legislative committee will without doubt be dropped. The opinion generally held is that public utility control is impracticable and that investigation would result in little information not already known.

Grass Valley Produces at Normal Rate Idaho-Maryland Vein Is Good

Between 1,100 and 1,200 men are employed in the Grass Valley district. The Brunswick mine has been unwatered below the 700 level, and preparations are being made for mining operations. The new vein discovered in the Idaho-Maryland has been opened up on two levels, and high-grade ore is exposed. It is conceded by mining men to be of great importance to the district. All other properties are producing at the usual rate. The Mugwump and Young America, at Forest, are to be opened up by the Diamond Peak Mining Co. Both are gravel properties. Mugwump has good possibilities for the discovery of rich veins.

ARIZONA

Alkali Desert Land Benefited by Acid From Copper Smelter

The Calumet & Arizona Mining Co. has donated a quantity of sulphuric acid to the agricultural department of the University of Arizona to be used in experiments being conducted near Casa Grande in the treating of alkaline soils. An application of about one hundred tons of low-strength acid has been completed, and the indicated results seem to be satisfactory. In a late rainstorm there was absorption of moisture to a depth of over 2 ft. by land that had previously been impervious to water. The soil treated is that known as "slick" or "playa," and the acid changes the black alkali, a sodium carbonate, to calcium sulphate.

Sinking of Verde Central Shaft Contracted

A contract for the sinking of the Verde Central shaft, at Jerome, from the 800 to the 1,000 level has been let to Dick Rowatt, a well-known local mining man of long experience at the United Verde and other mines. Actual work was scheduled to start on Jan. 22, and the management has announced that all other development will be subordinated to the sinking operations. After the 810 drift had been advanced 250 ft. in ore, it was stopped, and a crosscut has been started at about the center of the length opened. This crosscut has been advanced about 20 ft., exposing some of the richest ore yet found.

Milling Resumed at Black Canyon

The Verde Mines & Milling Co., whose property is in Black Canyon, seven miles north of Jerome, has developed sufficient water to allow resumption of operation of its 15-stamp mill. The ore is free milling, containing about $16 gold and 2½ oz. of silver to the ton. Most of the developments consist of tunneling, but there is a shaft 215 ft. deep on the property, which is expected to be deepened next spring.

OREGON

Red Ledge Group Will Be Developed

A development of the new year effecting operations in the Homestead district is the announcement that the Red Ledge group, near Homestead, will be developed. Diamond drilling operations were finished in 1921, since which time the property has been surveyed for patent, and it is now announced that immediate development will include extending the Homestead branch of the Union Pacific Ry. 16 miles below the present terminus at Homestead, and the erection of a concentrator with an initial daily capacity of 500 tons.

The Red Ledge group is owned by prominent iron-ore operators of Duluth, Minn., among whom is Cooley Butler. The Idaho Copper Co. has been incorporated to take over the Red Ledge. The property is near the boundary line between Oregon and Idaho.

NEW MEXICO

Mogollon Mines, Ltd., Has Leased Fanny Mine

The properties of the American Silver Corporation at Mogollon, north of Silver City, have been taken over by Mogollon Mines, Ltd., a continuous and profitable producer for many years.

The American Silver Corporation succeeded to the holdings of the Socorro Mining & Milling Co. after the latter had operated on a large scale for some years. The property embraces 26 patented claims aggregating 480 acres, and is known locally as the Fanny mine. It is extensively developed and is equipped with a cyanide mill and rope tramway. The ore carries principally silver, and a production valued at several million dollars was produced before the property was shut down. Retimbering and development will be started by S. J. Kidder, manager for Mogollon Mines, Ltd. The company owns the Alberta property immediately adjoining its new holdings and it is planned to operate the two properties as a unit. During its active period the Fanny property employed 300 men.

IDAHO

Success Nears Oreshoot

The Success Mining Co., of Wallace, is driving a crosscut on the 860 level, which is expected to cut the orebody within 100 ft. This orebody is the new discovery made about a year ago which suddenly restored life to that long inactive mine. The ore was found in ground which had long been classified as without possibility of mineral values, and that theory was disproved by following a knife-blade stringer of ore into the forbidden ground. Result, an orebody 250 ft in length and from 5 to 15 ft. thick, containing lead, silver, and zinc, with the former strongly predominating. The development of this ore has enabled the company to resume production. This ore was found on No. 7 or the main tunnel level, and the crosscut is being run 160 ft. below from the 860 level.

Montana-Idaho Will Be Developed

Stockholders of the Montana-Idaho Copper Co. have been advised of the completion of the crosscut tunnel almost two miles in length and the exposure of 2 ft. of copper ore, which, with its associated gold and silver, is valued at $77.61 per ton. Plans are now being worked out for the systematic development of the mine. This ore is at a depth of 1,800 ft. and 1,100 ft. below the bottom of a 700-ft. shaft sunk almost on the divide between Idaho and Montana, from which shipments were made many years ago. The new ore is of the same character as that taken from the shaft. The portal of the tunnel is near the Milwaukee railroad tracks at Adair, Idaho. Work in this tunnel has been going on for several years under the management of Otis Hill, one of the original locators of the property, formerly known as the Monitor.

NEVADA

Nevada Consolidated Will Produce 6,000,000 lb. Per Month

The milling capacity of the Nevada Consolidated Copper Co. at McGill is being steadily increased, about 4,000 tons of ore being hauled to the mill from the pits at Copper Flat, and an additional 450 tons of smelting ore is also being mined from the Ruth. By April 1 it is planned to increase production to 6,000,000 lb. of copper per month. Six mills are now running at the new concentrating plant and two more are almost ready to operate.

Tonopah Belmont Leases Old Property

The Tonopah Belmont Co. has taken a working bond on the property of the Tungsten & Gold Telluride Co., near the old camp of Douglas, about 18 miles from Mina. Values are in gold and silver, the latter predominating. Outcrop samples were said to have been satisfactory.

Construction Progresses on Three New Milling Plants

Preliminary construction work on the Bellehelen Merger Co.'s new 50-ton cyanide mill at Bellehelen is progressing rapidly. Grading is practically completed, part of the lumber is on the ground, and work on the mill building will be started soon. Power will be supplied by semi-Diesel engines. E. A. Strong is in charge of the work.

Mill machinery has been shipped from San Francisco by the Holly Consolidated Company to Eureka to complete its concentrating plant. The plant will treat 40 tons daily at the start, capacity to be increased later to 100 tons.

More than half the construction material and machinery for the new mill of the Consolidated Cortez Silver Mines Co. is at Cortez, and construction is being pushed as rapidly as practicable. The upper end of the mill is nearly completed and foundations are being laid for the lower part. The power house is well advanced.

MICHIGAN

Henry Ford Will Build Ore Dock

Henry Ford is to construct an iron ore dock at L'Anse, Mich., on the southern extremity of Keweenaw Bay, according to an announcement which he made recently while on an inspection trip to that place. Ore from the Imperial mine, Michigamme, on the Marquette Range, will be shipped to that point for loading on vessels. At present Ford is operating but one mine, but he has diamond drills at work on lands which he owns in the Lake country and is seeking new deposits.

Westinghouse Will Erect Insulator Manufactory

The Westinghouse Electric & Manufacturing Co. is about to erect near San Francisco Bay a plant for the manufacture of porcelain insulators. This will create renewed interest in clay deposits in California and will afford a new market for certain non-metallic minerals.

THE MARKET REPORT

Daily Prices of Metals

Jan.	Copper, N. Y., net refinery* Electrolytic	Tin 99 Per Cent	Tin Straits	Lead N. Y.	Lead St. L.	Zinc St. L.
25	14.50	38.875	40.00	8.00@8.15	7.90@8.00	6.65@6.75
26	14.625	39.00	40.125	8.00	7.90@8.00	6.75@6.90
27	14.625	39.00	40.125	8.00	7.90@8.00	6.80@7.00
29	14.75	39.125	40.25	8.00	7.95@8.00	6.85@7.10
30	14.75	39.125	40.25	8.00@8.15	7.95@8.00	6.90@7.10
31	14.75	38.625	39.875	8.00	7.95@8.00	6.90@7.05

*These prices correspond to the following quotations for copper delivered: Jan. 25th, 14.75c.; 26th and 27th, 14.875c.; 29th, 30th, and 31st, 15c.

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

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

London

Jan.	Copper Standard Spot	Copper Standard 3M	Copper Electrolytic	Tin Spot	Tin 3M	Lead Spot	Lead 3M	Zinc Spot	Zinc 3M
25	65 3/8	65 7/8	71 1/4	184 1/4	185 7/8	27 3/4	27 3/8	35 5/8	33 7/8
26	65 5/8	66 1/4	72 1/4	185 1/8	186 5/8	28 1/4	27 7/8	35 3/4	34 1/2
29	66 1/8	66 7/8	72 1/2	186	187 1/8	28 1/4	28	36 5/8	34 7/8
30	65 7/8	66 1/4	73	186 1/4	187 3/4	28 7/8	28 5/8	37 1/4	35 1/2
31	65 3/8	66	72 1/4	184	185 1/2	28 1/4	28	36 7/8	35 1/8

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

Silver and Sterling Exchange

Jan.	Sterling Exchange "Checks"	Silver New York Domestic Origin	Silver New York Foreign Origin	Silver London	Jan.	Sterling Exchange "Checks"	Silver New York Domestic Origin	Silver New York Foreign Origin	Silver London
25	4.65 5/16	99 3/8	66 1/2	32 1/4	29	4.63	99 3/8	64 7/8	31 5/8
26	4.64 5/8	99 5/8	66 1/2	32	30	4.64 1/4	99 3/8	65 1/8	31 5/8
27	4.63 1/2	99 5/8	66	32 3/16	31	4.63 1/4	99 3/8	64 3/4	31 7/16

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

Average Metal Prices for January

Copper:	
New York Electrolytic	14.510
London Standard	64.494
London Electrolytic	71.409
Lead:	
New York	7.633
St. Louis	7.571
London	27.119
Silver:	
New York, foreign	65.668
New York, domestic	99.625
London	31.928
Sterling Exchange	465.053
Zinc:	
St. Louis	6.815
London	35.733
Tin:	
99 per cent	37.986
Straits	39.173
London	181.852
Antimony	6.884
Quicksilver	72.731
Platinum	112.462

Metal Markets

New York, Jan. 31, 1923

All the non-ferrous metal markets show an improvement during the week. The greatest activity occurred in the zinc and copper markets, both of which showed a spurt upward.

Copper

Copper is now on a 15c. level. In the latter part of last week sales were made in fair volume at 14.75 and 14.85c. delivered; in fact, they were heavy enough to make producers ask an eighth more for the metal. At 15c. however, sales have not been particularly brisk, and by far the larger part of the week's business was transacted on Thursday, Friday, and Saturday. Some producers have asked even higher prices, but we have heard of no sales made above 15c. Consumption of copper is satisfactory so far as domestic business is concerned, but foreign purchases have not been encouraging, nor can they be expected to be substantial in view of the critical situation abroad. Nevertheless the week's rise in price is a striking illustration of the great importance of American purchases of copper, which have been so strong that they have made up for the lack of noteworthy foreign buying.

Lead

The official contract price of the American Smelting & Refining Co. continues to be 8c. per lb., New York.

The lead market has been somewhat erratic. The situation has been complicated by the sale in New York market of heavy foreign tonnages, over 4,000 tons. Some of this metal was sold for delivery next summer, but a good proportion is to be delivered in February and within the next three months. Sales have occasionally been made at a premium, but by far the bulk of the business has been done at 8c. At this level lead can still be obtained in good-sized quantities. The St. Louis and New York markets are now almost on a parity, as the American producers in the Middle West are well sold out, and Mexican lead, which has been going to Europe, is being shifted to this country, entering through New York.

Zinc

The price of zinc took a jump upward during the week, principally because of the heavy purchases of one large consumer, who required the metal for prompt shipment. Sales made were larger than for several weeks, and as prompt business increased greatly over that of last week, this condition is shown in our quotations.

Zinc was sold for European shipment last Thursday. High-grade metal continues to be sold for 7.75@8c. per lb., with usual freight allowance, in excellent volume.

Tin

Purchases of tin by the tin-plate companies have been a feature of the market. The fear of a coal strike in April and the possibility of being short

of tin at the time was probably responsible for the interest manifested

Arrivals of tin in long tons: Jan. 26, Java, 25; 27th, Straits, 550; China, 225; Java, 500; 29th, China, 225; Straits, 50.

Gold

Gold in London: Jan. 25th, 89s. 9d.; 26th, 89s. 10d.; 29th, 90s.; 30th, 89s. 1d.; 31st, 88s. 10d.

Foreign Exchange

On Tuesday Jan. 30, cable quotations on francs were 6.09c.; lire, 4.75c.; marks 0.0022c. and Canadian dollars 1⅛ per cent discount.

Silver

Spot prices have dropped during the week on account of China sales, although the decline has been checked at times by further purchases on Indian bazaar account.

Mexican Dollars — Jan. 25th, 50⅜; 26th, 50½; 27th, 50⅜; 29th, 49½; 30th, 49⅝; 31st, 49½.

Other Metals

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

Aluminum—General market for 99 per cent grade, about 22@23c. per lb.

Antimony — Chinese and Japanese brands, 7⅛@7½c. strong. W. C. C., 7⅞@8¼c. Cookson's "C" grade, spot, 8@8½c. Chinese needle antimony, lump, nominal, 5c. per lb. Standard powdered needle antimony (200 mesh), at 5½c. per lb. White antimony oxide, Chinese, guaranteed 99 per cent Sb_2O_3, 6.75@7c.

Bismuth—$2.50 per lb. London, 10s.

Cadmium—$1.15 per lb. London quotes 5s. 6d.

Cobalt—Metal, $2.65@$2.85 per lb.; black oxide, $2 per lb. in bbls. London 11 to 12s. for metal; black oxide, 9s.

Iridium—$250@$275 per oz.

Magnesium—Sticks, 1⅛ in., 99.9 per cent, $1.25 per lb. London quotes 4s.@4s. 9d. for 99 per cent.

Molybdenum Metal—In rod or wire form, 99.9 per cent pure, $32@$40 per lb., according to gage. Metal powder, 96@98 per cent, $3.50@$4 per lb.

Monel Metal — Shot, 32c.; blocks, 32c. per lb., f.o.b. Bayonne, N. J.

Nickel—25@30c. per lb. for 99 per cent virgin metal.

Osmium—Pure, $80@$85 per oz. troy, in Los Angeles. Strong.

Palladium—$65@$70 per oz. London, sponge, £11@£12 10s.

Platinum—$110 per oz. London, £23.

Quicksilver — $72 per 75-lb. flask. San Francisco wires $70.85. London, £12.

Radium—$70 per milligram of radium content.

[1]**Rhodium**—$4.50@$5 per gram.

Selenium — Black powdered, amorphous, 99.5 per cent pure, $2.15 per lb. Shortage of metal; price is advancing.

[1]**Tellurium**—$3 per lb. in 10-lb. lots.

[1]**Thallium Metal**—Ingot, 99 per cent pure, $4 per lb. in 25-lb. lots.

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

Metallic Ores

Chrome Ore—Indian chrome ore at $19.50 per ton, c.i.f. Atlantic ports. Rhodesian and New Caledonian, $26.

Iron Ore—Lake Superior ores, per long ton, Lower Lake ports: Old Range bessemer, 55 per cent iron, $5.95; Mesabi bessemer, 55 per cent iron, $5.70; Old Range non-bessemer, 51½ per cent iron, $5.20; Mesabi non-bessemer, 51½ per cent iron, $5.05.

Magnetite Ore—F.o.b. Port Henry, N. Y.: Old bed 21 furnace, $5 per long ton; old bed concentrates, 63 per cent, $5.25; Harmony, cobbed, 63 per cent, $5.25; new bed low phosphorus, 65 per cent, $7.50.

Manganese Ore—33c. per long ton unit, seaport, plus duty; Chemical ore, $75@$80 per gross ton.

Molybdenum Ore—65c. per lb. of MoS_2 for 85 per cent MoS_2 concentrates, plus duty.

Tantalum Ore—Hand-sorted ore, 70 per cent combined columbite-tantalite, 40c. per lb., South Dakota.

[1]**Titanium Ores**—Ilmenite, 52 per cent TiO_2, 1½@2c. per lb. for ore. Rutile, 96 per cent TiO_2, 10c. per lb. for ore, with concessions on large lots or contracts.

Tungsten Ore — Wolframite, $8; scheelite, $8.50@$9 per unit of WO_3, f.o.b. New York.

Uranium Ore (Carnotite)—Ore containing from 2 to 2½ per cent U_3O_8, $3.50 per lb. of contained U_3O_8.

Vanadium Ore—No quotation. Recently $1 per lb. of V_2O_5 content.

Zircon — Zirconium silicate, f.o.b. Pablo, Fla., 4½@13c. per lb.

Zinc and Lead Ore Markets

Joplin, Mo., Jan. 27—Zinc blende, per ton, high, $44.75; basis 60 per cent zinc, premium, $41; Prime Western, $40@$41; fines and slimes, $39@$37; average settling price, all grades of blende, $40.89. Calamine, basis 40 per cent zinc, $22@$24.

Lead, high, $105.75; basis 80 per cent lead, $100@$104; average settling price, all grades of lead, $96.21 per ton.

Buyers contracted for 16,000 tons of ore this week, the bulk of which was purchased as Prime Western, and for some of which a $41 basis was paid. Up to midweek the market was weak and inactive, and the heaviest buying was Saturday afternoon. The market rallied to a strong point, from the slight depression of last week.

Lead is reported at $102 basis and higher, but no buyer or seller will give out the higher quotation tonight, further than a rumor of $102.50.

Platteville, Wis., Jan. 27 — Blende, basis 60 per cent zinc, $43 per ton. Lead, basis 80 per cent lead, $100 per ton. Shipments for the week: Blende, 699; lead, 40 tons. Shipments for the year: Blende, 3,532; lead, 40 tons. Shipped during the week to separating plants, 536 tons blende.

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

Non-Metallic Minerals

Asbestos—Crude No. 1, $450@$550; No. 2, $250@$350; long spinning fibers, $150@$250; magnesia and compressed sheet fiber, $125@$175; shingle stock, $60@$80; paper stock, $30@$40; cement stock, $15@$20; shorts, $8@$12—all per short ton, f.o.b. mines, Quebec.

Rhodesian No. 1 crude, $400; No. 2, $250; inferior grade, $200—all c.i.f. Atlantic ports per short ton.

Market healthier than for some time. Demand increasing for all grades.

Barytes—Crude, $8.50@$9 per ton, f.o.b., mines. Ground, off color, $13@$13.50; white, $16@$18, f.o.b. plant. Prime white floated, $24@$27 per ton, St. Louis. Market improved.

Bauxite—American, crushed and dried, $6@$9 per gross ton; pulverized and dried, $12@$14 per gross ton; calcined, $22@$25 per gross ton, all f.o.b. shipping points. Foreign bauxite offered at $5@$8 per metric ton, c.i.f. Atlantic ports, depending upon grade.

Borax—Granulated and refined, crystals or powdered, in bags, carloads, 5½c. per lb.; in bbls., 5½c. Boric acid, 11c.

Chalk—English, extra light, 5c. Domestic light, 4½@4½c.; heavy, 3½@3⅝c. per lb., all f.o.b. New York.

China Clay (Kaolin)—Crude, $7@$9; washed, $8@$9; powdered, $13@$20; bags extra, per net ton, f.o.b. mines, Georgia; powdered clay, $14@$20, f.o.b. Virginia points. Imported lump, $15@$20, f.o.b. American ports; powdered, $45@$50, f.o.b., New York. 1A grade, refined, $14@$15 per ton, Delaware.

Canadian, in lumps, $16@$18, f.o.b. Quebec points. Demand good.

Diatomaceous Earth — Crude, air-dried material, in large lumps, $8 per ton, f.o.b. California quarries. Ground material for insulation is priced according to density. It is being sold for $35 per ton, having a settled weight of 15 lb. per cu.ft., and $25 per ton for 20 lb. per cu.ft. The highest grade of material, the so-called "air float" or "baghouse," suitable for polishes and similar uses, brings from $75 to $100 a ton. All prices f.o.b. quarry. Contracts with large consumers are at present in force at a figure as low as $17 per ton, f.o.b. quarries, for filter material. All above quotations are on a minimum car basis, a minimum car holding 20 tons of 2,000 lb.

Emery — Turkish and Greek manufactured emery, 6@8c. per lb. American, 3½@5½c. Inferior grades, 3½c., f.o.b. New England points. Imported Turkish and Noxos emery scarce and hard to secure because of conditions in Turkey and Greece.

Feldspar — No. 1 pottery grade, $6@$7.50 per long ton; No. 2, $5@$5.50; f.o.b. North Carolina points. No. 1, $7.50; No. 2, $6.50; ground, 60 to 80 mesh, $18@$20 per short ton; 120 to 150 mesh, $20@$24; 200 mesh, $25@$30, f.o.b. Connecticut points. No. 1, Canadian, $25 per net ton, f.o.b. Ohio mills.

First quality ground, $19 in New

Hampshire, $18 in Maine; second quality, $16 in New Hampshire. In Colorado, No. 1 crude, $5; No. 2, $4.50 per short ton.

Business good. Poor rail facilities hampering work.

Fluorspar — Fluxing gravel, 85 per cent CaF_2 and not over 5 per cent silica, $21.50, f.o.b. mines; not over 6 per cent silica, $21; 80 per cent grade, not over 5 per cent silica, $20; ground acid grade, $45 in bulk; ground enameling grade, $35 in bulk; packages, $4 extra, all f.o.b. mines, Illinois.

Gravel with limestone gangue, $14; lump, 92 per cent CaF_2, $17, f.o.b. New Mexico. Only a few mills active, owing to low prices.

No. 1 lump, $30; No. 2, lump, $25, f.o.b. Illinois mines.

Fuller's Earth—16 to 60 mesh, $19 per ton; 16 to 30 mesh, $17; 30 to 60 mesh, $18; 60 to 100 mesh, $14; 100 mesh and finer, $10; f.o.b. Florida mines.

Graphite—American flake, 4@5c. per lb. at mines. Ceylon lump, first quality, 6@6½c. per lb; chip, 5@5½c.; dust, 3@3½c. Mexican crude amorphous, $15@$35, f.o.b. New York.

Gypsum—Crushed rock, $3 per ton in most states. Ground, $3.50@$4, f.o.b. shipping points.

Kaolin—See China Clay.

Limestone—Crushed, New York State shipping points, ½ in. and larger, $1.10@$1.35 per net ton. Agricultural limestone, $2.50@$3 net ton, f.o.b. eastern shipping points.

Magnesite—$14 per ton for crude, $40 for calcined magnesite, f.o.b. California points. Dead-burned magnesite grains, $40 per net ton, f.o.b. Baltimore; $40@$42, Chester, Pa.

Western magnesite industry reports increased activity. Plastic material finding good use.

Manjak—Barbados, in 1 to 5 ton lots, grade "C" lump, $330 per short ton; "C" fine, $250; grade "A," $185—all c.i.f. New York.

Mica—Domestic, No. 1 quality, 1½x2 in., 15c. per lb.; 2x2 in., 35c.; 2x3 in., 80c.; 3x3 in., $1.20; 3x4 in., $1.60; 3x5 in., $2; 4x6 in., $2.80; 6x6 in., $3.60, all per lb., f.o.b. North Carolina, thumb trimmed; 1¼ in. disks, 75c. per lb. No. 2 stove mica: punch, 8c.; 2x2 in., 25c.; 2x3 in., 50c.; 3x3 in., $1; 3x4 in., $1.40; 3x5 in., $1.75; 4x6 in., $2.25; 6x8 in., $3.25; flake, 12c. per lb. Scrap, $25 per ton. All f.o.b. Virginia points.

Scrap, $22 per short ton; washer, 10c. per lb.; disk, 15c. per lb., f.o.b. Connecticut points. Market active.

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

Phosphate — 77 to 76 per cent tricalcium phosphate, hard rock, $8 per ton, f.o.b. Jacksonville; 77 to 76 per cent pebble grades, $7.50; 75 to 74 per cent pebble, $6; 70 per cent pebble, $4.50; 66 to 68 per cent pebble, $4.10, f.o.b. Tampa.

For 78 per cent lump, kiln dried, $8; 75 per cent, $6.50@$6.75; 72 per cent washed and cylinder dried, unground, $6@$6.50 per long ton; 70 per cent ground, $6.50 short ton; 65@70 per cent ground, $6 per short ton, f.o.b. Tennessee points.

Pumice Stone—Imported lump, 3@40c. per lb.; domestic lump, 5c.; ground, 5@6c., all f.o.b. New York.

Pyrites—Imported lump, 1 in. diameter and up, 12c. per unit; furnace size, 2½ in. diameter, 12½c. per unit; fines, through ½-in. mesh, 12c. per unit; cinder property of buyer, ex ship, Atlantic ports. Ore contains 50@51 per cent sulphur; cinder about 63 per cent metallic iron. Market weak.

Silica—Glass sand, generally $2@$2.75 per ton, f.o.b. shipping point; sand-blast material, $2.50@$5. Ground, 250 to 450 mesh, $22@$34, f.o.b. mills. Glass sand, $5@$10, f.o.b. Massachusetts.

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

Talc—150 to 200 mesh, $6.50@$8.50 per ton, Vermont. Price depends upon color as well as fineness. Paper bags, $1 per ton extra. Burlap bags, 12 to the ton, 10c. each extra, with 9c. return allowance. Market demoralized as to roofing grades, much of which was contracted at $5 per ton f.o.b. Vermont mills late in 1922. As an inducement to close such contracts offer was made to include any mesh. Embargoes on B. & M. and New Haven roads have almost stopped all shipments to New England points.

In New York, 200 to 325 mesh, $13.75@$14.75 per ton for air-floated talc. 300 mesh, $11.50@$13.50 per ton.

In Georgia, white, $7@$9; yellow, $9; red, $11.

In California, $16@$20 per ton, depending upon fineness and color.

Tripoli—Once ground, rose and cream colored, $16@$25; white, $18@$27; double ground, r. and c., $17@$25; w., $19@$30; air-float, r. and c., $25@$30; w., $35; super air-float, r. and c., $35@$40; w., $40@$45. All per short ton in 200-lb. burlap bags with paper liners, minimum car, 30 tons, f.o.b. Missouri points. Market strong.

Mineral Products

Arsenious Oxide (white arsenic)—12½@13½c. per lb.

Copper Sulphate — Large crystals, 6c. per lb.; small, 5.90c.

Sodium Nitrate—$2.475 per 100 lb., ex vessel Atlantic ports.

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

Sodium Sulphate—$25@$27 per ton, New York.

Ferro-Alloys

Ferrocerium—Per lb., $15@$20.

Ferrochrome—1 to 2 per cent carbon, 28c. per lb.; 4 to 6 per cent carbon. 12@14c. per lb.

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

Ferromanganese — Domestic, 78@82 per cent, $102.50@$107.50 per gross ton, f.o.b., furnace. Spiegeleisen, 19@21 per cent, $36, f.o.b. furnace; 16@19 per cent, $35.

Ferromolybdenum — $1.90@$2.25 per lb. of contained molybdenum for 50 to 55 per cent grades.

Ferrosilicon—10 to 12 per cent, $44@$51 per gross ton, f.o.b. works; 50 per cent, $82.50@$87.50 delivered.

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

Ferrotungsten—95c. per lb. of contained W., f.o.b. works. Market firm.

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

Ferrovanadium—$3.50@$4 per lb. of V contained, f.o.b. works.

Metal Products

Copper Sheets—New York base, 22.50c. per lb.; wire, 17.125c. net.

Lead Sheets—Full lead sheets, 10.25c. per lb.; cut lead sheets, 10.50c. in quantity, mill lots.

Nickel Silver—30c. per lb., for 18 per cent nickel Grade "A" sheets.

Yellow Metal — Dimension sheets, 20c. per lb.; rods, 17c. per lb.

Zinc Sheets—$9 per 100 lb., f.o.b. works.

Refractories

Bauxite Brick—$45@$50 minimum, per net ton, f.o.b. shipping point.

Chrome Brick—$50@$52 per net ton, f.o.b. shipping point.

Chrome Cement — $23 per net ton, f.o.b. shipping point.

Firebrick—First quality, $40@$46 per M., Pennsylvania, Ohio, and Kentucky works; second quality, $36@$41.

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

Magnesite Cement—$45 per net ton, f.o.b. shipping points.

Silica Brick—$42@$44 per M., Pennsylvania; $47@$50, Indiana; $48@$50 Alabama.

[1]Zirkite—Powdered, $50@$60 per ton; brick, $100 per ton.

The Iron Trade

Pittsburgh, Jan. 30, 1923

The Bessemer steel works at Bellaire, Ohio, have resumed operations after a long shutdown. Finished steel prices continue to stiffen. Merchant bars have practically followed shapes and plates in the latter's recent advance from 2.00c. to 2.10c. Wrought-iron pipe has been advanced $8 to $20 a ton and welded steel boiler tubes have advanced $6 a ton.

Pig Iron—The Pittsburgh-Valley market is less active than other pig iron markets, but is firm as to prices, at $27.50 for Bessemer, $25 to $26 for basic, and $27 to $28 for foundry, f.o.b. Valley furnaces, with $1.77 freight to Pittsburgh.

Connellsville Coke—Market firm at $8@$8.25 for furnace and $9.25@$9.50 for foundry.

Facts for the Stockholder

IV—National Lead Co.

THE NATIONAL LEAD CO. was incorporated in New Jersey in December, 1891; manufactures lead products and alloys of lead and tin; and mines between 10 and 15 per cent of the lead that it uses. Its numerous products include painters' materials, such as white and red lead, colors, and linseed oil; bearing metals and pressure die castings; lead pipe, tin-lined pipe, traps, bends, solder, and other plumbers' materials; printers' metals of all kinds; canners' soldering materials; lead oxides used in the glass, color, rubber, varnish, enamel, pottery, and battery trades; miscellaneous lead products such as bar lead, sheet lead, antimonial lead products, and lead wool and wire; and lead salts, linseed oil cake and meal, castor oil, and plastic molding materials.

It owns all or part of the capital stock of the following companies: Baker Castor Oil Co., Bass-Hueter Paint Co., Carter White Lead Co., Cinch Expansion Bolt & Engineering Co., Magnus Co., Inc.; Matheson Lead Co., River Smelting & Refining Co., Titanium Pigment Co., Inc.; United Lead Co., United States Cartridge Co., Williams Harvey & Co., Ltd.; Williams Harvey Corporation, and Hirst & Begley Co. The company's plants are situated in New York City, Buffalo, Cleveland, Cincinnati, Chicago, St. Louis, Philadelphia, Pittsburgh, Boston, San Francisco, and Buenos Aires. It maintains local offices in ten important cities.

Capital stock consists of 243,676 shares of 7 per cent cumulative preferred stock, $100 par value; and 206,554 shares of common stock, $100 par value. The company has no funded debt, but $8,595,000 bonds of subsidiary companies are outstanding. Common and preferred stocks have equal voting power, but the latter is preferred as to assets. The preferred stock is redeemable at the option of the company, at a price not less than par with accrued unpaid dividends, on thirty days' notice. On Dec. 31, 1921, the company had 5,095 preferred and 2,210 common stockholders, and 1,121 employees were purchasing common stock which stood in the name of a trustee.

The company has a remarkable earning record. Net income in 1912 was over $2,290,000, rose to $4,897,000 in 1917, and even in 1921, a year of depression for most industrials, was $3,481,000. During the ten years ended with 1921, net profits averaged 14.59 per cent on the outstanding preferred stock, and after allowing 7 per cent preferred dividends, averaged 8.95 per cent per annum on the common stock.

The preferred dividend has been maintained without a break since 1892, and common dividends have been paid every year since 1905. On Nov. 23, 1922, the common dividend rate was increased to 8 per cent, payable $2 quarterly. Previous dividends were at the rate of $1.50 quarterly since March, 1920.

On Dec. 31, 1921, net plant account, after deductions for depreciation and depletion, stood at nearly $43,000,000. Other investments amounted to over $7,000,000, and current assets were over $38,500,000, compared to current liabilities of $7,667,000. Net working capital was nearly $30,848,000, compared to $24,000,000 in 1917. Profit-and-loss surplus was $20,880,000, compared to $15,000,000 in 1917.

During 1922, the company acquired an interest in Compania Minera de Llallagua of Bolivia, the largest single tin producer in the world. This investment of about $1,500,000 for control of the Bolivian tin mines enabled the company to secure long-term contracts for more than 75 per cent of the tin ores from South America. National Lead uses about 10,000 tons of tin annually, and is the second largest consumer of tin in the world, the U. S. Steel Corporation using about 14,000 tons a year for plating.

In 1921, the company's white-lead business was the largest in its history, and the record for 1922 is not far behind.

Price range of stock during the past ten years has been: Preferred, high, 117⅛ in 1916; low, 99 in 1917; close Jan. 20. 1923, 113¾. Common, high, 129¼ in 1922; low, 40 in 1914; close Jan. 20, 1923, 126. INVESTIGATOR.

Ruhr Invasion Has No Serious Effect on German Metal Buying

SPECIAL CORRESPONDENCE

Charlottenburg, Jan. 12, 1923.—It is a somewhat astonishing fact that metal buying in Germany continues on quite a good scale despite the political chaos due to the occupation of the Ruhr district by foreign forces. However, the order books of the manufacturers who are working on foreign accounts are well filled, some of the orders having been given for near-by deliveries. The sudden fresh appreciation of the dollar exchange in terms of marks has brought about a new spread between inland and foreign price levels of German finished goods, and the result is now a renewed rush of orders from abroad awaiting execution. The outstanding difficulty continues to be the stringent coal shortage that may now begin to handicap seriously all industrial activity in the country. The coal-distributing body is no longer functioning as of old, and it will probably be necessary to import British fuel, which is dearer than German by a fourth. It is this very fourth that German manufacturers of finished metal goods rely on for much of their profit. Fortunately, however, the multitude of brass mills and galvanizing plants, sheet and wire makers, are domiciled in the occupied province, so that these concerns may look for a better supply of coal through the foreign controlling bodies that have the outspoken desire to satisfy the needs of the population with which they come in closest contact. This fact accounts for the continued activity in the metal market here.

English dealers have been offering electrolytic copper at 14.75c., which is somewhat below the American quotation of 15c. for wirebars, so that they have been doing a good business, but the price differential is not expected to last. Only financially strong companies are buying far ahead. Such a company is the Deutsch-Atlantische Telegraphen Gesellschaft, of Berlin, that had to surrender its entire sea cables to the Allies at the end of the war, and has been indemnified by the German republic to the extent of 500,000,000 marks. This company is about to lay fresh cables to Spain and the Azore Islands, and to combine its lines with those of the Commercial Cable Co. of New York. It is believed that the German company is providing the money for the necessary copper purchases.

A characteristic feature of late has been the reworking of tin cans in Germany. I understand the Th. Goldschmidt Aktiengesellschaft, of Essen, turns out a large quantity of pure tin out of this scrap material. There are plenty of tin cans of American and English origin in this country which may yet yield a considerable amount of tin. Several average-sized manufacturing concerns that have not the funds to buy foreign tin are being encouraged by this development.

As to the lead market, the scarcity of this metal is becoming catastrophic, as people here used to say. The most depressing factor is the increasing absorption of lead by the United States, with poor remnants being left over for European consumption. There is a famine of lead in the electrical industries of Germany. The Metallwirtschaftsbund has granted many importation permits for lead concentrates and pig lead of late; also for secondary metal. The so-called Raffinadeblei, or Berliner Blei, is more and more disappearing from the market, as is the supply of lead-bearing scrap. Enormous quantities of these forms of the metal are being consumed by the dye industry, for the German makers are still more or less of a world monopoly. As to hard lead, the slump of the printing industry, and the diminished application of antimony in domestic bearing metals, tends, on the other hand, to a further reduction of the volume of consumption of the first-named metal. In order to get more lead, a fresh movement to exploit idle or even abandoned mines has set in. For instance, the ancient mine of Haus Baden is again being worked.

With the recent depreciation in the value of the mark, the silver market has again taken on a speculative appearance. People are investing their money in silver and gold, whereas platinum is being carried beyond the borders to be ultimately sold in America.

METAL STATISTICS

Monthly Average Prices of Metals

Silver

	New York		London		Sterling Exchange	
	1922	1923	1922	1923	1922	1923
January	65.450	65.668	35.035	31.928	421.750	465.053
February	65.290		33.891		435.511	
March	64.440		33.269		436.912	
April	66.575		34.080		440.715	
May	71.154		36.023		444.106	
June	71.149		35.900		444.615	
July	70.245		35.644		444.165	
August	69.417		34.957		446.069	
September	69.515		35.305		442.800	
October	68.015		34.498		443.583	
November	65.177		32.882		447.484	
December	63.905		31.383		460.440	
Year	67.528		34.406		442.346	

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

Copper

	New York		London			
	Electrolytic		Standard		Electrolytic	
	1922	1923	1922	1923	1922	1923
January	13.465	14.510	65.226	64.494	72.321	71.409
February	12.864		60.250		66.125	
March	12.567		59.245		65.739	
April	12.573		58.799		64.028	
May	13.111		61.092		66.554	
June	13.575		61.988		69.333	
July	13.654		63.137		70.321	
August	13.723		63.784		69.932	
September	13.748		63.113		70 917	
October	13.632		62.773		70.693	
November	13.598		62.795		70.216	
December	14.074		63.267		70.132	
Year	13.382		62.123		68.859	

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

Lead

	New York		St. Louis		London	
	1922	1923	1922	1923	1922	1923
January	4.700	7.633	4.388	7.571	23.667	27.119
February	4.700		4.396		20.681	
March	4.720		4.421		21.266	
April	5.115		4.946		22.993	
May	5.420		5.281		24.462	
June	5.745		5.563		24.685	
July	5.729		5.447		24.869	
August	5.824		5.537		24.580	
September	6.110		5.868		24.131	
October	6.530		6.338		25.551	
November	7.047		6.868		26.199	
December	7.163		6.978		26.079	
Year	5.734		5.503		24.097	

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

Tin

	New York				London	
	99%		Straits			
	1922	1923	1922	1923	1922	1923
January	31.480	37.986	32.100	39.173	163.065	181.852
February	29.835		30.767		149.850	
March	28.426		29 171		143 152	
April	29 810		30.605		149.840	
May	30.149		30.971		150.163	
June	30.707		31.497		152.512	
July	31 025		31.733		156.149	
August	32.134		32.380		160.006	
September	32.075		32.395		160.065	
October	33.935		34.600		170.563	
November	35.911		36.734		179.341	
December	36.480		37.695		178.697	
Year	31.831		32.554		159.450	

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

Zinc

	St. Louis		London	
	1922	1923	1922	1923
January	4.691	6.815	26.321	35.733
February	4.485		24.213	
March	4.658		25.467	
April	4.906		26.576	
May	5.110		27.304	
June	5.346		27.893	
July	5.694		29.042	
August	6.212		31.170	
September	6.548		31.750	
October	6.840		34.528	
November	7.104		38.011	
December	6.999		37.757	
Year	5.716		30.003	

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

Antimony, Quicksilver and Platinum

	Antimony (a)		Quicksilver (b)		Platinum (c)	
	New York		New York		New York	
	1922	1923	1922	1923	1922	1923
January	4.463	6.884	49.960	72.731	97.260	112.462
February	4.416		48.295		89.545	
March	4.319		50.204		87.500	
April	4.980		52.280		87.500	
May	5.467		54.885		85.529	
June	5.145		55.115		87.212	
July	5.091		55.000		90.180	
August	5.315		57.593		98.370	
September	6.580		67.640		117.280	
October	6.905		72.560		109.440	
November	6.584		71.521		108.000	
December	6.382		72.300		113.600	
Year	5.471		58.946		97.618	

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

Pig Iron, Pittsburgh

	Bessemer		Basic		No. 2 Foundry	
	1922	1923	1922	1923	1922	1923
January	21.55		20.15		21.34	
February	21.46		19.71		20.88	
March	21.35		19.96		20.83	
April	22.50		21.26		22.70	
May	26.36		26.87		25.96	
June	26.96		26.96		25.96	
July	26.77		26.33		25.97	
August	30.44		27.18		30.81	
September	35.27		34.70		36.79	
October	35.27		31.77		33.40	
November	33.52		29.37		30.55	
December	29.87		26.34		27.69	
Year	27.61		25.88		26.91	

In dollars per long ton.

Monthly Crude Copper Production

	1922			
	September	October	November	December
Alaska shipments	5,250,340	6,771,700	8,959,037	7,937,421
Washoe Smelter	13,800,000	15,980,000	15,500,000	15,250,000
Calumet & Arizona	3,398,000	3,916,000	3,298,000	3,582,000
Calumet & Hecla	(c)	(c)	(c)	(c)
Other Lake Superior	(c)	(c)	(c)	(c)
Chino	3,390,086	(c)	(c)	(c)
East Butte	(c)	(c)	(c)	(c)
Inspiration	(c)	(c)	(c)	(c)
Miami	5,666,715	6,172,000	5,636,000	5,336,447
Nevada Cons	1,203,894	(c)	(c)	(c)
New Cornelia	3,065,400	3,226,618	3,178,556	3,256,547
Old Dominion	2,636.000	2,772,000	2,934,000	2,150,000
Phelps Dodge	7,609,000	6,984,000	9,890,000	6,697,000
Ray	3,532,817	(c)	(c)	(c)
Shattuck Arizona	(a)	(a)	(c)	(c)
Southwest Metals Co	716,000	(c)	(c)	(c)
United Verde	5,310,000	(c)	(c)	(c)
United Verde Extension	3,556,010	3,760,234	3,670,206	3,026,334
Utah Copper	10,605,132	(c)	(c)	(c)
Others, estimated	10,300,000	11,500,000	11,900,000	10,000,000
Total United States	.....	.....	.....	.....
Imports: Ore and concentrates, matte	12,815,916	.....	.....	.....
Imports of black and blister, unrefined	37,052,679	.....	.....	.....
Imports of refined and old	7,299,193	.....	.....	.....
Grand total	.....	.....	.....	.....
Backus & Johnston	(c)	(c)	(c)	(c)
Boleo	1,160,933	1,214,925	1,128,409	1,389,150
Cananea	(c)	(c)	(c)	(c)
Cerro de Pasco	(c)	(c)	(c)	(c)
Chile	(c)	(c)	(c)	(c)
Cons. M. & S. of Canada	(a)	(a)	(a)	(a)
Falcon Mines	584,000	582,000	558,000	.....
Furukawa	3,092,806	3,284,003	.....	.....
Granby Cons	2,179,890	2,638,414	3,975,000	(c)
Hampden Cloncurry	(c)	(c)	(c)	.....
Katanga	7,766,010	8,352,540	8,330,500	10,050,370
Mount Morgan	956,000	940,000	840,000	.....
Mount Lyell	2,252,600	588,000	962,000	.....
Phelps Dodge Mexican	2,500,000	2,732,000	3,533,000	2,558,000
Sumitomo	2,933,812	2,596,060	3,184,772	.....
Wallaroo & Moonta	(a)	(a)	(a)	(a)

Comparative Annual Copper Production

	1919	1920	1921	1922
January	135,733,511	121,903,744	90,596,597	32,010,292
February	111,649,512	117,540,000	86,682,941	45,957,530
March	102,040,460	120,309,316	91 046,345	55,705,760
April	98,808,998	116,078,871	46,946,523 (b)	76,601,000
May	92,652,975	114,964,207	25,310,511 (b)	88,714,000
June	95,856,570	116,107,856	24,623,693 (b)	93,740,000
July	100,369,247	109,729,610	22,033,739 (b)	91,000,000
August	107,994,040	112,460,254	23,248,398 (b)	101,188,000
September	108,703,075	104,919,562	23,855,316 (b)	96,408,000
October	115,143,143	105,231,571	23,231,572 (b)	103,273,000
November	117,289,735	106,700,178	28,341,442	.....
December	102,997,633	95,709,009	29,629.137	.....

(a) No copper produced during this month. (b) Department of Commerce. (c) Not available

MINING STOCKS

Week Ended Jan. 27, 1923

Stock	Exch.	High	Low	Last		Last Div.
COPPER						
Ahmeek	Boston	57	56	56	Dec. '22, Q	$1.00
Alaska-Br. Col.	N. Y. Curb	2¼	2	2		
Alloues	Boston	20	20	20	Mar. '19	1.00
Anaconda	New York	48⅜	46⅞	48	Nov. '20, Q	1.00
Arcadian Consol.	Boston	3½	3½	3½		
Ariz. Com'l	Boston	7½	7½	7½	Oct. '18, Q	0.50
Bingham Mines	Boston	17⅜	17⅜	17⅜	Sept. '19, Q	0.25
Calumet & Arizona	Boston	55	51½	53	Dec. '22, Q	0.50
Calumet & Hecla	Boston	296	290	293	Dec. '22, Q	5.00
Canada Copper	N. Y. Curb	*3	*3	*3		
Centennial	Boston	†9	†8	8	Dec. '18, SA	1.00
Cerro de Pasco	New York	43¾	42⅜	43½	Mar. '21, Q	0.50
Chile Copper	New York	30	28⅛	30		
Chino	New York	25⅛	24⅛	24⅜	Sept. '20, Q	0.37
Copper Range	Boston	36⅛	36⅛	36⅛	Mar. '22, Q	1.00
Crystal Copper	Boston Curb	1 1/16	1 1/16	1 1/16		
Davis-Daly	Boston	3⅛	2⅞	3	Mar. '20, Q	0.25
East Butte	Boston	8½	8½	8½	Dec. '19, A	0.50
First National	Boston Curb	*30	*30	*30	Feb. '19, SA	0.15
Franklin	Boston	1⅛	1⅛	1⅛		
Gadsden Copper	N. Y. Curb	*62	*62	*62		
Granby Consol.	New York	24½	23	23	May '19, Q	1.25
Greene-Cananea	New York	24	24	24	Nov. '20, Q	0.50
Hancock	Boston	†2½	†2½	2½		
Howe Sound	N. Y. Curb	3⅛	3	3	Jan. '21, Q	0.05
Inspiration Consol.	New York	34⅜	33	34½	Oct. '20, Q	1.00
Iron Cap	Boston Curb	†6	†5	4⅜	Sept. '20, K	0.25
Isle Royale	Boston	23	22½	23	Dec. '22, K	0.50
Kennecott	New York	36½	35¼	36	Jan. '23, K	0.75
Keweenaw	Boston	1¼	1¼	1¼		
Lake Copper	Boston	3¼	3¼	3¼		
Magma Copper	New York	30	29½	30	Jan. '19, Q	0.50
Mason Valley	N. Y. Curb	2¼	1⅞	1⅞		
Mass Consolidated	Boston	†2	†1½	1½	Nov. '17, Q	1.00
Miami Copper	New York	27½	27	27½	Nov. '22, Q	0.50
Michigan	Boston	2¼	2	2		
Mohawk	Boston	56½	55	55	Nov. '22, Q	1.00
Mother Lode Coa.	New York	11⅜	11½	11⅜	Dec. '22, K	0.50
Nevada Consol.	New York	15	14½	14½	Sept. '20, Q	0.25
New Cornelia	Boston	18	16½	18	Nov. '22, Q	0.25
North Butte	Boston	9⅜	9	9	Oct. '18, Q	0.25
Ohio Copper	N. Y. Curb	*48	*37	*42		
Old Dominion	Boston	20½	19½	20	Dec. '18, Q	1.00
Osceola	Boston	31	30	30	Dec. '22, K	1.00
Phelps Dodge	Open Mar.	†165	†160		Jan. '23, Q	1.00
Quincy	Boston	35	33½	33½	Mar. '20, Q	1.00
Ray Consolidated	New York	13⅜	13⅛	13⅜	Dec. '20, Q	0.25
Ray Hercules	N. Y. Curb	1⅜	1⅛	1⅜		
St. Mary's Min. Ld.	Boston	42	42	42	Apr. '22, K	2.00
Seneca Copper	Boston	8	8	8		
Shannon	Boston	*60	*55	*60	Nov. '17, Q	0.25
Shattuck Arizona	New York	8⅜	8⅜	8⅜	Jan. '20, Q	0.25
South Lake	Boston	†*75	†*50	*50		
Superior & Boston	Boston	2⅜	2	2		
Tenn. C. & C. cfs.	New York	11⅞	11⅛	11⅛	May '18, I	1.00
Tuolumne	Boston	*55	*52	*55	May '13,	0.10
United Verde Ex.	N. Y. Curb	26½	26½	26½	Nov. '22, Q	0.25
Utah Consol.	Boston	1⅝	1⅛	1⅜	Sept '18,	0.25
Utah Copper	New York	63⅛	62⅜	63	Dec. '22, Q	0.50
Utah Metal & T.	Boston	*95	*90	*90	Dec. '17,	0.30
Victoria	Boston	†1	†1⅛	1⅛		
Winona	Boston	*88	*65	*88		
Wolverine	Boston	8	7⅛	7⅛		
NICKEL-COPPER						
Internat. Nickel	New York	15	14½	14⅜	Mar. '19,	0.50
Internat. Nickel, pfd.	New York	74	74	74	Nov. '22, Q	1.50
LEAD						
Carnegie Lead & Zinc	Pittsburgh	4	3⅞	4		
National Lead	New York	125½	123½	125	Dec. '22, Q	2.00
National Lead, pfd.	New York	113½	112½	112½	Dec. '22, Q	1.75
St. Joseph Lead	New York	18½	18⅛	18⅛	Dec. '22, Q,X	0.50
ZINC						
Am. Z. L. & S.	New York	15½	15	15	May '20,	1.00
Am. Z. L. & S. pfd.	New York			50	Nov. '20, Q	1.50
Butte C. & Z.	New York	10⅜	9½	10⅛	June '18,	0.50
Butte & Superior	New York	30⅛	29½	30	Dec. '22,	0.50
Callahan Zn-Ld	New York	10⅜	9⅜	10⅛	Dec. '20, Q	0.50
New Jersey Zn.	N. Y. Curb	172½	172	172	Jan. '23, Q	2.00
Yellow Pine	Los Angeles			*77	Sept. '20, Q	0.03
SILVER						
Batopilas Mining	New York	⅛		⅛	Dec. '07, I	0.12½
Beaver Consol.	Toronto	*32	*30½	*32	May '20, K	0.03
Candelaria	N. Y. Curb	*38	*32	*33		
Coniagas	Toronto	2.10	2.05	2.10	May '21, Q	0.12½
Crown Reserve	Toronto	*38	*36	*38	Jan. '17,	0.05
Hilltop-Nev.	N. Y. Curb.	1⅜	1⅛	1 1/16		
Kerr Lake	N. Y. Curb	3⅜	3⅛	3⅛	Jan. '23, Q	0.12½
La Rose	Toronto	*26	*25	*25½	Apr. '22,	0.10
McKinley-Dar.-Sav.	Toronto	*20	*19	*19	Oct. '20, Q	0.03
Mining Corp. Can.	Toronto	*95	*95	*95	Sept. '20, Q	0.12½
Nipissing	N. Y. Curb	6	5⅜	5⅜	Jan. '23, Q,X	0.60
Ontario Silver	New York			5⅛	Jan. '19, Q	0.50
Temiskaming	Toronto	*33	*32	*32	Jan. '20, K	0.04
Trethewey	Toronto	4	4	4	Jan. '19,	0.05

Stock	Exch.	High	Low	Last		Last Div.
GOLD						
Alaska Gold	New York	⅛		⅛		
Alaska Juneau	New York	1⅛	1⅛	1⅛		
Atlas	Toronto	*13	*12	*12		
Carson Hill	Boston	8⅛	8	8⅛		
Cresson Consol. G.	N. Y. Curb	2⅛	2⅛	2⅛	Jan. '23 Q.	0.10
Dome Mines	New York	42	40⅜	42	Jan. '23, Q	0.50
Golden Cycle	Colo. Springs	*89	*85	*85	Dec. '22, Q	0.02
Hollinger Consol.	Toronto	12.25	11.90	12.25	Jan. '23, M	0.05
Homestake Mining	New York	77	76½	76½	Jan '23, M	0.50
Keora	Toronto	*11½	*11	*11		
Kirkland Lake	Toronto	*39⅜	*39	*39½		
Lake Shore	Toronto	3.09	3.07	3.07	Nov. '22, Q	0.02
McIntyre- Porcupine	Toronto	18.85	18.50	18.60	Jan. '23, K	0.25
Porcupine Crown	Toronto	*18	*17	*17	July '17,	0.03
Portland	Colo. Springs			*40	Oct. '20, Q	0.01
Schumacher	Toronto	*47	*29	*30		
Teck Hughes	Toronto	*90	*89	*89		
Tom Reed	Los Angeles	1.05	*93	1.03	Dec. '19,	0.02
United Eastern	N. Y. Curb	2	1⅛	1⅛	Jan. '23, Q	0.15
Vipond Cons.	Toronto	*68	*66½	*68		
White Caps Mining	N. Y. Curb	*7	*5	*6		
Wright-Hargreaves	Toronto	3.14	3.09	3.14	Jan. '23	0.02½
Yukon Gold	N. Y. Curb			*80	June '18,	0.02½
GOLD AND SILVER						
Boston-Mont. Corp.	N. Y. Curb	*13	*10	*10		
Cons. Virginia	San Francisco	*11½	*9⅜	*11⅛		
Continental Mines	N. Y. Curb	4⅛	1⅛	1⅛		
Dolores Esperanza	N. Y. Curb	2⅛	2⅛	2⅛	Jan. '23	2.50
Tonopah Belmont	N. Y. Curb	1 1/16	1⅛	1 1/16	Jan. '23, Q	0.05
Tonopah Divide	N. Y. Curb	*72	*70	*70		
Tonopah Extension	N. Y. Curb	3⅛	3	3⅛	Jan. '23, Q	0.05
Tonopah Mining	N. Y. Curb	3⅛	2⅛	3⅛	Jan. '23, SA,	0.15
West End Consol.	N. Y. Curb	1 1/16	1 1/16	1⅛	Dec. '22, Q	0.05
SILVER-LEAD						
Caledonia Mng.	N. Y. Curb	*9	*8	*9	Jan. '21, M	0.01
Cardiff M. & M.	Salt Lake			*32	Dec. '20,	0.15
Chief Consol.	Boston Curb	4⅞	4⅛	4⅛	Nov. '22, Q	0.10
Columbus Rexall	Salt Lake	*20	*19	*19	Aug. '22,	0.03
Consol. M. & S.	Montreal	27	25⅞	27	Oct. '20, Q	0.62½
Eagle & Blue Bell	Boston Curb	†3	†2	3	Nov. '22, K	0.05
Federal M. & S.	New York	8⅞	8⅛	8⅜	Jan. '09,	1.50
Federal M. & S. pfd.	New York	47⅛	44	45½	Dec. '22, Q	1.25
Florence Silver	Spokane	*43	*40	*40	Apr. '19,	0.01½
Hecla Mining	N. Y. Curb	8⅛	8⅛	8⅛	Dec. '22, Q,X	0.50
Iron Blossom Con.	N. Y. Curb	*30	*28	*29	Apr. '22, Q	0.02½
Marsh Mines	N. Y. Curb	*8	*6	*8	June '21, I	0.02
Park City	Salt Lake	3.40	3.40	3.40	Jan. '23,	0.10
Prince Consol.	Salt Lake	*10	*8	*10	Nov. '17,	0.02½
Silversmith	Spokane	*49⅛	*48	*48	Oct. '22,	0.01
Simon Silver Lead	N. Y. Curb	*36	*31	*33		
Tamarack-Custer	Spokane	1.40	1.32	1.40	Jan. '21, K	0.04
Tintic Standard	Salt Lake	2.80	2.40	2.55	Dec. '22, Q,X	0.10
Utah Apex	Boston	3	2⅛	2⅛	Nov. '20, K	0.25
IRON						
Bethlehem Steel "B"	New York	63¼	61¼	62	Jan. '23	0.25
Char. Iron	Detroit			¾		
Char. Iron, pfd	Detroit			2⅜		
Colorado Fuel & Iron	New York	25⅜	25⅛	25⅛	May '21	0.75
Col. Fuel & Iron, pfd.	New York			105	Nov. '22	2.00
Gt. North'n Iron Ore	New York	30⅛	30	30⅛	Dec. '22	1.00
Inland Steel	N. Y. Curb	47	47	47	Dec. '22	0.25
Mesabi Iron	N. Y. Curb	10⅜	10⅛	10⅛		
Replogle Steel	New York	27⅛	26⅛	26⅛		
Republic I. & S.	New York	49⅛	47⅞	48⅜	May '21	1.50
Republic I. S., pfd.	New York	92⅛	89	89⅞	Jan. '22	1.75
Sloss-Sheffield S. & I.	New York	49	45	48	Feb. '21	1.50
U. S. Steel	New York	106⅛	105	106	Dec. '22	1.25
U. S. Steel, pfd.	New York	122⅜	121⅛	121⅛	Nov. '22	1.75
Virginia I. C. & C.	New York	54⅛	54⅛	54⅛	Jan. '22	1.50
Virginia I.C.&C.,pfd.	New York			82	Jan '23	2.50
VANADIUM						
Vanadium Corp.	New York	36¼	35½	36¼	Jan. '21, Q	1.00
ASBESTOS						
Asbestos Corp.	Montreal	64	63½	63½	Oct. '22, Q	1.50
Asbestos Corp. pfd.	Montreal			84½	Oct. '22, Q	1.75
SULPHUR						
Freeport Texas	New York	20⅛	19	20⅛	Nov. '19, Q	1.00
Texas Gulf	New York	62½	60⅜	61⅛	Dec. '22, QX	2.00
PLATINUM						
So. Am. Gold & P.	N. Y. Curb	3⅛	3⅛	3⅛		
MINING, SMELTING AND REFINING						
Amer. Metal	New York	51⅛	51	51⅛	Dec. '22, Q	0.75
Amer. Metal pfd.	New York	115⅛	115½	115⅛	Dec. '22, Q	1.75
Amer. Sm. & Ref.	New York	55⅛	53	55⅛	Mar. '21, Q	1.00
Amer. Sm.& Ref. pfd	New York	98⅛	98⅛	98⅛	Dec. '22 Q	1.75
U. S. Sm. R. & M.	New York	37⅛	35	36⅛	Jan. '21, Q	0.50
U.S. Sm.R.& M. pfd.	New York	47	46⅛	47	Jan. '23 Q	0.87½

*Cents per share. †Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. K, Irregular. I, Initial. X, Includes extra.

Toronto quotations courtesy Hamilton B. Wills; Spokane, Pohlman Investment Co; Salt Lake, Stock and Mining Exchange; Los Angeles, Chamber of Mines and Oil; Colorado Springs, Colorado Springs Stock Exchange.

NEW MACHINERY AND INVENTIONS

To Demonstrate Liquid Air Machines and Explosives

Adolph Messer, head of the firm of Messer & Co. in Germany, is now in this country for the purpose of acquainting engineers with the progress that has been made in the liquefaction of air and the commercial applications of the products. It is with a small Messer machine that air is liquefied and liquid oxygen for explosive purposes made at the Real del Monte mine at Pachuca, Mexico, the practice having been described in the Dec. 2, 1922, issue of the *Journal-Press*. The use of liquid oxygen has progressed much farther in Germany than in this country, according to Mr. Messer. There, it has even been used to enrich the blast for metallurgical furnaces, two machines, capable of making 90 cubic meters of liquid oxygen per hour, being installed for a Siemens-Martin iron furnace at Dortmund, Germany. Pure oxygen is used at the start, and then a mixture with air running about 26 to 27 per cent of oxygen is employed. The increased power obtained from the exhaust gases and the increased tonnage and superior control of the furnace operation are important advantages.

A 3,000 cubic meter per hour machine is now being built for one of the Stinnes plants. This is by far the largest machine ever constructed, and with it it is expected to produce 100 cu.ft. of pure oxygen at an expenditure of 2.25 kw. Purification of the air—i.e., removal of the moisture and carbon dioxide—is the principal problem of liquefaction.

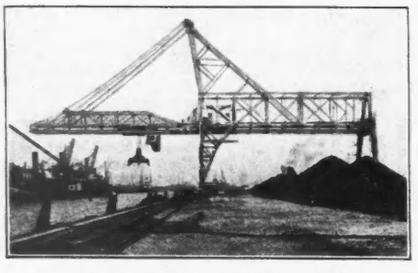
It is planned to sell the Messer machines outright to companies which expect to use liquid oxygen on a large scale. A demonstration of the use of the carbon-oxygen explosive is expected to be made within the next two or three weeks at some point in the East. Meanwhile, Mr. Messer's visit is attracting considerable attention among mining engineers anxious to learn as much as possible about this development. Mr. Messer expects to return to Germany about the middle of February. Until then he may be addressed in care of M. Keith Dunham, 110 South Dearborn St., Chicago, Ill.

Europe Buys American Equipment

Changes brought about by the war have raised the cost of labor in Europe materially, and there is an increasing demand there for equipment of American type. An interesting example of this is a crane supplied to the Coal Trading Association of Rotterdam by the Brown Hoisting Machinery Co., of Cleveland, Ohio. In spite of the depreciated state of German currency and the lower price of labor in England, Belgium, and France, the Rotterdam business men purchased this equipment in America and place it in the most competitive center of industrial Europe. The machinery is now in operation, being used to transfer ore from tramp steamers to Rhine barges and coal from like barges into ocean-going steamers for shipment abroad.

Each crane will operate on barges of 3,600 tons' capacity, 103 meters long by 13 meters wide, and in free coal or ore have a capacity of 600 tons per hour from barge to steamer and vice versa. The main particulars of each of these cranes are: Span, 155 ft. 8 in.; length of apron, including cantilever, 164 ft. 0 in.; total trolley travel, 273 ft. 8 in.; height of trolley runway above crane rails, 58 ft.

The crane is equipped with a turntable trolley arranged to operate a coal grab bucket of 400-cu.ft. capacity, or an ore bucket of 115 cu.ft. capacity. These loads are handled at the following speeds: Hoisting, 175 ft. per minute; trolley travel, 800 to 900 ft. per minute; bridge travel, 50 to 70 ft. per minute.



Trolley bridge equipped to operate coal or ore grab buckets

The turntable makes it possible to operate the bucket either parallel to or crosswise of the runway. The crane is electrically equipped throughout, using direct current at 480 volts, and some of the motors are as large as 175 hp.

Refractory Firebrick and Cements

Among the products, used in metallurgical operations, which were developed during the past year should be mentioned a neutral, refractory firebrick cement, known as "Hifire Bond," which is said to have the same coefficient of expansion and the general physical and chemical characteristics as high-grade firebrick. This tends to make an excellent bond at low and high temperatures. The cement is packed in 100-lb. sacks, and is shipped dry. This obviates danger of freezing in transit, the probability of waste in use, and results in a great saving of freight, as 100 lb. of dry material will make about 130 lb. of cement mixed with water ready for use.

Another similar product is "Ibex" brick, a superrefractory firebrick or fireclay blocks containing well above 70 per cent alumina, with a fusing point above 3,500 deg. F., and having a very low coefficient of expansion. These bricks are made by the stiff mud process, hand moulded and burned to a high temperature, resulting in a hard, tough brick, that in addition to its ability to withstand chemical action and temperatures that ordinary firebrick will not stand, is said to be capable of withstanding severe abrasion. Blocks can be supplied of any size of shape desired in addition to a complete line of fireclay bricks and shapes.

Both of these are manufactured by the Denver Fire Clay Co., Denver, Colo.

The Mine and Smelter Supply Co., has taken over exclusive representation for the states of Colorado, Utah, Nevada, Wyoming, New Mexico and western Texas for Wilson plastic-arc welders and Wilson "Colortipt" welding metals.

TRADE CATALOGS

Industrial Diamonds—Diamond Drill Carbon Co., 53 Park Row, New York, has issued an attractive 36-p. booklet entitled "Industrial Diamonds and Diamond Pointed Tools." The history of industrial diamonds is briefly given, methods of mining ore outlined, and the various applications of these valuable and useful stones are detailed. A number of interesting illustrations show the utilization of the stones in turning, boring, and other cutting tools.

Spiral Riveted Pipe—American Spiral Pipe Works, Chicago, Ill., has recently issued Catalog No. 22, "Taylor's Spiral-Riveted Pressure Pipe." The issue is well arranged and profusely illustrated. The initial pages are devoted to a short description of the method of producing Taylor's spiral riveted pipe, which has for many years been the standard for exhaust steam purposes and is also extensively used on high-pressure hydroelectric installations. Price lists, hydraulic tables and charts, and a number of valuable references to other equipment similarly used are given. Undoubtedly the book will be of interest to everyone concerned with piping or similar problems.

Conical Mills—Hardinge Co., Inc., 120 Broadway, New York, has recently issued Catalog No. 13, "Hardinge Conical Mills," which covers conical ball and pebble mills and their application to the field of grinding and pulverizing. The bulletin treats the matter of pulverizing and grinding, both wet and dry, in a manner never before attempted. Although the Hardinge mill itself has been in extensive operation for a number of years, the development which has occurred in the last three years has been marked and the method of operation has changed greatly. The booklet takes up the principles of grinding and explains how these principles apply to any class of material, whether this grinding is to be accomplished wet or dry, or whether the product desired is to be as granular as possible or extremely fine and uniform in texture. The new type of conical mill is also described.