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Ore Deposition at Franklin Furnace

Unique features of the mineralization at the most important zinc mine in the United States

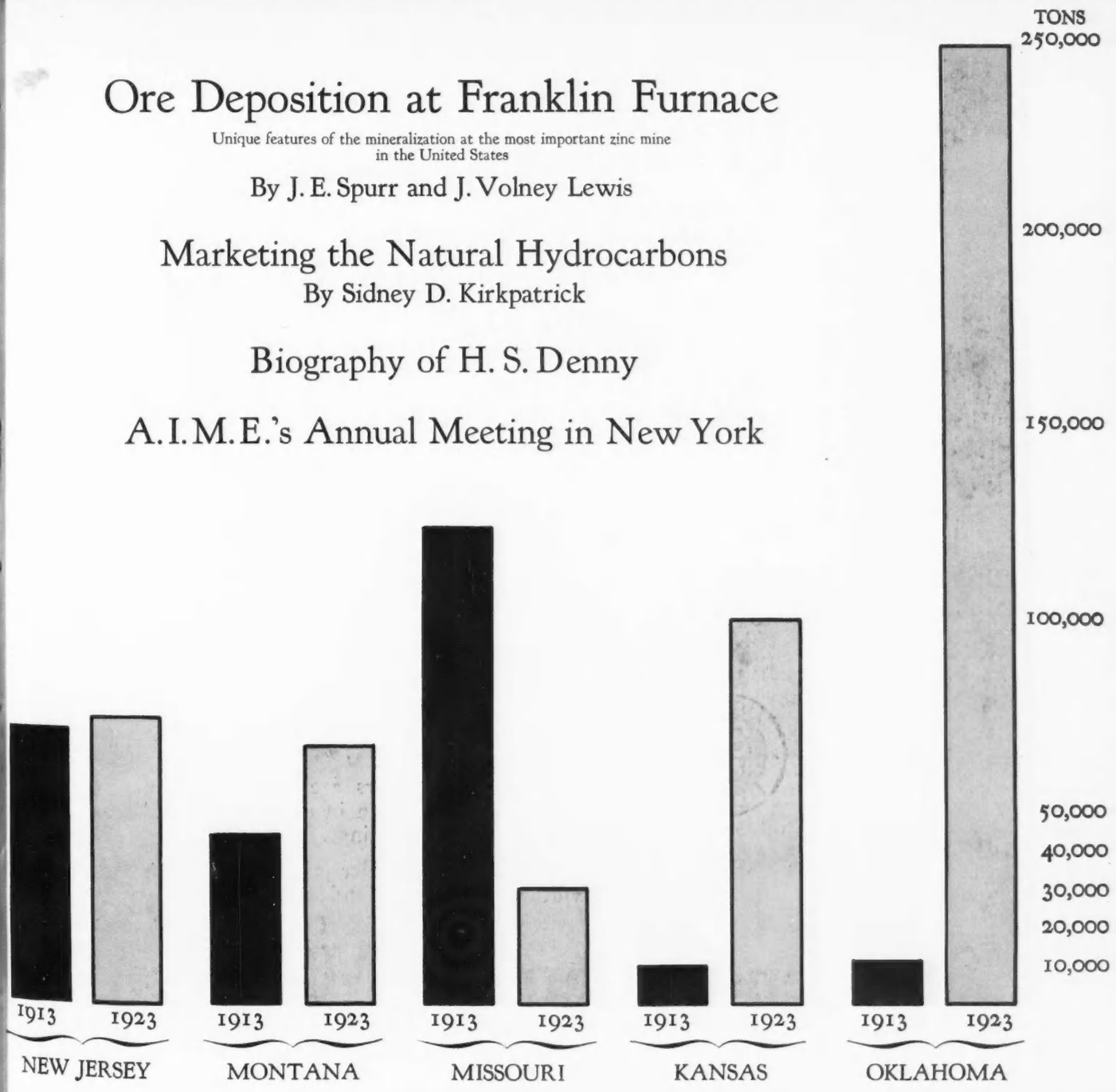
By J. E. Spurr and J. Volney Lewis

Marketing the Natural Hydrocarbons

By Sidney D. Kirkpatrick

Biography of H. S. Denny

A.I.M.E.'s Annual Meeting in New York



Zinc Output, in 1913 and 1923, in the Five Principal Producing States

Of these New Jersey has had the steadiest production, which has come entirely from the Franklin Furnace mines

ENGINEERING AND
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JOSIAH EDWARD SPURR, Editor

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Lake Superior Iron-ore Problems

THE FUTURE of the Lake Superior iron-ore regions is discussed comprehensively and ably by Mr. M. C. Lake in a paper prepared for the August, 1925, meeting of the Lake Superior Mining Institute. The development of the region is sketched, and the controlling economic factors which apply to the present and to the future are indicated. The self-evident and often-repeated warning is given that "depletion of ore reserves is an ever pressing and important problem of the mining industry; reserves are wasting assets, for the tonnage that is mined disappears and never returns. The search for new orebodies and the research to determine the material left behind by the selection of high-grade ore must be continuous." This basic truth, indeed, cannot be repeated too often, for it has not yet sunk into the consciousness of the public, the legislators, or even the economists.

The rate of production of ore from the Lake Superior region has increased steadily since its active exploitation. If this increase be projected onward for twenty years, the region would be producing 75,000,000 tons of iron ore by 1944; and, on this assumption, by 1944 the present reserves would be exhausted. On the other hand, if the present tendency toward an increased scale of production is checked by a governing complex of economic conditions, the known ore reserves might last twenty-one to twenty-seven years, with an additional life of perhaps twenty years more to consume the ore estimated as "probable," though not part of the known reserves.

Factors that may tend to check the increasing rate of production are the increasing costs as deeper mining becomes necessary, and increased taxation; all this resulting in lending strength to the competition from other iron regions. The Birmingham region in Alabama; the magnetite deposits of New York, New Jersey, and Pennsylvania, and other ore deposits which are developing at different points in the United States will have an increasing advantage in supplying the markets near their respective centers. Importations of iron ore into the United States from other countries will also tend to increase shipments from Europe, Africa, Cuba, Chile, and Brazil. Eastern Canada will probably increase her iron-ore production, for her own use and on occasion for export to the United States.

The chief work of the future, as to prolonging the ore supply (and this applies to the mineral problem in general as well as to the Lake Superior region), is in the two fields of geological investigation and metallurgical progress. The actual costs of mining, as above stated, cannot be expected to decrease considerably, since the increased use of machinery instead of manpower will tend to be offset by higher wages and greater mining depths. As to ore dressing or beneficiation, much progress has already been made in the Lake Superior region, and the product of plants like that of the Mesabi Iron Co. at Babbitt, in Minnesota—a plant which concentrates low-grade magnetic, low-phosphorus ores—will prolong the economic life of the region. Washing plants have also made it possible to mine more largely the low-grade manganiferous iron ores of the Cuyuna range in Minnesota. The ore-testing laboratories of the U. S. Bureau of Mines and of the mining departments of the universities of Minnesota and of Wisconsin are enumerated by Mr. Lake as of past, present, and future value in the ore-dressing problem.

As to the value of mining geology, it is universally recognized as having always been great. The U. S. Geological Survey and the state surveys of Wisconsin, Michigan, and Minnesota have all been active in this work—particularly, in recent years, the Wisconsin Survey. As to the future, Mr. Lake concludes, much geological work remains to be done. He points out that very few new deposits of ore have been discovered in the last ten years; but that further careful detailed surveys would probably add to the ore reserves. This work, he concludes, should be done by the state surveys of Minnesota, Michigan, and Wisconsin, and he makes the very practical and pertinent suggestion that "A larger percentage of money secured by the state from its mineral resources should be put to use in maintaining those sources of wealth which are fundamental to the prosperity of the country. Each of these states maintains a Geological Department, with able State Geologists, and the state and the industry should be interested in seeing that they have the use of a sufficient amount of revenue to permit them to expand the geological work over their various fields."

The state legislatures should comprehend this and recognize it as sound, and part of the state taxes on iron and other mines should be regarded as a revolving fund to develop new ore reserves to replace those mined. At present, a permanent endowment fund is devoted, by the State of Minnesota, out of these taxes for the permanent maintenance of schools and colleges within the state, but this is not so pertinent and practical a use as that which would endow the creation of new ore reserves by geological and metallurgical researches.

Returning Mining Capital to Investors

MINES ARE WASTING ASSETS. Obvious as this fact may seem, it is often lost sight of, particularly by investors in mining enterprises. Every ton of ore removed from a mineral deposit decreases the value of that deposit by the worth of the ore removed. So as not to deplete a mine completely, only to discover that the investment in the property is practically worthless after the mine is worked out, except for the scrap value of plant and equipment together with quick assets, accountants and engineers have established a depletion account for use on the balance sheet to take care of this situation. The object of a depletion reserve is to accu-

mulate a fund with which to return the capital invested in a mine to the investors, either before it is worked out, during the time that it is being worked out, or after a mine has been completely worked out. The depletion reserve may also be used to purchase new properties to lengthen the life of a mining company.

We are reminded of this depletion factor by the annual statement of the Texas Gulf Sulphur Co. for 1924. It states that dividends amounting to $4,762,500 were paid, and makes the significant announcement that 65.6 per cent of this distribution was made from depletion reserve, which, under the federal revenue laws, is to be treated as a capital distribution. The importance of this declaration lies in the freedom from taxation which payments as return of capital enjoy. Hence the necessity of knowing just what part of any dividend received is a capital repayment from depletion reserve. It means a saving in dollars and cents to the taxpayer. Other mining companies follow the practice of Texas Gulf Sulphur. Homestake Mining Co. recently indicated to its stockholders that the dividends disbursed in 1924 were drawn to the extent of 54.63 per cent from surplus and were a return of capital. But the practice is not so general as might be assumed. Many companies do not make any reference to disbursements from depletion. In some cases this is doubtless owing to the small capital investment compared with the high earnings. Hecla is an example. The mine is capitalized at 25c. per share and earnings have been this much per quarter for many years. A return of capital has been made many times over by Hecla. The tax saving that could be made in declaring part of each dividend a return of capital would be negligible here.

The Marketing Campaign of *Engineering and Mining Journal-Press*

THE PROBLEM of the economical and efficient distribution of products is one of the important studies in the field of increasing industrial wealth and opportunity, as Mr. Hoover has recently pointed out. In our own field of mining and metals this was realized with great force by the editorial management of this journal five years ago: and a persistent and constructive program of analysis of distributing—that is to say, marketing—the products of our own industries has been pushed forward ever since. The result is the series of articles which we are now bringing to a close—a series of investigations conducted and written up according to a unified plan worked out in advance by *Engineering and Mining Journal-Press*—which cover the marketing methods in the whole field of our industries. This series is about to be brought out in book form, published for *Engineering and Mining Journal-Press* by the McGraw-Hill Book Co. It is the first thorough attempt to cover this important subject of marketing in the mining industries: and these investigations have been carried on abreast of or in advance of the realization of the importance of the subject of marketing in other industries. President Coolidge and Mr. Hoover have recently stressed the subject as the one whose illumination was most essential to the problems of the farmer.

In bringing out a book on metal and mineral marketing, therefore, *Engineering and Mining Journal-Press* has become a pioneer in the field. It is our editorial opinion that this book will be the most important single book ever published for the mining industry—since it will appeal to every one in the industry, which no other book of which we know does—and as the editors of *Engineering and Mining Journal-Press* have been responsible for a number of books written on different phases of the mining industry, their opinion may be of some weight. One of the most striking things about the book on Marketing of Metals and Minerals is the lack of references to existing literature—the reason being that there has been virtually no earlier literature on the subject.

Employee Representation

THERE ARE NOW over 800 works councils or employee representation plans, affecting directly more than a million workmen, in operation in the United States, according to a report of the National Industrial Conference Board (New York City). The increase in number of councils has been continuous since 1917. During the last five years, it has risen from 225 in 1919 to 814 in 1924; and the membership covered from 391,000 in 1919 to 1,177,000 in 1924. The largest number of these works councils are in Massachusetts, which had 105 in 1924. New York had 60, Washington 45, Illinois 39, Ohio 30, Pennsylvania 29, Connecticut 28, California 27, New Jersey 19, Maryland 18, Minnesota 13, and Wisconsin 11.

Considered by industries the metal trades account for one-third of the total number of councils; lumber for about one-fifth; and the printing trades for about one-seventh. By far the larger number of councils are in large industrial establishments, the reason probably being that in small establishments the constant contact between employer and employee renders any formal organization unnecessary.

Evidently, the works council has sufficient merits so that it is in many cases a desirable and profitable thing. It does not always work: indeed, there is no social or governmental device which always functions as intended; but apparently it is as a rule a welcome palliative and lubricant. The distribution of councils shows that they are operative chiefly in great industrial centers where the growth of great corporations makes some such a thing necessary. They have not been developed much in mining operations, for the reasons above suggested, although they have been tried and found acceptable in some large mining companies. They represent in general much the same spirit as do the voluntary courts of arbitration between business men, a form of settlement of disputes which has had lately a steady growth.

Although we resent the tyranny locally imposed upon Mr. Average Citizen by the labor unions; although these acts are sometimes subversive of justice and liberty: the general opinion is that the labor union is indispensable and that without it the general condition of the industrial worker would be far worse. Combinations of capital make necessary corresponding combinations of industrial workers. This condition is not without its disturbing extensions. The farmers, squeezed between these two groups of combinations, have effected a third group and are seeking to make it economically effective. The proper balancing of all industrial groupings calls for a nice and continual adjustment.

One group which still has its representation problems largely unsolved is the white-collar group. While in

many organizations, conditions are such that their problems are not acute, the fact remains that their average wages are low and that in many enterprises they are hired and fired without any great reason and without due consideration. Labor, in this sense, is not treated so much like a commodity as is white-collar service. The white collar, to a large proportion of its wearers, is not only a badge of respectability but a badge of servitude as well.

Record Prosperity for the Rand Gold Producers

DIVIDENDS paid by Transvaal gold-mining companies during 1924 set a new record, being half a million pounds sterling higher than the previous mark set in 1910, and a million and a half pounds above the 1923 returns. Last year, thirty-one companies paid almost £10,000,000, or about $44,000,000 at the average rate of exchange for the year. This reflects a most prosperous condition on the Rand, and one that is continuing into 1925. With sterling approaching parity with the dollar, producers no longer receive the premium they have so long obtained; in fact, the first of June has been decided upon officially as the termination of such premiums; but apparently this is not worrying the mining companies much.

Working costs have decreased somewhat, with improved operating conditions, and the tonnage milled has increased. These two factors have been the principal causes of the increased dividends, recoveries per ton being somewhat lower.

Thus does the Rand continue to shine with undimmed glory as the premier gold-producing district of the world. The New Modderfontein Gold Mining Co. is its leading representative. This company distributed £1,400,000 ($6,160,000) to its stockholders last year, which compares with $3,198,000 paid by Hollinger, $2,000,000 paid by Dome, and $1,758,120 by Homestake, this continent's leading gold mines as judged by dividends. The New Modder still has about 9,000,000 tons of $8.75 ore in reserve. It has not the possibilities for the future that some of the northern Ontario mines have, but it has been producing for thirty-two years and it is given to but few properties to reach such a prosperous old age.

Gold mining in the United States is improving, but no record dividends are being paid. California producers are still pretty much down and out; at least that is the impression one gets from the comments of miners in that section of the country, though it may be observed that California produced more than twice as much gold as any other state last year. Next to California, in point of state production, comes South Dakota, where the Homestake, the greatest gold mine in the United States, after paying dividends almost continuously since 1879, still finds $125,000 monthly available for its stockholders, with an occasional bonus.

Destroying the Initiative of Technical Men

RECENTLY we were told the following incident by an enterprising metallurgist who had invested his money and his brains in a custom treatment plant for the handling of gold mill concentrates by hydrometallurgical methods: In an endeavor to get business for the plant, which was in successful operation, an offer was made to treat the concentrates of a neighboring mine. The price that was offered represented a substantial saving over the cost of shipping the concentrates to a smelter and the treatment charges involved. The manager of the gold mine took the offer under consideration and then approached the smelting company and succeeded in getting his smelting charge reduced by an amount equivalent to the saving that would have resulted had the concentrates been treated at the local custom plant. When this was made known to the metallurgist in question, he promptly stated that he would make a sporting proposition to the manager and do the work for 50c. per ton less than his previous figure. The mine manager took the proposal under advisement and wended his way in the meantime over to the smelting company's office and made them knock an additional 50c. per ton off from their price.

All's fair in love and war, and the smelterman is sometimes looked upon as fair game by certain miners, but the foregoing incident involves features that are worth discussing at length. Obviously, the smelter's price under previous existing conditions was such as to take some advantage of the absence of local treatment plants and therefore included perhaps something more than a fair profit. The successful initiation of local treatment made new conditions which the manager used to his own advantage and to the smelter's disadvantage. The smelterman sought to maintain his business by meeting competitive prices, although the margin of profit was undoubtedly seriously reduced. Unlike the metallurgist, however, he had sufficient financial backing to continue buying the concentrates even though he made a loss upon its treatment. In the end revenue from other ores would have compensated for this, but the injustice of this practice to other ore sellers is plain.

Stifling of initiative is the most important indictment that can be drawn from this incident. The metallurgist had, by systematic research and practical plant operation, developed a commercial process which represented an improvement over existing methods. He invested his money and his technical ability. He should have received a commensurate reward. The mining company so far appears to be the direct beneficiary. It paid no fees for technical services. It contributed in no way to the development of the local custom plant. Nevertheless, it directly benefited to the extent of an additional annual return which could not have been obtained were it not for the initiative of the metallurgist. If the mining industry is to advance, technical men must of necessity find compensation for their efforts, otherwise the industry will lose the benefit of the experience and intelligence of a group of men who are well worthy of their hire.

Give the Assayer Time Enough

A MINING ENGINEER may spend several weeks or more in making a careful examination of a mining property. Samples are taken and every effort is made to insure accuracy. When he sends his samples to an assayer, almost invariably he asks for a report on the day or day after the receipt of samples. Seldom will he give two whole days to the assayer for this work. Even the best mining engineers will rush an assayer. Obviously the experienced assayer is human. Hurried work usually interferes with accuracy. The exact determination of the contents of a sample is necessary, as otherwise all of the care taken in securing the samples may be more or less futile. Ample time should be allowed the assayer as an essential condition to securing satisfactory results.

Mining Engineers of Note

Harry S. Denny

By W. A. Doman

BORN IN AUSTRALIA in 1872, Harry S. Denny has had a remarkable experience as mining engineer. Apparently he inherited his partiality for such an occupation, as his father was a mechanical and mining engineer. At nineteen he received the coveted degree of S. M. B. from the Ballarat School of Mines, at Victoria, since when he has held appointments in many countries. Leaving Australia he became assistant manager of a gold-silver mine in Austria-Hungary, and later erected and operated a test gold-milling and recovery plant in Portugal. To extend the scope of his experience, he engaged himself at a large engineering works in England, superintending the manufacture of a gold-milling plant for South Africa. This plant was erected in Zululand to treat a banket ore similar to that of the Witwatersrand. South Africa being the land of mining opportunities, Harry Denny decided to remain there, and with his brother George investigated the economic possibilities of Klerksdorp, which at that time were thought to be equal to those of the Rand. A stay of a year disillusioned them. There remained the Rand, which held out such wonderful prospects, and thither the brothers trekked. After studying the district they concluded that the method of working some of the mines was uneconomical and endeavored to solve some of the problems that existed. From this time on the brothers worked in partnership, and their services were enlisted by George Albu for the General Mining & Finance Corporation. Experience gained elsewhere was brought into play, and the reorganization of workings and plant at two of the mines controlled by the corporation converted a heavy monthly loss into a heavier monthly profit within a twelvemonth. It was due to the energy of the Denny brothers that the Meyer & Charlton, under their administration, was the first to resume mining operations after the Boer War. Harry S. Denny first came into real prominence in 1903, when he read a revolutionary and epoch-making paper before the Chemical and Metallurgical Society of South Africa severely criticising Rand metallurgical practice and advocating the use of tube milling, filter pressing and circulation of cyanide solution through mills, on the Rand. Later, with his brother, he was responsible for installing the first plants on the Witwatersrand built on the all-sliming principle. In 1905, before the South African Association of Engineers he presented a second far-reaching paper called "Grading Analysis," which clearly showed the necessity for fine grinding as the foundation of the "all-sliming" process. It is only after twenty years that the Rand has been entirely converted to the virtues of that process, and "all-sliming," originally ridiculed, is now being generally adopted there at the newer mines. The brothers Denny, having a group of mines under their control, were able to put many of their progressive ideas into practice, and were responsible for the introduction of many innovations. The Meyer & Charlton was the first mine selected by them for erecting a plant with all the elements of the all-sliming process, and the plant is running today practically as they designed it twenty years ago. On leaving Johannesburg in 1906, offices were taken in London, and between then and 1914 many missions were undertaken abroad, technical work being done in Mexico, the United States, the Continent of Europe, and elsewhere. Like many mining engineers, Harry Denny was pressed into the government service during the war, and designed and operated various explosives plants. After the armistice he was appointed head of the Technical Department to assist Lord Plumer in the British occupied territory in Germany. Since then he has divided his interests between the chemical industry and the mining industry. Two years ago he made an exhaustive examination of a concession area of 40,000 square kilometers in Angola, Portuguese West Africa. He is a member of the Institute of Mining & Metallurgy; of the A.I.M.E.; the South African Institute of Engineers; of the Institute of Petroleum Technologists; past vice-president of the Mexican Institute of Engineers; managing director of the Denny Chemical Engineering Co., Ltd., and of the Callow Rock Lime Co., Ltd. He is the author of a number of technical papers.

HARRY S. DENNY

Ore Deposition at Franklin Furnace, New Jersey

By J. E. Spurr and J. Volney Lewis

IN BOTH economic and scientific interest the mines of the world offer few parallels to the great zinc deposits at Franklin Furnace, N. J. They have long been among the most productive in the world. The zinc

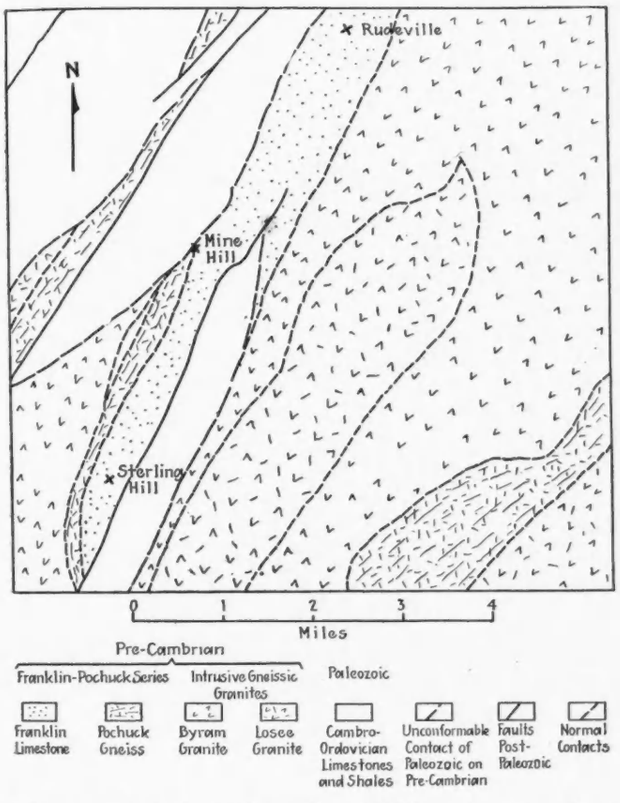


Fig. 1—General geology in vicinity of zinc mines. Adapted from map by H. B. Kümmel, Arthur C. Spencer, and Stuart Weller, Folio 161, U. S. Geological Survey.

is almost free from lead, and hence the prepared zinc oxide is highly desirable as a pigment and filler and brings a higher price than the ordinary zinc. Geologically, the deposits are unique, since the ores consist of minerals that are hardly known elsewhere, or known only as rare species, while at Franklin they have been produced in great quantity. Moreover, the shape of the orebody is unusual, although by no means so distinctive or extraordinary as the mineral composition.

We are fortunate in having had excellent geological studies of the Franklin ores, pre-eminent among which is the fine memoir of Spencer[1] and associates. More recently also a thoughtful paper has been contributed by Ries and Bowen[2]. These, together with the earlier work of Wolff and Brooks, Kemp, Nason, Bayley, and others, have given us a wealth of observation. Such a literature enables the trained observer to comprehend much in the course of a few days' study. Into this background after repeated visits to the region during the last year, the writers have endeavored to fit their own observations and conclusions in the preparation of this article, which is offered as an informal contribution to the discussion of a classic occurrence.

The mines lie in the New Jersey highlands within easy reach of New York. The ores are in Pre-Cambrian crystalline rocks (Fig. 1). These rocks, and the ores, are uncomformably overlain by Cambrian and Ordovician strata, which are folded but not much altered or crystallized (Fig. 2).

The Pre-Cambrian rocks comprise the ancient Franklin limestone and a series of crystalline gneisses and gneissoid granites. These gneisses and granites have been divided into three groups, although locally they are difficult to distinguish. The Pochuck gneiss is the most typical gneiss of the region. It is highly crystalline, foliated, dark in color, and somewhat basic in composition. In the vicinity of Franklin Furnace there is no plain clew to its origin, whether igneous or sedimentary. At the Andover iron mine, about twelve miles to the southwest, it is clear that some at least of the Pochuck gneiss is sedimentary, including metamorphosed impure quartzites and other siliceous sediments. The Franklin limestone may be a member of the same sedimentary series. Besides the Pochuck there are several varieties of more massive gneisses, which are generally characterized by a parallel linear structure rather than by definite planes of foliation. These gneisses are commonly divided into two groups, known as Byram and Losee. They are undoubtedly, as all agree, gneissoid granites and are later than the Pochuck, into which they are intricately intrusive, while also occupying large areas by themselves. The Byram and Losee gneisses, though generally distinct, are essentially contemporaneous and are regarded as potassic and sodic phases of the same magma.

The Losee is typically lighter in color than the Byram. It is characterized by dominant soda-lime feldspars, and hence is essentially a quartz monzonite, although containing only minor amounts of dark minerals. The Byram gneiss contains mainly potash feldspars, and is hence a true granite. These gneissoid granites grade into one another and in many places are not separated by distinct boundaries. Often their differentiation requires the use of the petrographic microscope. The different types are also interleaved in all proportions and

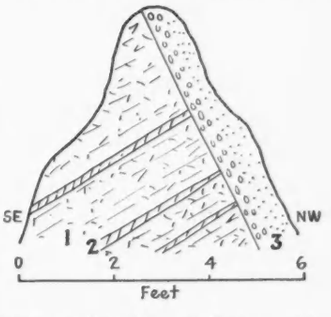


Fig. 2—Sketch showing unconformable overlie of Cambrian on Pre-Cambrian, as shown in outcrop in village of Franklin Furnace

1. Pochuck gneiss; 2, pegmatitic quartz veindikelets. Both of these are Pre-Cambrian. 3, Hardyston quartzite (Cambrian) with basal conglomerate.

[1] A. C. Spencer: Folio No. 161, U. S. Geol. Surv.
[2] *Econ. Geol.*, Vol. 17, No. 7, Nov., 1922, p. 517.

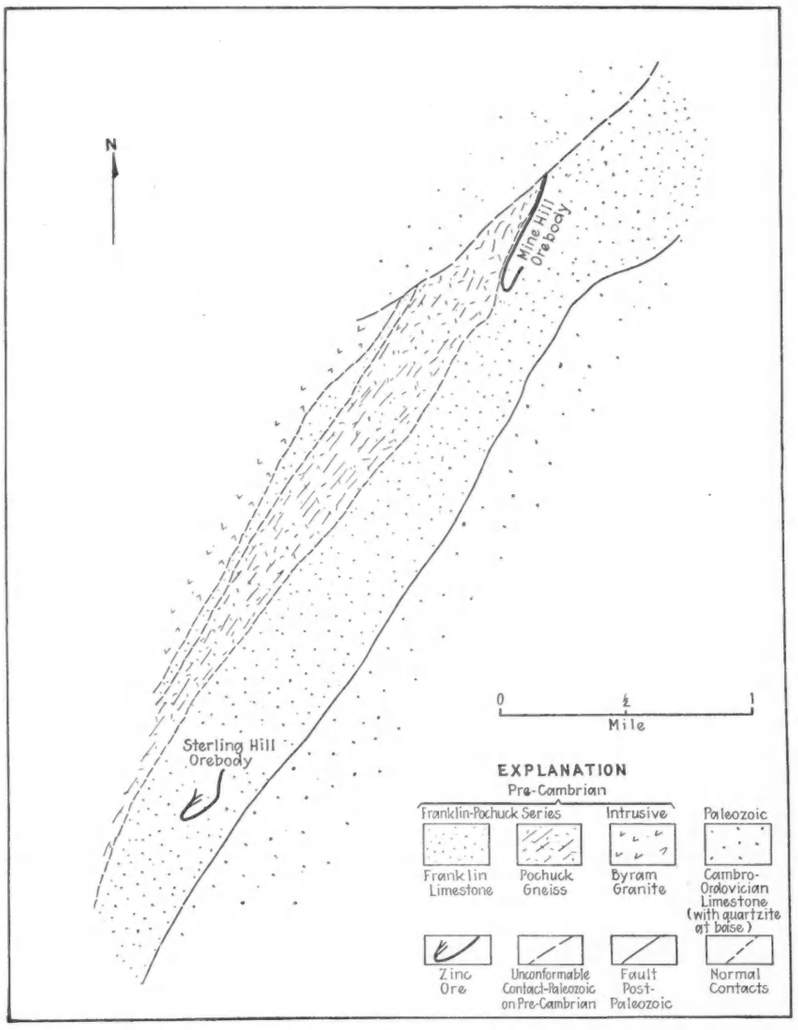


Fig. 3 — Surface map, showing zinc orebodies and rock formations. Adapted from map by Arthur C. Spencer, 1905, Folio 161, U. S. Geological Survey.

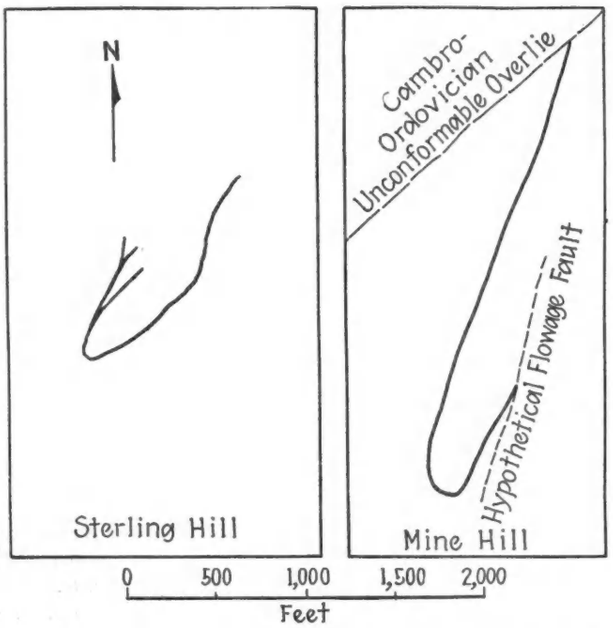


Fig. 4—Outcrops of Mine Hill and Sterling Hill zinc orebodies.

in every degree of intricacy; hence their delineation on the map can represent only the general preponderance of one type or the other. Both the Losee gneissoid monzonite and the Byram gneissoid granite are cut by abundant pegmatite, which is not gneissic. Similar massive pegmatite has also invaded the Pochuck gneiss and the Franklin limestone.

Only two zinc orebodies are known in this region. They are situated about three miles apart, in the Pre-Cambrian Franklin limestone, near a long straight contact of the limestone with Pochuck gneiss (Figs. 3 and 4). We shall try to present a brief picture of the elements of the problem and show the history of events so far as they are clear or may be fairly inferred.

Concerning the ancient Franklin limestone little is known. It is apparently the equivalent of the Grenville limestone of the Canadian geologists, which is the formation in which lie the Edwards zinc orebodies, recently described by one of the authors.[3] The Grenville limestone in Canada and northern New York has generally been considered older than both the Laurentian and Algoman periods of widespread granitic intrusion, so that the Byram gneissoid granite and the Losee gneissoid quartz monzonite may perhaps belong to one or both of these igneous periods.[4] The Franklin limestone has undergone prodigious movement and recrystallization throughout its extent. At Franklin Furnace no signs of stratification survive, so far as the authors observed; but strong gneissic structure has been developed in the limestone, dipping steeply and trending northeast-southwest. This is also the general trend of all the Pre-Cambrian gneissic planes; it is, moreover, the trend of the late Paleozoic folding and, indeed, the

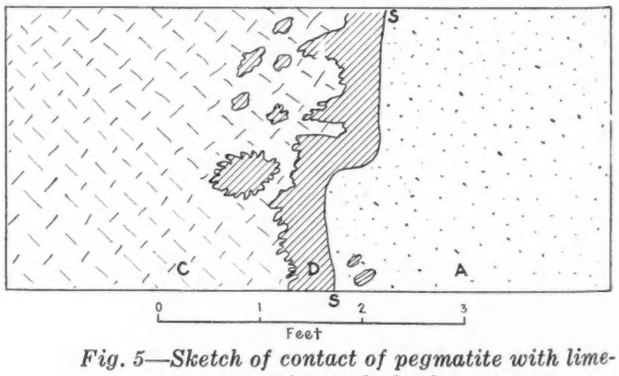


Fig. 5—Sketch of contact of pegmatite with limestone, near zinc orebody, in open cut.

A, Franklin limestone, with disseminated franklinite; C, pegmatite (no franklinite); D, garnet chiefly; S-S, sharp intrusive contact of pegmatite into limestone. Shows sequence: 1, limestone; 2, ore introduction; 3, pegmatite; 4, reaction rim of garnet, in pegmatite.

[3] *Mining Journal-Press*, Vol. 117, No. 17, April 26, 1924, p. 684.

[4] Quirke (*Jour. Geol.*, May-June, 1924, p. 316) has, however, recently presented evidence from which he concludes that the Grenville sediments are of Huronian age.

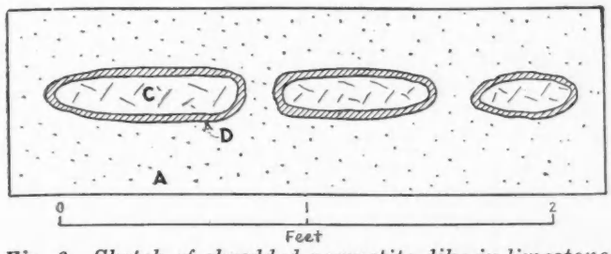


Fig. 6—Sketch of shredded pegmatite dike in limestone, 100 ft. east of vein, Mine Hill

A, limestone; C, pegmatite; D, pyroxene-garnet reaction rim.

subsequent, probably Post-Triassic, faulting—all of which are elements in the Appalachian structure along the Atlantic seaboard. Therefore compressive forces acted from a southeast or northwest direction since the Pre-Cambrian time when we first glimpse it; and Post-Triassic relaxing forces acted along the same lines. How idle, then, to picture a theory of mountain building in the Appalachians based upon the postulate of forces exerted by the accumulation of Paleozoic sediments! Vast mountain ranges were built up before the Cambrian by pressures parallel with those which folded the Paleozoic strata. These ancient mountains underwent deep erosion and repeated upheaval. Therefore the force which uplifted them is of greater antiquity than we can descry.

In accordance with all this, the Franklin limestone which incloses the orebodies is a long narrow strip running northeast (Figs. 1 and 3). To the northwest, on a long straight northeast-trending contact, is the Pochuck gneiss; on the southeast a long, straight, northeast Post-Paleozoic (perhaps Post-Triassic) fault, which throws up the Franklin limestone against the (Cambro-Ordovician) Kittatinny limestone.

Whether the contact between the Franklin limestone and the Pochuck gneiss is a sedimentary or an igneous contact (both of which have been argued) we shall not here discuss; or whether it may be an ancient Pre-Cambrian fault contact, which is also possible. Certain it is, however, that both limestone and gneiss were squeezed by tremendous northwest-southeast acting forces, to which they yielded by a process of cold flowage and thus developed the steeply dipping northeast-trending gneissic structure. Before the late Paleozoic folding both this structure and the gneiss-limestone contact were about vertical (Fig. 2).

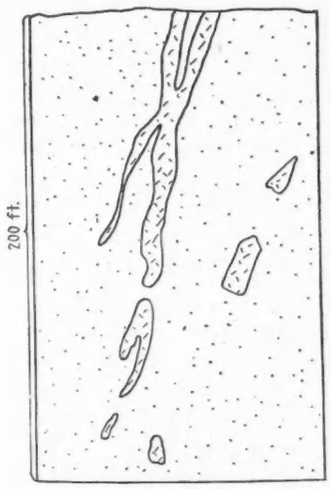


Fig. 7—Shredded pegmatite dikes in limestone.

Sketch in wall of open cut, 150 ft. east of orebody at Mine Hill. Scale about twenty feet to the inch; not accurately drawn to scale.

[5]Folio 161, U. S. Geol. Surv.

The Pochuck gneiss itself occupies but a narrow northeast strip at Franklin Furnace. Beyond it to the northwest, as shown on the geological map by Kümmel, Spencer, and Weller (Fig. 1),[5] is a great northeast belt of the Byram gneissoid granite nearly two miles wide. This granite, although slightly gneissic, is an intrusive; indeed, the geological map shows large irregular, apparently engulfed blocks of both the Pochuck gneiss and the Franklin limestone. How great a displacement of these last-named rocks this intrusion accomplished, and what pressures must have been produced upon them! They must have made room by thinning out, which could have been accomplished only by flowage—a flowage upward as the intrusive granite wedged its way in. And of this flowage we have some even more striking evidence than the gneissic foliation of the intruded rocks, as we shall see.

On the other side, southeast of the Franklin limestone belt, we have another great northeast belt of Byram gneissoid granite several miles wide; and this contains an inner belt of Losee gneissoid quartz monzonite, a mile wide in itself.

The chief zinc mine, that at Mine Hill, lies in the Franklin limestone very close to the Pochuck gneiss contact at the northwest. In the open cuts here we find valuable historical data offered by certain pegmatite dikes which cut the limestone, apparently in general conformity with the gneissicity. In texture many of these pegmatites are like granite of medium to coarse grain; and as a rule they are highly feldspathic, with normally little quartz or dark minerals. They have sharp intrusive contacts against the limestone, and therefore must have been as dry a magma as the ordinary igneous rock—a contrast to the usual pegmatitic magma, which is prone to combine with intruded limestone to form lime silicates. While the pegmatite has not evidently metamorphosed the limestone, the limestone has modified the pegmatite from an inch to several inches deep along the contact, producing principally pyroxene and garnet (Fig. 5). This remarkable interaction between pegmatite and limestone is of a type not previously recognized, and hence is further discussed in the following pages of this article.

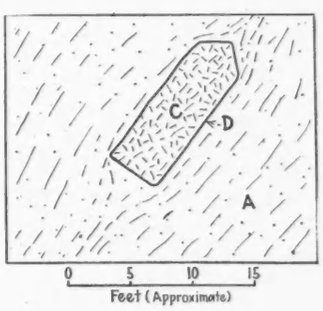


Fig. 8—Detail of block of pegmatite shown in Fig. 7

This shows (1) flowage lines of limestone around pegmatite block; (2) black reaction rim, chiefly pyroxene-hornblende, one-half inch to two inches wide. A, limestone; C, pegmatite; D, lime silicate black reaction rim.

Light is shed on the dynamics of igneous intrusion by considering these pegmatite dikes. The intruding pegmatite magma could not have risen to fill fissures, not even in proportion as fissure walls tended to relax. The rocks, as recorded previously, were under tremendous lateral pressure at the time of the pegmatite injection, and were yielding by flowage under this pressure. The pegmatite magma must therefore have risen under still greater pressure and thus forced its way along the gneissic flow lines. That it did not combine with the limestone indicates a dry magma, not even a moderately aqueous one—rather in this respect what one of the authors has described as an aplitic magma.[6] Its rather coarse crystallization in many places may possibly have resulted from extraordinarily slow cooling permitted by

[6]J. E. Spurr: "The Ore Magmas," Vol. I, p. 313.

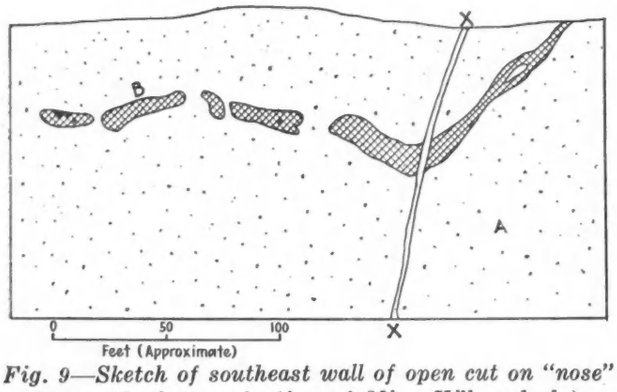


Fig. 9—Sketch of southeast wall of open cut on "nose" (or southerly termination of Mine Hill orebody).

Shows shredding of Pre-Cambrian basic dike, along strikes: A, limestone (Franklin); B, basic dike (minette); X, Post-Paleozoic camptonite dike.

the high general temperature of the invaded limestone. The crystallization of the limestone itself is phenomenally coarse.

The gneissic flowage of the limestone continued after the intrusion of these pegmatite dikes, but the dikes were unyielding and refused to be stretched out with the limestone; therefore they were pulled apart and the fragments separated. In many cases they broke square off at the ends, and angular fragments are common; so that the dikes are represented by strings of separated blocks around which wrap the gneissic flow lines of the limestone (Figs. 6, 7, and 8). Some of the dikes have been thus extended to twice the original length, while parallel ones not far away have been extended several times that amount. This great variation in the amount of extension may indicate either intrusion at different stages of the limestone flowage or different degrees of flow along different zones, or both.

That there were differences in degree of flow and that this is perhaps competent to explain all the observed phenomena was shown by an examination of the open cuts under the guidance of Dr. A. C. Spencer. At a portion of the vein outcrop called Double Rock it was observed that pegmatites which had cut the Pochuck gneiss near the contact of the limestone had undergone little or no extension. The contacts remained much as they were at the time of the pegmatite intrusion. But dikes of evidently the same pegmatite, lying out in the limestone, 20 to 50 ft. away, had been powerfully fractured by the limestone flow and pulled apart into detached blocks. This shows that the limestone flowed much more freely than the gneiss, and also it experienced a great amount of flowage after that of the gneiss had practically stopped. The same pegmatites cut (and are therefore later than) the ore in the mine workings, as recorded by Spencer and as now shown at the surface near Double Rock; and in this position they are relatively undisturbed, as Spencer has also noted. Bearing in mind that the ore zone, although in the limestone, lies close to the gneiss, being separated from the gneiss by only 15 or 20 ft. of limestone, these two sets of observations show that the orebody, although it became somewhat gneissic, was protected by the rigid gneiss against the greater flowage which fractured the dikes and separated the blocks throughout the great body of the limestone beyond the ore zone.

With and between these pegmatite dikes are dikes of dark-colored fine-grained igneous rock, apparently lamprophyres, containing abundant dark mica and hornblende. They are parallel with the gneiss and with the pegmatite dikes and are about the same thickness (up to several feet) or thinner than the pegmatites. They have been broken and strung out, in vertical section, like the pegmatites, and in many cases they have been extended to twice their original length and in places even much more. On a horizontal plan there has been stretching also, but to a lesser degree (Figs. 9 and 10).

Where a pegmatite dike has been thus separated into distinct blocks by the flowage of the limestone, the contact rim of pyroxene, hornblende, and garnet is as characteristic of the broken ends of the blocks as of the

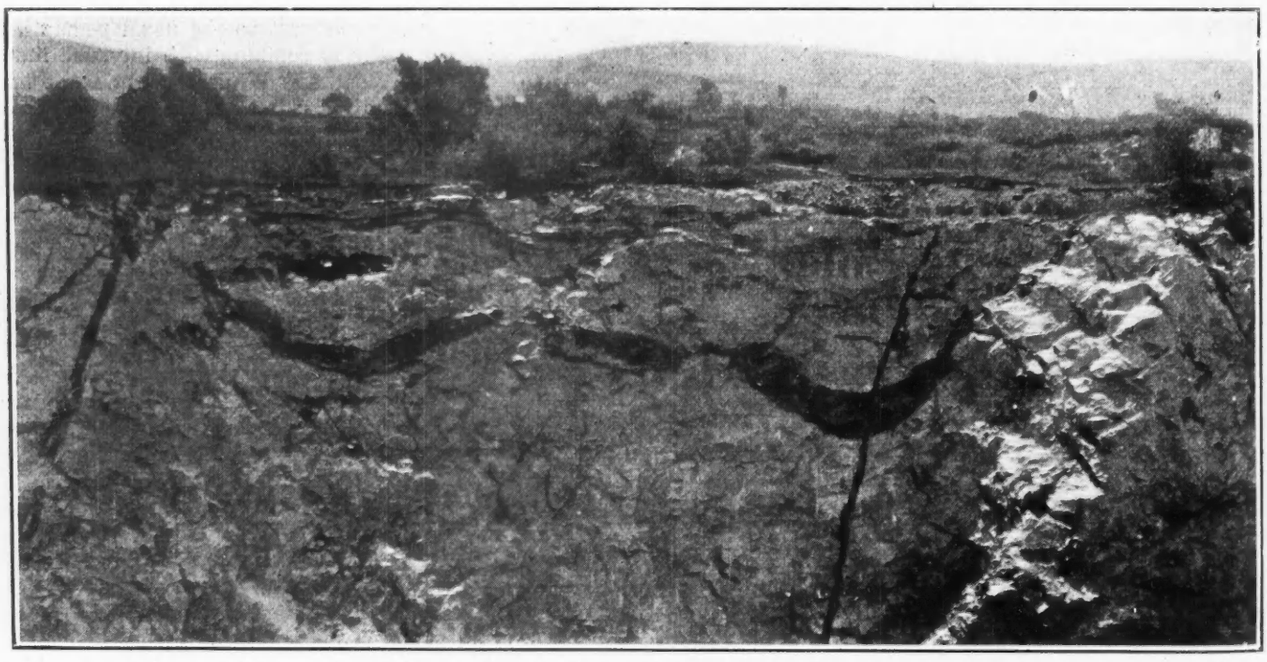


Fig. 10—Same as Fig. 9. Stretching of Pre-Cambrian basic dike in limestone, as seen in open cut on Mine Hill orebody. Narrow nearly vertical dikes are Post-Paleozoic, probably Triassic, diabase.

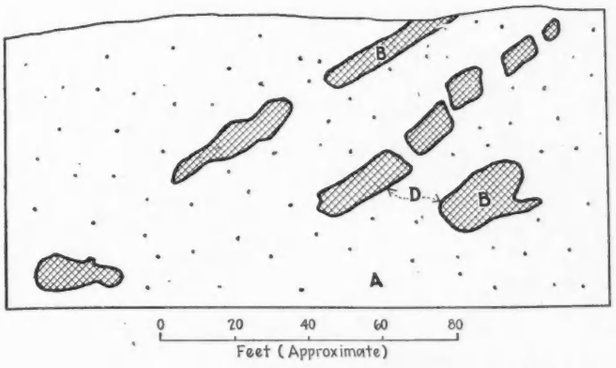


Fig. 11—Shredded dioritic dikes (B) in Franklin limestone (A)

Sketch of wall of Atlas Portland Cement limestone quarry at Rudeville. d, pyroxene-garnet reaction rims.

walls (Figs. 6 and 8). This shows that these lime silicates are not due to "contact metamorphism." It also fixes the date of their formation as not only subsequent to the dike intrusion but subsequent to the later flowage and fracturing. They are, in fact, "reaction rims," as we have termed them, of lime silicates due to chemical reaction between the inclosing limestone and the solid pegmatite blocks—not the magma. Contacts between limestone and the blocks of the basic dikes also show reaction rims, but generally not quite so strongly developed. Contacts between pegmatite and (earlier) gneiss show no such rims. But large and small fragments of dikes, wherever situated in the open cuts, show the same formation of these silicates where in contact with limestone; and some of the smaller fragments are wholly replaced by them.

A general or regional condition is therefore indicated. We must believe that an elevated temperature was required for the pyroxene-hornblende-garnet crystallization (over 500 deg. C.);[1] and this temperature must have characterized the whole terrane, near and far from the vein. It was therefore independent of and altogether later than the pegmatite and lamprophyre intrusions. This conclusion is unmistakably corroborated by the occurrence of the pyroxene-hornblende-garnet aggregate, not only as reaction rims surrounding the pegmatite blocks, but also as distinct veins cutting the larger masses of pegmatite. A curious phase is where the plastic limestone has been forced into a fissure in the pegmatite, forming a limestone dike, which in contact with its pegmatite walls has subsequently developed the characteristic pyroxene-garnet reaction rims. That these conclusions are correct is abundantly shown in other localities. At Sterling Hill, three miles southwest of Franklin Furnace, a basic dike rock (exposed in the open cut), identical in general type with those at Mine Hill, shows strong reaction rims on both sides, in contact with limestone. At Rudeville, about three miles northeast of Franklin Furnace, in the quarry of the Atlas Portland Cement Co., basic dikes like those at Franklin Furnace and Sterling Hill have been injected into the highly crystalline Franklin limestone and have experienced the same remarkable fracturing and separation into detached blocks as at Mine Hill (Figs. 11, 12 and 13). Here also the reaction rims run all around the isolated blocks of dike rock, and the reaction minerals (pyroxene, hornblende, garnet, and many others) are the same and quite as strongly developed as at Mine Hill.

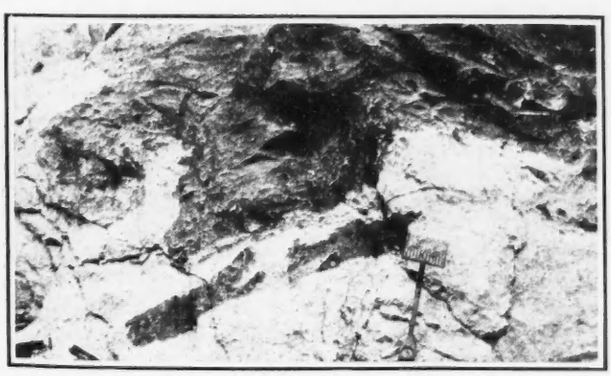


Fig. 12—Pre-Cambrian basic dikes in Franklin limestone, fractured and separated into detached blocks

Basic dikes are dark; the limestone is white. Note the large basic dike in the upper part of the photograph. Photo in the quarry at Rudeville.

[1] "The Ore Magmas," Vol. I, p. 263.

Fig. 13—Pre-Cambrian basic dikes in Franklin limestone, fractured and separated into detached blocks by flowage of the unbroken limestone

The separation of blocks has been so extreme in some cases that blocks occur without any evident connection with other blocks, as "islands" in the limestone. Photo in the quarry at Rudeville.

The general high temperature that brought about these reaction rims, therefore, extended to the region of the Rudeville quarry at least. It will be noted incidentally (see Fig. 1) that the Rudeville locality has the same general relation to the Byram gneiss contact (instrusive into the Franklin limestone) as have the Mine Hill and Sterling Hill localities; but there is no ore deposition at Rudeville, whether of zinc or of magnetite. We therefore conclude that the elevated temperature and the pyroxene-garnet crystallization had no indicated connection with ore deposition. The same observation applies to the whole list of minerals in the Rudeville quarry, which includes fluorite, tourmaline, ilmenite, spinel, apatite, phlogopite, pyrrhotite, titanite,

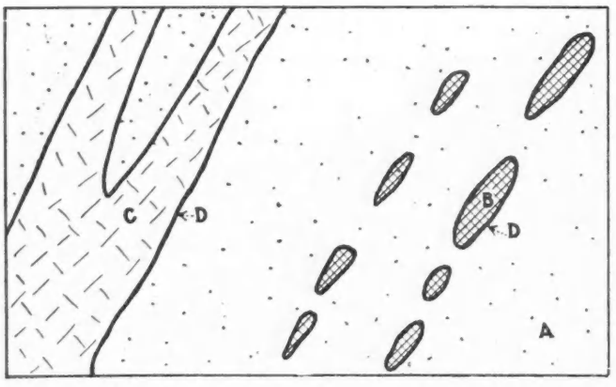


Fig. 14—Detail sketch showing upper portion of pegmatite dike shown in Fig. 7, together with shredded small basic dikes not shown on scale of Fig. 7

Black reaction rims, probably largely pyroxene, one-half inch to two inches deep, border basic fragments and pegmatite alike, regardless of the bulk of the fragment. A, limestone; B, basic dike rock; C, pegmatite; D, lime-silicate black reaction rims. Scale about 4 ft. = 1 inch.

and chondrodite, species which are also found at Franklin Furnace. We have at Franklin Furnace a great array of minerals, amounting to more than a hundred species, many, perhaps most, of which, as appears from the above, are not especially connected with the ore, but represent a later period and a different process.

On the other hand, at the quarries of the Edison company, near Buttzville, about 30 miles southwest, basic dikes of the same type cut the same coarsely crystalline Franklin limestone, and show the same fragmentation and separation by flowage; but the contact reaction rims are lacking. This indicates that the elevated temperature did not extend to the Buttzville region, or, if it did, it was not of sufficient duration to produce the results. It also shows that the effects (the crystallization of the lime silicates) are not due to the flowage of the rocks, since the lime silicates have not formed at Buttzville, where the flowage has been marked. The approach of a batholith from below and the permeation of the overlying rock by vapors from it may be postulated as the cause of the heat and the recrystallization to lime silicates. The Byram granite, which now appears at the surface half a mile to a mile from the Rudeville, Mine Hill, and Sterling Hill localities, may constitute this batholith.

The relative age of basic dikes and of pegmatites at Mine Hill is not certain; but some occurrences, such as that sketched in Fig. 14, suggest that the pegmatite was the later. The two intrusives may perhaps have been in general contemporaneous.

Microscopic study of some of these basic dikes, by Spencer and others, shows that in places scapolite largely takes the place of the feldspar, so that some of the rocks have been called scapolite gabbro. Scapolite is a metamorphic mineral containing chlorine, and it seems most likely that its formation took place at the same period of regional heat and metamorphism when the reaction rims of pyroxene, garnet, and other minerals were developed. The whole group of phenomena, indeed, indicates a general long-continued moist heating, with a passage through the rocks of certain gases, such as chlorine, fluorine, boron, and water gas, but without considerable addition of solid substances in solution.

Rough measurement of the width of the gneissoid granite belts (principally the Byram granite), on each side of this belt of Franklin limestone with Pochuck gneiss, indicates that originally this gneiss-limestone belt may have had a width four times or more greater that the present width. Granite intrusion has compressed the Pochuck-Franklin belt to one quarter its original width, and thus the height of the belt must have been increased four or more times. This, of course, must ultimately have been translated into terms of surface uplift, and the parallel up-welling of the granite belts had the same effect. Thus were formed the high Pre-Cambrian ranges, which underwent vast erosion before the deposition of the Cambrian sediments—erosion that bit deep into the roots of the ranges and laid bare the deep-seated rocks that are now again exposed after removal of the thick Paleozoic cover and are the theme of our study.

The orebody at Mine Hill is a warped tabular body, like a bent vein or bed (Figs. 4, 15 and 16). Throughout most of its extent it has the general shape of a vein, and it lies in the limestone only a few feet away from the straight and smooth gneiss contact. It is fairly regular and is several feet thick, although varying considerably. The essential minerals are willemite, a silicate of zinc; zincite, an oxide of zinc; and franklinite, an oxide of zinc, iron, and manganese. These metallic minerals are inclosed in and mingled with the coarsely crystalline calcite of the Franklin limestone. There is also an unusually great variety of minerals in the mine, many of which are uncommon or rare. The vein walls are definite but usually not sharp; though in places they are fairly clean-cut. In the leaner parts of the ore the metallic minerals pepper the calcite limestone in the familiar manner of minerals replacing a rock.[8] In the richer parts these replacing minerals are grouped closely together. Where the ore deposit (so far as known) ends, at the north end of the mine workings, the ore becomes leaner till it fades into barren limestone. Clearly, then, the ore represents a definite zone of intensive injection or replacement of limestone by zinc, iron, and manganese. The northerly termination of the west branch of the Sterling Hill ore-

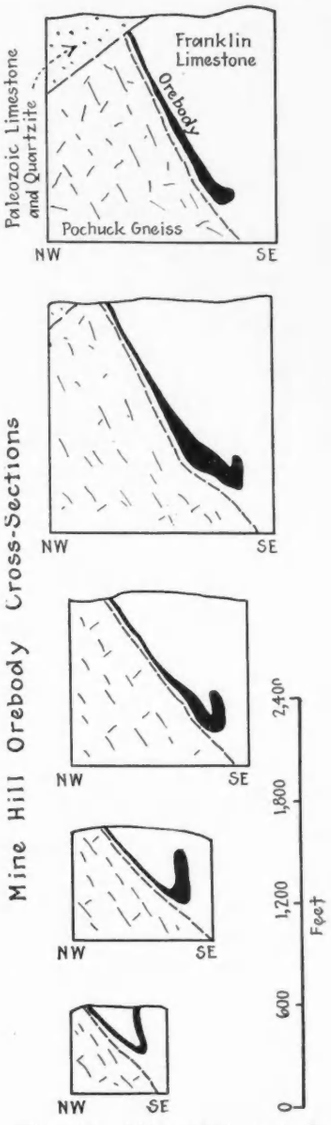


Fig. 15—Mine Hill orebody cross sections

Spaced successively from southwest (at bottom) to northeast (above). See surface map, Fig. 3. Arthur C. Spencer, 1905, Folio 161, U. S. Geol. Surv.

[8] J. E. Spurr: "Ore Injection at Edwards, N. Y.," *Mining Journal-Press*, April 26, 1924, pp. 686, 687.

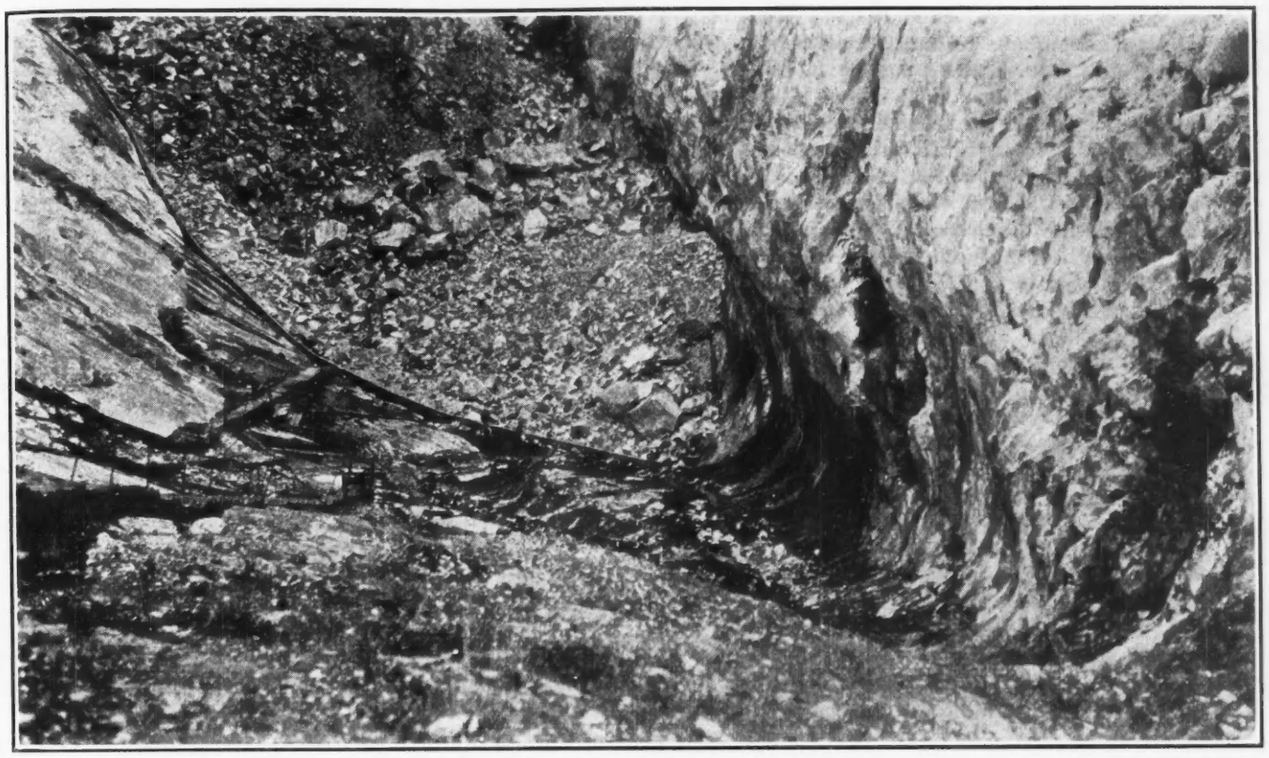


Fig. 16—Photograph showing footwall of Mine Hill orebody, at the keel of the fold, not far from its southern end at the surface. The ore and the overlying rock have been removed, leaving an open cut. View looking northeast, down the pitch of the keel

body, as seen underground, is a little different in that the ore behaves more like a very definite vein which grows thinner and thinner till it pinches out, but retaining to the last its fairly sharp individuality. In other parts of the Sterling Hill mine, however, there has been a good deal of disseminated ore deposited in the walls and between the main vein branches.

Why, then, the tabular form of the Mine Hill orebody; and, very particularly, why the fishhook cross-section (Fig. 15)? The first impression, on viewing the shape of the orebody, is that it represents a fold; and the further assumption is easily slipped to, that the ore has replaced a favorable bed in the limestone. This supposition, however, even if correct, could no longer be established. Not only are there no traces of bedding in the inclosing limestone, but, as above shown, the gneissic flowage has completely destroyed whatever original structure may have been present. The ore vein, as above noted, has not been broken and pulled apart by the flowage, as have most of the pegmatite and lamprophyre dikes. The ore has a distinct but not highly developed gneissic structure, and the vein is continuous. As previously explained, it has been protected from the fracturing and extension which characterize the dikes farther out in the limestone by the greater rigidity of the gneiss, which it follows so closely, and by the calcite gangue, which permitted moderate flow without fracturing. The possibility that the limestone-Pochuck contact, which is parallel to the orebody and to the gneissic foliation, may be an ancient sedimentary contact has been pointed out; but, as shown above, several alternatives seem equally plausible, and whatever evidence might have served to discriminate between them was long ago destroyed.

The alternative hypothesis, if the orebody does not represent a folded bed, is that it may be a bent or folded vein; and the facts appear to warrant this conclusion. Particularly striking evidence in support of this view is found in the Sterling Hill orebody, at Ogdenburg, as pointed out further on in this article. That the folding took place after the ore deposition is indicated by a thickening of the ore at the bottom of the synclinal fold (Fig. 15), as has been pointed out by other geologists. Moreover, at Mine Hill we observed basic dikes of the early stretched type above described, which had also been folded to the fishhook cross-section, in the limestone above the folded vein.

The Mine Hill vein, as shown in Fig. 15, ends abruptly upward on the short, or east, leg of the syncline, with thick ore where it terminates. This blunt termination, so different from the normal thinning out of the vein at the north end of the mine, is probably due to faulting—a conclusion supported by the fact that this termination follows a nearly straight line, nearly parallel with the axis or bottom of the slight synclinal trough. This ex-

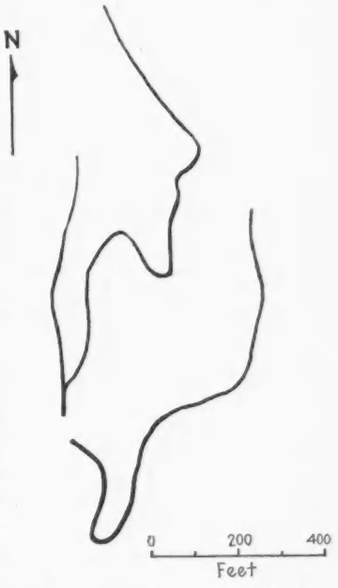


Fig. 17—Plan of Sterling Hill vein on 1,100-ft. level (in limestone)

planation is in accordance with Spencer's view. But no trace of the fault plane or fault zone has been found; therefore the fault movement was probably within the period of plastic flow. The displacement must have been up on the east side, and the fishhook curve is held to represent the drag. The detached and up-dragged part of the vein has been far uplifted and perhaps entirely eroded. Probably the fact that the more plastic limestone flowed upward faster than the less plastic Pochuck gneiss produced this differentiated movement, or faulting.

At the Sterling Hill mine, the vein is also bent into a fold, pitching north, as at Mine Hill; so that it has a U-shaped or V-shaped outcrop, roughly speaking (Figs. 4 and 17). The veinlike character is shown by repeated branching of one leg of the exposed vein at the surface (Fig. 4), and Ries and Bowen describe a similar phenomenon in the mine, which the writers of this article have also seen on their inspection. The strongest branch is a notable feature from the surface down to the deepest workings. Fig. 17 shows the plan of the Sterling Hill vein on the 1,100-ft. level; a plan which we interpret, as above stated, as resulting from the flow-folding of the vein, which has resulted not only in the main loop, but also in minor corrugations. Another bit of evidence is the description by Spencer[9] of two distinct layers in portions (now mined) of the Sterling Hill orebody. One layer, on the hanging wall of the eastern leg of the vein, was composed mainly of zincite and calcite, while the footwall layer was mainly franklinite and calcite. On the western leg a similar zincite layer was found on the footwall. Bearing in mind that the two legs of the folded vein dip in the same direction, we see that the zincite and franklinite layers (the "zinc" and "franklinite" veins of the early miners) keep the same respective sides of the vein on both legs. This would conform to what is found in many normal straight sulphide veins, which are compound veins due to separate injections. An original compound vein having nearly pure blende on one side and mixed pyrite, blende, and manganese carbonate on the other, would, after metamorphism and folding, result in the Sterling Hill phenomena described. A third evidence of the original vein character at Sterling Hill is the occurrence cited by Ries and Bowen[10], where in the mine the vein "splits into three fingers, one of which consists of franklinite, another of franklinite and willemite, while the third carries chiefly hornblende." This again indicates a compound vein which resolved itself into its elements on splitting—one branch carrying more zinc than the second and the third none at all. Moreover, at Sterling Hill, dikes that lie close to the vein and have been folded with it have been found. Ries and Bowen describe such a dike (which the authors also examined) as syenite. Its mineral composition we estimate roughly from thin section as follows: feldspars, chiefly plagioclase, 50 per cent; hornblende, 40; titanite, apatite, and magnetite, 10 per cent. In general appearance it is very similar to some of the stretched lamprophyre dikes at Mine Hill. Also, as at Mine Hill, the dike antedated the regional metamorphism.

In this connection we pause to consider a matter which will be puzzling to anyone who studies the geologic maps, such as Fig. 1. If the orebodies at Mine Hill and Sterling Hill are folded veins, why does the limestone-gneiss contact not show comparable distortion; and why is there no evident trace of such folding exhibited by the various Pre-Cambrian rock contacts which have been mapped? These contacts, it will be seen, are linear, not curved; they represent gneissic flowage, not folding.

Let us consider the case of a vein which partly followed the limestone-gneiss contact, and partly diverged from it—whose whole trend, in short, was somewhat oblique to the contact. Since the flowage of the limestone was greater than that of the gneiss, as we have shown, that part of the vein which extended into the limestone away from the sheltering gneiss would be caught in the tide of the limestone flow, and would drift along with the limestone. This is what we believe happened to the southwest end of the Mine Hill vein, and the drift is shown by the hook. We have above ascribed the faulting of the vein to this differentiated flowage, and we now see that the folding is due to the same well-established process. Therefore, these structures are not faulting and folding in the usual conception of the terms, but are flow-phenomena. They may then be called flow-faulting and flow-folding.

The drift of the veins thus serves as a register of the general drift of the flowing limestone past the more obdurate gneiss, and the hooking of the veins as seen on the surface plan indicates that the limestone flowed northeast relative to the gneiss. But the surface, after all, affords only a single fortuitous section of the rocks; evidently the exact direction of limestone flow was at right angles to the pitch of the flow-folded veins. Both the Mine Hill and the Sterling Hill veins slope about 45 deg. to the southeast; but, as indicated by Fig. 2, this slope is probably due to Post-Paleozoic rotation of all the rocks in this belt; and it is likewise indicated that the veins, like the gneisses at the gneiss-limestone contact, stood nearly vertical before this rotation. When the veins are visualized as rotated back so that the dip is vertical, the general pitch of the keel of the trough-shaped fold at Mine Hill is about 20 deg. N.E. (Fig. 19), while that of the Sterling Hill vein trough is nearly 80 deg. (Figs. 18 and 20). Therefore, a fairly representative cross-section of the trough is afforded by the vertical section at Mine Hill, while at Sterling Hill a vertical section is not far from being a longitudinal section, and a horizontal section like that of the 1,100-ft. level (Fig. 17) is a true cross-section. At Mine Hill, therefore, the drift of the limestone past the gneiss was apparently to the northeast and up, at an angle of 70 deg. from the horizontal; while at Sterling Hill, three miles away, the drift was to the northeast and up, at angles of 10 to 20 deg. from the horizontal. It is possible that unrecorded deformation in the rocks may in part account for this difference; but it may, on the other hand, in part or in all, record local differences in direction of the limestone drift-flow.

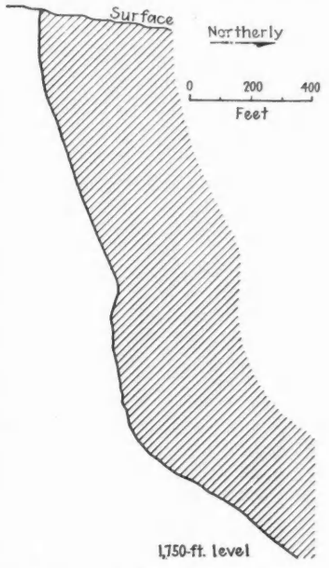


Fig. 18—Vertical projection of keel of fold in Sterling Hill vein, showing northerly pitch

[9]Folio 161, U. S. Geol. Surv., p. 7.
[10]*Op. cit.*, p. 640.

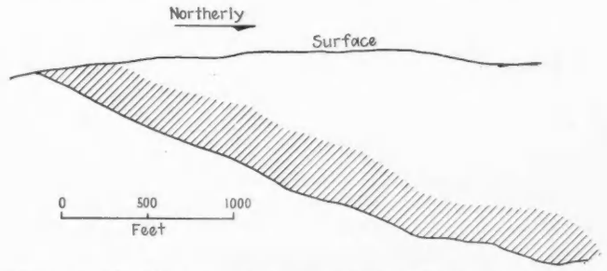


Fig. 19—Vertical projection of Mine Hill vein, showing pitch of keel of fold. After A. C. Spencer

If the orebodies are then bent veins, we must observe and consider the phenomena of their original tabular form, so different from many ore deposits in limestone. And here, as in the case of the pegmatite dikes, one must infer a relatively dry ore magma injected along the gneissic planes against heavy rock pressure; but a magma which at the same time was fluid enough to mingle with the limestone along its course and to replace it at least in part, instead of simply shoving it bodily to one side and the other as the pegmatites did; although the element of forcible intrusion must also have been present. Our view, therefore, practically coincides with that of Spencer, who writes[11] that "it may be that the main ore layer at Sterling Hill and the mass of ore at Mine Hill were injected bodily into the limestone after the manner of igneous rocks. If the layer of ore at Sterling Hill originated in this way, it would seem that the lean ore of the deposit must have been formed by solutions which accompanied the igneous injection."

Our observations on the effects of regional metamorphism on the dikes in limestone, previously referred to, tend to neutralize the apparent evidence of replacement along the contacts of the orebody at Mine Hill, for example—evidence which under ordinary conditions might well be accepted as sound. In the Rudeville quarry regional metamorphism affecting the contacts between basic dikes and limestone in many cases has changed the sharp contact to a transitional contact, in which limestone and the silicate minerals are intercrystallized; it is, in fact, the type of contact that we find on the margins of the Mine Hill orebody at Franklin Furnace. Since the orebody (being older than the pegmatites which at Mine Hill have been so conspicuously affected) must have undergone the same metamorphism as the dikes, the conclusion is driven home that even if the orebody had originally had a clear-cut knife-edge contact, it would have been altered by interpenetration of limestone and ore, during the period of regional metamorphism, to the condition in which we now find it.

As to the principal ore minerals—willemite, franklinite, and zincite—which Spencer regards as the essential primary minerals of the ore, many geologists have inclined to the view that the silicate and oxide form of these minerals is the result of metamorphism; and the present authors coincide with this belief.[12] One of the authors has already pointed out that this combination of zinc, iron, and manganese is a typical zinc ore magma, such as ordinarily crystallizes as sulphides and carbonates (blende, pyrite, and manganese carbonate),[13] and has presented the argument that the transformation to oxides and silicate, with distillation of sulphur and carbon dioxide, must have been accomplished by a temperature higher than that of any known zinc ore magma.[14] The metals that crystallize as a part of the texture of igneous rocks do so mainly as oxides and silicates, instead of sulphides, while much sulphur and carbon dioxide are given off. Only at a lower temperature, later than the igneous rock, are sulphides crystallized. Willemite, zincite, and gahnite (the last another of the Franklin ore minerals) have been observed in furnace slags, the first two in association with tridymite, the high temperature form of silica, indicating a temperature above 800 deg. C., while pegmatites and pegmatitic quartz veins have crystallized below 575 deg.[15] One of the authors has estimated the normal temperature of ore magma freezing as between 575 deg. and 365 deg.,[15] which would place the freezing temperature of the typical zinc ore magma around 400 to 500 deg. C.

We have shown in the foregoing discussion that subsequent to the introduction of the orebody the whole region was subjected to a slow heating which brought about the crystallization of much pyroxene, hornblende, garnet, and other silicates, wherever there were materials that could combine *in situ* to form these minerals, although there was little introduction of foreign material. This was therefore a stage of regional metamorphism, not contact metamorphism. The orebody was certainly subject to the heat and recrystallizing influences of this period, since it is older than the pegmatites, which we have shown to have been thus affected. Therefore, an original body of zinc blende, pyrite and manganese carbonate would have been roasted to oxides and silicates, probably without a trace of sulphur remaining. Considering the absolutely unique position that this great body of zinc oxide silicate ores occupies in the world, as contrasted with the numberless occurrences of zinc and iron sulphide bodies; considering, also, the established place and approximate temperature the zinc ores occupy in the recognized zonal arrangement of ores, indicating the definite and moderate temperature at which the typical zinc ore magma freezes: it seems safe to infer that it was this stage of regional metamorphism which metamorphosed primary zinc sulphides to silicate and oxides. We have seen that where the pegmatites—even the broken and widely separated fragments in the limestone — reacted

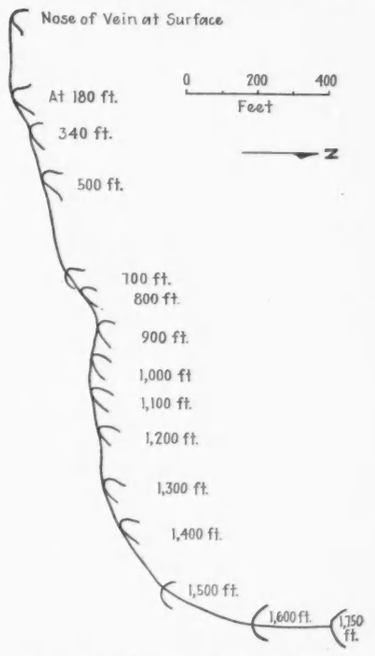


Fig. 20—Horizontal projection of keel of fold in Sterling Hill vein, showing easterly slope

[11] Folio 161, U. S. Geol. Surv., p. 8.
[12] This, however, is not the view of Spencer, who is inclined to believe that these minerals were originally deposited in their present form.
[13] Wright and Larsen: *Am. Jour. Sci.*, Vol. 27, June, 1909, p. 446.
[14] "The Ore Magmas," Vol. 1, p. 427.
[15] "The Ore Magmas," Vol. II, p. 657.

with the limestone at this period of regional metamorphism, they produced reaction rims of silicates which are characteristic of the broken ends as well as the original intrusive contacts—silicates that penetrated the pegmatites and the limestone alike, in the general vicinity of the reaction zone. Where these pegmatites cut the (earlier) orebodies, with their calcite gangue and their metallic ores, such reaction rims due to regional metamorphism must have taken place also and must have differed from those in the barren limestone on account of the metals which lent themselves to the process of silicate building. This is what has been described by Spencer and Palache, although the metamorphism has been ascribed by them to the influence of the pegmatite—a view which is believed to be eliminated by the evidence that the metamorphism on the contact of the pegmatite in the limestone belongs to a distinctly later stage than that of the pegmatite intrusion, as we have shown above. The results, however, coincide with our explanation. Spencer says:[16] "That the silicate minerals containing essential proportions of zinc and manganese were formed by metamorphism due to the pegmatite is shown by the fact that they do not occur throughout the ore mass, but only along or near the contacts with the pegmatite. It is believed that the metal-bearing silicates were formed by an interchange of materials between the previously existing orebody and the [invading] pegmatite, because the minerals which characterize the walls of the dikes where they penetrate the ore are not present where the dikes pass out of the ore mass into the country limestone." Holding our own conclusion in mind, we can subscribe to this quotation with the exception of the single word "invading," which we have bracketed. Also, Palache observes that "the constituent minerals of the pegmatite also become . . . intimately mixed with the ore minerals."[17]

Some of the pegmatites which occur in the mine contain much hornblende and magnetite, and there is a good deal of segregation; locally, the hornblende increases till it forms considerable masses, and the same is true of the magnetite. The magnetite is thus clearly a pegmatitic mineral, essentially contemporaneous with the other minerals—most closely, perhaps, with the quartz; and, while all the magnetite is believed to belong to one general period, it also appears to overlap the other minerals, and, slightly later, occurs on the margin of the pegmatite dikes as a considerable band. Such a magnetite band characterizes the contact of the gneiss and the limestone and thus lies some feet beneath the zinc orebody, from which it is typically separated by a thin band of limestone. The fissure which this band follows and occupies locally has pegmatite on one wall and limestone on the other, showing in this instance a later crystallization than the pegmatite (Fig. 21). The magnetite is thus seen to be closely allied to the pegmatite injection, as pointed out by Spencer;[18] and hence it is distinctly later than the zinc ore, which is cut by the pegmatites. These magnetite and zinc orebodies are in general separate and distinct from one another, though close together and parallel. At one locality, however, we observed a narrower magnetite vein or veindike which had apparently been injected along the hanging wall of the main zinc vein. This magnetite band is about six inches wide, and regular, and is in contact with the limestone above and the zinc ore below. On each side of this band silicates have developed, in a zone ten or twelve inches wide in each case. On the footwall side there has been developed much rhodonite in a definite band, although rhodonite is lacking in the rest of the vein at this point: on the hanging-wall side there lies a definite, but more spotty, band of lime-iron-silicates—green garnet and pyroxene. Disseminated magnetite is common to both the rhodonite and the garnet-pyroxene bands. Probably the main magnetite vein contained quartz, and during the intense and prolonged heating which subsequently took place this silica combined with the manganese of the ore vein below to form rhodonite, the silicate of manganese, while the combination of the iron and silica of the magnetite vein with the limestone above produced ferrous lime silicates.

Keeping in mind our explanation of the formation of franklinite as the result of the roasting of pyrite in the presence of zinc, it is seen as a possibility that if there

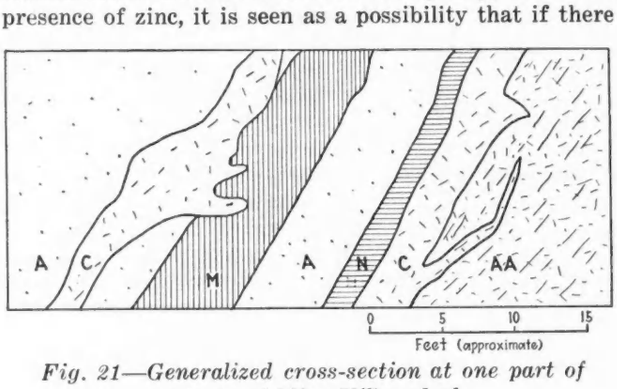


Fig. 21—Generalized cross-section at one part of outcrop of Mine Hill orebody

Partly sketched and partly restored. A, Franklin limestone; AA, Pochuck gneiss; M, Mine Hill zinc orebody; C, pegmatite intrusive into all the foregoing; N, magnetite vein (with a little pyrite), slightly later than pegmatite. Scale is approximate.

were places in the vein where zinc blende was scarce, there might have been magnetite formed instead of zincite. Spencer[19] notes that in certain parts of the Sterling Hill vein analysis shows the franklinite to contain "less than half the ordinary amount of zinc" and there may be other localities in the Sterling Hill vein where there is so little zinc in the franklinite that the mineral approaches a magnetite. Such occurrences, however, are not to be confounded with the distinct magnetite injection.

Underground at Mine Hill the main magnetite vein, which is not gneissic, appears to curve with the zinc orebody as the nose of the fold in the latter is approached; but it was not found on the east leg of the orebody. On the contrary, as the map shows, it follows the gneiss-limestone contact, with slight breaks, for nearly three-quarters of a mile past the termination of the zinc orebody. All along this stretch it is accompanied by the pegmatite with which it is associated at Mine Hill. At the Hill magnetite mines, which begin about a quarter of a mile southwest of Mine Hill, there are many old workings, where the magnetite ore is shown in two habits: (1) as a true pegmatitic mineral, contemporaneous with quartz, feldspar, and hornblende, and also slightly later, but always of the same crystallization period; and (2) as abundant impregnation of the intruded Pochuck gneiss. It is impossible not to refer this to a single general magmatic period. Exactly

[16]Ann. Rep. Geol. Surv. N. J. for 1908, p. 38.
[17]Folio 161, U. S. Geol. Surv., p. 10.
[18]Ann. Rep. Geol. Surv. N. J. for 1904, pp. 250, 251.
[19]Franklin Furnace Folio 161, U. S. Geol. Surv., p. 7.

the same type of occurrence of magnetite was observed by the writers at the old Hurdtown mine, 15 or 20 miles farther south, on Lake Hopatcong, where the ore occurs in Byram gneissoid granite far from limestone. At the Andover mine magnetite has replaced quartzites, which are to be referred either to the Pochuck or to the Franklin, and is associated with pegmatite, which here is mainly later than the magnetite ore. Similarly, at the Olive mine, near Buttzville, magnetite ores in Franklin limestone are apparently older than accompanying pegmatite. All this shows the close relation between pegmatite and magnetite, although the pegmatite is in some places earlier than the magnetite, in others later, and in still others contemporaneous. Magnetite ores of this type are widespread in this region, chiefly in the gneisses and granites, while the zinc ore is limited to these two neighboring occurrences in limestone at Franklin.

Thus it is indicated that the magnetites and the zinc ores are distinct injections, even where they occur side by side, as at Mine Hill.

The magnetite at Mine Hill and elsewhere contains a little pyrite, which we assume to be later and deposited at a lower temperature than the magnetite. At Mine Hill insignificant amounts of blende and galena are associated with the lime silicates (pyroxene and garnet), but are distinctly later than them. It is altogether unlikely that any of these sulphides existed at the time of maximum temperature which produced the silicates. A view that has much to commend it would ascribe the later blende, galena, and much of the pyrite and other sulphides to the influence of Triassic intrusives. Fluorite and sulphides, including galena and blende, are found at many places in the Cambro-Ordovician (Kittatinny) limestone and are particularly abundant near the later basic dikes, which are perhaps Triassic. These minerals also occur with the Palisade diabase sill (Triassic) and its offshoots in the Triassic sediments in eastern New Jersey and southwesterly across the state.

The foregoing is an outline of the principal Pre-Cambrian events, with many details omitted, since they are relatively unimportant and would confuse the picture.[20]

Reverting now for a moment to the broken and extended dikes in the Mine Hill open cuts, we recall that this characteristic association of pegmatites and lamprophyres occurs in the aureoles of great batholithic intrusions. The two are considered to be complementary, representing opposite poles of differentiation, as viewed from the composition of the parent magma. The relations of these two sets of extended dikes at Mine Hill conform to this typical occurrence. What appeared to be examples of these lamprophyric dikes are described by Spencer as made up of hornblende and oligoclase, or hornblende and scapolite. Some of them contain more biotite than hornblende.

All of the foregoing events were Pre-Cambrian and were separated from Cambrian by an immensely long period of erosion. The Cambrian basal sandstone (Hardyston) and the overlying Cambro-Ordovician limestone (Kittatinny) were laid down upon the vertically banded gneisses and the gneissic limestone. Subsequently these and later Paleozoic deposits were compressed into long northeast-striking folds of considerable accentuation, so that the strata acquired relatively steep dips. The structure sections of the Franklin Furnace quadrangle show these folds. To this folding is probably due the tilting of the folded vein away from the vertical, together with the tilting of the gneiss-limestone contact and the gneissic structure in general, as shown by our sketch (Fig. 2) of the outcropping unconformity in a locality overlying the mine, in the town of Franklin.

All geologists who have studied this district have noted unbroken dikes which cut the orebodies at right angles at Mine Hill; and all agree that these are later than the ore deposits and have no connection with them. Wolff classified them as camptonites. In this connection we were shown by Benjamin F. Tillson, mine superintendent, a limestone quarry at the south foot of Mine Hill where a sill of basic rock, perhaps the same as that of the later dikes at Mine Hill, followed in part the contact between the underlying Franklin limestone and the overlying Cambrian sandstone.[21] Associated with this basic rock were irregular subsequent impregnations of fluorite, arsenopyrite, pyrrhotite, sphalerite, galena, and many other minerals. These, being certainly Post-Cambrian and possibly Post-Paleozoic, have clearly no connection with the Pre-Cambrian zinc ores or the magnetite ores. It is possible that minerals of this period—apparently economically unimportant but varied as to species—may have been deposited in and near the zinc ores also, as pointed out above. Ries and Bowen record a case at Mine Hill where sphalerite is undoubtedly Post-Ordovician, and expressed the view that most of it must be later than the Pre-Cambrian period. Kümmel and Lewis[22] are inclined to correlate these basic intrusives under consideration with the basic magmas of the Triassic. Should this supposition be true it may be that some of the rarer minerals in and near the Mine Hill orebody are later than the bulk of the zinc ores by a billion years or more.[23]

Out of this reasoning and justifiable surmise from observed phenomena, we may in résumé list the following sequence of events:

Pre-Cambrian

1. Deposition of Grenville series (Franklin limestone and sedimentary part of the Pochuck gneiss).
2. Intrusion of basic igneous rocks into the Pochuck, now wholly gneissic and not generally distinguishable.
3. Surgence of a great granite-monzonite batholith, causing great lateral compression and flow of (1) and (2).
4. Very local injection of zinc-iron-manganese sulphide magma as strong replacement veins or veindikes.
5. Widespread injection of relatively basic, in part probably lamprophyric dikes; continuation of gneissic flow, fracturing and extending the dikes, and producing flow-folding and faulting of zinc veins; widespread injection of pegmatites; continuation of gneissic flow, breaking and separating the blocks of pegmatite; widespread magnetite invasion over a great area, closely allied to the pegmatite invasion, in part contempora-

[20] Ries and Bowen (*Econ. Geol.*, Nov., 1922) by a microscopic examination of the ores, have established the following sequence of crystallization of the principal minerals: (1) willemite, (2) franklinite, (3) zincite. This sequence is indeed clear in hand specimens of the ore with the aid of a lens; but it is a detail of minor interest to the geologist, who must maintain a correct perspective. Geologically speaking, all these minerals are contemporaneous. Their order of crystallization has much the same significance as that of the different minerals in a dike rock.

[21] In an early stage of the quarry, Wolff and Brooks (18th Ann. Rep. U. S. Geol. Surv., pt. II, p. 454) found that the sandstone occupied a nearly vertical cavity in the limestone.

[22] Geol. Surv. N. J. Bull. 14.

[23] See Time Scale, "The Ore Magmas," Vol. I, p. 396.

neous with the pegmatite, in part subsequent, in part antecedent, but at Mine Hill at least mainly distinctly subsequent.

6. General rise of temperature; suffusion of rocks with water and other gases. Reaction of limestone with pegmatites and basic dikes, producing reaction rims of pyroxene, hornblende, garnet, and many other minerals; general alteration of zinc-iron sulphides of main orebodies to present condition of silicate and oxides; contact reaction rims crystallized out between pegmatite and ore, producing a long series of unusual silicates containing zinc and manganese, including manganese pyroxene, hornblende, garnet, and mica; zinc pyroxene, zinc-manganese garnet, rhodonite, and numerous others. As the temperature dropped very sparse sulphides may have succeeded the silicates and oxides; this may account for the small amounts of pyrite, galena, and sphalerite (compare No. 11 below).

7. Immensely long period of erosion.

Paleozoic

8. Deposition of Paleozoic sediments unconformably on Pre-Cambrian.

9. Heavy Appalachian folding and thrust faulting (Carboniferous-Permian).

Mesozoic

10. Injection of basic dikes, probably Triassic.

11. Local deposition of metallic and non-metallic minerals in small amounts, including pyrite, pyrrhotite, arsenopyrite, galena, sphalerite, and fluorite. (Compare end of No. 6 above).

12. Heavy normal faulting, probably Post-Triassic.

From the foregoing outline it will be observed that the Pre-Cambrian magmatic succession was as follows: (1) basic Pochuck intrusives; (2) granite-monzonite batholith (Byram and Losee); (3) zinc ore magma (sulphides); (4) lamprophyre dikes; (5) pegmatite and magnetite; (6) lime silicate regional metamorphism. Following the greater intrusives, (3) to (6) indicate a constantly rising temperature in the invaded rocks, even to the relative age of lamprophyres and pegmatites, which is the reverse of the normal succession.[24] The rise of temperature between the pegmatite period (5) and that of metamorphism (6), at least, was contemporaneous with the flowage of the limestone (and to a less extent of the Pochuck gneiss), which we have previously pointed out was most likely caused by the long-continued intrusion of the granite-monzonite batholith (3). Concerning the pegmatite at Mine Hill, indeed, Dr. Spencer has personally stated to the writers that it has the characteristics of the pegmatite of the Byram granite. Also, magnetite is perhaps more characteristic of the Byram than the other granites, although it is found in all of them, and all are differentiation phases of the same magma.[25] Instances of ore deposition in a period of rising temperature have been given by one of the authors.[26] All of the observed phenomena therefore may be explained by the slow surgence of the Byram-Losee batholith, the successive injections having taken place closer and closer to the rising igneous margin. Spencer has shown[27] that the gneissoid structure of the granites themselves is an igneous flow-structure acquired by crystallization under the intense pressure and slow movement of intrusion.

One of the most profound impressions of the above-recorded schedule is that of the immense duration of Pre-Cambrian historical time. Another definite lesson is that of the scant quantity and intensely localized character of the zinc ore magmas, in contrast with the abundance and widespread occurrence of other magmatic injections. This is in keeping with the observed habit of ore magmas everywhere, and again emphasizes the fact that the origin of ores, such as those of zinc, cannot be attributed to any widespread agent, such as magmatic waters, but can be explained only as a rare and highly differentiated form of igneous magma.

[24] Paul Niggli: Die Leichtfluchtigen Bestandtheile im Magma. Leipzig, 1920, p. 130.

[25] See Spencer: Franklin Furnace Folio 161, U. S. Geol. Surv., pp. 5, 6. Speaking of the magnetite deposits of the region, he says: "Perhaps the most usual country rock is Byram gneiss, though the Losee gneiss is almost as commonly present."

[26] "The Ore Magmas," Vol. I, pp. 287-291.

[27] *Mining Mag.*, Vol. 10, No. 5, 1904.

Contact Bay, Wabigon Lake, western Ontario

Marketing the Natural Hydrocarbons

How Gilsonite, Wurtzilite, Elaterite, Manjak and Grahamite and the Mineral Waxes, Ozocerite and Ceresine, Are Sold

By Sidney D. Kirkpatrick
Assistant Editor, *Chemical and Metallurgical Engineering*

THE NATURAL-OCCURRING solid hydrocarbons are a comparatively little known but interesting group of commodities of wide utility in the industries. They are related in that all are mixtures of the various hydrocarbons (compounds of carbon and hydrogen), yet they differ widely in properties due to essential differences in composition. Included in the group for discussion in this article are the native asphalts—namely, hydrocarbons of the asphalt series (gilsonite or uintahite, as it is sometimes called; wurtzilite, elaterite, grahamite, and manjak), and the mineral waxes ozocerite and montan wax. Ceresine, also discussed here, is a purified derivative of ozocerite. Of the other natural hydrocarbon products, petroleum and amber (an oxygenated hydrocarbon) have been treated in other articles of this series.

Fig. 1—Gilsonite mine at Rainbow, near Watson, Utah

Gilsonite of Most Commercial Importance

From the viewpoint of value of output, gilsonite is the most important of the natural asphalts found in the United States. It is a black, brittle, asphaltic substance, remarkably uniform in composition and properties. It is one of the purest known natural hydrocarbons. Gilsonite has been found in only one locality in the United States, the Uintah Basin along the Utah-Colorado border. Most of the important veins are in the vicinity of Watson and Dragon, Utah.

Gilsonite occurs in perpendicular veins; those now being worked vary from 3 to 8 ft. in thickness, although at least one deposit 18 ft. wide is known. In most places the veins extend to the surface and can thus be easily traced, often for from 6 to 8 miles. The vertical walls are principally of shale, although some limestone is encountered in the district. The gilsonite is usually held under some pressure, and in practically all of the workings considerable timbering is required. The veins are worked from the surface to depths as great as 450 ft., although 200 to 250 ft. is most common. Because of its flammability there is considerable fire hazard in mining gilsonite, and unusual precautions must be observed. Mining operations, however, are quite simple, requiring little or no machinery. The gilsonite is easily shattered loose with a light pick, and as it is practically uniform in quality, sorting is not usually necessary. It is bagged underground by the miner and hoisted to the surface by motor-driven or team hoists. The ordinary miner will usually mine and sack about five tons of gilsonite a day. At the Rainbow mine, near Watson, Utah, the management has set a limit of fifty-one bags (of 225 lb.) per man per eight-hour day.

As the gilsonite is brought to the surface it is loaded

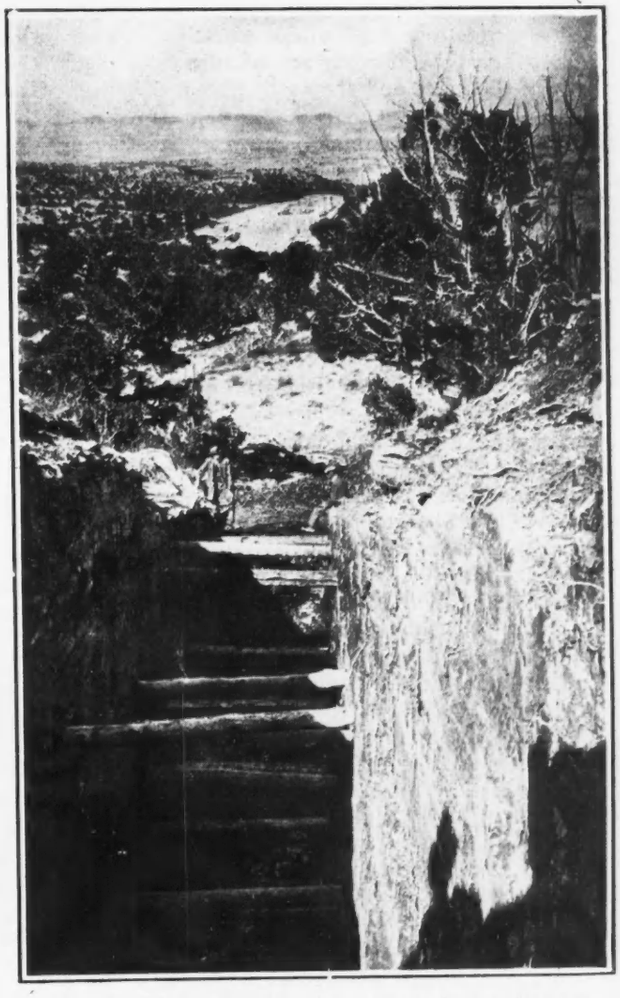


Fig. 2—Characteristic gilsonite working, showing method of timbering

Table I—Chemical and Physical Properties of Gilsonite

	Gilsonite Seconds	Gilsonite Selects	Jet Asphaltum
Specific gravity 77-78 deg. F., original substance dry	1.049	1.044	1.076
Color of powder or streak	Brown	Brown	Brown
Lustre	Lustrous	Lustrous	Very brilliant
Structure	Homogenous	Homogenous	Pencilated
Fracture	Subconchoidal	Subconchoidal	Conchoidal parallel to grain, subconchoidal across grain.
Hardness (Moh's scale)	2	2	2
Melting point, deg. F.	300-325	275	400 approximately
Penetration at 78 deg. F.	0	0	0
Dry substance			
Loss, 212 deg. F., one hour sample lump, per cent	.....	.52	.49
Loss, 212 deg. F., one hour sample ground, per cent	.....	.64	.61
Loss, 325 deg. F., seven hours sample lump, per cent	2.3	1.335	1.085
Character of residue	Intumesces	Fused, surface granular	Softened not fused
Loss, 400 deg. F., seven hour sample lump, per cent	4.0	1.44	1.34
Character of residue	Intumesces	Fused, surface bubbly	Melted, surface rough
Solubility in carbon bisulphide, per cent	99.9	99.98	99.97
Solubility in carbon tetrachloride, per cent	99.6	99.96	99.96
Solubility in benzol, per cent	.....	99.81	99.86
(All solutions twenty-four hours at 70-80 deg. F., five-gram samples. Same results by extraction method.)			
Bitumen yields on ignition, fixed carbon, per cent	13.4	15.74	18.89

on mine cars or is trucked to the narrow-gage Uintah R.R. for shipment to Mack, Colo., on the Denver, Rio Grande & Western R.R., and the principal warehouse and distribution center.

There are two primary commercial grades—gilsonite selects and gilsonite seconds—although some special varieties are marketed by the producers and distributers. Jet asphaltum is one of these products of high purity. Screened gilsonite is another which is in special demand for the export trade, since some of the foreign consumers—perhaps suspicious of sophistication—object to any considerable quantity of fines. The better grades of gilsonite are usually taken from the center of the veins and show a conchoidal fracture with a brilliant luster. The seconds come from near the surface or the walls, and because of weathering are less lustrous. The principal physical and chemical characteristics of jet asphaltum, selects and seconds, will be found in Table I. In this connection it should be pointed out that since gilsonite is a crude commodity, absolute uniformity is not guaranteed by the producers, but variations are known to be slight.

Gilsonite Has Desirable Properties

The most valuable characteristics of gilsonite are its chemical purity, its black lustrous appearance, and its resistance to attack by acids and alkalies. For this reason, one of its principal uses is as a base for marine paints and for protective coatings for steel work. Lately considerable interest has centered in its application in the black, baked enamels and japans for automobile finishing. Gilsonite is used in roofing paper, in saturating paper felts for floor coverings, in waterproofing and insulating compounds and in the manufacture of automobile tires and other rubber products.

In 1918 the U. S. Geological Survey reported the production of 30,848 short tons of gilsonite, valued at $606,639 f.o.b. the mine, or about $22 per ton. Freight to Mack, Colo., from the mines averages about $10 per ton. Production reached a maximum in 1920, with 56,204 tons, worth $548,776; dropped to 10,066 tons in 1921; returned to 29,693 tons in 1922, and in 1923 further increased to 34,425 tons. In 1924 jet asphaltum was worth $36 per ton, selects were quoted at $33, and seconds at $25.50 per ton, f.o.b. mines. The largest of the three producers is the Gilson Asphaltum Co. of Watson, Utah, which is a subsidiary of the Barber Asphalt Co. of Philadelphia. The other producers are the American Asphalt Association of Dragon, Utah, and St. Louis, Mo., and the Utah Gilsonite Co., of Watson, Utah.

Wurtzilite, the Elaterite of Commerce

Some confusion exists in the scientific and commercial classification of elaterite. Most authorities, including the U. S. Geological Survey, hold that elaterite is merely the trade designation for wurtzilite, but Abraham ("Asphalts and Allied Substances," Van Nostrand, 1918) states that it is a different material, found in a few localities, in small amounts and of scientific interest only.

The elaterite of commerce (wurtzilite) is a black, asphaltic substance resembling gilsonite in appearance, but softer and more elastic. It has the same conchoidal fracture and bright luster, a specific gravity of 1.05 to 1.07, and a hardness between 2 and 3. It is found only in Uintah County, Utah, in the general vicinity of Fort Duchesne. Compared with gilsonite, the veins are very narrow, varying from a few inches to a maximum of 3 ft. The larger veins have been worked commercially since 1912, but development has been on a small scale. One of the reasons for this, in addition to the mining difficulties, is that the material must be drawn by teams over very poor roads for a distance of 90 miles to the railroad at Price, Utah—the principal shipping point. Statistics for wurtzilite production are meager. In 1917, 821 tons was produced, which sold at the mine for about $89 per ton. In 1923 the U. S. Geological Survey reported an output of 200 tons, valued at $12,000. Crude elaterite was quoted during 1923 at $120 f.o.b. Chicago. Since 1918 there has been only one producer, the Raven Mining Co., of Chicago.

Crude elaterite is an insoluble, refractory mixture of hydrocarbons and must be treated by heating to 500 deg. F. under pressure for several days to yield a soluble product. The resulting material, sometimes referred to as refined elaterite, but generally known by the trade name of "kapak," has a melting point of 265 to 270 deg. F. and is soluble in the ordinary solvents. It is shipped in sheet-iron drums holding approximately 400 lb.

Elaterite paint made from the treated wurtzilite is used as a protective coating for the inside of galvanizing, electroplating, and pickling tanks which are subject to the action of acids and corrosive salts. The same paint is a preservative for underground iron and wood

Fig. 3—A gilsonite vein cuts through a hillside at Rainbow, Utah

pipes, poles, and posts. Because of its elastic, rubber-like properties, elaterite is sometimes called mineral rubber and is used to a considerable extent in rubber compounding.

Grahamite and Manjak

Another brittle, black asphalt of rather scattered occurrence in this country is grahamite. It differs from gilsonite in that it is heavier, contains more mineral matter, gives an irregular, hackly fracture, and very often the broken surface is dull instead of lustrous. Its specific gravity is 1.15 to 1.50, its hardness is 2 to 3, and it fuses above 350 deg. F. It is found in Ritchie County, W. Va., in Grand County, Colo., in Fayette and Webb counties, Tex., and in Pushmataha, Atoka, and Stephens counties, Okla. The largest known vein, 19 to 25 ft. wide and more than a mile long, is in Jackford Valley, near Tuskahoma, Okla. Unlike gilsonite, it is found in a number of foreign countries, the deposits in Cuba, Mexico, and on the Island of Trinidad being most important.

Production figures are not available, but Ladoo, in the U. S. Bureau of Mines "Report of Investigations," May, 1920, makes the statement that the Oklahoma deposit "has been worked extensively, and many thousand tons removed." Grahamite finds its chief use in the roofing industry, since when mixed with asphaltic fluxes it forms a rubbery, elastic covering very satisfactory for this purpose. With other bitumens it yields varnishes, rubber substitutes for water-proofing, and compounding materials for electrical insulation.

Manjak is a term that originated on the island of Barbados, where it was applied to a high-grade black bitumen, which breaks with a conchoidal fracture, exposing a bright, lustrous surface. Barbados manjak has a specific gravity of 1.10, a hardness of 2, and a fusion point of 320 to 430 deg. F. It contains a varying amount of mineral matter and about 90 per cent of carbon, of which 25 to 30 per cent is fixed carbon. The essential characteristics of Barbados manjak will be found in Table II. Trinidad manjak differs principally from the Barbados in that it has a higher specific gravity (1.175) and a lower total carbon content. Both are exported to the United States, but the Barbados variety commands a much higher price.

Manjak finds its principal application in paints and varnishes, in which it is usually mixed with mineral oils. These are used as protective coverings on pipe lines, structural steel work, and machinery. An interesting application of some promise is as a pipe cement and packing at the joints of rotary drill pipe, especially in the oil fields.

According to recent quotations (January, 1925) Barbados manjak in one to five-ton lots sold in New York for the following prices: Grade A, 6c. per pound; grade AA, fine, 8c. per pound, and grade C, lump, 12c. per pound.

Ozocerite and the Mineral Waxes

The mineral waxes differ chemically from the asphalts in that they are substantially free from oxygenated bodies and contain considerable crystallizable paraffine hydrocarbons. Ozocerite and montan wax are the principal members of the group.

Ozocerite is colorless to white when pure, but in its natural state may vary from light green to a dark brown. It has a low melting point, 140 to 200 deg. F., and a specific gravity of 0.85 to 1.00. It is easily refined to yield a purified wax known as ceresine or as ozocerite paraffine. There are several refining processes based either on a chemical treatment and filtration through fuller's earth or on steam distillation.

Table II—Characteristics of Barbados Manjak

	In Per Cent—Grade A	AA	C
Total carbonaceous matter	86.10	95.58	98.37
Mineral matter (ash)	13.90	4.42	1.63
Volatile matter on ignition	56.90	63.85	68.47
Fixed carbon on ignition	29.20	31.73	29.90
Solubility in petroleum ether	29.75	33.45	36.37
Solubility in 90% benzol	84.30	94.48	95.23
Solubility in carbon disulphide	93.40	94.95	95.76
Specific gravity	1.146	1.153	1.128
Softening point (Kraemer & Sarnow) deg. C	162	160	139
Melting point (Kraemer & Sarnow) deg. C	180	177	145

Before the war ozocerite was supplied to American consumers mainly from Galicia. Domestic sources of supply were confined to a single district near Soldier Summit, Wasatch County, Utah. This was worked on a considerable scale when the war cut off the foreign supply, but for some years has been inactive. The principal producer was the American Hydrocarbon Co., of Soldier Summit, Utah.

In 1917 the U. S. Geological Survey reported the production of 36,000 lb. of ozocerite valued at $1,000.

Fig. 4—Hoisting gilsonite to the surface for trucking to the railroad

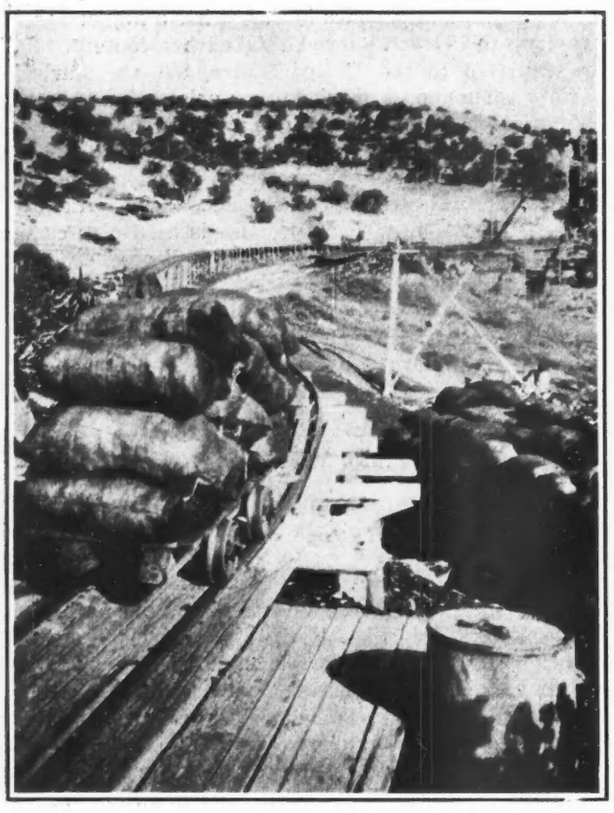


Fig. 5—Mine car loaded with gilsonite

In 1918 the output increased to 74,000 lb., worth $45,399. The annual imports of ozocerite before the war were in excess of 5,000,000 lb., reaching a maximum of 8,191,529 lb. in 1924. This was exceeded in 1922, when the United States imported 8,989,972 lb., invoiced at $371,161. In 1923 we received 5,000,597 lb., valued at $216,906, from abroad, and 20,000 lb., valued at $2,000, was produced in this country.

Ozocerite in bags was quoted early in 1925 in the New York market at 22 to 24c. per lb. for the black variety, 160-deg. melting point. The green wax of 170-deg. melting point was quoted at 24 to 26c. per lb. The imported yellow ceresine was selling for 10 to 12c. and the white for 18 to 29c. in New York in January, 1925.

Ozocerite is used for the manufacture of wax ornaments, dolls, candles, and similar articles; in compounds to protect polished metal surfaces, in floor waxes, and as a constituent in wood fillers and polishes. It is also used in the manufacture of certain types of electrical insulation.

Montan wax, which has been previously referred to, is not found in a pure state, but is obtained by the extraction of certain lignites of Saxony and Thuringa. It is not produced in the United States. It is brown in color, but can be steam-distilled to yield a white product. It is used as a substitute for carnauba wax in polishes, in place of ozocerite and ceresine in electrical insulation, and in the production of phonographic records. It was recently quoted in New York at 6 to 6¼c. per pound in bags for the crude material. This is practically the same as the pre-war price.

Canada's Mineral Production Increases

By S. J. Cook
Dominion Bureau of Statistics, Ottawa

PRIMARY METALS produced in Canada during 1924 reached a total value of $98,300,000, an advance of nearly $14,000,000 over the total for 1923; non-metallic minerals and structural materials showed a lower total value than in the preceding year, at $107,100,000, a loss of $22,500,000, due mostly to the loss in production of coal, and the total estimated value of the mineral production of Canada during 1924 was $205,462,000, compared with $214,079,331 in 1923. The accompanying table shows details.

Silver from the Cobalt area, including the metal produced in the reduction works at Cobalt and at the south Ontario smelters as well as the silver contained in cobalt-bearing ores exported, made up slightly more than half the total. Practically all the rest was recovered from British Columbia ores treated at Trail or in United States smelters. Two companies, the International Nickel and the Mond Nickel, produced nickel-copper ores throughout 1924, and operated their smelters in the Sudbury area. The British America Nickel Corporation was forced into liquidation in July, and operations at its mine, smelter, and refinery were discontinued. In spite of this loss, the output of nickel, determined mostly as the nickel contents of matte made in the Sudbury smelters, advanced 6,800,000 lb. to 69,250,000 lb., which, valued at the average New York market price for refined nickel, would be worth $18,697,500.

Copper contained in matte produced constituted about one-third of the total production during the year; the output from the Granby smelter contributed about another third, and the remainder was from British Columbia copper ores and pyritic ores from Quebec treated in United States smelters.

Progress in the production of lead at Trail continued unimpeded during 1924, and the new high record established in 1923 yielded place to the 1924 output. Including the lead contained in Yukon ores and the lead from Ontario ores (mostly from Galetta), the total lead produced in Canada in 1924 was 168,713,500 lb.

Sales of cobalt and its compounds were well maintained throughout 1924. White arsenic, which was produced as such at Deloro, Ontario, and was contained in Hedley concentrates exported to the United States, and Nova Scotia concentrates shipped to Europe, fell off about 1,000,000 lb. from the total recorded in the preceding year. During 1924 a few tons of bismuth contained in lead matte were shipped from the south Ontario smelters.

Canada's mineral industry ranks third among the primary sources of national wealth, agriculture and forest production taking precedence over minerals in the value of their annual production. Employment in the mines, mills, and smelters gives work for about 60,000 men on the average, and the annual salary and wage bill totals about $75,000,000. Nearly two thousand properties reported production in 1923, and the investment in the industry is more than $500,000,000.

Discussion

"Engineering and Mining Journal-Press" is not responsible for statements or opinions published under "Discussion." In many cases the views expressed are diametrically opposed to editorial policy and belief.

France's Solvency

THE EDITOR:

Sir—The opinions expressed in your editorial entitled "Losing a Friend," which appeared in your issue of Jan. 31, are of the sort now frequently expressed in the American press. But the fallacies involved, it seems to me, should be evident to engineers if they are not to the less analytical public.

You say "We have loaned France money." Certainly we did not ship them gold; much less packages of dollar bills. What we did was to open credits here in their favor, by drawing on which they bought American goods and services with which to fight. If part of them were used for purposes not contributory to fighting the war, then that part might be considered on a different basis; but that reasoning would not apply to the whole. The aforesaid goods were sold to the French at highly inflated prices, which not only left enormous profits to the producers, capitalists as well as labor, but also substantial sums collected by our government as taxes. Before the war the United States was a prosperous but a debtor nation. Today it is the richest country in the world. Where did we get it if not from sales to our Allies, and to neutrals whose markets we were able to capture because the war effort of our Allies made them unable to continue in the field?

You say "It was not our fight." I do not think you said that at the time of the war. At that time our President, our public men, all of our newspapers which were not pro-German and the vast majority of our citizens said and believed it was our war. As one English writer has put it, certainly the United States did not go into the war because of France's *beaux yeux*.

You say "we were prodigal with men and money after we went in, and France is here to tell the tale, which she otherwise would not be." That is an opinion not subject to proof, any more than it would be to say the same of our being here to tell the tale, etc., because France fought. That your opinion, however, is not universally accepted on the other side is illustrated by the following editorial remark in the English review *The New Statesman* of Jan. 17, 1925: "America came into the war of her own free will; she made no very great contribution to the final victory of the Allies. . . ."

As for the practical matter of repayment, it would seem that no body of men could so well understand the case as the mining profession, because the debts are "gold debts," and therefore closely connected with the stock and production of gold.

Several years ago Mr. Loucheur, former French Minister of the Liberated Regions, was reported to have said, "I say plainly that I believe we never will be able to pay a sou to America. America has all the gold, and we never could pay in goods on account of the customs barriers raised by the United States itself."

For this statement he received harsh criticism here and continues to do so. But so far as I know, his reasons have never been refuted.

To be sure, we have not all the gold. We have only slightly more than half of it. But of the rest, the Allies, and France in particular, have but a very small part, and cannot get what remains. No sensible man would suggest asking for the gold they have, since that would endanger the gold standard itself. The gold production of the world, outside of the United States, is practically all from the British Empire. It is sufficient in amount to supply the British with their payments to us, and already we are receiving each year gold to the amount of nearly the world's production. But there is not enough gold produced in the world to pay even the interest on both the British and French debts; and if payment can be made only in gold it is evident that it is not the British who will first find themselves without it.

As far as goods are concerned, those we now import go to pay for part of our exports. The rest of our exports are now balanced by new foreign loans. Cut out the latter, and even our present exports cannot be paid for except with further imports. If France is to pay it would mean still more imports. Presumably we now import all we need of non-dutiable goods, since if more could be sold here they would be imported. Of dutiable imports the same may be said if the statement be qualified with the phrase "at the prices resulting from our tariff." Confessedly, our tariff is designed to keep them out.

I would like to ask *Mining Journal-Press* to answer Mr. Loucheur's reasoning and show how France could pay, assuming that she is prosperous enough to do so.

New York. HUNTINGTON ADAMS.

Engineers' Reports

THE EDITOR:

Sir—Your article entitled "Evolution of Mining" is most interesting. I do not question your conclusions in general, but you make one serious error. On page 6 it is stated that out of 4,000 reports submitted to an exploration company, 3,600 prospects were rejected on the basis of the report, and 375 more after examination. None of the 375 were anything like the report.

The reader is led to believe that there were 4,000 real mines and prospects. This is not true. When employed as an examining engineer I have had to deal with hundreds of these reports. A large proportion of them are not legitimate reports, on legitimate prospects, but the work of bunco artists, written to be used in "slipping something over." A surprisingly high proportion of them are based on mere holes in the ground or not even that—just locations. Quite often they are submitted in good faith by the claim owners

or by brokers. These persons, having no technical knowledge, cannot distinguish the true from the false. Sad to relate, many such reports are made by real engineers gone wrong. It is probable that the 375 were this kind. Many of the 3,600 were no doubt honest, but described properties not desired by the exploration company. However, it is not correct to figure the proportion of poor prospects to "live ones" from the above figures.

Another point worth bringing up is that many prospectors and small operators know of the prevalence of fake reports and distrust any person claiming to be a mining engineer. They never have reports made on their properties, and the examining engineer does not learn of their existence unless he stumbles on them. Too often the engineer employed by an exploration company finds his time taken up following false leads. The prospects of merit are likely to be in places difficult of access and unadvertised.

I am convinced that there are a great many worthwhile prospects still to be had, and that there are a great many more of them than some of our office-chair engineers would have us believe. JOHN B. PLATTS.

Boise, Idaho.

Haps of the Prospector

THE EDITOR:

Sir—How is this for a year's record for a rank, tenderfoot prospector and shoestring mine operator? Beginning in June, 1924, I started upon my adventures that just about finished me before the close of the year. I was anxious to open up an old tunnel that had been abandoned for more than thirty years. The timber was in bad condition, the tunnel full of water. I crawled into a bad mess when I dropped my candle and could find no more matches. There I was, stuck in a dark hole, water to my waist, and a tunnel as crooked as an old-fashioned corkscrew. To make it more miserable, this old tunnel had drifts and crosscuts every few rods.

After I had splashed and crawled in total darkness until I thought it was all over and still could not see the light of day, I began to use my noodle and to recall that the main tunnel had a track. So it was up to me to wallow around in the muck and cold water until I found a rail and then to hang to this rail to the end. It was too dark to see and too cold to feel. However, by following along the track I managed to keep the right direction, and was glad to get out finally and warm up in the afternoon sunshine.

Later, I was with an old prospector who wanted me to look at an old claim of his. The workings consisted of a drift of about 150 ft., then a shaft of about 30 ft.—that is, the prospector told me that the shaft was 30 ft. deep when he left it, some "forty years ago." I got a rope just 40 ft. long, and we secured it firmly so as to enable me to descend the dark old hole with the consolation that one end was at least "in place." Halfway down the shaft, I dropped the candle and was in total darkness and at the same time was reaching the end of my rope. Swinging and kicking, I yelled up to my prospector friend, and he assured me that the shaft was less than 30 ft. I could not feel the bottom, and of course I could not see it. I took the old man's word for it and dropped—about ten feet. I sure was glad that the old shaft was not 100 ft. deep!

Some time later, I was exploring some old workings. My old friend the prospector could not keep up with me. I heard him call to me, but paid little attention. Rushing ahead, I entered an old tunnel, and soon was busy digging at a promising streak of ore, when in rushed my partner who began to splutter about something. Later I found out the cause of his excitement: Where I was busy digging was an old shaft that was completely covered with debris of many years of active work on the part of a large family of mountain rats. I had walked over the mouth of the shaft, which was 60 ft. deep. How I escaped I do not know unless there is no room in heaven for reckless fools. We just poked the piled-up sticks and leaves with our feet, and the whole top went down with a crash, leaving the open shaft in view and making me realize what I had escaped.

Every reader of the *Mining Journal-Press* has had his experience, some time or other, with mountain rats. I was staying overnight in an old cabin. The rats had chewed up or carried off all the beds and bedding. My partner and I lay on the floor. Sometime in the night I let out a big yell that caused my sleeping partner to jump up and exclaim, "Glory be! What's eating you—eh?"

I answered back with intense feeling as I rubbed one of my ears: "Say—you'd yell, too, if you had a mountain rat chewing on your ear!" Sure enough, while I was sleeping, a big rat had taken a liking to one of my ears and had nibbled freely on this important organ until he had drawn the blood and woke me up. Later we finished the rat with a stick of wood, and then we finished the night in peace.

Just before the climax of my adventures, I was digging like a badger in an old tunnel, badly caved in. I dug away a big slide and was real busy and all ready to crawl in and do some exploring. The timber was down, I crawled into a small opening and was pushing my way forward, when some loose rock and gravel fell down my neck. Glancing up I had the real thrill of having a big rock hanging over my neck ready to drop at any moment. It was not pleasant to realize that it would be the end of me if that rock fell. But I did have sense enough to keep cool—and to back out of that hole gently but firmly while I was being showered with rock and dirt. As long as I moved without disturbing the rock above me, I knew I had a chance. When I did crawl out I was rather weak in the knees. A few seconds later, the rock came crashing down, and I had to make a run for it, as a whale of a slide came down. I left a wheelbarrow, some picks, and a good muck stick behind me as I beat it. These useful tools are still under tons of rock and waste. I may dig for them this coming summer.

We needed meat badly. So the first day that the deer season opened, I started out with an old 44-40 Winchester. I got on the trail of a big herd of deer. The snow was knee deep, and in a country of fallen timber—just on the edge of timber line. When running down a gulch, tumbling every 10 ft. over concealed logs and fallen timber, I had the darn luck to strike the old 44 against a rock while I had my right hand over the muzzle. There was a terrible roar in my ears and I had daylight shot through my right hand. I was about four miles from the cabin. I don't believe I will ever forget that trip, alone and bleeding quite freely. I felt pretty tough, for I was afraid that my hand was gone, and a man with a wife and two kiddies needs a good right hand. My partner fixed me up the best he could, and the following morning I rode 12 miles to

the train and 40 miles farther on I had the hand dressed by a good doctor and surgeon. For eight weeks he worked on my hand every day and saved it. I lost only the little finger, which had to be taken off at the wrist, for there was not much left of the finger. The bullet went through the palm and came out close to the wrist, tearing an ugly hole. After three months, I am still crippled, but in time will hit the trail for the hills again. But I think and hope that during 1925, if I go prospecting, that I am going to be real careful—Safety First! GEORGE GIBBONS HAYES.

Ashcroft, Colo.

The Prospector

THE EDITOR:

Sir—From time to time we are asked what has become of the prospector. There are several types of men and women that come under this title, and when I hear the question I wonder just which kind of a prospector is meant. There is the fellow that goes out every summer for a few weeks, with a fancy fishing rod, a book of flys, a shotgun, a rifle, a canvas suit, high top shoes, and a single hand pick. He finds a nice shady nook along a cool bubbling brook, takes a day to fix camp, another day to rig out his finishing tackle, oil his guns, and shoot chipmunks, bluejays, and camp birds. Then the trout and grouse had better hide, for he is ready to begin prospecting. If a piece of quartz as big as a wheelbarrow and rich with free gold was to come tumbling from the hill right at his feet, he never would notice it. In a few days he gets tired, the fish do not bite, wood ticks and skeeters do, or maybe a porcupine comes to camp. Anyhow he has proved that there is no mineral up in that gulch. He goes back to the city, sunburned, tired out, and tells of the hardships he has endured, and the money he has put in trying to develop the mineral resources of the state, and he comes under the head of "prospector."

We have the gentleman who combines promotion and prospecting. He stays in town, writes many letters, hangs around the hotel, watches the trains, and is on hand to help the stranger within our gates. Any time some prospector makes a find, Mr. P. and P. gets there quick, locates all around the new strike and tries to tie the new strike up on a lease and bond. He then gets a few lines in the local paper to the effect that he was very fortunate in securing the extension both ways on the new discovery, and if anything a much better showing. He sticks around the hotel for the next sixty days, pesters every one that is unfortunate enough to meet him, and when the sixty days are up, he gets busy with his lead pencil again. He has plats, maps, the dope on mill and smelter returns for all the big producers within 50 miles of his holdings. He never had a pick or a muck stick in his hand, and never put a dollar of his own into a claim. He keeps development in the district back as long as he lives, and people call him a prospector.

Then comes the old boy that located the first claim in the camp. It was a big well-defined fissure vein of quartz. It is yet, 7 ft. between walls. He has been forty years driving 30 ft., has never cut either wall, does not know what formation he is in, and a picked specimen will not assay $2. He is known as a good old prospector.

There is the fellow that staked a prospector thirty years ago to $15 worth of grub. He did not get any returns and he is sore. He never gets tired of telling of the money he lost prospecting; he played for a big stake, and lost.

Group after group of patented mining claims is laying idle today that never has been prospected. The men that managed them and shut them down couldn't distinguish the difference between yellow pyrite and free gold. All they knew about the business was to unload their stock. The result is that one-third of the most promising mineral land is tied up in groups of idle patented claims. The men that tied them up are called prospectors and mining men.

Here is another chap: He calls himself a prospector for a purpose. He watches the delinquent tax list for a claim that has some timber worth while. He is figuring on a sawmill, wood pulp and mining timber. He is afraid that some leaser, prospector, or summer tourist may discover some good croppings and he will do all he can to keep people out of that neighborhood.

We have business men, whose business depends entirely on the mineral production of the camp, that get by each year on from $25 to $50 for assessment work on from one to ten claims, and the work is done where it can be done the quickest and cheapest, regardless of the mineral showing. They will tell you that they are prospectors.

But the real prospector is still on the job; he is chasing float, breaking quartz, panning gravel, and digging trenches, and he does not give a snap if the assessment year begins on the first of June or first of January. He is always doing assessment work. If it was not for the leaser and prospector, there would not be much doing in the mining game.

I have met a few women prospectors and many women that backed their men in the business. They certainly deserve to be called prospectors. One woman helped us buck the snow through from the head of Taylor River over the Highland Pass, in the Gunnison excitement in 1880. I think her name was Mrs. Jones. She was a good prospector. Another woman camped with us at Crested Buttes. She took care of the wagon and camp while her man prospected. They had just come in from Deadwood. She was doing her part. Last summer two women were prospecting on Mount Abram in the San Juan. They were real float chasers and had some good quartz.

So here's to the leaser, the prospector, and their backer! When they quit, roll your tent.

Ouray, Colo. RICHARD NURDI.

Sulphur as a Fertilizer

THE EDITOR:

Sir—About twenty-five years ago Dr. Bernard Dyer, an agricultural chemist of repute and associated with the Chilean Nitrate Committee, published a book in England entitled "Artificial Manures," in which a long appendix was devoted to the narration of experiments with ferrous sulphate, copperas, or green vitriol. Apart from the increased yields obtained, the most remarkable feature was the great increase in phosphoric acid content of the crops, particularly in beans. The fertilizer seemed to be efficacious only on sour soils, and it seems possible that the iron combined with excess humic acid, while the sulphuric acid rendered available phosphates already present. R. T. HANCOCK.

Maracaibo, Venezuela.

News of the Week

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

Summary

A NEW FLOTATION CONCENTRATOR to cost $500,000 will be erected this spring by the United States Smelting, Refining & Mining Co. near its smelter at Midvale, Utah. Treatment of lead-zinc ore on a custom basis is planned.

Decision against the defendant smelting companies in the case of the Carson reverberatory furnace patents broke shares on New York Exchange.

One hundred small producers have already consigned shipments to the new ore purchasing plant at Kingman, Ariz.

Operators in the Joplin-Miami district continue to build and rebuild concentrating plants in various sections of the field.

The Consolidated Mining & Smelting Co. has begun to ship surplus lead concentrate from its Sullivan concentrator to the Bunker Hill smelter. Excess zinc concentrate goes to the Great Falls zinc plant.

Producing 15,700,000 lb. of zinc cathodes in January, the Anaconda Copper Mining Co. established a new record at Great Falls.

The new crushing and screening plant of the Oliver Iron Mining Co. at Virginia, Minn., is effecting marked economies.

F. H. Brownell, president of the Federal Mining & Smelting Co., finds that new lead mines are scarce.

Senator Oddie denies that the Senate Gold-Silver Commission divulged confidential data supplied by mine operators.

Active development is the program of the Hercules Mining Co. in the Coeur d'Alene district in Idaho.

Gilbert, Newest Nevada Gold Camp, Will Have Newspaper

"Claim Jumpers" and "Back-daters" Not Popular—Modern Vigilantes at Work

F. F. Garside has announced that he will immediately start the publication of a weekly newspaper under the caption of *The Gilbert Record* to serve the new gold camp west of Tonopah, Nev. For the present, this paper will be issued from the plant of the *Tonopah Daily Times*, of which Mr. Garside is publisher.

The townsite of Gilbert is now being laid out, and lots are being taken up as fast as the surveyors can stake them. With the opening of several business houses, real-estate values have already shown a tendency to skyrocket.

This new district has taken a firm hand in dealing with "fraction hunters" and "back-daters," with the result that so far there has been very little dispute over titles. One Malapai John, known throughout this part of Nevada for his activities in mining-camp "technical" manipulation of the sort above mentioned, was arrested on a warrant, issued in Goldfield, for claim jumping at Gilbert. During his enforced absence from the district, some unknown forces removed all trace of his camp and equipment, and he returned with a full realization that he would not be tolerated. Such drastic action in dealing with unscrupulous locators will undoubtedly lessen the probability of future litigation.

The Homestake group is reported to be included in a sale of considerable importance. Prominent mining men of Nevada will be interested in the new company and are prepared to finance an operating company to develop this property. The most recent discovery of gold ore was made on this group.

Decision in Carson Patent Case Affects Smelters Share

A decision handed down on Feb. 17 by the United States Circuit Court of Appeals reverses the lower court and sustains the contention of George Campbell Carson that the American Smelting & Refining Co. and other smelting companies have been infringing his patents covering the side-feeding of reverberatory copper furnaces. About $20,000,000 is involved in the suit, according to dispatches from San Francisco, but New York officials of the companies declare this figure is ridiculous. Carson, who calls himself an itinerant miner and inventor, has been backed in his suit by Rudolph Spreckels and Robert Hayes Smith, of San Francisco.

Receipt of the news in New York resulted in a sharp break in copper stocks on the New York Stock Exchange, but officials of the various copper companies were not perturbed regarding the matter. American Smelting, which opened at 99⅛, sold up to 100 during the forenoon, but on receipt of news concerning the suit the shares immediately broke 7½ points to 92⅛, but recovered to 96⅛ just before the close.

Lucky Jim Hopes To Build Mill at Zincton, B. C.

Good Ore Developed—Trail Shipments Bring $15 Per Ton—Lead, Zinc, and Silver

The Lucky Jim Lead & Zinc Co., which owns and operates the Lucky Jim mine, at Zincton, B. C., has issued a circular to its shareholders, giving an account of the exploration that has been accomplished since the mine was reopened. In September last the downward extension of the orebodies between No. 4 and No. 5 levels was developed, with the result that ore giving an average assay of 22 per cent of zinc, 12.2 per cent of lead, and 11.2 oz. silver per ton was found. This gradually improved: a recent sampling gave 28 per cent of lead, 24 per cent of zinc, and 25 oz. of silver.

Three carloads of ore, each of about 50 tons, were sent to Trail, which, after freight and treatment charges were paid, brought a return of $15 per ton. The ore was picked to separate the zinc from the lead, and in the picking a considerable dump of milling ore was obtained. The company now is negotiating for the purchase of a mill from an idle mine in the district, and it is hoped that the negotiations will be completed at an early date and the mill will be in operation in the early summer. The extension of the adit at No. 3 level has found ore, and a raise will be put up from No. 4 level, giving connection with No. 5, which is the main haulage adit.

Custom Ore-purchasing Plant Revives Oatman, Ariz.

One Hundred Shippers Sell Small Lots for Cash—Black Range Backed by United Eastern

The opening of the sampling and ore-purchasing plant at Kingman, Ariz., last October by the Western Ore Purchasing Co. has stimulated small-scale mining in the Oatman district. The plant has opened a market for lots of ore gleaned by small lease holders and prospectors who were unable to ship to the smelter at a profit. When the sampling mill was first opened only a few men were working; but there are now more than 100 parties producing ore in the district. Financing their properties has been made easier for the small operators for the reason that they receive their checks from the purchasing office within two days after delivery of the ore.

Several companies whose mines have been inactive have been induced to reenter the field. Among them are the Black Range Mining Co., the Gold Dust Mining Co., the Hart Leasing Co., the Oatman United Mining Co., and the United Eastern Co. The Black Range is a corporation capitalized at $1,500,000. The United Eastern Co. is said to be heavily interested in this property. It is now working a 22-ft. vein which averages $9 per ton. The United Eastern is now working a new location about 1,500 ft. from the Black Range.

More than $35,000 worth of ore has been bought by the Western Ore Purchasing Co. since the opening of the sampling plant. The company has also taken over the Stockton-Hill property, lying 11 miles north of Kingman, and is operating part of it and leasing the remainder.

California Rand Milled 9,598 Tons in January

According to the report issued by the California Rand Silver, Inc., for January, 1925, the product of the mine at Randsburg, Calif., for the month was 9,598 tons of milling ore. Development advanced 1,508 ft.; ore milled totaled 9,598 tons; average heads were $22.65 per ton; average tailings were $1.36; and the total recovery was $204,341. Concentrates produced amounted to 866.8 tons, totaling $188,581 in value. Disbursements for the month were $226,976. The examination of the mine by engineers for New York interests has been completed, but no action has been taken upon the option to purchase.

Reopens California Zinc Mine

A. G. Miller, owner and operator of the Colorado zinc mine nine miles northeast of Darwin, Calif., announces that he has closed a one-year contract with the Grasselli Chemical Co. for the shipment to Chicago, Ill., of 150 tons of ore monthly.

The ore as mined ranges from 40 to 53 per cent zinc. Operations were recently resumed after a shutdown since 1920. During the war, approximately 6,000 tons of ore was shipped from the property.

Revive Old Lead-Zinc Property

The famous old Tennessee mine, in the Chloride-Mineral Park district of Mojave County, Ariz., has been purchased by B. X. Dawson and associates and is soon to be put into operation. The Tennessee was a big lead and zinc producer in the Southwest for a number of years and the present high price of metals is responsible for the reopening of the property.

U. S. S., R. & M. Co. Will Erect $500,000 Flotation Plant

Plans To Buy Lead-Zinc Ores on Custom Basis—Third Buyer To Enter Utah Field

Within sixty days the breaking of ground for the erection of a new 500-ton flotation plant will be begun by the United States Smelting, Refining & Mining Co. at Midvale, Utah, where the company now operates its lead smelter, according to announcement made by D. D. Muir, Jr., general manager. As the estimated cost of construction of such plants is about $1,000 a ton capacity, the new metallurgical plant will represent the expenditure of approximately $500,000.

At the Midvale smelter in Utah

Adjoining this plant is the site of the new flotation concentrator that is to be built by the United States S., R. & M. Co.

The decision of the smelting company comes as a result of the perfecting of a simplified process of treating complex ores and the desire to open up a market for the large tonnages of lead-silver-zinc ores. Heretofore, zinc has been penalized because of the added cost of treatment. This condition has laid an embargo on many deposits containing important tonnages, because the ore is too low grade to stand the penalty for zinc.

When the new flotation plant is put into operation the company will be enabled to pay for the zinc in addition to the silver and lead.

During the last six months two other plants have been put in operation in Utah for the treatment of lead-zinc ores, one by the International Smelting Co. at Tooele, and one by the Combined Metals company at Bauer. Operation of the new flotation plant at Midvale will be for both company and custom business. A department will be maintained to which shippers can consign samples of their ores for testing purposes and the co-operation of the company in the solution of ore-marketing problems is promised.

The profitable exploitation of complex zinc-lead ores is one of the most pressing facing the Western miner, and the smelting companies will share the benefit of the solution of it.

Packs Mexican Ore Three Days to Railroad

W. E. MacEwen, manager for the Majestic Mining Co., operating in Oaxaca, Mexico, has made another shipment of high-grade ore. The last lot assayed 42 kg. of silver per ton, besides the gold content. The mine is the Guacamaya, situated in the Totolapam district, about two days by saddle from Oaxaca. The company is overhauling and rehabilitating a small mill near the mine to make milling tests on the lower-grade ore. The ultimate plan includes the construction of a 250-ton mill. Lack of cart roads, at present, makes it necessary to ship all ore by pack animals, at a cost of 65 pesos per ton. Three days are required on the road.

Plan to Start Vanadium Mining in Southern Utah

The carnotite mines formerly known as the Kearns group, situated in Dry valley, 40 miles south of Moab, Utah, are being prepared for increased output by the United States company, which now controls the property.

Under the direction of L. R. Steele, a crew of about twenty-five men is at work, some being occupied in taking out ore, but most being engaged in completing a mill and concentrator.

About 2,000 tons of ore is stored awaiting the completion of the plant. The ore is being mined for its vanadium content. The concentrate will be shipped to Jersey City and Niagara Falls, where it will be reduced to ferrovanadium for use in steel works.

No Dividends Yet for Chief Consolidated in Utah

Brighter Outlook for 1925—Some Adjustments Needed at New Mill —Better Smelter Contract

Hope of the Chief Consolidated Mining Co. resuming dividends this quarter has not been realized, according to President Walter Fitch's letter to stockholders in the annual report for 1924. Profits were more than enough to meet the operating costs, but large expenditures necessary for the construction of the new mill and the near approach of the settlement with the government of the dispute as to additional war taxes made the declaration of the dividend inadvisable. Payment of the tax bill is now being made. Resumption of the dividends will be necessarily governed by the reaccumulation of cash which this impending tax bill has so seriously impared.

Results of the last year, says Mr. Fitch, were affected by the character of the ore, which was much poorer than usual. Profits were restricted by the expense of building a mill and by the existence of an unfavorable smelting contract, which has been replaced by a more favorable one.

The general manager's report points out that three miles less development work was done in 1924 than in the previous year, but it was supplemented by ten miles of deep-hole drilling, a method that develops geologic information just as well as the older method of prospecting, but at a largely reduced cost.

The volatilization department of the new ore-reduction plant started the latter part of December. Some adjustments were found to be necessary. It is now expected that continuous operation will be possible. The finding of higher-grade ore, due to the possibility of being able to ship the low-grade product to the mill, has proved possible in several instances. The total shipments of ore were 120,707 tons, yielding, after transportation, sampling, and all operating charges, $357,556.67.

Metal production for the year was: Gold, 14,194 oz.; silver, 2,536,417 oz.; lead in lead ores, 21,804,249 lb.; copper in copper ores, 893,963 lb.; lead in zinc-lead ores, 26,835 lb.; zinc in zinc-lead ores, 49,462 lb. The average gross value per ton of all ores was $32.08; smelting, freight, and sampling, per ton, cost $15.02, leaving the average net value $17.06.

Water Shuts Down Michigan Iron Mine for Weeks

Operations at the Ashland mine, at Ironwood, Mich., have been resumed after an interruption of a few weeks caused by the flooding of the lower levels of the mine. A battery of special pumps was required to unwater the mine, but the flow of water is now back nearly to normal. The normal flow in most of the mines on this range is not large, and so when a vug is cut, as occasionally happens, the pumps are unable to handle the rush of water. In some mines heavy concrete dams have been installed to protect the pumps and shafts.

Verde Central Has 6 Per Cent Ore

Development work on the 1,500 level of the Verde Central mine at Jerome, Ariz., is reported to be showing up favorably. The face of the north crosscut is said to be in ore running between 5 and 6 per cent copper, and occupying the full width of the face. Formation in the east crosscut has changed markedly in the last few rounds, and it is believed that the working will penetrate the same orebody as the north crosscut soon.

Continue to Transplant and Build Mills in Joplin-Miami District

THE Liza Jane Mining Co. has purchased the Sinden mill, in Picher, Okla., and will move it to its lease west of Baxter Springs, Kan., in the Joplin-Miami district. The company, of which W. T. Landrum, of Baxter, is manager, has been prospecting and developing the lease for more than a year. It adjoins a lease where the Golden Rod Mining & Smelting Co. recently erected a new mill.

The Kansas Explorations Co. will have completed and placed in operation its new Isherwood mill at Smithfield, Kan., before March 1.

The Big Elk Mining Co. announces it will rebuild the mill which was destroyed by fire about three weeks ago.

The Richardson mine, situated in the heart of Quapaw, Okla., will be placed in operation once more. The lease and mill were purchased recently by R. A. Hartley, of Kansas City, from M. R. Lively and George W. Moore. Heavy water has prevented operation of the mine.

The American Zinc, Lead & Smelting Co. has taken a lease on the Freehold Oil & Gas Co.'s No. 4 mine, in the Waco, Mo., section, and has moved drills upon the tract, planning complete development. The other properties of the Freehold Co. were recently taken over by Frank Childress and associates, of Joplin.

Bunker Hill Smelter Gets Sullivan, B. C., Lead Concentrates

Shipment of high-grade lead concentrates from the milling plant of the Consolidated Mining & Smelting Co. of Canada, at Kimberley, B. C., to the Bunker Hill smelter at Kellogg, Idaho, was recently initiated. These lead concentrates, representing the surplus over and above the capacity of the lead smelter at Trail, B. C., are now going forward at the rate of 150 tons per day. The arrangement with the Bunker Hill smelter, as well as a similar arrangement with the Anaconda Copper Mining Co. to take care of the surplus of zinc concentrates, is presumably temporary and was made to take advantage of the favorable lead and zinc markets.

Hercules, Now Wide Awake, Looks for New Mine

Numerous Development Projects in Cœur d'Alene—Now Controls Success Mine

If the Hercules Mining Co., of Wallace, Idaho, had displayed the same activity in the development of new mines before the Hercules bonanza had been bottomed that it is showing now in that respect, the company might easily be disbursing dividends instead of drawing upon its surplus for the purpose of acquiring mining property and in developing new orebodies. The Hercules mine ceased production last December, and it was not until the end was clearly in sight that the company seems to have grasped the fact that unless it developed new mines it would soon be out of the productive class.

As evidence of the eager activity of the Hercules, some of its more recent development enterprises are here given. After holding the Maher-Hearn group of claims for many years without making a move toward development, the Hercules last fall purchased the control of the Gertie Mining Co., to secure the use of that company's mile-long crosscut as the most feasible means of reaching the Maher-Hearn, which is now being developed. Last year it went into the open market and bought up control of the Western Union Mining Co. and is now carrying out an extensive development program. The Stratton mine, the discovery of which through the novel "ten-dollar option" plan of promotion created a sensation, was gathered in by the Hercules people and is now being operated. Control of the Honolulu, lying just north of the Hercules, was taken over under an agreement to develop it by crosscutting from the Hercules workings, work that is now nearing completion.

The recent shutdown of the Success mine and its resumption under new management revealed what had for some time been suspected, that control of that mine had also passed to the Hercules. The latest acquisition is an option on control of the C. & R. Mining Co., which owns a group of ten claims north of the Honolulu which will be developed by continuing the Honolulu crosscut.

According to well-founded report, the Hercules is now negotiating for control of the Guelph, also north of the Hercules and joining the Honolulu on the west. On all of these properties the Hercules company is engaged in active development.

Central Eureka Accumulates Reserve Fund From Earnings

The Central Eureka Mining Co., operating the Central Eureka mine at Sutter Creek, Calif., has accumulated a reserve fund of $100,000 and has paid $36,000 toward its purchase of the Old Eureka mining properties. Drifting on the new 4,400 level to a total distance of 575 ft. was accomplished by the close of 1924. The north drift on this level is being extended with the objective of further exploring the Old Eureka ground.

Mystery of Lost Minnie Moore Vein Seems Solved

SUCCESS apparently has rewarded the efforts of the Primos Chemical Co., of Philadelphia, in its search for the faulted segment of the famous Minnie Moore vein near Bellevue, Idaho. The company has been trying for a year to find the vein beyond the fault after the Federal Mining Co., which had the Minnie Moore under option, had given up the search. It is estimated that about $500,000 has been spent in the last twenty years in exploration. On Feb. 7, 5 ft. of ore estimated to run 10 per cent lead and 20 oz. silver per ton was encountered on the 900 level near the point where Oscar Hershey, the geologist in the employ of the company, estimated the faulted portion of the vein would be found.

The Minnie Moore mine has yielded $10,000,000 to early operators, but was shut down about twenty years ago when the vein was lost.

Mohawk Nears Capacity Output With 1,600,000 Lb. Monthly

In the Michigan copper country, the Mohawk shafts of the Mohawk Mining Co. are well manned and close to capacity production. Rock hoisted averages about 2,300 tons daily, while 600 to 800 tons daily are coming from the Wolverine shafts. Splendid ground continues to be opened in Nos. 4 and 6 shafts, Mohawk, particularly in No. 6. No. 1, to the north, which is in leaner territory, is showing improvement. Rock yielding 22 to 23 lb. per ton is coming from Nos. 4 and 6, and No. 1 rock runs from 18 to 21 lb. Mohawk production will show an increase when all four heads in the stamp mill are equipped with regrinding units in the spring. From 1½ to 2 lb. of copper per ton of tailings will be saved through regrinding. The one unit in operation is working efficiently. Present production is estimated at approximately 1,600,000 lb. of copper per month. The Wolverine shafts are nearing the end of their career, both being bottomed at the thirteenth level, working upward in old stopes and pillars.

Dome Bullion Output $351,301 for Month of January

In January, the Dome Mines Co., operating at Porcupine, Ont., treated 45,000 tons of ore and produced bullion to the value of $351,301, as compared with $361,504 in December. The average recovery was $7.81, against $8.32 in the previous month, but the tonnage treated constituted a new record for the mine. The lower grade is accounted for by the large amount of ore from development work going to the mill. It is understood that the new orebody in the Keewatin is showing up better than was anticipated.

Bigger than it looks!

New crushing and screening plant of the Oliver Iron Mining Co. at Virginia, Minn. The trestle is 90 ft. above the foundations.

Crushing and Screening Plant at Virginia, Minn., Cuts Costs

Serves to Separate Waste Taconite and to Obviate Block-holing—Changes in Slope of Bins Necessary

One of the largest construction projects completed on the Mesabi range, in Minnesota, recently, is the crushing and screening plant of the Oliver Iron Mining Co. at Virginia. Because of the peculiar ore formation where large chunks of taconite are found embedded with the ore, this plant is needed to make the separation more economically. Previously, this work was done at the steam shovel, but it is a slow process and greatly reduced the loading capacity of the shovel. With the new plant in operation the shovel can load both ore and waste at full capacity into 30-yd. dump cars; these are then hauled to the new plant, where separation can be made with no time lost. The other use for this plant is to crush hard ore found in certain places in the pit, which, when blasted, breaks in large chunks. These are handled by the huge crushers instead of being reduced in size in the pit by re-blasting.

The crude material comes to the plant from the pit over an earth fill 4,000 ft. long containing 1,200,000 yd. of material. A 400-ft. steel viaduct connects this fill with the building, which is 87x109 ft. on ground plan, and the dump cars enter the plant 90 ft. above the foundations.

Directly beneath the entering track is a receiving pocket large enough for a train of crude ore. In the bottom of the bin are two 8-ft. pan conveyors built by the Allis-Chalmers Manufacturing Co., which draw the material from the bin to a manganese steel bar grizzly that allows the fine material to drop through into bins below while the large chunks are passed on to a second pan conveyor which elevates them to the crushers if they are ore, or passes them on to the waste rock pocket through a movable chute if they are taconite. The first pan conveyor is belt-driven by a 35-hp. 440-volt General Electric motor; a 10-hp. motor drives the second.

The crushing equipment consists of two 48x60-in. Blake type jaw crushers built by the Allis-Chalmers company, each driven through a 36-in. belt by 200-hp. 2,200-volt motors. These crushers are mounted on concrete piers 40 ft. above the building foundations, each pier containing about 400 cu.yd. of concrete. Above these crushers is a thirty-ton Whiting electric traveling crane to make quick repairs. A duplicate crane runs above the entering track. The large receiving bins underneath the crushers are equipped with quick-opening clamshall type gates, controlled by compressed-air cylinders. In fact, all movable chutes and gates are controlled by compressed air.

In one end of a building on the ground floor is located a 500-cu.ft. Chicago Pneumatic Simplate valve air compressor driven by 100-hp. motor, with automatic starting and stopping equipment that keeps pressure between 95 and 110 lb. At the other end is a 300-kva. 600-volt Westinghouse synchronous converter that operates the twenty-ton General Electric locomotive used for disposing of the rock in 20- and 30-yd. dump cars.

The mill during 1924 treated 200,000 tons of crude material. This test proved that the receiving bin needed sloping sides for directing material to pan conveyors, and these sides are now being put in. A. A. Krogdahl is superintendent of the plant, which takes material from both the Missabe Mountain and Minnewas mines.

Anaconda Breaks Record at Great Falls Zinc Refinery

During January the Anaconda Copper Mining Co. produced 15,700,000 lb. of electrolytic cathodes at its zinc plant at Great Falls. This exceeds by 200,000 lb. the highest previous record, made in May, 1924. Gradual improvement in the work of the zinc plant is being made, and as a consequence a higher percentage recovery is effected.

Most of Anaconda's zinc comes at present from ore mined and concentrated at mines owned by other companies, so that Anaconda is, as it were, mainly a custom leacher and refiner of zinc concentrates. But in the western part of the Butte district, Anaconda is opening up important bodies of high-grade zinc-silver ores.

Washington News

By Paul Wooton

Special Correspondent

Moroccan Phosphate Has Little Bad Effect on U. S. Industry

Big Increase in Production—Germans May Buy Phosphate To Sell Potash

In producing 436,000 tons of phosphate in 1924 the French in Morocco exceeded their own estimates by nearly 10 per cent. The 1923 production was 190,632 tons; that of 1922, 80,549 tons, and of 1921, 8,232 tons. Production this year is expected to exceed that of 1924 by 150,000 tons.

The great increase in Moroccan production seems to have had no important effect on the foreign markets where most of the American phosphates are sold. German purchases of American phosphate are increasing, as are those of Japan—the best two customers of the United States. Germany seems to have taken little of the Moroccan product, and none has gone to Japan. Apparently, most of the Moroccan output is going to near-by countries. France is responding generously to the propaganda to promote the use of its own fertilizer material. Intensive sales efforts are being put forth in other countries, to good effect in Spain, Belgium, Italy and other near-by territories, but with indifferent success in those far away.

Apparently, the American producers are going to be able to retain most of the Far East market. The Moroccans have a considerable geographical advantage with respect to the German market, but the Germans are more inclined, as long as prices are comparable, to buy their phosphate from their best potash customer. There was talk last fall of an agreement between Germany and France which in effect would reserve the German market for Moroccan phosphate. In the meantime, however, it has been revealed that Germany has had no thought of such an arrangement, and is more inclined to enter into plans calculated to increase its potash sales in the United States. Her inclination is much more toward saying to the United States "you take my potash and I will take your phosphates" than it is toward addressing such a proposal to France.

Silver Purchase Bill May Die

Congress continues to receive memorials from the legislatures of Western states and from associations and civic bodies urging the passage of the bill providing for the purchase of 14,437,000 fine ounces of silver at the Pittman price. The bill has passed the Senate and is now waiting action on the House calendar. Representative McFadden, the chairman of the Committee on Banking and Currency, and many Western members are using their every influence to secure the consideration of this legislation. Owing to the congestion incident to the lateness of the session, a special rule will be required.

Federal M. & S., Like Others, Finds Scarcity of Mines

COMMENTING on the life of the Federal Mining & Smelting's various properties, F. H. Brownell, president, declared that within two years production of mines now owned in the Tri-State field would be greatly reduced and all these mines probably would be exhausted in five years. "The company's future will then be dependent on new properties, if any, which it may in the meantime be able to acquire, and on the Morning mine." This is the Coeur d'Alene, Idaho, property of the company. His company, Mr. Brownell said, has been unable to find new profitable mines, although they have been sought vigorously in Idaho, Montana, British Columbia and elsewhere. It intends to prospect 12,000 acres of wildcat ground in the Oklahoma-Missouri field, which it will churn drill. Mines in the Tri-State field, which cost $1,299,844, have already paid the company a profit of $1,554,068.

Commission Didn't Divulge Confidential Copper-Mine Data

Mining Operators Not Unit in Backing Continuation of Gold-Silver Inquiry

Division of interest and opinion within the mining industry may encompass the defeat of Senator Oddie's resolution providing for the continuance during the next Congress of the Senate Commission of Gold and Silver Inquiry.

Some interests, Senator Oddie declares, whose chief concern is with minerals other than gold and silver, are highly indifferent if not in direct opposition to his proposal. He resents strongly the attitude of Senator Smoot. Senator Smoot comes from a mining state, he points out, and is thoroughly conversant with the industry. For that reason Senator Oddie feels that he should appreciate what the commission has done for the producers of gold and silver.

A deliberate effort has been made, Senator Oddie believes, to injure the commission by the circulation of reports that confidential information with regard to the business of copper producers has been turned over to the Bureau of Internal Revenue. Senator Oddie denies vehemently that any confidential material has been made available to any person or to any government agency. Certain persons, Senator Oddie declares, learned that the commission had delivered to the Bureau of Internal Revenue photostatic copies of some of its statistics. From this they jumped to the conclusion that confidential information was being divulged. As a matter of fact the photostats were tables of interest rates which had been compiled with the aid of the Bureau of Internal Revenue. As the statisticians of the bureau, as well as those of the commission, had use for these tables, they were furnished copies.

Toronto Letter

By Our Special Correspondent for Northern Ontario

Crown Reserve Plans 250-Ton Mill at Larder Lake

Has $1,000,000 in $7 Ore—Lake Shore Installs Larger Hoist—Noranda Development Cost $300,000

Toronto, Feb. 14—The annual report of the Crown Reserve company, to be issued soon, deals almost entirely with the company's property in Larder Lake, Ontario. Development during the last year has been more to open orebodies previously indicated than for the purpose of discovering new ore, so that no material increase is shown in the ore reserves. At the first of the year these stood at 160,000 tons of $6.82 ore, but deducting the ore above the 175 level, which averages only $5.54, the remainder averages $7 a ton, with a gross value of $1,000,000.

Since the report was prepared a new discovery has been made on the 425 level, in which the small amount of work done to date indicates values better than the average shown above. The most important development work during the year was the sinking of a winze 300 ft. below the 550 level. This winze shows about $7 ore all the way down, and when the two proposed levels are opened up from it, ore reserves should show a substantial increase.

Construction of a 250-ton mill in the spring is under consideration. The financial statement shows current assets of $54,300 and current liabilities of $15,200. The company has, however, underwritten a large amount of treasury stock to a brokerage house, which is supplying the funds as needed.

In December the Lake Shore mine, of Kirkland Lake, treated 9,554 tons and recovered $175,038, an average of $18.34 a ton. A new and much larger hoist is being installed.

Officials of the Noranda Mines, which owns the Horne property, in Rouyn, Quebec, state that approximately $300,000 has been spent on this property. This expenditure has resulted in the discovery of six orebodies in an area 1,400 by 1,700 ft., and high-grade ore has been proved to a depth of 455 ft., by diamond drilling. Two shafts have been sunk. At No. 1, now to the 110 level, 82 ft. of drifting shows an average of $9.60 in gold and 15.7 per cent copper, over the width of the drift, although the orebody is much wider than this. No. 2 shaft, which is 1,000 ft. north of No. 1, is down 80 ft. and will be connected with No. 1 on the 110 level. A total of 14,000 ft. of diamond drilling has been done to date.

It is reported that on the Amulet Gold Mines, about 4 miles north of the Horne property, test pits sunk across the deposit found some time ago have shown a width of 85 ft. with copper-bearing material running up to 16 per cent. The gold content is much lower than on the Horne. The company is controlled by interests in Montreal and is understood to be negotiating for a substantial amount of new capital to carry on development work.

Johannesburg Letter

By John Watson
Special Correspondent

No Breach of Regulations in Accident That Killed Thirty-One

Falcon Mines, Ltd., Asks Subsidy—Cultivating Mine Timbers Big Industry

Johannesburg, Jan. 6—A government inquiry was conducted on Dec. 29 at the South Vertical Shaft office of the Randfontein Estates by the Krugersdorp additional magistrate, and also the chief and district inspectors of machinery. The accidental snapping of the winding cable had caused the death of one European trammer and thirty natives. At the conclusion of the evidence, the magistrate said the court was quite satisfied, and their finding, which was signed by all the members, was: "The deceased persons met their death due to the cage rope breaking. The evidence does not clearly show what was the cause of the rope breaking, beyond it being evident that it was being subjected to some abnormal load. There was no breach of the regulations or negligence on the part of any of the persons concerned."

The union production of minerals for November was:

	Quantity	Value
Gold, oz.	811,261	£3,446,020
Silver, oz.	112,842	16,928
Osmiridium, oz.	1,030	26,429
Diamonds, carets	194,650	672,764
Copper, tons	390	21,414
Tin, tons	101	16,183

The government has decided to send an expert to the Batavia gold fields, in the Rustenburg area, early this year, to thoroughly investigate the areas which are supposed to contain gold, and report to the government.

News comes from Umirima, Southern Rhodesia, that the management of the Falcon mine has applied to the government for assistance to enable the mine to carry on. Gold and copper ore have been extracted from this mine, for some years; but now its lease of life is doubtful.

The Rand mines group use about 3,500,000 mining poles per annum, of sizes varying from 3- to 12-in. diameter. A correspondent of *The Star* recently visited the nursery and plantations on the Crown Mines property. This year the nursery has 250,000 seedlings. The varieties of eucalyptus favored are Viminalis and Martinii. At present, the Rand Mines, Ltd., has more than 4,000 acres under trees.

The Steelpoovt Valley, Lydenburg, is the scene of the latest platinum finds. Geologists who have visited the district describe the platinum as being found in two zones in norite (gabbro). Outcrops of chrome ore occur in the same district. Much denudation has gone on, and the valley contains alluvial areas similar to those in the Ural Mountains of Russia. Extensive prospecting has recently been done in the neighborhood of the chrome outcrops, for about 70 miles, on a line running, roughly, north and south. No such high values have been found here as in the Waterberg platinum area; however, values ranging from 2 dwt. to 1 oz. per ton over an average width of 4 ft. have been reported, with fair consistency for a length of 4 miles.

London Letter

By W. A. Doman
Special Correspondent

"Irregular Distribution of Gold" Suggested in Bingo Fiasco

Maylay Speculators May Have Tin—Hope to Extend Rand—New Mining Finance Corporation

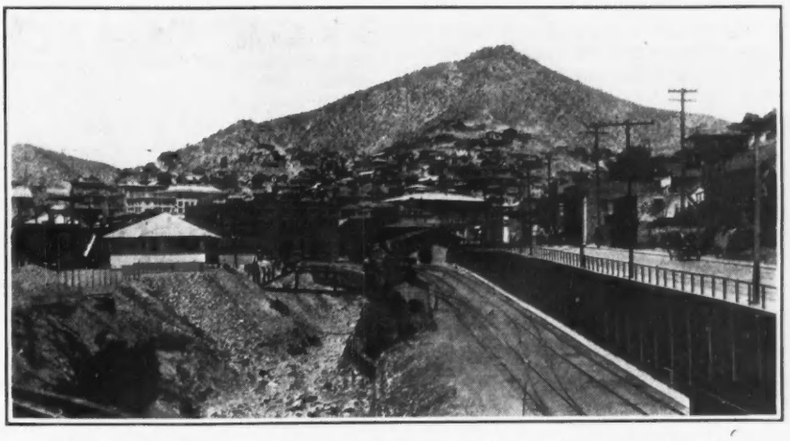
London, Feb. 3—In previous letters I have mentioned the Bingo Gold mines, which two years or so ago floated an issue of preference shares on the London market. Owing to very glowing accounts of the richness of the ore, the price was run up to 25s. A meeting of shareholders was held last week, and the board gave an explanation of the falling away in the shares until they were of merely nominal value. It appears that about 1,000 samples originally were taken, largely by officials of the company, and much was made of the statement that the ore values were consistently good, not to say high. As a result of a re-sampling by the Dorr Company, and an examination by Mr. Dresser, past president of the Canadian Mining Institute, values were found to be unpayable, and it was suggested that the result might be due to the irregular distribution of the gold—quite the reverse from what was previously stated. The directors suggested that the shareholders appoint two persons to assist them in solving the mystery, but the shareholders, like the sheep they usually are, left the matter in the hands of the board. A day or so afterward a sensation was created by the arrest of Joseph Myers, the managing director, and one of the persons interested in the promotion of the company. There, perhaps, the matter had better be left for the moment. If the affair is not a case against mining in Canada, it certainly is against mining methods. All sorts of stories are in circulation, but the case is now *sub judice*, and the tale can be told on a future occasion.

The South American Copper Co. has yielded some capital stuff in the past, but there would appear to have been a desire somewhere for a change in the management, and it is now stated that a well-known engineer at present engaged in South Africa has been appointed general manager.

A report from Rangoon dealing with the tin position in the East suggests that though all the tin acquired under the Bandoeng agreement has been disposed of by the government, some stock may still be held by market dealers. The idea is that as consumption is exceeding production, the price of the metal is bound to rise, and that the present holders expect to realize £300 per ton. An even higher figure is predicted.

For years R. E. Bleloch has put forward the view that the Main Reef series would be found to extend into the Boksburg gap, and also into the Nigel-Heidelberg district. He has been a voice crying alone, mainly because the finance houses of the Rand did not find it profitable to take up claims there, beyond what were being worked already. In the Boksburg district those who have sunk their money have had little or no return for it, though rather better fortune has attended operations in the Heidelberg area. Now it is stated that the commission appointed by the Union Government to study the question has reported in favor of Mr. Bleloch's views.

Although on a modest scale, a new mining finance company has been formed. The moving spirit is James Fairbairn, who, after examining the position of the Barrier & General Trust, dealing mainly with Broken Hill Proprietary (New South Wales), has reorganized the whole undertaking. He has engaged one or two mining engineers to assist him, the principal member of his staff being Frank B. Powell. A mining finance company, though established on a modest basis only, can—with proper technical administration or advice—build up a satisfactory business, and Mr. Fairbairn's experiment will be watched with great interest.



Bisbee, Ariz., as seen from the approaching railroad tracks, the headquarters of Phelps Dodge mining operations

Men You Should Know About

O. H. Fairchild, of Chicago, is in Arkansas City, Kan., engaged in professional work for the Universal Oil Products Co.

A. C. Young, recently attached to the Canadian Bureau of Statistics, has been appointed statistician of the Ontario Department of Mines.

Cyril W. Knight, former associate Provincial Geologist of Ontario, has been awarded the Bigsby medal by the London Geological Society.

Charles T. Swartz, manager of mines for the St. Louis Smelting & Refining Co., is in Salt Lake City, Utah, inspecting the new mill of the National Lead Co.

Charles Henry White, of San Francisc, who has been in Miami, Ariz., on professional business, returned to his headquarters in San Francisco on Feb. 15.

T. F. Lennan, of Joplin, Mo., manager of the Quapaw Mining Co., has gone to New York to confer with **Charles Schwab, Benjamin Lissberger,** and others.

Dr. Roy R. Morse, who has just completed a term of four years as professor of geology in the University of California, has joined the geological forces of the Shell Company of California.

James W. Neill, mining engineer of San Francisco, is now in Japan, examining mines for the Great Matsukatas. He is expected back in the United States some time in February.

W. Lee Heidenreich left New York on Feb. 11 for Colombia, South America, where he expects to be engaged until about April 15 in the Department of Antioquia. Mrs. Heidenreich accompanied him.

Charles Bocking, of the Butte-Superior Copper Co., has been appointed general manager for the Granby Consolidated Mining, Smelting & Power Co. He is expected at Anyox on March 1.

A. M. McQueen, vice-president of the Imperial Oil Co. has returned from a visit to the company's Royalite No. 4 well in the Turner Valley field of Alberta, where 300 barrels of oil per day is being obtained from the flow of wet gas.

R. S. Baverstock, of Los Angeles, has recently been in Prescott, Ariz., Hachita, N. M., and Nogales, Ariz., on professional business. He reports considerable scouting around Sonora, Mexico, and activity at Nogales and Patagonia, in Arizona.

Thomas W. Gibson, Deputy Minister of Mines for Ontario, has been in ill health for some time. He recently underwent an operation and is progressing favorably. **W. R. Rogers** is acting as Deputy Minister until Mr. Gibson is able to resume his duties.

Edwin S. Tomkins, mining and metallurgical engineer of New York, has opened offices at 90 West St., New York City. He will represent exclusively the Hatfield-Penfield Steel Co., Denver Fire Clay Co., Stearns-Roger Manufacturing Co., and Deister Machine Co.

George A. Parks, mining engineer, has been nominated to be Governor of Alaska. His nomination was on Feb. 14 sent to the Senate by President Coolidge for confirmation. He will succeed Scott C. Bone, who is not an applicant for reappointment and whose term expires on June 15 of this year. The new appointee has been a resident of Alaska for sixteen years and is the best-informed man on Alaskan conditions ever named for that office. He has been in the Alaskan field service of the General Land Office of the Interior Department since 1907, his duties taking him to every part of it in both winter and summer. He began as a government practical miner in Alaska at a salary of $1,320 and has worked his way up to the position of Assistant Supervisor of Surveys and Public Lands. Parks was graduated from the Colorado School of Mines in 1906 and went to Alaska as a mining engineer for several private mining companies, later being appointed practical miner of the General Land Office in 1909. He then became mineral examiner for the Interior Department, his duties consisting of the examination of homestead and mineral claims. In 1918 he resigned from the government service to enter the engineering corps of the Army during the World War. He was commissioned a first lieutenant and promoted to the rank of captain. At the end of the war in 1919 he re-entered the Alaskan service of the Interior Department, being advanced to the position of Chief of the Field Division of Alaska, having charge of public lands in the territory. He was made superintendent of townsite sales for the Alaska Railroad and had supervision of the disposition of all the townsites along the railroad. He also acted as trustee in the sale of many other government townsites in Alaska. In 1924 he was advanced to the post of Assistant Supervisor of Surveys and Public Lands in Alaska, which placed under his control the entire administration of public lands in the territory, including their survey and disposition under the various homesteading and mineral acts of Congress. His selection by the President to be Governor of Alaska is in recognition of his long and faithful public service in that territory. He is the first Alaskan citizen ever nominated to be its Governor. Parks will not assume office until the expiration of Governor Bone's term on June 15.

George A. Parks

W. A. Clark, president of the United Verde Copper Co.; **Robert E. Tally,** general manager, and **Tom Taylor,** smelter manager, are making an inspection tour of the northern part of Arizona in the vicinity of the big copper mines, in order to secure first-hand knowledge of the copper-mining industry in the state.

C. W. Barron, publisher of the *Wall Street Journal* and *Barron's Financial Weekly* and founder of the *Philadelphia Weekly* and the *Boston News Bureau,* was a recent visitor to Arizona, being the guest of **William Boyce Thompson** at Superior, Ariz. During Mr. Barron's visit, he was the guest of honor at a dinner of sixty prominent business men in Phoenix.

John Penberthy, formerly with the Shannon Copper Co. and the Moctezuma Copper Co., has been appointed by the State Tax Commission of Arizona to act as an appraiser to investigate technical problems that have arisen in the suit of the United Verde Extension Mining Co. in protest against the valuation placed on its property by the State Tax Commission. The Board of Supervisors of Yavapai County has appointed **Charles H. Dunning,** consulting mining engineer of Prescott, Ariz., as a representative of that board in appraisement work incident to the issue.

Obituary

Arthur J. Shores, of New York, general counsel for the Anaconda Copper Mining Co., died in Washington, D. C., on Jan. 30. He was seventy-one years old.

Dr. William F. Hillebrand, Director of the Bureau of Standards, died on Feb. 7, following a short illness. He was seventy-one years old. Dr. Hillebrand was born in Honolulu. His boyhood was spent in the Sandwich Islands and in California, with visits to China, Java, and India, and the last two years of his teens were passed in Ithaca as a student at Cornell University. Following his sophomore year at Cornell, Dr. Hillebrand began his studies in Germany, at first under Bunsen. In 1875, with T. H. Norton, he was the first to prepare metallic cerium, lanthanum, and what was then called "didymium." After leaving Heidelberg, Dr. Hillebrand studied for a time under Fittigrat, at Strassburg. For awhile he worked as an assayer at Leadville during its roaring days, then followed a period of five years, 1880 to 1885, at Denver with the U. S. Geological Survey, after which he was transferred to Washington. He remained with the Geological Survey until 1908, when he was made chief chemist of the Bureau of Standards, remaining there until his death.

A. I. M. E. Members Meet in New York

Staff Report

ONE of the most successful of the annual meetings of the American Institute of Mining and Metallurgical Engineers that in accordance with long established custom are held in New York each February came to an end on Thursday, the 19th, after lasting four days. Engineers and operators from all parts of the country, and some from abroad, were on hand to fraternize and exchange experiences, as well as to present and discuss the papers on the program of the various technical sessions. It was at the smoker held in the Café Savarin on Monday evening and at the annual banquet at the Waldorf Astoria on Wednesday that the size of the gathering was noted to best advantage. On these two occasions all who registered were present at the same time and place. More than 700 were seated at the banquet.

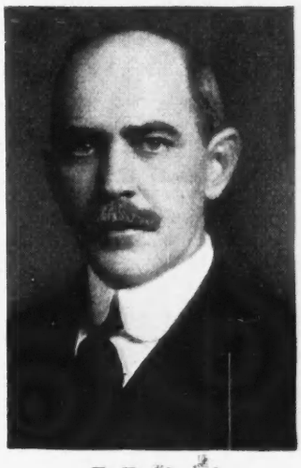
The Institute of Metals, now a division of the A.I.M.E., had a prominent part in the program, and its meetings were well attended. Other important sections of the program were devoted to coal and coke, iron and steel, petroleum, to the non-metallic minerals, and to mining, milling, and metallurgy. Several joint sessions with the National Safety Council were held, in one of which the Mining and Metallurgical Society of America participated.

A noteworthy event of the meeting was the unveiling of a life-size bronze tablet of Dr. Rossiter W. Raymond—a gift of some of the members. This ceremony was conducted by Colonel Arthur S. Dwight. The tablet, which is the work of a well-known New York sculptor, has been given a prominent place on the main floor of the Engineering Societies Building.

Official Reports Read

The annual business meeting, which under the Institute's by-laws must be held in New York, was called Tuesday morning. William Kelly, the retiring president, presided. Mr. Kelly said that the members were to be congratulated on having had *Mining and Metallurgy* come through the last two years with some profit. The magazine enabled the Institute to present to its members the information required by the constitution and by-laws, he said, and it also gave the members a thorough knowledge of Institute affairs. The Institute, with the other founder societies, said Mr. Kelly, had been invited to take part in an engineering convention in 1926, but had finally decided not to go into this undertaking, as it was doubtful whether the Institute could offer anything of a constructive character.

The Secretary, F. F. Sharpless, then presented his report, which had been distributed in printed form among the members present. He referred to the report of the membership committee saying that it was regrettable that the number of members had decreased by 310 in 1924 and by about 1,000 in the last three years, or approximately 10 per cent. This, he said, was due to economic conditions and a similar decrease had been experienced abroad in the Institute of Mining Engineers and the Institution of Mining and Metallurgy. There had been, however, he said, a decided change in the attitude of members in the latter part of the year as the prices of metals rose. A material increase in opportunities was evidenced by the Engineering Societies employment bureau, which in the last two years had placed about 2,000 members. Mr. Kelly pointed out that the income from dues had dropped only 5 per cent.



F. F. Sharpless
Secretary of the Institute

At this time suggestions and questions were invited from the members from the outside districts. C. H. Wegemann, of Denver, on behalf of the Colorado Section, invited the Institute to spend a day at Denver this fall while en route to Salt Lake City for its field meeting. This was applauded. The secretary replied that whether the Institute could stop at Denver or not would depend on the number of Denver members who were going on to Salt Lake. Invitations were presented from both the Philadelphia and Pittsburgh sections to hold the 1926 field meeting in their respective cities.

Charles F. Rand, treasurer of the A.I.M.E., reported the Institute to be in a strong financial position. The income of the year exceeded expenditures by a safe margin, but the surplus had been secured, he said, only by constant watchfulness.

In discussing the report of the Committee on Publications it was said that sometimes it was necessary to turn down valuable papers because of lack of space. About half of those received suffered this fate, though more because of the criticism of the groups to whom the papers were submitted than because of lack of space. Many papers were presented on subjects that were not new.

J. V. W. Reynders, first vice-president, was elected president. Of the eight directors, three retired—namely, B. B. Thayer, A. S. Dwight, and T. B. Stearns. Ralph H. Sweetser, John L. Agnew, and J. M. Callow were elected to fill their places. Sydney H. Ball, George D. Barron, W. H. Bassett, Charles F. Rand, and Mr. Reynders were re-elected.

At the meeting of the directors held later, the first vice-president was chosen in the person of E. L. DeGolyer.

Non-Metallic Mineral Session Opens Program

About forty members attended the non-metallic mineral session held on Monday morning in Room 903, under the chairmanship of Heinrich Ries, assisted by Dr. Oliver Bowles. The papers had all been printed as separates for distribution before the meeting and so were presented only in abstract form. The first, by J. R. Thoenen, of Greenville, Ohio, discussed "Limestone Production as a Mining Problem." The similarity of methods and equipment in the mining of limestone and metallic ores was brought out, and the advisability of employing experienced mining engineers emphasized.

An abstract of the paper "Engineering in Limestone Production," by C. C. Griggs, was read by Dr. Bowles, who also presented written discussion by W. C. Phalen. John Rice, president of the Crushed Stone Co., elaborated on Mr. Griggs' paper, mentioning railroad ballast as a leading byproduct of his company. He also spoke of motor trucks as being an important means of distribution, one quarry alone in which he was interested shipping as much as 600 tons a day to market by this method. Points as far as 30 miles away were reached by the motor trucks, though most of the deliveries were within 15 miles. N. C. Rockwood, editor of *Rock Products*, pointed out the lack of reliable data on screening in the stone business; he also made facetious comments on the six places of decimals used by Mr. Griggs in arriving at the valuation of a limestone property. Dr. Bowles spoke of the facility with which the extent and quality of limestone orebodies could usually be ascertained, but comment was made that the life of the market was often more important than the extent of limestone supply.

An abstract of a paper by John J. Porter on "Manufacturing Problems of Cement Industry" was read by Dr. Bowles. Brief mention is made in this paper of the effect of variation in chemical composition and in the degree of burning. There was no discussion.

Dr. Frank A. Wilder presented his paper on "Rotary Calciners for Gypsum" in person, elaborating some of the points with the aid of the blackboard. At present, rotary furnaces are practically confined to use in one district, in western New York, though they have been very successful there. In the discussion, it was pointed out that sizing, time, and temperature were the

Prominent Officers of the A.I.M.E.

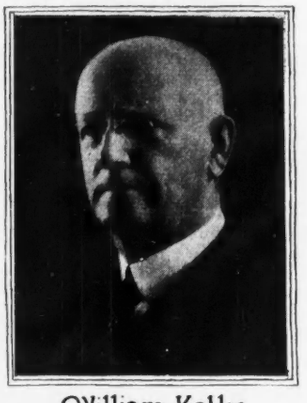
Walter H. Aldridge

Charles F. Rand

E. L. De Golyer

Arthur S. Dwight

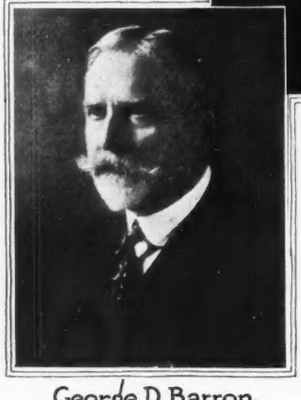
J. V. W. Reynders
The New President of the Institute



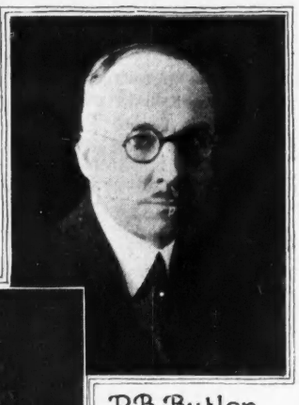
William Kelly

Frank M. Smith

E. P. Mathewson



George D. Barron



P. B. Butler

three most important factors in rotary calcining. Following the presentation of Mr. Wilder's paper, a series of excellent slides were thrown on the screen, showing scenes in a representative limestone plant.

The last paper was the most complete of any, covering the "Phosphate Deposits of Idaho and Their Relation to the World Supply." The author, Virgil R. D. Kirkham, was not present, but the paper was read in abstract. The various phosphate deposits of the world are given in a classified list, in Mr. Kirkham's paper, covering the country, method of occurrence, geologic age, methods of mining, production, and reserves, a similar table being presented for the various deposits in the United States.

Mining Methods in the United States and Abroad Discussed

Under the able chairmanship of Prof. R. M. Raymond, the Mining Session, held on Tuesday morning, proved one the most interesting of the entire meeting. In the absence of several of the authors of various papers presented at this gathering Professor Raymond contributed from his rich store of mining knowledge to the mining problems presented by each paper. He opened the meeting by going over an excellent paper by A. J. M. Ross and R. G. Wayland describing the mining methods of the Homestake mine, in South Dakota, the greatest gold mine in the United States. Professor Raymond indicated the gradual evolution of the mining system used by the Homestake during its many years of operation and illustrated his talk with lantern slides.

He then discussed an entirely different type of mining—the narrow veins of the Cornucopia district in Oregon—and asked F. E. Wormser to read the interesting paper which Robert M. Betts had written on the subject. Mr. Wormser pointed out the simplicity of Cornucopia mining methods and supplied a few details about the manner of working.

Rudolph Emmel next read a paper on the mining methods of the Zaruma district, in Ecuador, where a most important factor was the inefficiency of the labor, or, as Mr. Emmel remarked, the surprisingly little work that a native miner could do in a day. This prompted Fred Hellman to make a defense of the South American miner, especially the Chilean, with whom Mr. Hellman has had much to do. He stated that the Chilean miner has done good work in Chile and at low costs. According to Mr. Hellman, it would be difficult indeed to better the mining costs of Chilean miners. Mr. Hellman also made a comparison of Chilean with Kafir labor and estimated that the Chilean was at least 50 per cent more efficient. The Kafir was willing to be taught, however, which was a point in his favor.

"Mining Methods of the Jarbidge District, Nevada," a paper by John Park, was presented by George Packard, who pointed out the close agreement between the tons per man per hour at Jarbidge, Cornucopia, and Cripple Creek, which seemed to indicate that here was a level useful to engineers in the estimation of labor productivity—a standard.

Arthur Notman, in contributing to the discussion as to the relative outputs of various classes of labor, gave the following information which he had recently acquired from his own investigations. In the Katanga district of Africa the copper output per man per day was 35 lb.; in Chile the copper output per man per day was 115 lb.; and in the porphyry mines of the United States the range was from 150 to 190 lb. per man per day, despite the lower tenor of the ores in South America and the United States. Mr. Hellman called attention to the difference in the labor of the Congo and the Rand. The Central African tribes were weaker physically than those farther south and did not make such good workmen.

Professor Raymond then reviewed a paper by R. T. Mishler and L. R. Budrow entitled the "Methods of Mining and Ore Estimation at the Lucky Tiger Mine, Sonora, Mexico." B. Tillson discussed the sampling features of the paper and gave a formula which he maintained was better than the prismoidal formula in estimating tonnages. Mr. Hellman said that no prismoidal formula is needed in ore calculations and that he didn't know where to apply it. Mr. Tillson said that its use was necessary to influence lawyers who might attempt to pick flaws in an engineer's report of a mine.

Doherty Talks on Conserving Oil

Easily the most interesting paper offered at the sessions of the Petroleum Section was that entitled "Suggestions for Conservation of Petroleum by Control of Production" delivered by Henry L. Doherty. Declaring that the nation's petroleum resource is being dissipated at an alarming rate, Mr. Doherty proposed a plan for the production of petroleum which, he said, had already been explained to the board of directors of the American Petroleum Institute and some of their committees but which had never before been explained in public. This, the so-called "Doherty plan" had been vigorously attacked.

The law of capture applied to petroleum led to many evils, said Mr. Doherty. If a wildcat well struck oil, a frenzied scramble resulted in the rush to get the oil first. Gas was wasted, the energy value of which was more than the energy value of the oil recovered. Provision must be made, he said, for the unit operation of pools. "Instead of paying the land owner his royalties according to the amount of oil captured on his land, we must pay all of them according to the amount of oil which underlaid their land when the oil and gas existed as an undisturbed pool." Mr. Doherty recommended, first, that no land be drilled for oil until opened up by a government permit. Second, that all land within drainage distance of existing production be opened for drilling, thus enabling existing pools to be driven to their boundaries and without opening up other and distinct pools. Third, that permission to drill land not subject to drainage be granted only when an oil exploration district has been formed.

The Federal Government has power to legislate on this matter and should do so, in Mr. Doherty's opinion.

The subject was then thrown open for discussion. Creation of an Institute committee which should take the Doherty plan as a starting point and work to see if it could be of any aid to the President's petroleum conservation commission was proposed. This motion was voted down, however, it being felt that there was enough machinery in motion today to make such an appointment unnecessary.

The New President of the A.I.M.E.

John Van Wicheren Reynders, steel maker, who has just been elected president of the A.I.M.E. after serving as its first vice-president during the last year, was born in Hoboken, N. J., in 1866. He was graduated as a civil engineer from Rensselaer Polytechnic Institute in 1886 and in the same year entered upon the manufacture of steel at Pittsburgh. From 1892 to 1906 he was the managing head of the Pennsylvania Steel Co., and for many years was actively engaged in bridge-building enterprises for this company. In the course of this work he built the steel railway arch across the Niagara River; the Gokteik Viaduct, 2,000 ft. long and 320 ft. high, in Burma; the Queensboro Bridge, in New York; and the Memphis Bridge, across the Mississippi. Recently Mr. Reynders undertook the construction of the Bear Mountain - Hudson River Bridge and its approach highways, as representative of the various interests involved. This bridge is of the suspension type, the main span being 1,632 ft. long, which, with the exception of the Delaware River Bridge, now under construction, is the longest span in existence. The project has involved the most difficult rock excavation, and the work has been conducted with remarkable speed.

Mr. Reynders rebuilt the steel making facilities of the Pennsylvania Steel Co. and managed it as vice-president from 1906 to 1916. He was receiver for the Central Iron & Steel Co., Harrisburg, Pa., from 1912 to 1917; president of the American Tube & Stamping Co., Bridgeport, Conn., 1917 to 1919, and is now a director and member of its executive committee. Today Mr. Reynders is professional adviser to many steel works and banking institutions.

In 1904, Mr. Reynders originated the "Harrisburg Plan" of civic improvement, resulting in the park system, water filtration, sewage systems, and paving. He was president of the Town Council of Steelton, Pa., 1906 to 1916, and completed many public improvements there. He is a member of many clubs and makes his home in New York City.

George Otis Smith, Director of the U. S. Geological Survey, who was present, was called upon to discuss the President's Petroleum Commission, on which he represents the Secretary of the Interior. He responded, saying that he had been asked what the board intended to prove. He said that it did not intend to prove anything, but rather wished to improve something—namely, the national situation as to an important resource, petroleum: it intended to study petroleum. As to the program back of it he could say only that there was an earnest desire to improve production conditions. The board was facing the situation in a spirit of scientific and technical investigation—not of investigation in the political sense.

A long program had been provided for the Petroleum Section. E. L. De Golyer presided over all the sessions. A résumé of the world production of petroleum in 1924 was presented by the chairman. Joseph E. Pogue, of New York, read a paper entitled "Bearing of Price Upon Oil Reserves," which was discussed at considerable length. The remaining papers consisted for the most part of résumés of conditions in the various states of the United States and in various foreign countries. A paper on Russia, by A. Beeby Thompson, of London, was especially recommended by the chairman. Many of these papers were presented only by title, owing to lack of time.

Milling Session Informative

Probably the outstanding paper at the meeting of the Milling Methods section was that of C. R. Davis, J. L. Willey, and S. E. T. Ewing on "Recent Developments in Fine Grinding and Treatment of Witwatersrand Ores." As Charles E. Locke, who presided at the meeting, remarked, a few additional nails were apparently driven into the coffins of stamp milling and of amalgamation of gold with mercury. The most important part of the paper, which was presented by Arthur F. Taggart, had to do with the plant at the Spring mines.

Essentially, the new procedure consists of feeding tube mills with crude ore crushed to pass about 1½ in., though containing much finer material. A heavy circulating load, passing in closed circuit through Dorr classifiers, produces in a single stage a pulp for direct slime cyanidation without amalgamation or sand leaching. Rejected pebbles are screened out and sent to the stamp mill for crushing. In a new plant they would probably be crushed and returned to the circuit. Change to a cyanide solution circuit from the water circuit for crushing is to be made as a logical consequence. A saving in working costs of at least 5d. per ton milled and a saving in residues of at least 10d. is claimed as compared with the former stamp mill, amalgamation, sand-leaching of 40 per cent of the ore, and slime treatment of 60 per cent. The capital cost of a 40,000-ton per month plant is figured at £6.17 per ton milled per month, as compared to £8.34 for a plant of the older type.

H. W. Hardinge commented on the dimensions of the mills and ventured the opinion that mills of greater diameter would prove more effective. H. N. Spicer said that reports recently received by him indicated that Dorr bowl classifiers were giving better results than those of the ordinary rake type. G. M. Brown put in a word for shorter tube mills.

A practicable method for determining the quantity of dissolved oxygen in cyanide solutions was described in detail in a paper by A. J. Weinig and Max W. Brown, who orginated the scheme at Golden, Colo. The method is quick, reliable, and fool-proof. A statement that surprised most of the audience was that the removal of oxygen by the Crowe vacuum process, according to determination made on mill solutions from a number of plants, averaged only about 50 per cent of the total content. A. L. Blomfield, of the Golden Cycle Reduction Works, at Colorado City, however, in written discussion of the paper, showed much better results at his plant. For example, the percentages of maximum oxygen saturation of untreated solution ranged from 47 to 63 per cent. After passing through the Crowe tanks these same solutions ranged from 8 to 16 per cent. Evidently, Mr. Blomfield knows how to use the Crowe tank better than others, or else he has to get better clearance to obtain satisfactory precipitation. The point of a paper by Robert Lepsoe was that users of zinc dust for cyanide precipitation should aim to get a material of such fineness that it approaches fume. The thickness of active surface is determined to be only 0.0005 mm., so that the reason for the conclusion is obvious.

A paper by John Gross and J. Walter Scott, read by S. C. Lind, gave an account of experiments in the use of charcoal for the precipitation of gold and silver from cyanide solutions. Under various special conditions charcoal may find useful application, but that it can displace zinc seems highly improbable.

An unusually informative discussion and one that it is hoped will lead to the collection of valuable data was that of the subcommittee on Mine Sampling and Estimating of the Mining Methods Committee. Henry Krumb, S. J. Jennings, Arthur Notman, W. R. Crane, Pope Yeatman, W. Spencer Hutchinson, and others contributed at length to the discussion.

Interesting Sessions Conflict

Unfortunately, the sessions on milling methods and non-ferrous metallurgy were both scheduled for the same time, Wednesday afternoon, several of the members being interested in both subjects. E. P. Mathewson was chairman of the metallurgical meeting. Charles H. Fulton presented a paper describing "A New Roasting Furnace for Zinc Flotation Concentrate," written by himself in collaboration with J. Burns Read. Brief discussion was participated in by Messrs. Dalbey, Witherell, Dwight, O'Harra, and Stock.

Kurt Stock then read a brief comment on his paper on the "Redistillation of Zinc." He commented on the lack of co-operation between competing zinc smelters, and even more so between zinc producers and consumers, which, he said, accounted for much of the backwardness of zinc metallurgy.

Fred E. Beasley's short paper on "High Zinc in Lead Blast-furnace Slags," which was read by E. P. Mathewson, aroused the most discussion of the afternoon, about a dozen of those present relating their views and experiences. E. W. Steel read an abstract of his paper on the "Application of Pulverized Coal to Copper Refinery Furnaces," summarizing the results of the practice at other plants besides Perth Amboy, with which the author is connected. The discussion brought out the improved economy of waste-heat recovery with this type of firing.

C. P. Linville wound up the afternoon by giving a résumé of his unpublished paper on the "Recovery of Arsenic and Other Valuable Constituents from Speiss." "Speiss," he said, "is a metallurgical condition rather than a metallurgical composition," and he drew up a new definition by which all iron might be displaced from the compound, and the arsenic be replaced by antimony. Several contributed to the discussion, describing their experiences with "the devil's own mixture" of arsenic, nickel, and cobalt.

Three papers were presented at a session devoted to a consideration of the topic of ground movement and subsidence, over which Louis S. Cates presided. One of these by Mr. Cates, who is vice-president and general manager of the Utah Copper Co., was entitled "Factors Affecting Bank Slopes in Steam Shovel Operation." Walter R. Crane, superintendent of the Southern Experiment Station of the U. S. Bureau of Mines, talked on "Mine Support and Mine Subsidence in the Birmingham District," illustrating his address with slides. The third paper was on "Rock Bursts and Bumps," by George S. Rice, chief mining engineer of the Bureau of Mines.

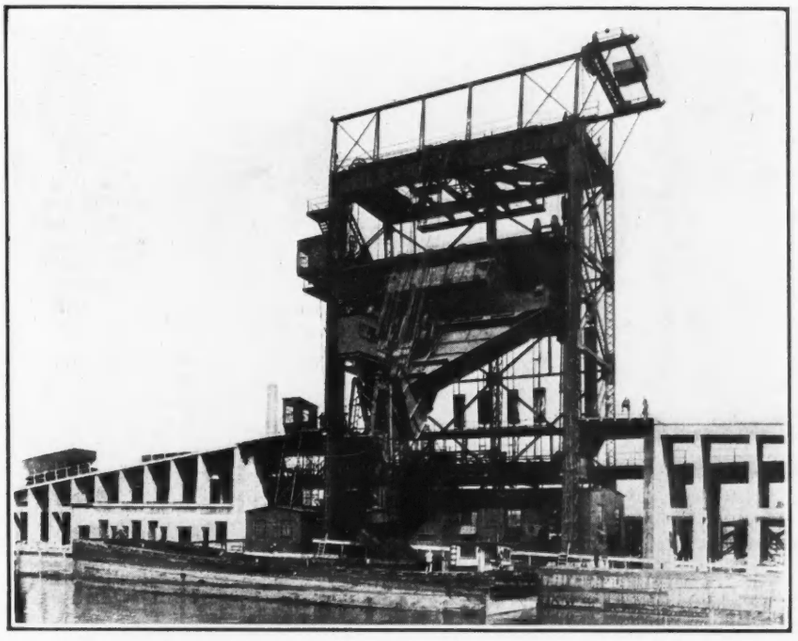
Presentation of the James Douglas medal to William H. Bassett, technical superintendent and metallurgist for the American Brass Co., in recognition of his accomplishment in the field of non-ferrous metallurgy, was the principal ceremony at the annual dinner at the Waldorf on Wednesday evening. The incoming president made the speech of presentation. W. L. Saunders, past president, served as toastmaster in his usual happy style, and the responses were well received by diners.

On Thursday, Feb. 19, about 200 members of the Institute and their friends traveled by special train to the Naval Air Station at Lakehurst, N. J., where the "Shenandoah" and "Los Angeles" are housed. The trip included a visit of inspection to the repurifying plant where the helium gas used in the dirigibles is treated. The members were entertained with the utmost cordiality, and returned home late in the afternoon.

The 131st meeting of the Institute wound up on Friday by a visit to the smelter and refinery of the Nichols Copper Co., at Laurel Hill, Long Island, N. Y., where a buffet luncheon was served. This plant was described in *Mining Journal-Press* of Feb. 14, 1925.

A particularly interesting program was arranged for visiting ladies by the Woman's Auxiliary with several features for each day of the meeting.

New Machinery and Inventions



The capacity of this car dumper is estimated at 4,000 tons per hour when handling 100-ton cars

This Dumper Handles 120-Ton Capacity Cars

The accompanying photograph shows a car dumper that was recently installed for the Philadelphia & Reading Ry. at its wharfs at Philadelphia, by the McMyler-Interstate Co., Cleveland, Ohio. The dumper is built to handle 120-ton capacity cars. At present, there are only a few cars of this capacity in service, but the tendency is toward heavier equipment. The dumper will handle forty such cars an hour. Thus, its capacity is 4,000 tons per hour, when handling 100-ton cars, or 4,800 tons per hour when handling 120-ton cars.

The extreme over-all height of the dumper is 125 ft. 5 in. to the top of rail. The distance from center to center of the front posts is 72 ft. The maximum lift is 32 ft. 1 in. Both electric and steam power are used in its operation.

Loaded cars are pushed onto the cradle by a barney or "mule." This mule has an arm which automatically drops when the loaded car is in position on the cradle. The mule then backs down to its orignal position ready for another car. It is operated by ropes connected to drums driven by a steam engine, located in the main engine house beneath the dumper.

When the loaded car reaches the cradle, it is clamped in place by four clamps, elevated, and rotated through 150 deg. The operation is then reversed and the empty car pushed off the cradle by the next on-coming loaded car. Empty cars run down from the cradle by gravity until they reach an incline which is sufficient to reverse their direction. They then pass through the car dumper, in order to save space, back to the car yard.

When a car is dumped, the coal falls onto a pan or apron, the height of which is adjustable. At the lower end of this pan is a telescopic chute, the position of which can be varied by the operator located in the house supported by the apron.

Coal may be distributed directly through this telescopic chute into the ship's hold, or it may be passed through a high-speed belt trimmer. The function of this belt trimmer is to store the coal in every part of the ship's hold without hand labor. By its use, coal can be thrown a distance of 50 ft.

The dumper is operated from a house situated at the side of the frame, 80 ft. above the foundation. One operator controls the cars coming onto the dumper, and another operator controls the hoisting and dumping mechanism as well as the mechanism for elevating and lowering the pan and chute. A third operator controls the operation of the telescopic chute and the trimmer. He can also raise and lower the pan.

Quick Change of Electrodes Possible in This Welder

A new type of welding electrode holder marketed by the General Electric Co. allows welding operators to make a quick change from burnt stub to new electrode. The operator needs only to strike the stub end of the old electrode, causing it to drop out, when the new wire can be inserted instantly without unnecessary effort.

The new holder consists of a punched fibre tube with a tinned brass plug inserted in the end. A steel spring rod holds the electrode in place against one of a number of different sized notches provided for the purpose. The welding cable running to the source of power is soldered to the other end of the holder by removing the fibre tube and fibre guard, accomplished by loosening a single screw.

The construction of this holder is such that the contact of the electrode is not weakened by heat, since it does not depend upon any heat-affected spring.

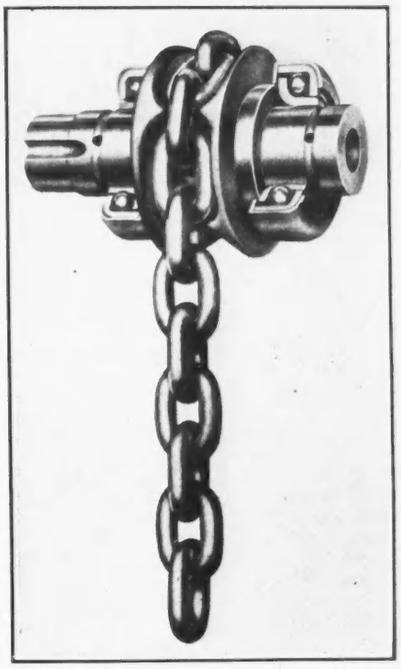
An Alloy for Use in Valves

E. G. Jarvis, vice-president and general manager of the Niagara Falls Smelting & Refining Corporation, Buffalo, N. Y., has been granted a patent on a new alloy that is said to be especially fit for use in valves and other parts subjected to the effects of overheated steam and high temperature and to the effects of concentrated or diluted hot and cold acids. This patent has been assigned to the Merco-Nordstrom Valve Co., producers of the Nordstrom plug valve, which is self-lubricating. The corporation is controlled by the inventor and Mr. Merrill, of the Merrill Co., of San Francisco.

Something New in Chain Blocks

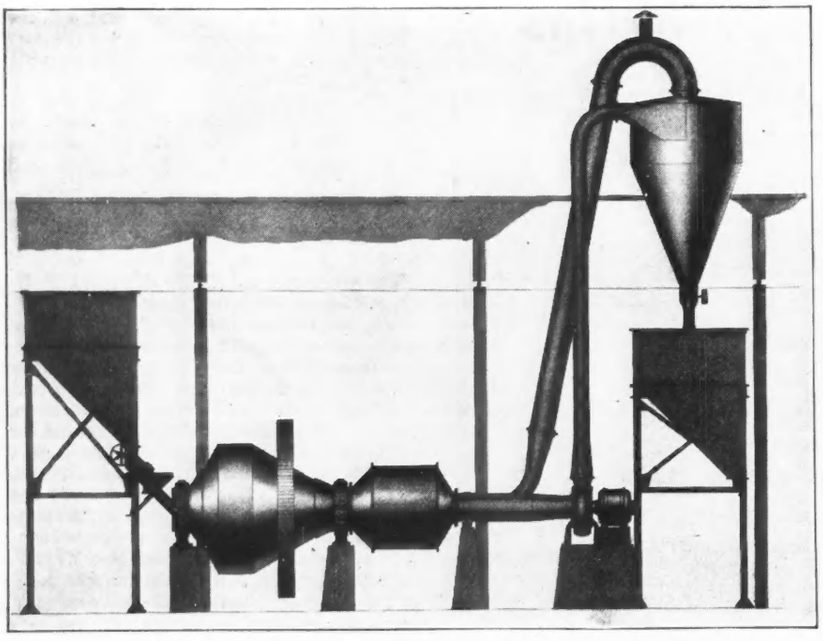
A new ball-bearing chain block is being put on the market by the Yale & Towne Manufacturing Co., of Stamford, Conn. The introduction of large-capacity ball bearings which support the load sheave is the latest important step in a long series of improvements in this block. These ball bearings are so situated that they carry or support the full load, and the manufacturers claim that this latest improvement reduces friction, adds to the life of the block, and greatly increases its efficiency.

It is claimed that the number of pounds of hand chain pull required to



The latest development in chain blocks consists of the introduction of large-size ball bearings to support the load sheave as shown.

This block's high mechanical efficiency is said to result principally from the use of chrome vanadium steel ball bearings of large size.



Layout showing rotary air classifier attached to conical mill. A new basic principle is used, it is claimed

lift any given load has been much reduced, due to a lessening in friction at the bearing points of the load sheave shaft.

The design and arrangement of these bearings provides for their being retained by steel and felt dust-proof washers, and for continuous lubrication of the bearings, driving pinion, shaft, and planetary transmission.

These blocks are being built in a number of sizes, ranging from one-fourth of a ton to twenty tons.

New Gasoline Locomotive for Industrial Purposes

Growing popularity of gasoline-powered equipment of various kinds is given as the reason for the addition of an 18-ton gasoline locomotive (Model HL) to its present extensive line by the Fate-Root-Heath Co., Plymouth, Ohio. This model is offered by them for switching of railroad cars and for handling large and heavy industrial and construction cars. It is furnished in all track gages, from 23⅝ to 56½ in.

It is built on heavy lines and is very substantial throughout, the foundation being an exceedingly heavy frame with steel girder beam and bar sides, and cast steel bumpers of liberal dimensions to withstand the severe service for which it is intended. The four wheels are all drivers and of 33 in. diameter.

The power plant consists of a Climax R6, 6-cylinder, vertical L-head engine, with 5½ in. bore and 7-in. stroke, of heavy duty type, with full force feed oiling system and built-in governor. This is provided with a high-tension dual ignition system.

Hand brakes are provided regularly for industrial service, and straight system air brakes are furnished when required, as are also Westinghouse automatic air brakes for railroad service. The cab is 11 ft. high and 10 ft. wide in the case of 56½ in. gage.

Two New Air Classifiers for Dry Grinding

Experiments have been conducted for several years by the Hardinge Co., of York, Pa., with an air classifier to be used with the Hardinge conical mill. As a result, the rotary and the rotary-and-superfine classifiers have been introduced for dry grinding. The basic principle, it is claimed, is entirely new —that involving the use of reversed air currents.

The equipment is very simple, all auxiliary apparatus being eliminated. The accompanying layout shows the rotary air classifier attached to a Hardinge mill. With this classifier, the company claims, it is possible to obtain a fineness up to 98 per cent passing 48 mesh or 80 per cent passing 200 mesh. For a finer product, the rotary-and-superfine classifier is used, as a double classification feature in this makes it possible to meet the most severe specifications regarding fineness that are likely to be prescribed.

The same volume of air is used throughout the entire process, separation being secured by regulation of velocity in the different sections of the classifier. The current first enters the mill, stirs up the material, hastening its discharge, and at the same time reduces any moisture content. As the material discharges into the classifier, the same current carries the fines directly to the finished product bin, and, returning at a greater velocity, blows the oversize back into the grinding zone, where the same operation is repeated. The prompt removal of fines results in an immediate increase in capacity of the mill. This, of course, results in the reduction of the power cost per ton of material ground.

Capacities range from 400 lb. to 35 tons an hour for the rotary and 300 lb. to 23 tons an hour for the superfine classifier.

Trade Catalogs

Rock Drills—Two new catalogs of great interest have been received. In them is announced for the first time a line of rock drills made by the Gilman Manufacturing Co., East Boston, Mass., a new entrant in the manufacturing field. Bulletin 100 covers hand-held rock drills, including a plug-hole hammer drill, a foot-hole hammer drill, two types of light sinker hammer drill and two types of heavy sinker hammer drill. Bulletin 101 covers mounted hammer rock drills, including two types each of a "bantam" drifter, a light drifter, pneumatic feed drifter, a heavy drifter, and a pneumatic feed heavy drifter.

Heat - Treating Machine—In Bulletin 103 the Gilman Manufacturing Co., East Boston, Mass., which, as stated above, has just entered the manufacturing field, describes its automatic heat-treating machine for rock drill bits. This machine was described in the *Mining Journal-Press* of Feb. 7.

Coal - Measuring Meter — Bulletin CM-27 of the Republic Flow Meters Co., Chicago, describes the Republic coal meter, which is intended to measure coal volumetrically as it enters the fire door. This will be described in an early issue of the *Mining Journal-Press.*

Conveyors—The Jeffrey 47-A sectional conveyor is described in Bulletin 407 issued by the Jeffrey Manufacturing Co., of Columbus, Ohio. This is intended for concentrated systems of mining coal, assuring a greater output from given size territory, it is claimed. Those outside of the coal industry who are interested in this conveyor with a view to adapting it to their own line of work may secure a copy of the catalog by applying to the company.

Gears—Catalog No. 29 of the W. A. Jones Foundry & Machine Co., of Chicago, Ill., is a book of 225 pages covering the Jones line of gears, including spur, bevel, mitre, worm, spiral, and speed-reducing gears, made of various materials.

Motors—Bulletin 861 (January, 1925), issued by the Electric Machinery Manufacturing Co., Minneapolis, Minn., is devoted to a discussion of synchronous motors for pumping. A long list of users of E-M synchronous motors is given in Bulletin 785-A, which was issued in November, 1924.

Filters — "Pressure Type Water Filters" is the subject of Bulletin 501 issued by the Graver Corporation, East Chicago, Ind. It describes filtration methods and shows the construction of the Graver filters which are furnished with a perforated strainer plate instead of a pipe manifold and strainer heads for the collection of filtered water. Complete tables of sizes and capacities are given.

Stokers—A bulletin of the Combustion Engineering Corporation describes a stoker which has been installed successfully throughout the British Isles and Continental Europe. The stoker possesses several features which are unique in this country, by reason of which the company believes it will find application here to a number of plants which have not previously been able to avail themselves of the advantages of automatic stokers.

The Market Report

Daily Prices of Metals

Feb.	Copper N. Y. net refinery*	Tin		Lead		Zinc
	Electrolytic	99 Per Cent	Straits	N. Y.	St. L.	St. L.
12	.....	.....	.....	....	....	.....
13	14.50	57.25	57.75	9 50	9.20	7.475–7.525
14	14.50	57.125	57.625	9.50	9.15	7.45@7.55
16	14.375	57.00	57.50	9 40	9.10	7.50@7.55
17	14.25	56.625	57.125	9.25	9.10	7 45
18	14.25	56.50	57.00	9.25	9.00	7.40@7.45
Av.	14.375	56.900	57.400	9.38	9.11	7.480

*The prices correspond to the following quotations for copper delivered: Feb. 13th and 14th, 14.75c.; 16th, 14.625c.; 17th and 18th, 14.50c.

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

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

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

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

London

Feb.	Copper			Tin		Lead		Zinc	
	Standard		Electro-lytic						
	Spot	3M		Spot	3M	Spot	3M	Spot	3M
12	65	66	70	263 7/8	267 1/8	38 3/4	37 3/8	36 1/2	36
13	65 1/4	66 1/8	70	264 5/8	267 3/8	38 1/4	37 3/8	36 3/8	35 7/8
16	64 7/8	65 7/8	69 3/4	263 3/4	266 5/8	37 3/4	37	36 5/8	36 1/8
17	64 3/8	65 3/8	69 1/2	262 3/4	265 3/4	37 1/4	36 3/8	36 1/2	35 7/8
18	64	65	69	262 1/4	265 1/4	37 3/16	36 5/16	36 3/8	35 15/16

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

Silver, Gold, and Sterling Exchange

Feb.	Sterling Exchange "Checks"	Silver		Gold London	Feb.	Sterling Exchange "Checks"	Silver		Gold London
		New York	London				New York	London	
12	.....	...	32 1/2	86s 8d	16	4.76 3/4	68 3/8	32 1/4	86s10d
13	4.77 3/8	68 3/8	32 3/16	86s 8d	17	4.76 3/4	68 1/2	32 5/16	86s10d
14	4.76 3/4	68 3/8	32 1/4	...	18	4.76	68 3/8	32 3/16	86s11d

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

All Metal Prices Lower in Lifeless Market

New York, Feb. 18, 1925—With rather unfavorable news from Europe, lower prices in the London metal market, and an unsteady stock market in New York, metal consumers were in no mood to place any orders of consequence for their raw material during the last week. There was also little pressure to sell, as the excellent consumption has relieved the producers from the incubus of large unsold stocks. However, in a weak market, some speculatively held metal always appears, which, together with that seeking a market through some of the custom smelters, is sufficient to establish the market at lower levels.

Copper at 14½c. Delivered

Sales of copper during the last week, beginning with the Lincoln's Birthday holiday on Thursday, have been the smallest for some time, with selling agencies reporting hardly an inquiry. Offers of copper for early delivery at 14¾c. were renewed on Friday, with occasional sales at that level, even into the second quarter. With no interest at this price on Monday, one or two interests reduced their quotations to 14⅝c. delivered, and yesterday a fair tonnage found a buyer at 14½c. for February-March delivery. This same price was offered by one or two sellers today, without causing much interest on the part of consumers. Most producers, however, are offering nothing at current levels, holding nominally at from 14¾ to 15c., feeling that a large amount of buying for the second quarter must come soon, and that when it does, the price will quickly react upward. The better prices that have recently been obtained have had an effect on production, the output of primary copper by United States smelters being 82,149 tons in January, compared with 75,333 tons in December. The January figure is higher than that for any month of 1924.

The foreign demand during the last week has been somewhat better than the domestic, but has not amounted to much at that. Continental agencies did most of their business at 14.925 or 14.95c., though yesterday and today some offerings were made below these levels.

Lead Prices Reduced Twice

The contract price for New York lead, set by the American Smelting & Refining Co., was reduced from 9.75 to 9.50c. on Friday, Feb. 13, and to 9.25c. on Tuesday, Feb. 17. These reductions were occasioned by lower London cables and by undercutting of the Smelting company's price in the outside market.

The demand for lead has been better than for any of the other non-ferrous metals, as consumers are pretty bare of stocks, but they are buying for only immediate requirements, and in small tonnages, evidently feeling that further reductions are likely; so far, they have been right. Most of the business has been done on contract, lower prices named by some of the smaller interests for individual lots not resulting in many sales. Monday, before the second reduction, to 9¼c., was made by the Smelting company, lead was offered as low as 9.325c., New York, and a few sales were made in surrounding districts at from 9.30 to 9.40c. It might be possible today to obtain lead at less than 9¼c., but there is little effort to sell.

In St. Louis and Chicago, the market has not declined so fast as in the East, producers getting as high as 9¼c. there on Monday and Tuesday. Since the reduction to 9¼c. in New York, all business seems to be on 9c. basis, St. Louis. Some inquiry for prompt corroding lead in the Middle West has developed the fact that this grade is scarce, as high as $6 per ton premium having been paid during the week for immediate shipment, though for forward deliveries the customary differential of $2 to $3 per ton is quoted.

The foreign demand for lead, which has been excellent right along, is somewhat diminished, but is still good.

Zinc Declines After Advance

The zinc market improved until Tuesday, as high as 7.55c. having been done for prompt metal, but the slight decline in London yesterday had an unfavorable effect here. Buying has been fairly good in the last two or three days, but not more than sufficient to absorb the more weakly held offerings. Most sellers have been willing to sell only at somewhat higher prices than we quote. Forward zinc is easier to obtain than prompt, concessions of about 2½ points per month being made; yesterday, for example, April-May was sold at 7.40c., whereas March brought 7.45c. High-grade is still in fair demand at unchanged prices, 8¾c. per lb., delivered in the East, being quoted by all producers.

Tin Quiet but Holds Well

Consumers remained indifferent to the tin market, only buying an occasional small lot at concessions. On the whole, with the weakness in other metals and the meager sales, the price of tin has held up remarkably well, apparently indicating that the London holders expect the metal markets to give a better account of themselves in the next month or two than they have done in the first six weeks of the new year.

Arrivals of tin to and including Feb. 17 totaled 3,700 long tons.

Foreign Exchanges Weak

The principal foreign exchanges have not given a particularly good account of themselves during the last week. Closing cable quotations on Tuesday, Feb. 17, were: francs, 5.295c.; lire, 4.1125c.; and marks, 23.81c. Canadian dollars ⅛ per cent discount.

Silver Steady

The market maintains a steady tone, with India the supporting factor.

Mexican Dollars—Feb. 12, holiday; 13th, 52⅝c.; 14th, 52⅝c.; 16th, 52⅝c.; 17th, 52⅛c.; 18th, 52⅝c.

Other Metals

Quotations cover large wholesale lots unless otherwise specified.

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

Antimony — Prices have advanced further.

Chinese brands, 21.50c. per lb.

Cookson's "C" grade, 22c.

Chinese needle, lump, nominal, 10c.

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

White oxide, Chinese, 99 per cent Sb_2O_3, 16@16½c.

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

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

Iridium—$325 per oz.

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

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

Platinum—$117 per oz. for refined. Crude, $113@$115.

Quicksilver—$78.50 per 75-lb. flask. San Francisco wires $80.15. Quiet. London, £12¼.

The prices of **Cobalt, Germanium Oxide, Lithium, Magnesium, Molybdenum, Monel Metal, Osmiridium, Osmium, Radium, Rhodium, Ruthenium, Selenium, Tantalum, Tellurium, Thallium, Tungsten,** and **Zirconium** are unchanged from the prices given in the Feb. 7 issue.

Metallic Ores

Chrome Ore—Indian ore, $21@$22 per ton, c.i.f. Atlantic ports.

Tungsten Ore—Per unit, N. Y.:

Chinese wolframite, $9.25@$9.50.

High-grade Western scheelite, $9.50 @$9.75.

Iron Ore, Galena Radio Crystals, Manganese, Molybdenum, Tantalum, and **Vanadium Ores** are unchanged from Feb. 7 quotations.

Zinc Blende in Demand—Lead Ore Unchanged but Less Active

Joplin, Mo., Feb. 14, 1925

Zinc Blende	Per Ton
High	$56.45
Premium, basis 60 per cent zinc	$54.50@$55.50
Prime Western, 60 per cent zinc	$52.50@$54.50
Fines and slimes, 60 per cent zinc	$53.00@$49.00
Average settling price, all	$52.17

Lead Ore	
High	$144.80
Basis 80 per cent lead	$125.00
Average settling price, all	$132.97

Shipments for the week: Blende, 17,726; calamine, 42; lead, 3,117 tons. Value all ores the week, $1,341,180.

One buyer, out of the market several months, was forced to advance zinc ore prices to procure the tonnage for which he had orders. Other buyers had generally taken the usual tonnage, up to 5 o'clock this afternoon, but the head of one metal company is in the field, and some are looking for an active market tonight.

The high lead production is a general surprise, the average being 2,853 tons per week for the seven weeks of this year. High settlement prices continue to prevail, indicating that the production is being pushed on contracts made at the high level the first of the year.

Weather conditions continue admirable for February, and the temperature is generally above freezing. It is claimed that a number of the mines have ceased to operate night shifts, and as a result production has lowered 1,000 tons per week.

Platteville, Wis., Feb. 14, 1925

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

Lead Ore	
Lead, basis 80 per cent lead	$126.50

Shipments for the week: Blende, 922 tons; lead, 40 tons. Shipments for the year: Blende, 4,604; lead 240 tons. Shipments for the week to separating plants, 1,148 tons blende.

Non-Metallic Minerals

Amblygonite, Asbestos, Barytes, Bauxite, Beryl, Borax, Celestite, Chalk, China Clay, Corundum, Diatomaceous Earth, Emery, Feldspar, Fluorspar, Fuller's Earth, Garnet, Gilsonite, Graphite, Gypsum, Ilmenite, Iron Oxide, Lepidolite, Limestone, Magnesite, Manjak, Mica, Monazite, Ocher, Ozocerite, Phosphate, Potash, Pumice, Pyrites, Quartz Rock Crystals, Rutile, Silica, Spodumene, Sulphur, Talc, Tripoli, and **Zircon** are unchanged from Feb. 7 prices.

Mineral Products

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

Copper Sulphate, Sodium Nitrate, Sodium Sulphate, and **Zinc Oxide** are unchanged from Feb. 7 prices.

Ferro-Alloys

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

Ferrocerium, Ferrochrome, Ferromolybdenum, Ferrosilicon, Ferrotitanium, Ferrotungsten, Ferro-uranium and Ferrovanadium are unchanged from the prices given in the Feb. 7 issue.

Metal Products

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

Zinc Sheets—Base price, 10.50c. per lb. with usual discounts and extras, f.o.b. La Salle, Ill.

Yellow Metal, Nickel Silver, and **Lead Sheets** are unchanged from Feb. 7 prices.

Refractories

Bauxite Brick, Chrome Brick, Firebrick, Magnesite Brick, Magnesite Cement, Silica Brick, and **Zirkite** are unchanged from Feb. 7 prices.

Steel and Pig Iron Dull

Pittsburgh, Feb. 17, 1925

Steel production has increased month by month since last July and is now rounding the turn or is about to do so. January ingot production was 4,179,498 tons, or 89 per cent of capacity, the rate late in the month being over 90 per cent. Consumption promises to increase seasonally and not much decrease is to be expected in production, merely a gradual relaxation. Trading is dull, generally speaking, in finished steel products, and thoroughly dull in pig iron, coke, and scrap.

Finished-steel prices as recently advanced are well maintained, but are not being tested to any extent, buyers being covered at lower prices. About 150,000 tons of line pipe buying has been reported in the past fortnight, and there has been good buying of rails and freight cars.

Pig Iron.—Bessemer iron is now offered at $22.50, Valley, or 50c. below the previous market, making a quotable market of $22.50@$23. The old $22, Valley, quotation on basic has not lately been tested. Foundry remains at $22 @$23, Valley. The market is dull.

Connellsville Coke.—The market has softened again, with spot furnace coke at about $3.75 and spot foundry at $4.50 @$5. Consumers are very conservative in making commitments.

Company Reports

International Nickel Co.

Nickel; Ontario

A statement showing the financial condition of the International Nickel Co. on Dec. 31, 1924, and earnings for nine months previous follows:

Comparative Consolidated General Balance Sheet, Dec. 31, 1924

Assets

	Dec. 31, 1924	March 31, 1924
Property	$50,214,702.33	$50,773,103.93
Investments	231,114.14	236,459.42
Inventories	7,965,975.91	7,469,249.47
Accounts receivable	2,485,372.20	1,918,899.97
Advances	127,482.18	112,223.79
Government securities	1,106,568.75	602,350.00
Loans on call	900,000.00	1,000,000.00
Cash	1,304,475.35	728,233.75
	$64,335,690.86	$62,840,520.33

Liabilities

	Dec. 31, 1924	March 31, 1924
Preferred stock	$8,912,600.00	$8,912,600.00
Common stock	41,834,600.00	41,834,600.00
Accounts payable and tax reserves	990,831.74	814,144.76
Preferred dividend payable	133,689.00	133,689.00
Insurance and contingent reserves	481,221.41	395,645.07
Surplus	11,982,748.71	10,749,841.50
	$64,335,690.86	$62,840,520.33

Comparative Consolidated Profit-and-Loss Statement

	Nine Months Dec. 31, 1924	Nine Months Dec. 31, 1923
Earnings	$3,033,945.48	$1,992,175.21
Other income	152,356.83	153,513.18
Total income	$3,186,302.31	$2,145,688.39
Administration and general expense	288,821.96	282,547.71
Reserved for federal and franchise taxes	294,276.73	143,354.27
Net operating income	$2,603,203.62	$1,719,786.41
Depreciation and depletion	887,463.45	856,034.88
Orford works property and shutdown expense (a)	81,765.96	75,559.64
Profits	$1,633,974.21	$788,191.89
Preferred dividend	401,067.00	401,067.00
Balance	$1,232,907.21	$387,124.89

(a) Insurance, taxes and pensions of ex-employees.

Texas Gulf Sulphur Co.

During 1924, the Texas Gulf Sulphur Co. paid four distributions to its stockholders, which distributions came from free surplus and reserve for depletion as follows:

Date	Amount Per Share	From Free Surplus, in Per Cent	From Depletion Reserve in Per Cent
March 15, 1924	$1.75	33.7446	66.2554
June 14, 1924	1.75	39.5477	60.4523
September 15, 1924	1.75	36.1613	63.8387
December 15, 1924	2.25	29.5249	70.4751

The distributions from depletion reserve are, under the federal revenue laws, to be treated as capital distributions.

Income Account for 1924

Gross income	$9,814,976.64
Total cost of sales and other expenses, including federal taxes	5,000,960.06
Profit-and-loss surplus	$4,814,016.58
Add surplus at beginning of period	7,055,767.44
	$11,869,784.02
Deduct dividends 10, 11, 12, and 13	4,762,500.00
Total surplus carried to balance sheet	$7,107,284.02

Balance Sheet Dec. 31, 1924

Assets		
Property and plants at cost:		
Lands and development	$2,776,740.31	
Plants, buildings, machinery and equipment	5,445,049.58	
		$8,221,789.89
Working and trading assets at cost:		
Materials, supplies and sulphur inventories		5,241,571.98
Current assets:		
Cash on hand and on deposit	$3,255,975.31	
Securities	27,358.96	
Accounts receivable—customers	1,358,216.80	
Notes and trade acceptances receivable	108,563.02	
Miscellaneous receivables and advances	381,172.65	
		5,141,286.74
Deferred assets		17,083.23
Total		$18,621,731.84
Liabilities and Capital		
Capital stock: Authorized, issued and outstanding, 635,000 shares at $10 par value		$6,350,000.00
Current liabilities:		
Accounts payable and taxes accrued		254,908.83
Reserves, including reserve for depreciation and for unpaid federal taxes		4,909,538.99
Surplus, including reserve for depletion		7,107,284.02
Total		$18,621,731.84

New Jersey Zinc Co.

A statement of the New Jersey Zinc Co. for the quarter ended Dec. 31, 1924, follows:

Income (including dividends from subsidiary companies) after deductions for expenses, taxes, maintenance, repairs, depreciation, depletion and contingencies		$1,449,686.13
Deduct		
Interest on first-mortgage bonds		40,000.00
Net income		$1,409,686.13
Deduct		
Dividend 2 per cent payable Feb. 10, 1925	$981,632.00	
Employees' profit-sharing distribution	340,000.00	1,321,632.00
Surplus for the quarter		$88,054.13

Summary

Net income		
First quarter		$1,800,849.74
Second quarter		2,140,100.80
Third quarter		1,055,006.31
Fourth quarter		1,409,686.13
Net income for 1924		$6,405,642.98
Deduct		
Dividends	$4,906,160.00	
Employees' profit-sharing distribution	340,000.00	5,246,160.00
Surplus for the year		$1,159,482.98

Estimated Production of Certain Minerals in Canada, 1923 and 1924

The Mining, Metallurgical and Chemical Branch of the Dominion Bureau of Statistics, of Canada, has issued the following statement of metal and mineral production in the Dominion for 1924, giving, also, for comparison, the figures for the production and value in 1923:

	1923 Quantity	1923 Value	1924 Quantity	1924 Value
Metallics				
Gold, oz.	1,233,341	$25,495,421	1,525,000	$31,522,000
Silver, oz.	18,601,744	12,067,509	20,363,500	13,644,000
Nickel, lb.	62,453,843	18,332,077	69,250,000	18,697,500
Copper, lb.	86,881,537	12,529,186	101,565,000	13,204,000
Lead, lb.	111,234,466	7,985,522	168,713,500	13,497,000
Zinc, lb.	60,416,240	3,991,701	90,000,000	5,670,000
Other metals	.....	3,989,802	.....	2,067,500
Totals		$84,391,218		$98,302,000
Fuels and other non-metallics				
Coal, tons	16,990,571	$72,058,986	13,100,000	$54,280,000
Asbestos, tons	231,482	7,522,506	220,000	7,200,000
Natural gas, M. cu.ft.	15,960,583	5,884,618	16,000,000	5,950,000
Gypsum, tons	578,301	2,243,100	615,000	2,450,000
Salt, tons	202,397	1,713,516	215,000	1,600,000
Other non-metallics	.....	2,514,006	.....	2,350,000
Totals	.....	$91,936,732	.....	$73,830,000
Structural materials and clay products				
Cement, bbl.	7,543,589	$15,064,661	7,250,000	$13,400,000
Lime, bushels	10,035,319	3,266,608	.....	2,780,000
Brick, tile, stone, sand and gravel	.....	19,420,112	.....	17,150,000
Total	.....	$37,751,381	.....	$33,330,000
Grand total	.....	$214,079,332	.....	$205,462,000

Transvaal Gold Production

In Fine Ounces

	1918	1919	1920	1921	1922	1923	1924
Jan.	714,182	676,059	670,503	651,593		764,469	796,768
Feb.	659,759	636,728	625,330	558,137	639,728	704,970	760,617
March	696,281	712,379	707,036	671,123		761,586	795,671
April	717,000	694,944	686,979	681,382	511,338	743,651	768,923
May	741,317	724,995	699,041	687,776	629,786	786,564	809,003
June	727,696	702,379	715,957	678,490	675,697	755,309	773,053
July	736,199	725,497	736,099	689,555	730,635	754,306	829,437
August	740,210	706,669	702,083	711,526	752,490	769,371	809,571
Sept.	708,206	698,558	682,173	691,026	747,089	739,504	799,422
Oct.	697,764	723,722	662,472	707,825	778,159	793,842	827,583
Nov.	658,701	677,970	633,737	704,236	764,476	780,639	802,313
Dec.	641,245	650,791	632,215	681,847	790,712	778,849	825,273
Totals	8,420,560	8,330,091	8,153,625	8,114,516	7,020,110	9,133,060	9,597,634

Mining Stocks

Week Ended February 14, 1925

Stock	Exch.	High	Low	Last		Last Div.
COPPER						
Alaska-Br. Col.	N. Y. Curb			*6		
Anaconda	New York	46¼	44½	44½	Ja.17, Fe.16,	0.75
Arcadian Consol.	Boston	2½	2⅜	2⅜		
Ariz. Com'l.	Boston	14⅜	13½	13½	Ja. 19, Ja. 31	0.50
Calaveras	N. Y. Curb			2		
Calumet & Arizona	New York	54⅞	53	53	De.5, De.22 Q	0.50
Calumet & Hecla	Boston	16⅛	15⅞	15⅞	Ja.30, Mh.4	0.50
Canario Copper	N. Y. Curb	4	3¾	4		
Cerro de Pasco	New York	54⅞	53	53	Ja. 22, Fe. 2, Q	1.00
Chile Copper	New York	37½	36	36⅜	Mh.3,Mh.20, Q	0.62½
Chino	New York	28⅜	26½	26½	Sept., 1920	0.37½
Con. Coppermines	N. Y. Curb	4	3⅜	3 11/16		
Copper Range	Boston	30½	28	28⅛	May, 1924	1.00
Crystal Copper	Boston Curb	*64	*61	*61		
Davis-Daly	Boston	*78	*73	*78	Mar., 1920	0.25
East Butte	Boston	5⅜	5¼	5¼	Dec., 1919	0.50
First National	Boston Curb	*38	*29	*35	Feb., 1919	0.15
Franklin	Boston	1⅛	1⅛	1⅛		
Gadsden Copper	Boston Curb	*80	*64	*64		
Granby Consol.	New York	20⅞	19⅛	19⅛	May, 1919	1.25
Greene-Cananea	New York	18	17	17	Nov., 1920	0.50
Hancock	Boston			1½		
Howe Sound	N. Y. Curb	3⅞	3½	3⅝	April 1924	0.05
Inspiration Consl.	New York	30⅛	29	29	De.20, Ja.7, Q	0.50
Iron Cap	Boston Curb	2½	1⅞	2⅛	May, 1923	0.15
Isle Royale	Boston	17½	17	17	Sept. 1923	0.50
Jerome Verde Dev.	N. Y. Curb	1⅞	1½	1⅞		
Kennecott	New York	56½	54⅜	54½	Mh.6, Ap.1, Q	0.75
Keweenaw	Boston	*75	*75	*75		
Lake Copper	Boston	2⅜	2⅛	2⅛		
Magma Copper	New York	42⅛	40¼	40½	Jan., 1919	0.50
Mason Valley	N. Y. Curb	2⅛	2	2		
Mass Consolidated	Boston	1⅛	1	1	Nov., 1917	1.00
Miami Copper	New York	22⅛	22⅛	22⅛	Fe.2 Fe.16 Q	0.50
Mohawk	Boston	38⅛	37⅛	37⅛	Ja. 13, Mh. 2	1.00
Mother Lode Coa.	New York	8⅛	8⅛	8⅛	De. 12, De. 31	0.37½
Nevada Consol.	New York	15⅞	15⅝	15⅝	Sept., 1920	0.25
New Cornelia	Boston	23⅛	23	23	Fe. 6, Fe. 23	0.25
New Dominion	N. Y. Curb			2½		
North Butte	Boston	2⅛	2⅛	2⅛	Oct., 1918	0.25
Ohio Copper	N. Y. Curb	1 1/16	1	1⅛	No.14, De.2	0.05
Old Dominion	Boston	25	24	24⅛	Dec., 1918	1.00
Phelps Dodge	Open Mar.	†125	†120		De.2, Ja.2 Q	1.00
Quincy	Boston	33	31⅞	32	Mar., 1920	1.00
Ray Consolidated	New York	17⅛	15¾	16	Dec., 1920	0.25
Ray Hercules	N. Y. Curb			*8		
St. Mary's Min. Ld.	Boston	44⅛	42	42½	May 1924	3.00
Seneca Copper	New York	⅛	⅛	⅛		
Shannon	Boston	1⅛	1	1	Nov., 1917	0.25
Shattuck Arizona	New York	7	7	7	Jan., 1920	0.25
Superior & Boston	Boston	1⅞	1⅞	1⅞		
Tenn. C. & C.	New York	9⅞	9	9	De.31, Ja.15,Q	0.25
United Verde Ex.	N. Y. Curb	28½	28	28	Ja. 2, Fe. 2	0.50
Utah Copper	New York	91⅞	90½	91	De.12, De.31,Q	1.00
Utah Metal & T.	Boston	85	*70	*70	Dec., 1917	0.30
Victoria	Boston	*75	*75	*75		
Walker Mining	N. Y. Curb	3⅛	3⅛	3⅛		
Winona	Boston	*25	*20	*25¼		
NICKEL-COPPER						
Internat. Nickel	New York	27⅜	26⅛	26⅜	March, 1919	0.50
Internat. Nickel pfd.	New York	99⅛	99⅛	99⅛	Ja. 15, Fe. 2, Q	1.50
LEAD						
Carnegie Lead & Zinc	Pittsburgh	7⅜	6⅞	7⅛		
National Lead	New York	164⅜	158	162½	De.12, De.31, Q	2.00
National Lead pfd.	New York	117⅛	117⅛	117⅛	Fe.2, Mh.14, Q	1.75
St. Joseph Lead	New York	44	41⅛	43⅛	Mh. 5, Mh. 20	0.50
ZINC						
Am. Z. L. & S.	New York	11	10⅜	10⅜	May, 1920	1.00
Am. Z. L. & S. pfd.	New York	35⅞	32½	34	Nov., 1920	1.50
Butte C. & Z.	New York	8⅛	7⅜	7⅜	De.10, De.24	0.50
Butte & Superior	New York	22⅛	20⅛	20⅛	June, 1923	0.50
Callahan Zn-Ld.	New York	4	3⅛	3⅜	Dec., 1920	0.50
New Jersey Zn.	N. Y. Curb	191¼	190	191	Ja.20, Fe.10	2.00
United Zinc	N. Y. Curb			*15		
Yellow Pine	Los Angeles	*73	*66	*70	De.10,De.15 Q	0.04
SILVER						
Alvarado	Boston Curb			1½	Oct. 1920	0.50
Beaver Consol.	Toronto	*33	*31½	*32	May, 1920	0.03
Castle-Trethewey	Toronto	*77	*74	*75		
Coniagas	Toronto			2.27	May, 1924	0.12½
Keeley	Toronto	2.29	2.24	2.27	Mh.1,Mh.15 SA	0.12
Kerr Lake	N. Y. Curb	1⅜	1⅜	1⅜	Oc. 1, Oc. 15,	0.12½
La Rose	Toronto	*39	*34½	*37	Apr., 1922	0.10⅛
Lorrain Trout Lake	Toronto	1.15	1.10	1.10		
McKinley-Dar.-Sav.	Toronto	*22½	*21½	*22	Oct., 1920	0.03
Mining Corp. Can.	Toronto	2.68	2.56	2.60	Sept., 1919	0.12½
Nipissing	N. Y. Curb	6⅜	6⅛	6⅜	Ja.18,Ja.20,QX	0.30
Ontario Silver	New York	5⅛	5⅛	5⅛	Jan., 1919	0.50
Temiskaming	Toronto	*24	*22	*22	Jan., 1920	0.40
GOLD						
Alaska Gold	New York			*25		
Alaska Juneau	New York	1⅜	1⅛	1⅛		
Argonaut	Toronto	*44	*40	*43		
Carson Hill	Boston	*50	*50	*50		
Consol. W. Dome L.	Toronto	*17⅛	*16⅜	*17½		
Cresson Consol. G.	N. Y. Curb	3⅞	3 11/16	3⅞	De.31, Ja.10 Q	0.10
Crown Reserve	Toronto	*50	*48	*48	Jan. 1917	0.05
Dome Mines	New York	16	15⅛	15⅛	De.31, Ja.20, Q	0.50
Golden Cycle	Colo. Springs	1.47½	1.45	1.47½	Dec.11, 1924	0.03
Hollinger Consol.	Toronto	14.70	14.50	14.55	Fe.9, Fe.26, M	0.05
Homestake Mining	New York	44¼	44	44¼	Fe.20,Fe.25,M	0.50
Jib, Cons l.	N.Y. Curb	*40	*29	*29		
Kirkland Lake	Toronto	*44	*40	*42½		
Lake Shore	Toronto	5.90	5.05	5.55	De.1, De.15,XQ,	0.10
McIntyre-Porcupine	New York	17⅞	16⅞	17⅛	Fe.2, Mh.2,	0.25
Newray	Toronto	*26	*25¼	*25½		
Night Hawk Pen.	Toronto	*36	*35	*35		
Portland	Colo. Springs	*44	*44	*44	Oct., 1920	0.01
Rand Mines	New York	*34½	*34½	*34⅝	Aug. 1924	1.71
Teck-Hughes	Toronto	1.34	1.31	1.33		
Tom Reed	Los Angeles	*62½	*59	*59½	Dec., 1919	0.02
Tough-Oakes	Toronto	*38	*36½	*37½		
United Eastern	N. Y. Curb	*60	*55	*60	July, 1924	0.05
Vipond Cons.	Toronto	1.29	1.27	1.28		
Wright-Hargreaves	Toronto	4.85	4.00	4.40	De.15, Ja.2,QX	0.05
GOLD AND SILVER						
Black Oak	N. Y. Curb			*81		
Con. Cortez	N. Y. Curb	*10	*10	*10		
Con. Virginia	San Francisco	6½	4½	6½		
Continental Mines	N. Y. Curb			1¼		
Dolores Esperanza	N. Y. Curb	*61	*55	*61	July, 1923	0.05
Premier Gold	N. Y. Curb	2½	2 1/16	2⅛	De.22, Ja.5,QX	0.10
Tonopah Belmont	N. Y. Curb			*60	Apr., 1923	0.05
Tonopah Divide	N. Y. Curb	*26	*26	*26	Se. 22, Oc. 10	0.10
Tonopah Extension	N. Y. Curb	3	3	3	De.11, Ja.1	0.05
Tonopah Mining	N. Y. Curb	2⅛	1⅞	1⅞	Ap. 1, Ap. 21,	0.07½
Unity Gold	N. Y. Curb	*61	*60	*60		
West End Consol.	N. Y. Curb			*46	Mar., 1923	0.05
Yukon Gold	N. Y. Curb	*50	*50	*50	June, 1918	0.02
SILVER-LEAD						
Ahumada	Boston Curb	10⅜	10⅛	10⅛	De.15, Ja.2, X	0.15
Bingham Mines	Boston	36⅛	32⅛	35⅛	De.20, Ja.2	0.50
Cardiff M. & M.	Salt Lake	1.70	1.60	1.70	De.16, No.18	0.10
Chief Consol.	Boston Curb	4	3⅛	3⅛	May, 1924	0.10
Columbus Rexall	Salt Lake	*25	*23	*25	Aug., 1923	0.05
Erupcion	Boston Curb	3⅛	3⅛	3⅛	De.15, Ja.2, X	0.15
Federal M. & S.	New York	23	23	23	Jan., 1909	1.50
Federal M. & S. pfd.	New York	63⅛	62	62	No.25, De.15,	1.75
Florence Silver	Spokane	*4½	*4½	*4½	Apr., 1919, QX	0.01
Hecla Mining	N. Y. Curb	16⅛	15⅛	15⅛	Fe.15, Mh.15	0.50
Iron Blossom Con.	N. Y. Curb	*30	*30	*30	Oc.25, 1924	0.02½
Marsh Mines	N. Y. Curb			*6	June, 1921	0.02½
Park City	Salt Lake	5.50	5.10	5.50	De. 15, Ja. 2	0.15
Park Utah	Salt Lake			3½	April, 1924	0.15
Prince Consol.	Salt Lake	*32	*20	*26½		
Silver King Coal	Salt Lake	5.95	5.60	5.95	De.20, Ja.2, Q	0.20
Silversmith	Spokane	*29¼	*28½	*29½	Ja. 1, Ja. 10	0.02
Tamarack-Custer	Spokane	*82	*82	*82	Se. 22, Se. 29	0.25
Tintic Standard	Salt Lake	9.00	8.90	8.90	Ja.2, QX	0.50
Utah-Apex	Boston	7⅛	6⅞	6⅞	Ja.10, Ja.15,	0.25
IRON						
Bethlehem Steel	New York	51⅓	46⅞	47½	Jn.1, Jy.1, Q	1.25
Char. Iron	Detroit			*20		
Char. Iron pfd.	Detroit	*80	*80	*80		
Colorado Fuel & Iron	New York	47⅞	44⅛	44⅜	May, 1921	0.75
Gt. North'n Iron Ore	New York			108⅛	De.10, De.27	2.00
Inland Steel	New York	49½	46⅛	47	Fe.14, Mh.20 Q	0.625
Mesabi Iron	N. Y. Curb	3⅛	3⅛	3⅛		
Replogle Steel	New York	20⅛	19	19		
Republic I. & S.	New York	58⅓	53⅓	53⅓	May, 1921	1.50
Republic I. & S. pfd.	New York	94	93	93⅛	Mh.8, Ap.1, Q	1.75
Sloss-Sheffield S. & I.	New York	95⅓	90⅛	91⅛	Mh.10, Mh.20 Q	1.50
Sloss-Shef. S.&I. pfd.	New York	96⅓	96⅓	96⅓	Mh.20, Ap.2, Q	1.75
U. S. Steel	New York	128	125	125	Fe.28,Mh.30,QX	1.75
U. S. Steel pfd.	New York	123⅛	123	123	Fe.1, Fe.27, Q	1.75
Virginia I. C. & C.	New York			42	De.15, Ja.2	1.50
Virginia I.C.&C.pfd.	New York			79	De. 13, Ja. 2, Q	2.50
VANADIUM						
Vanadium Corp.	New York	30⅛	28⅛	28⅛	Jan., 1921	1.00
ARSENIC						
Western Utah Copper	N. Y. Curb	*25	*20	*22		
ASBESTOS						
Asbestos Corp.	Montreal	43¼	43	43	Fe.1, Fe.15 Q	2.00
Asbestos Corp. pfd.	Montreal	83	82	82	Ja.2, Ja.15, Q	1.50
SULPHUR						
Freeport Texas	New York	10⅜	10⅛	10⅛	Nov., 1919	1.00
Texas Gulf	New York	105½	103⅛	103⅛	De.1,De.15, QX	2.25
DIAMONDS						
De Beers Consol.	New York			24⅛	Ja.6, Fe.2	0.95
PLATINUM						
So. Am. Gold & P.	N. Y. Curb	3¼	3⅛	3⅛		
MINING, SMELTING AND REFINING						
Amer. Metal	New York	52⅛	50½	50⅞	Fe.18, Mh.2 Q	0.75
Amer. Metal pfd.	New York			114⅛	Fe.19, Mh.2, Q	1.75
Amer. Sm. & Ref.	New York	106⅛	102	102	Ja.16, Fe.2, Q	1.50
Amer.Sm.&Ref.pfd.	New York	110⅛	110	110	Fe.6, Mh.2 Q	1.75
Consol. M. & S.	Montreal	71⅛	67⅛	67⅛	De.11, Ja.15 SA	0.75
Federated Metals	N. Y. Curb			37⅛		
Southwest Metals	N. Y. Curb			1		
U. S. Sm. R. & M.	New York	36	34⅛	34⅞	Jan., 1921	0.50
U.S. Sm. R.&M.pfd.	New York	46⅛	46	46⅛	Ja.8, Ja.15	0.87½

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

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