

ENGINEERING AND MINING JOURNAL-PRESS

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By John Melhase

Cyclone Dust Collectors for Recovering Zinc Oxide

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Zonolite—a New Mineral Product of Commerce

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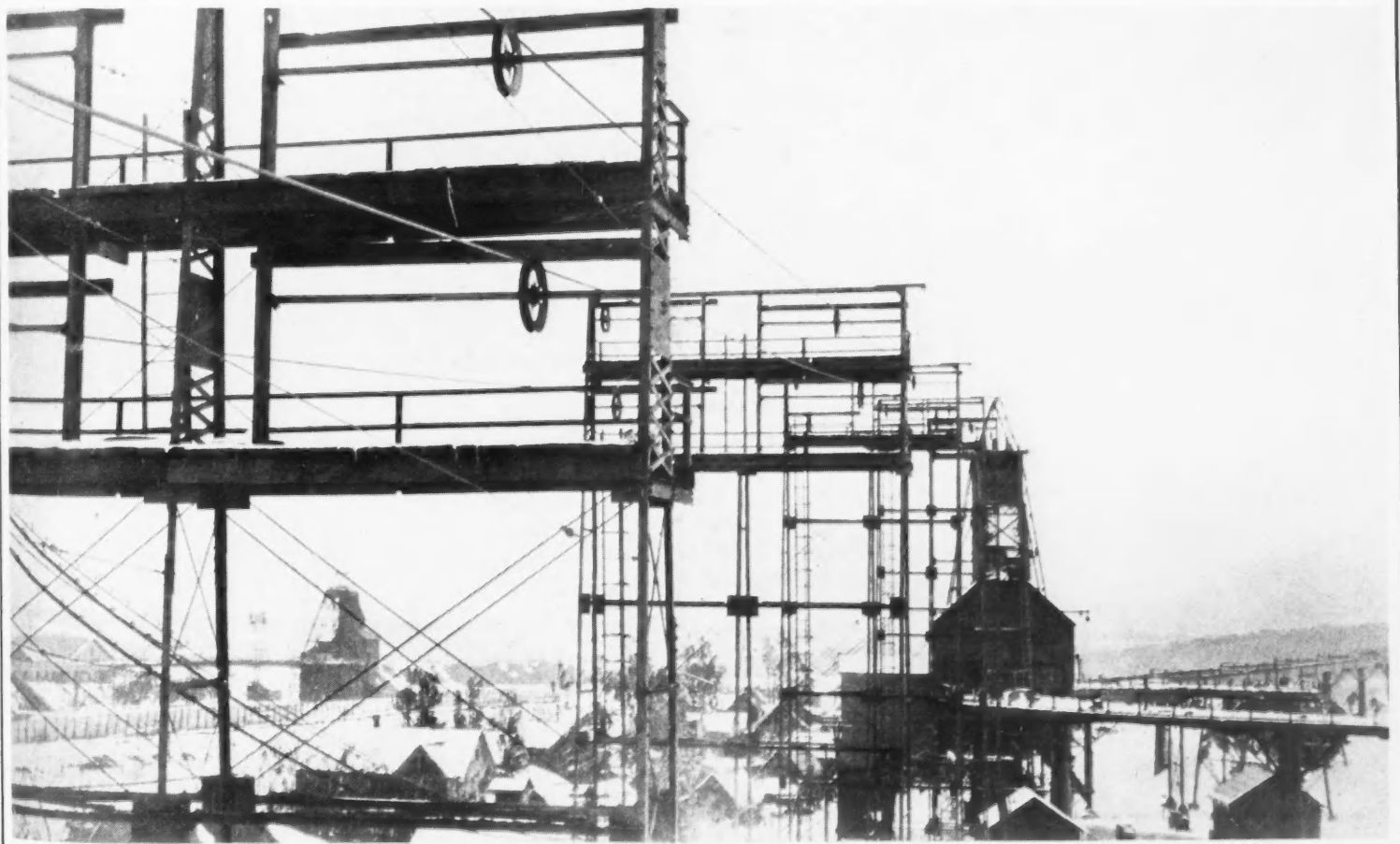
Ancient Copper Mining and Smelting in Central Africa

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Biography of Melville Fuller Coolbaugh

President of Colorado School of Mines

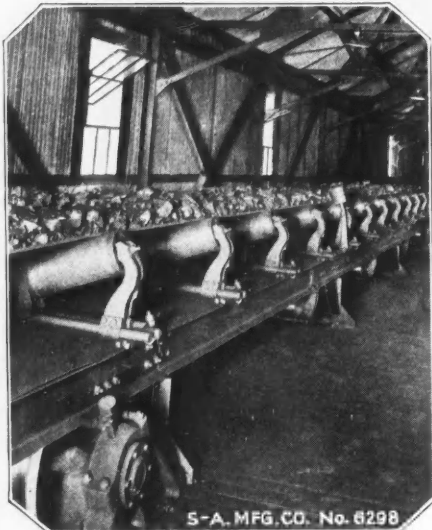
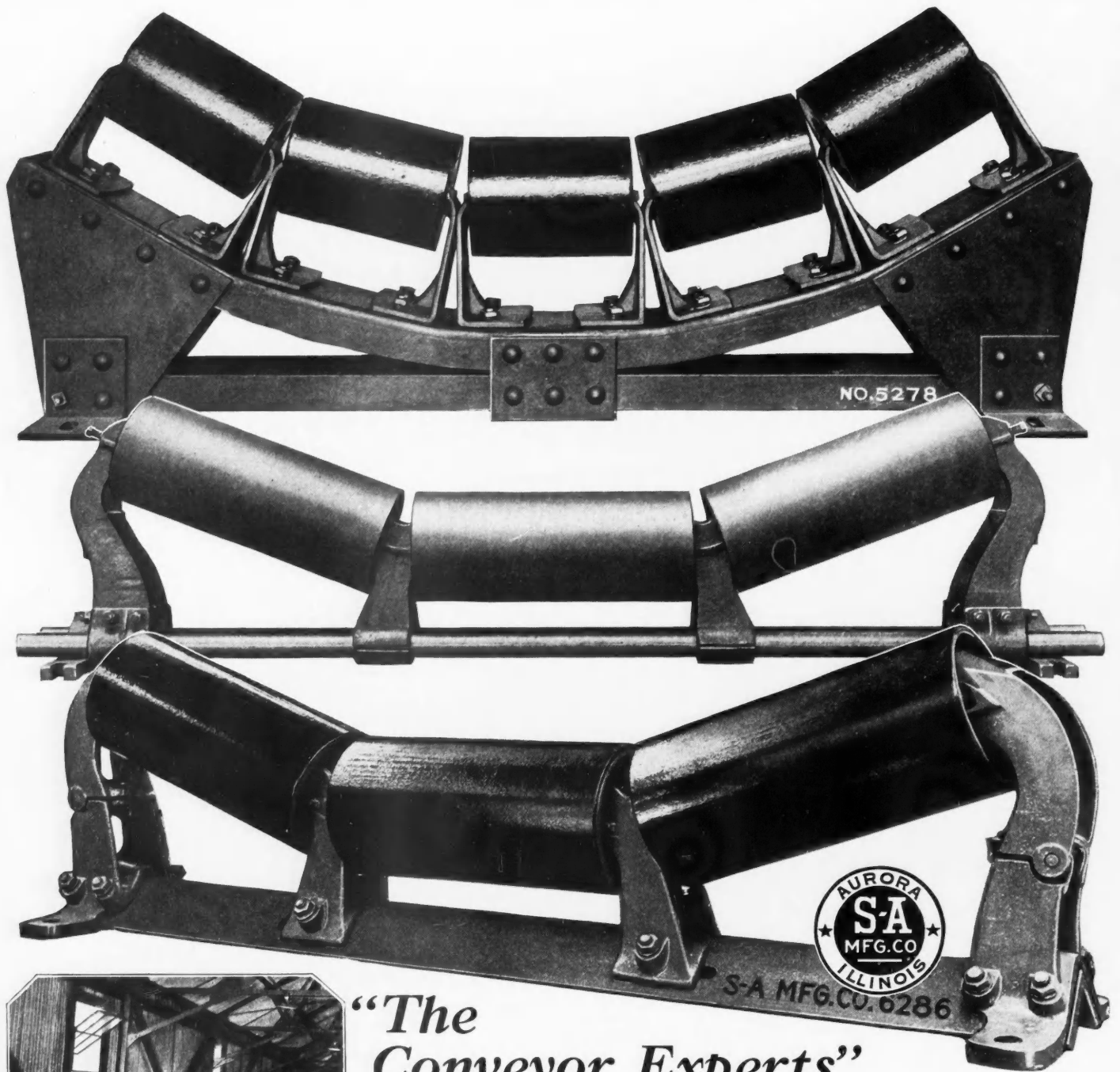
Also: Two cases where oxy-acetylene welding
was used to advantage



Shaft house and idler stands of the Athens Mine of the Cleveland-Cliffs Iron Co. at Negaunee, Michigan, on the

IN THE
LAKE SUPERIOR IRON COUNTRY

Marquette Range. In the distance is a similar plant, that of the Negaunee Mine, belonging to the same company.



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ENGINEERING AND MINING JOURNAL-PRESS

JOSIAH EDWARD SPURR, Editor

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The Inconstant Month

THE METRIC SYSTEM has nothing to do with the measurement of time, and, even if it had, possibly our present system would be found difficult of perfecting. It is true, however, that the varying length of time represented by a month leads to much inaccuracy of statement. In the *New York Evening Post*, for example, recently appeared a headline saying "Transvaal Gold Output Declines," the text following reciting the fact that the mines had produced only 797,247 oz. in September, compared with 808,218 oz. in August. True enough, this was a decline, but the rate of output actually increased, owing to the fact that September had only thirty days, whereas August had thirty-one, so the headline is misleading. At the August rate, the September production would have been only 782,147 oz.

Headline writers often jump at conclusions and magnify the importance of small things. In interpreting statistics where monthly figures are given, one should always consider the number of working days in a month, a factor oftentimes of much importance, as in the Joplin district, where Sundays and holidays mean a shutdown of the mines and mills. At least, the total number of days contained in a month should be considered. Where possible, the daily rate should be enumerated as well as, or in place of, the monthly total. This is done, for example, in the copper-production statistics of the American Bureau of Metal Statistics, which were last published on page 757 of the Nov. 7 issue of *Mining Journal-Press*.

The Bureau of Mines Director

THE APPOINTMENT of Mr. Scott Turner to be Director of the U. S. Bureau of Mines appears to be a step in the right direction. It fulfills essentially the principle which *Mining Journal-Press* has editorially advocated for years—namely, the appointment of an active operating mining man to the position of Director. The fact that Mr. Turner in the course of an active career has also been an editor and again a geologist will not be remembered against him. Even Mr. Hoover, let it be whispered confidentially, was at one remote period a geologist, and is actually a member of the Society of Economic Geologists. Whether the job will suit Mr. Turner as well as he suits the job is another question. The position of Bureau Director in Washington is hedged around with many restrictions and annoyances, difficult at times to brook. Mr. Hoover will, however, certainly be a more comfortable chief than have been the long line of Secretaries of the Interior, who have been ignorant of and indifferent to the mining industries and their problems.

The Bureau of Mines was organized as a purely technology bureau, and still so remains. Within the

Bureau there has always been resistance to the idea of making it in any sense an industrial bureau. Yet that is precisely what Mr. Hoover hopes to do with it, and is the justification in his own mind for his rather high-handed capture of the Bureau of Mines and the confiscation into his organization. Certainly the mining industries will benefit by the carrying out of Mr. Hoover's hopes to industrialize the Bureau. Mining is primarily a business, not primarily an art or a science.

Individuality in Government

MR. HOOVER'S method of annexing the Bureau of Mines and then appointing a committee of mining engineers to give him advice and tell him why he had done it and what for—which the committee solemnly set about at once—is without criticism. Has not Mussolini, the strong man who has raised Italy to greater prosperity and better government, recently frankly said that representative government in Italy was a joke, and he would no longer countenance the hypocrisy of pretending it? It was also Roosevelt's policy to do what he thought best and let the people approve it or disapprove it afterward. When he made the Panama Canal coup, he acted first and then notified the government and the people. And Roosevelt was a hero. Still more self-sufficient and arbitrary was another American statesman who made himself to many a hero—Woodrow Wilson. He disregarded even Congress, even his own Cabinet. He kept us out of the war, and he plunged us into the war, as he individually thought fit. On the other hand, the consult-everybody-and-offend-nobody politician is likely, perhaps, to prosper, but not rise. There is an unconfessed popular reliance on leaders. We don't want to think: we want to think we think, while people we admire are running things with a high hand. We don't want to play ball; we want to stand in the bleachers and yell. It would appear, therefore, the best sort of a government is that which we have: which will allow every citizen to believe that he is the equal of a king of any other country, while as a matter of fact the nearest he ever comes to the actual contact of government is when he is insulted by the traffic cop, or called a liar by the tax collector.

All this is puzzling to the man who once in a while sits down and tries to think it out—think out the recollection of a world that was to have been made safe for democracy. Certainly the early pattern of government in America has been lost—the pattern of the Mayflower contact, and the early representative system in Massachusetts. The increasing multitude dwarfs the individual and submerges him: increasing standardization makes him a cog in a vast machine, not a sovereign entity. The machine runs by a higher power, and with little or no evident influencing by his wildest exertions and clamor—if and when he ever exerts himself or clamors. Mining engineers have

become reconciled—if they ever objected—to a stultification of the principles of popular government in their societies. They do not want or approve such a government. A benevolent despotism—a gracious and honorable oligarchy—is, in the outspoken judgment of many an intelligent engineer, the most practical and best method of running the societies. And if the societies, of course the city and the country.

When Do Tailings Become Ore?

A FEW MONTHS AGO Harr Brothers, of Osburn, Idaho, secured a lease on the Osburn tailings dam, built many years ago by the Cœur d'Alene Mine Owners' Association, and began shipment of the old tailings direct to the Bunker Hill smelter, at Bradley, on which they paid the railroad company freight at the rate of 50c. per ton, the railroad claiming that this material is concentrate. After several shipments had been made it was decided that better results could be obtained by concentrating the material before sending it to the smelter. Thereupon shipments were routed to the Sweeny mill, at Bradley, Idaho, paying the same freight rate of 50c. per ton to the railroad company. Harr Brothers later learned that a freight schedule of 30c. per ton from Burke to Bradley had already been established on "ore having a value of not more than \$20 per ton." Osburn being an intermediate station between Burke and Bradley, it followed that Osburn should be entitled to at least the Burke freight rate. Application was made for a refund of the difference of 20c. per ton on the Sweeny shipments, which refund was granted by the Oregon Railway & Navigation Co. Harr Brothers applied for a similar refund on the earlier shipments made direct to the Bunker Hill smelter at Bradley, but this the railroad company refused to grant, on the ground that the Burke rate of 30c. per ton applied to "ore," while the shipments from Osburn to the smelter were "concentrate."

Harr Brothers insisted that the material (tailings) they were shipping was ore, contending that the concentrate had been recovered in the original milling operation and that they are now mining ore and that their shipments are entitled to classification as ore. That is the issue now before the Utilities Commission awaiting decision—i.e., whether this material is "ore" or "concentrate."

This is a case in which what was considered waste material in days gone by has, by reason of increased prices and more efficient methods of extraction, become a source of metal to meet present-day demand, as in the case of the old mill tailings in the Michigan copper district, or the copper slag of twenty-five years ago at Bisbee, Ariz. In our editorial of Oct. 3, 1925, "Terminology That Will Not Terminate," it was brought out that ore is a metalliferous mineral which can be mined or treated at a profit, while concentrate is the enriched product of treating or milling crude material (ore) as obtained from the mine. In the instant case the accumulated tailings are the waste products from an old mill or mills which are now being re-treated to form another marketable concentrate which will go to the smelter for further reduction. There seems, therefore, to be no question that the tailings now being shipped can properly be classed as ore, as they are a mineral or aggregate of minerals from which a metallic element may be obtained at a profit.

The Trade Cycle

THAT the efforts of economists to analyze and check the trade cycle have not been successful is evidenced from the tendency toward inflation and speculation which has been steadily growing. In the stock market the result has been, as usual, to carry speculative buying for a rise in many cases far beyond the point where business judgment based upon real underlying values would dictate. History shows that these movements are invariably followed by the corresponding ebb, indications of the imminence of which have already appeared. The fever of Florida land speculation is another proof that nothing will curb the foolish optimism of youth but an occasional spanking. Florida is full of people who go to buy at any price—options, not land—in order that they may sell at a higher price, and then buy some more to sell again. There never was a bubble, of course, blown so big and so glittering but that it finally burst.

The inflation and speculative fever have, it is true, been only exuberant offshoots of a general real prosperity. Even this, however, real though it is, must evidently, must eventually, be effected by the reactions of its too-enthusiastic exploiters. History proves that the stock market, for example, in some way not fully understood, discounts in advance, as the phrase goes, business progress or retardation. This is some result of mass action—certainly not the result of individual intelligence; indeed, whether the course of business is thus foretold by the general market movement, or whether general business conditions are seriously affected by the bursting of speculative bubbles and the consequent psychology of distrust and undervaluation, is a moot question. Certain it is, however, that the collapse of a boom stock market, of a boom real-estate market, comes at a time when all business reports and even indices are excellent, and there is a general atmosphere of security and easy money. The market is set on a hair trigger; a breath is sufficient to set it off. The explanations are post mortem—they come after the event; indeed, to a large degree they come from conditions that originate when the downward journey has already begun.

It is accordingly the part of prudence to recognize at the present time that the biblical alternating lean years and fat years are symbolic of the periods of fluctuating rise and decline of prosperity which have always been characteristic of fluid business, and which to all appearances will continue to obtain.

The Petroleum Situation

SOME TIME AGO a committee of the American Petroleum Institute issued a report on the oil situation, in which it denied that there was any danger of exhausting or even lowering the supplies of American petroleum, or that there was any undue waste in the production. This was, of course, in refutation of representations made by Mr. Henry L. Doherty to the contrary; and the report was intended to still the troubled waters of inquiry and possible interference. To those who are familiar with the situation it was a palpable whitewashing of the problem; and Mr. Earl Oliver, of Ponca City, Okla., has taken it upon himself to write to the Federal Oil Conservation Board, of Washington, pointing this out and analyzing the Petro-

leum Institute's report in a brief, copy of which he has sent to *Mining Journal-Press*.

As opposed to the committee's report as to inexhaustible supplies, Mr. Oliver points out that the definitely available reserves are sufficient for only seven and one-half years:

"Attention is here specifically called to the fact that in all the immense quantity of reserves as set forth in this report, the last two described items make up the entire amount of unmined reserves actually known to exist and that are not subject to future discoveries or to processes, methods, and sources yet experimental and subject to development. The classes of reserves that might be considered definite and certain and subject to being produced under present methods, even when accepted at the inflated figure given in this report, total only seven and a half years' supply, based upon 1924 consumption. Part of these can be produced only over many years."

The Petroleum Institute report listed as reserves the oil remaining in the sand after the flowing wells are exhausted, the oil in all the oil shales of the country, the oil that could be extracted from coal and lignite, and arrived altogether at a grand total of a thousand years' supply at the 1924 rate of consumption. The glieness of this listing is evident on the face of it, recalling roseate promoters' reports which we have read; and Mr. Oliver truly remarks concerning the possible availability of these substitutes for flowing oil wells:

"Students of the petroleum industry know that current requirements are supplied by current discoveries; that petroleum is a wasting asset subject to definite exhaustion; that each pool discovered and depleted leaves one less to be discovered; that no man knows, or can know, under present conditions of rapid depletion of pools immediately upon discovery, whether a national shortage will occur in three years or fifty-three years. But they do have reason to believe the vast quantity of substitutes listed in the American Petroleum Institute report as reserves will not be drawn upon until after an oil famine will have occurred to force their development."

It is cogently pointed out that the United States will consume in the next twelve years 15,000,000,000 bbl. of oil, an amount greatly in excess of all the oil produced in all the world since the beginning of time.

Mr. Oliver also refutes the popular theory that all that is needed to increase mineral supplies is higher prices. No shallower fallacy than this exists, yet it is frequently cited by men of prominence as a comfortable panacea of mineral supply problems. And Mr. Oliver observes:

"When new discoveries are equally difficult in the other three quarters of the United States as is now experienced in the northern quarter, then supply from present methods will not be responsive to price."

It is quite natural for the petroleum producers, being comfortable, to wish to be let alone and to argue to that effect. On the other hand, the future petroleum situation is a matter which concerns the nation far more than it does the producers.

The Genesis of Lithium Pegmatites

A VALUABLE TECHNICAL PAPER on "The Genesis of the Lithium Pegmatites" has recently been published by Dr. W. T. Schaller in the *American Journal of Science*. There are four chief areas of lithium-bearing pegmatites, in which occur the lithium minerals, lepidolite, spodumene, amblygonite, lithium tourmalines, and other minerals. These areas are: the New England area, chiefly Maine, Mas-

sachusetts, and Connecticut; the Black Hills area in South Dakota; Southern California; and Northern New Mexico. Dr. Schaller's paper is the result of a study of the Southern California field, as Dr. Hess' recent paper in the *Mining Journal-Press* resulted from a special study of the Black Hills field.

In the Southern California field the lithium pegmatites lie in gabbro, and to a less extent in granodiorite. They dip 20 deg. to 30 deg. on the average; and in many cases the upper part is different from the lower part in mineral composition and texture. In many dikes there is a third element—the pay streak—which lies between the two main parts, and contains the lithium minerals and the gem minerals—tourmaline, kempite, beryl, garnet, and topaz. The upper part of the dikes is graphic pegmatite, composed of quartz and feldspar (microcline); the lower half is fine grained and aplitic, consisting of albite, quartz, and garnet bands. In general the lower part grades into the upper part.

The studies of Drs. Schaller and Larsen indicate that the quartz-microcline rock of the upper half of the dikes is the original magmatic crystallization; and that other phases have originated through replacement of this. Albite is a secondary mineral, having replaced both microcline and (later) quartz. Muscovite accompanies or follows albite. Garnet and tourmaline come into the dikes later than albite, and replace it as well as the primary minerals; the lithium minerals are still later and have replaced any or all of the earlier-formed minerals.

Dr. Schaller also cites the report of Lacroix on Madagascar pegmatites, where original orthoclase has been altered into mica, quartz, albite, lithia mica, beryl, and other minerals: from which Lacroix concluded that the lithia minerals are always "the result of the last act in the history of the granitic magma."

These are highly valuable observations, and throw additional light on the sequence of magmatic processes. They may be called, perhaps, phenomena of endomorphism, the result of the alteration of earlier-formed magmatic minerals by magmatic minerals of a later stage—a phenomenon which is widespread in igneous rocks and the importance of which in the granitic family has probably not yet been grasped. Dr. Schaller tends in his thinking to sharply divide the different magmatic stages—believing that the first stage was crystallization from a "molten magma"; the latter ones, which show replacement, from "hydrothermal" solutions. There is no warrant, however, in the phenomena described for this sharp division: these phenomena show successive stages confined to a single dike fissure, which stages certainly illustrate magmatic evolution: accordingly, neither the starkly opposite terms "molten magma" nor "hydrothermal solutions" are justified nor clarifying. Dr. Schaller commits the ancient oversight of assuming that "replacement" must be due to "water," and even does not indicate that this is water of magmatic origin: indeed, he seems to assume that it was not. Yet it has been shown that dry melts may accomplish replacement. It has also been shown that all magmas contain much water. Therefore Dr. Schaller's observations do not indicate, as he suspects, that pegmatitic magmas are not rich in water and other gases; indeed, they demonstrate the correctness of the accepted theory, as, for example, expressed by Lacroix.

Mining Engineers of Note

Melville Fuller Coolbaugh

THE BOARD OF TRUSTEES, in choosing a president for the Colorado School of Mines, interviewed men from every quarter of the United States, pre-eminent as educators, executives, and engineers. In choosing Professor Coolbaugh the board is confident it has a man with an educational vision and a power of leadership, who will mold engineering education in a way to keep pace with new conditions, and especially with those affecting problems in the field of mining and metallurgy. Melville Fuller Coolbaugh, research chemist, practical mining man, and educator, was born in Pennsylvania, but is essentially a Western man, having been closely associated with mining interests of the West for many years. He received his Bachelor of Science degree from Colorado College and for two years was instructor in chemistry at his alma mater. His graduate work was done at Columbia, in New York City, where he received his master's degree in chemistry. Professor Coolbaugh's teaching experience has been in technical schools, he having held the chair

of chemistry at the South Dakota School of Mines and having been assistant professor in chemistry at the Case School of Applied Science, as well as head of the chemistry department at the Colorado School of Mines. He did valuable research work at the Massachusetts Institute of Technology, and during the World War served with the offense division, in the chemical warfare service. For the last eight years Professor Coolbaugh has been identified with mining interests of the West and of Colorado in particular. He is known through the "Sulphating" process, which he and his associates installed and operated at a plant at Durango, Colo. This was an innovation in metallurgy, being a treatment of complex ores by a sulphating roast for recovery of zinc by leaching preliminary to the smelting of the lead in the ordinary blast-furnace plant. Professor Coolbaugh has contributed extensively to scientific magazines on various subjects such as the determination of antimony and lead, the treatment of complex ores, and other contributions valuable to min-

ing and metallurgical engineers. In addition to his ability as a teacher and investigator in chemistry, Professor Coolbaugh has the faculty of enlisting the enthusiastic interest and support of the students, not only in his department but in the institution as a whole.

During the period that he was in charge of the department of chemistry at the South Dakota School of Mines, the school went through several periods of student turmoil, and it is said that it was always Professor Coolbaugh who more than anyone else impressed the students with the fact that the faculty was their best friend after all. In the spring of 1917, Professor Coolbaugh was elected head of the department of chemistry at the Colorado School of Mines, which position he held one year. This sufficed to make him recognized as the strongest man who had ever been head of the department. He resigned in 1918, partly because he wished to undertake war work and partly because he did not feel in sympathy with the administration at Golden. At Washington, he took charge in the last-named year of a group of research



MELVILLE FULLER COOLBAUGH

men, in the development of a practicable method for producing liquid arsine. The work was successful and, when the armistice was signed, large quantities of liquid arsine were on the dock and on the way to France. Professor Coolbaugh's sense of fairness and justice is said to be exceedingly keen. He is credited with marked success in stimulating backward students to greater efforts. At the same time he has little patience with those who display a tendency to shirk. As a public speaker he never fails to interest his audience. There is a certain intensity in his words which immediately arouses the interest and expectation of his hearers.

With him in the office of president, friends of the Colorado School of Mines look forward to a new régime for that institution, in which its prestige shall increase. Apparently there are no elements in the situation at Golden—educational or administrative—which Professor Coolbaugh's personality, technical knowledge and ability cannot harmonize.

Asbestos Deposits of Arizona*

Occur in Four Districts in Gila County—Commercial Ore Found Along Diabase Intrusions in Limestone—Western Markets Essential for Full Development

By John Melhase

Geologist, Southern Pacific Co., San Francisco, Calif.

ASBESTOS was discovered in Arizona in 1872 by Charley Newton, an Indian fighter who, in company with a small force of pioneers, was pursuing a band of Apaches through the upper Salt River wilderness. The pursuit culminated in a battle, which was fought at "72" Springs, so named for the year, and during the engagement Newton came upon an asbestos outcrop, about three miles northeast of Chrysotile, in the Ash Creek district, Gila County, where the largest asbestos mine in the United States is now in operation. More than thirty years ago Newton showed his discovery to others, but no interest was taken in this deposit until after the Hance brothers located asbestos claims in the Grand Canyon 70 miles northwest of Flagstaff, in 1900. This was followed immediately by similar discoveries 30 miles down the canyon near Bass Ferry. The news of these discoveries spread rapidly, and by 1912 attention had concentrated on the Gila County deposits and all asbestos-bearing ground was covered by claims.

DISTRIBUTION OF ASBESTOS AREAS

Districts—Disregarding the Hance and Bass mines in the Grand Canyon, and minor occurrences near Quartzite, Winkleman, and Kingman, the commercial asbestos deposits of Arizona may be grouped into five well-defined districts, all of which are in Gila County, as shown on the map (Fig. 1). These are known as the Mogollon Rim, Cherry Creek, Sierra Ancha, Ash Creek or Chrysotile, and Globe districts.

Mogollon Rim—The Mogollon Rim district occupies an extremely rugged region lying under the precipitous bluffs known as the Mogollon Rim, which forms the northern boundary of the county. It is approximately 50 miles north of Roosevelt Lake and the same distance southwesterly from Winslow. This district, which covers an area of about 120 square miles, has some interesting possibilities, but because of its remote and inaccessible location it is not well known and there has been no production.

Cherry Creek District—The Cherry Creek district embraces an area of about 75 square miles in an elongated strip up the canyon of Cherry Creek. The southern end of the district is 25 miles east of north from Globe. Considerable mining has been done in Cherry Creek, and among the principal mines and claims of the district are the Riga Asbestos Co., Triangle Asbestos Co., Aileen Asbestos Association, and the Reed, Spring, and Fulton groups of claims.

Sierra Ancha District—The Sierra Ancha district is 22 to 35 miles northwesterly from Globe, adjoining the Cherry Creek district on the west. It is an elliptical area of about 60 square miles upon the undulating crest and steep slopes of the Sierra Ancha range. The principal asbestos properties of the district are the Clark

mine, the Riga Asbestos Co. property, and the American Ores mine. The latter is the best-known mine in the state, and is the principal producer of this district.

Chrysotile District—The Chrysotile district lies on both sides of Salt River in a pear-shaped area of about 100 square miles. From Globe, it is 24 miles north 30

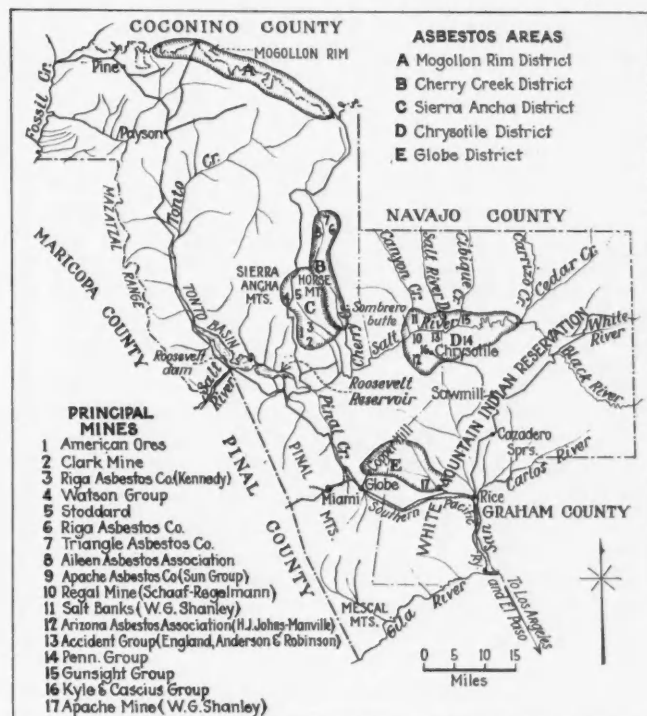


Fig. 1—Map of Gila County, Ariz., showing the five asbestos-bearing districts

deg. east to Chrysotile, which is the center of the H. W. Johns-Manville Co.'s mining activities on Ash Creek. The principal properties in this district are the Arizona Asbestos Association (Johns-Manville), Canadian Group, Regal mine, Accident, Great View, Horseshoe, Snake Hill, Salt Banks, Penn Asbestos Co., Squirrel, Apache Asbestos Co., Gun Sight, Last Chance, Sun, Seneca, Sunset, Fourth of July, Riverside, Malone, Bluejay, and many others. The Johns-Manville mine on Ash Creek is the largest and best-developed asbestos mine in the United States and has been a steady producer since 1912.

Globe District—The Globe district is the newest of the five. Its western extremity is at Copper Hill, four miles north of Globe, and its area is about 60 square miles extending easterly toward San Carlos River. The district is still in the prospective period of development, but good showings of asbestos were noted in prospects at Copper Hill. The principal deposit is at the Apache mine, 14 miles east of Globe and three miles north of Reppy siding, on the Southern Pacific Railway.

That part of Arizona in which the asbestos depos-

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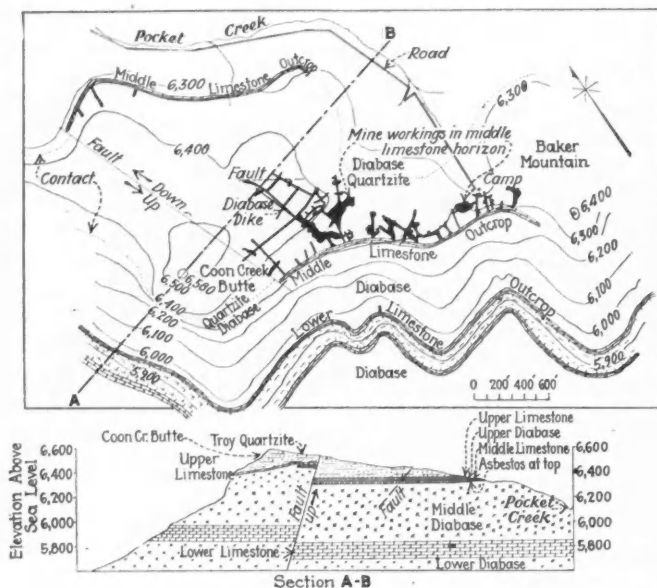


Fig. 2—Map showing the fifteen claims and plan of mine working, American Ores mine

its of Gila County occur may be referred to as the mountain region, in distinction from the plateau region to the northeast and the desert region to the southwest. Elevations range from 2,300 ft. above sea level at Roosevelt Lake to over 7,500 ft. in the Pinal range south of Globe. Salt River, with its numerous tributaries, rises in the western breaks of the plateau region and flows westerly across the central part of the county, through a deep and sinuous gorge. At the western border of the county Salt River breaks through the Mazatzal range in an equally scenic gorge and continues westward across the state. At the point where the river enters this gorge the government in 1911 constructed the Roosevelt dam, which is 280 ft. high and 1,080 ft. in length, and which, when full, impounds 1,575,000 acre-feet of water, known as Roosevelt Lake, which now fills the lower part of Tonto Basin. The hydrographic basin that drains into Roosevelt Lake has an area of 4,200 square miles.

CLIMATE OF GILA COUNTY

The climate of Gila County is delightful during the cooler months of the year, but the summers are hot and dry. The average rainfall at Globe, which is at an elevation of 3,525 ft., is 17.20 in. per annum, and the rains are heaviest during the months of July and August, when cloudbursts are prevalent. During the winter some snow falls on the summits of the higher ranges, but its stay is short.

GEOLOGIC SERIES IN ASBESTOS AREAS

Rocks of many types and geologic ages are found in Gila County. The oldest of these is the Pinal schist, of Archean age, which outcrops in the Pinal and Mazatzal ranges and around Miami. The Mazatzal quartzite in the northern end of this range is provisionally assigned also to the Archean. Granite and related crystalline rocks, mostly of Pre-Cambrian age, outcrop in a broad crescent-shaped area beginning in the southern part of the Mazatzal range and curving south of Roosevelt Lake and up Salt River to Canyon Creek. Rocks of similar character occur about Payson and in the mountains south of Globe. Resting upon these older

crystalline rocks are great thicknesses of sediments, beginning with the Lower Cambrian (Apache series), which includes the Dripping Springs quartzite, Mescal limestone, and Troy quartzite. In the northwestern corner of the county the Apache series is overlain by the Tonto series of Upper Cambrian age.

At Roosevelt dam the Tonto series is absent and the Apache is followed successively by the Martin (Devonian) limestone and the Tornado (Carboniferous) limestone. North of Payson the Redwall (Devonian) limestone outcrops in a wide belt at the base of Mogollon Rim and southeasterly along Salt River Draw and up the forks of Salt River to the county line. Overlying the Redwall limestone are the Supai (Pennsylvanian) formation and the Coconino (Permian) sandstone, which together form the breaks of Mogollon Rim and the uplands of the northeastern part of the county. Mogollon Plateau, north of the Rim, is formed by the Kaibab limestone, also of Permian age.

Diabase Intrusions—An extensive intrusion of diabase is found outcropping at intervals throughout a broad belt which reaches from the extreme southern end of the county northward to Mogollon Rim and from Roosevelt Lake easterly beyond Chrysotile. Since it cuts the Apache series, it is not older than the Cambrian, although it is assigned to the Pre-Cambrian on the new geological map of Arizona. Local irregularities in the prevailing dip are occasioned by the intrusion of great masses of diabase into the lower part of the Cambrian section. The Mescal limestone, especially, has been split along the bedding planes, and the beds are separated by numerous sills of the diabase, some of which are of considerable thickness (Fig. 2). This condition is of great economic significance, for it is only along the contacts of the diabase and Mescal limestone that the asbestos seams are found.

Volcanics of Cretaceous and Tertiary ages occupy extensive areas on the plateau in eastern Gila County and lesser areas near Miami and Globe and in the extreme northwestern part of the county. Basalt flows of Quaternary age occur on San Carlos River in the vicinity of Rice; and the Gila conglomerate and other fluvial deposits of late Tertiary or Quaternary age occupy Tonto Basin, Pleasant Valley, and the lowlands between Miami and San Carlos.

NONCONFORMITY ON PINAL SCHIST

The stratified rocks resting upon the eroded surfaces of the Pinal schist and Pre-Cambrian intrusives succeed one another in apparent conformity. At the top of the Carboniferous, however, a hiatus occurs, the overlying rocks being volcanics of Cretaceous age or younger. Block faulting is responsible for the main structural features. The dominant dip of the older strata is toward the east.

Formation of Deposits—The generally accepted theory of the genesis of the asbestos is that it was formed through the hydrothermal alteration of magnesian limestone induced by the intrusion of the diabase sills. The direct result of the alteration was a zone of serpentine near the contact, the chrysotile being the ultimate result of changes that took place subsequently in the serpentine itself. The asbestos is never found where serpentine is absent, but extensive developments of serpentine occur without any showing of asbestos.

The serpentine occurs in bands which vary in thickness from a fraction of an inch up to four feet or more,

lying in the altered limestone anywhere up to six or eight feet from the diabase contact. The thickness of the serpentine appears to depend largely upon the chemical composition of the limestone beds. Where these are dolomitic the development of serpentine is most extensive. Structural conditions bear definite relations to both the serpentine and the inclosed asbestos. Where the limestone is slightly domed and the roof assumes an inverted saucer shape the thickest ore zones are found; whereas in areas over which the roof is broken and fissured the ore is poorly developed or wanting entirely. Such structural conditions presumably affected the movements of gases and thermal solutions emanating from the diabase sills and which, when confined beneath an impervious caprock, acted upon the serpentine to form the asbestos seams, or if unconfined escaped without forming asbestos.

Conditions throughout the several districts are so similar in respect to geological environment, origin, and character of the asbestos deposits that for the purpose of this description the deposit and mine of the American Ores has been selected as being typical of the whole group.

AMERICAN ORES MINE, IN SIERRA ANCHA DISTRICT

The American Ores mine is owned and operated by International Asbestos, Inc., of Globe, Ariz., the main offices of which company are at 450 South Normandie St., Los Angeles. The property consists of twenty-five contiguous mining claims in the Sierra Ancha district, 36 miles northwesterly from Globe. Fifteen of these claims are on the crest of the Sierra Ancha mountains overlooking Tonto Basin from a mean elevation of 6,300 ft. (Fig. 2). To the north the surface slopes into the canyon of Pocket Creek; and to the south and

west it breaks away abruptly in a succession of cliffs and steep slopes toward Roosevelt Lake. A prominent rim-rock of resistant quartzite encircles the mountain and forms a small mesa on the summit. The mine buildings are near the southern edge of the mesa; and just under the rim are the adits of the mine workings.

Pine and oak timber covers the mesa and the northerly slopes. A spring affords a supply of excellent water for domestic uses. When the mine is running, additional supplies of water are pumped from a large spring in the canyon of Pocket Creek. With respect to the water supply and timber for fuel and mining purposes, the American Ores is more fortunately located than are most of the mines of the region.

Geologic Section of Sierra Ancha—The abrupt southern breaks of the Sierra Anchas expose an excellent section of the rocks. The upper part of the section here exposed, in descending order, is as follows:

Rock	Thickness, in Feet	Character
Sandstone and quartzite . . .	20 to 25	Red, gray, and black
Upper limestone (Mescal) . . .	3	Thin-bedded, highly metamorphosed
Upper diabase	3 to 12	Sill of variable thickness
Middle limestone (Mescal) . . .	8 to 25	Gray dolomitic limestone altered on upper contact to serpentine and asbestos
Middle diabase	475 to 500	Thick sill
Lower limestone (Mescal) . . .	125 to 140	Similar to upper limestone except that contact with diabase is highly metamorphosed and discolored.

The bedding throughout is nearly horizontal save for local rolls in which dips of four or five degrees may be seen. The outcrops of the several members are visible in the southern slope of the mountain and may be traced to the west and around into the canyon of Pocket Creek on the north. The elevations of the key beds are slightly lower in Pocket Creek than they are under the south rim. The outcrop of the upper limestone is continuous and of uniform thickness, whereas

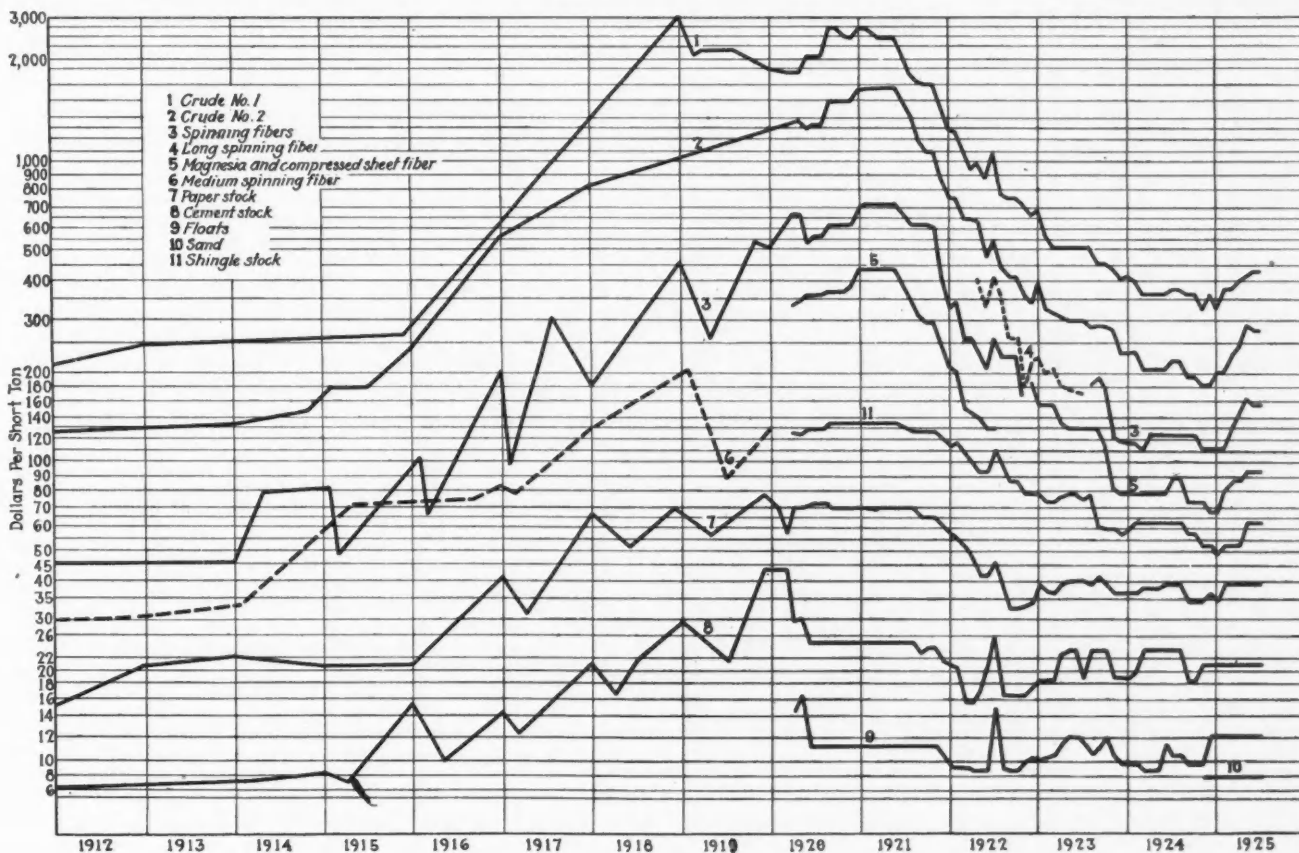


Fig. 3—Chart giving price of various grades of asbestos, f.o.b. mines, Quebec, 1912 to 1925



Surface croppings of asbestos deposits at the Apache mine, east of Globe

the middle limestone appears to be lenticular and outcrops in the north and south slopes of the mountain only. It thins out toward the eastern side of the property. On the west it is terminated by a reverse fault striking almost due north and having an upthrow on the west of 150 ft.

Mescal Formation—The upper, middle, and lower limestones are simply different beds of the Mescal formation, split along the bedding planes and separated by the diabase sills. The sills are referred to as the upper and lower diabase. Both are tongues of the same magma, and they are connected by occasional dikes which have penetrated the intervening middle limestone.

The three limestone members are each of somewhat different chemical composition, and they exhibit differing degrees and phases of alteration by the diabase intrusion. Where large amounts of impurities were present, as in the upper and lower members, the contact surfaces have been baked and silicified to a depth of two or three feet; farther from the contact the limestone has been converted into a dirty gray, coarsely crystalline marble. The middle limestone being free from sand and clay, and containing a high magnesium content, produced serpentine and asbestos upon alteration. The alteration, however, was confined chiefly to the upper contact of this member, and practically all of the serpentine and asbestos are found within six feet of the overlying diabase. The diabase is of greenish-black color, medium grained and of even texture. It is composed essentially of basic feldspar, augite, brown mica, and magnetite. The pronounced decomposition of the component minerals in diabase from the mine workings shows that it has been acted upon by thermal waters since it crystallized. Normal diabase selected from deeper outcrops in the canyon of Pocket Creek does not show this alteration. The sandstone and quartzite of the Troy formation immediately overlying the upper diabase has been baked to a flinty, brick-colored rock.

WORKABLE ASBESTOS DEPOSITS

Practically all of the minable asbestos at the American Ores mine is found in the upper two feet of the middle limestone, although it may occur sporadically in serpentine at other horizons within this member. It is of the chrysotile variety, characteristic of deposits throughout the state. Usually it occurs in wavy intermittent bands alternating with serpentine. Sometimes as many as twenty or thirty alternating bands of these minerals, none of which is over one-half inch in thickness, may be seen in a single ore zone. The asbestos ranges from white to creamy or to pale tints of pink,

green, and brown. Some varieties, viewed lengthwise of the fiber, are translucent and of a beautiful rose or golden color.

Character of Fiber—The fiber lies perpendicular to the contact or parallel to the direction of greatest pressure, which, in this instance, is practically vertical. The average length of fiber is from one to one and one-half inches, although fiber two inches long is abundant, and exceptional specimens of fiber six to eight inches long have been found. Two types of fiber prevail: the soft or silky, and the harsh or brittle, in the proportion of about 75 per cent soft to 25 per cent harsh. The silky type is composed of extremely fine fibers of high tensile strength and is excellent for spinning purposes. The harsh type is brittle and splintery and of lower tensile strength, but most of it can be spun. There appears to be little if any difference in the chemical composition of the two types of fiber, and it is thought that the harshness of the one may be due to a coating and partial cementing together of soft fibers by infiltrations of retinalite, which has the same composition as the chrysotile and therefore could not be detected by analysis. The best grades of fiber occur in bunches or pockets throughout the deposit, and mining has been localized to these pockets, some of which have yielded several tons of the best fiber.

Reserves—The average thickness of the asbestos seams in the minable zone is about eight inches. The area thus delimited is approximately 3,000,000 sq.ft., the maximum area in which fiber may reasonably be expected. The present mine workings cover an area of 750,000 sq.ft., including some blocks of ore which have not been removed. When deductions are made for the worked-out portions of the mine, with a further deduction of one-third for possible barren areas in the ore zone, there still remains an area of 1,400,000 sq.ft. of possible productive ground.

Production—Mine records show that 1,300 tons of Crude No. 1 and 300 tons of Crude No. 2 were won from the present mine workings. In addition to this, thousands of tons of mill fiber were thrown on the dumps or used to fill stopes. Should these proportions hold throughout the unworked area, the ore reserves in the deposit should be approximately 2,400 tons of Crude No. 1 and 560 tons of Crude No. 2. The recovery of Crude No. 2 during previous operations, however, was incidental, and the figures do not represent the true ratio of the two grades as they occur. Screen tests and measurements show the relative percentages of the various grades of fiber to be: Crude No. 1, 5 per cent; No. 2, 10 per cent; No. 3, 35 per cent; and No. 4, 50 per cent. If we assume these ratios to hold throughout the undeveloped portion of the deposit, and that all grades of fiber be saved, the total yield should be: No. 1, 2,400 tons; No. 2, 4,800 tons; No. 3, 16,800 tons; No. 4, 24,000 tons, making a grand total of 48,000 tons of all grades.

MINING METHODS AND COSTS

In the exploitation of the Arizona asbestos deposits mining and transportation costs were the controlling factors. Only the better grades of fiber could be won and marketed in competition with the Canadian and African output. As a result "high-grading" was common, with a deplorable waste of the low-grade fiber. None of the smaller mines was equipped with machinery or mill for the recovery of mill fiber, and consequently the entire output of these mines consisted of Crude

No. 1. At present the Johns-Manville mine and a few of the smaller ones, including the Apache, near Globe, are equipped with mills for the recovery of shorter fiber.

Development Work—At the American Ores mine roughly parallel adits were driven in the middle limestone member, and an attempt was made to block out the ore in approved manner by a number of crosscuts spaced at more or less regular intervals. It was found that the ore seams were undulating and "pockety," sometimes pinching out entirely or else jumping from roof to floor of the limestone lens, thus making it necessary to drive headings of excessive height in order to intersect the sporadic ore seams. The original plan of blocking out the ore and mining the blocks successively was abandoned and mining operations were confined to the pockets or irregular areas in which long fiber or unusually thick seams of asbestos occurred. When such were encountered, large rooms were excavated, often 8 to 12 ft. high, in which the entire thickness of the limestone was broken down, leaving floor and roof of solid diabase. Timber was not required. The waste rock and large quantities of low-grade ore were used to fill the stopes; the high-grade ore was hauled to the surface, where it was hand cobbled, the gangue and all fiber shorter than No. 2 Crude being thrown over the dumps.

Labor—During the period of greatest activity at the American Ores mine about 275 men were employed. Machine drills are driven by a 35-hp. gas engine operating a 9x8 Ingersoll-Rand compressor. The main tunnels and haulageways were driven by contract at \$4 per foot, the contractor furnishing all labor, equipment, and supplies needed in the work. After the main tunnels were completed, the rich ore areas were marked off in blocks about 50 ft. square and leased to miners, usually two men to the block, who mined the ore, cobbled the fiber, and segregated it according to grade ready for shipment. This was all hand work, for which the lessees received payment according to the amount and grade of fiber produced. For Crude No. 1 they received from 8 to 14c. per pound, and for Crude No. 2, 7½ to 12½c. Skilled Mexican asbestos miners were employed, and the average production of crude fiber amounted to 75 lb. daily per man.

Freight—Freight on supplies from Globe to the mine is \$5 per ton of fiber produced; the freight on the fiber to Globe is \$10 per ton. From some of the more remote mines where pack animals are used the freight to Globe is as much as \$30 per ton. Railroad rates from Globe to Los Angeles are \$15 per ton on Crude No. 1; to Chicago, New York, or other Eastern points the rate is \$25.60.

Asbestos properties situated on Indian reservations are leased from the government and are subject to the payment of royalties which amount to 10 per cent on Crude No. 1 and 5 per cent on all other grades. Liberal deductions are allowed for freight, cobbing, milling, and depreciation, in determining the net value upon which the royalties are computed.

THE JOHNS-MANVILLE MINE

The Johns-Manville mine at Chrysotile is equipped with a mill consisting of crushers, cyclones, and screens, which prepares four grades of mill fiber in addition to the more important output of crude fiber. The mine is the largest and best producer of crude fiber in the United States. In 1912 there were 550 men employed

in and around the mine. There are approximately 20,000 ft. of tunnels and drifts on four levels, all connected with two haulage tunnels. The longest of these haulageways extends 1,250 ft. in an easterly direction 90 ft. below the ore deposit. Ore has been mined 2,000 ft. in from the outcrop without reaching the limit of the deposit. The best ore is found at the base of the limestone, where it rests on diabase. At several places good ore occurs in the upper part of a limestone that is overlain by a sill, in close analogy to the occurrence at the American Ores. The usual occurrence of the asbestos is in two zones of three to five small seams each, which reach a combined thickness of 4 ft. The two zones are separated by 4 ft. of altered limestone which contains many nodules of serpentine. The output of crude fiber at the Johns-Manville mine is much greater than that of mill fiber. In this respect the deposit is unique, as the reverse relation prevails at practically all other asbestos mines.

PREPARATION AND GRADING OF FIBER

The only treatment accorded crude fiber at the mines is hand cobbing to remove adhering gangue. The mill fiber is screened and separated into four grades, as follows: No. 1 mill fiber, ¾ to 2½ in. long; No. 2 mill fiber, ¾ to ¾ in.; No. 3 mill fiber, ½ to ¾ in., and No. 4 mill fiber, ½ in. and less. In the Arizona field it has been customary to grade the crude fiber as run of mine between certain lengths, but the present practice is to follow the standard grading methods adopted at the Canadian mines. This is done by means of a screen test. A nest of screens of ½-, ¼-, and ⅛-in. mesh is used. A 16-oz. sample is put on the upper or coarsest screen and the nest is then placed in a shaker, where it is shaken for exactly two minutes. The number of ounces of fiber remaining on each screen and passing through the finest is recorded. This record may read 2 — 9 — 4 — 1, which means that 2 oz. of the sample was over ½ in., 9 oz. over ¼ in., 4 oz. over ⅛ in., and 1 oz. less than ⅛ in. in length. Screen tests as adopted by the Asbestos Mine Operators' Association of Quebec are compared below with tests given in a leading dealer's catalog:

Dealer's Catalog Grade	Screen Test	Operators' Association Grade	Operators' Association Screen Test
Crude No. 1	Average 1 in.	Mill 2 B	4-7-4-1
Crude No. 2	Average ½ in.	Mill X	0-8-6-2
Long spinning fibre	2-9-4-1	No. 1	0-2-10-4
Short spinning fibre	0-8-6-2	No. 2	0-1½-9½-5
Magnesia and compressed sheet fibre	0-6-6-4	No. 1	0-0-9-7
Shingle stock	0-1½-9½-5	No. 2	0-0-10-6
Paper stock	0-0-10-6		
Cement stock	0-0-6-10		
Floats	0-0-J-16		

When spinning fiber is received at the spinning mill



Close-up view of outcrop and waste dumps at American Ores mine

it is placed first in a chasing mill, which consists of a rolling edge-wheel attached to a radial arm and revolving in a trough. This machine crushes the fiber without breaking it and separates it into a fluffy mass ready for winnowing. In the winnowing process a blast of air is used to blow all the minute particles of rock and grit out of the fiber, leaving it ready for the third step, which is termed mixing. The asbestos is placed in the mixing machine with a certain percentage of cotton, the percentage depending upon the nature of the article to be made, and the whole is thoroughly mixed. The mixture goes next to the carding machines, which consist of a series of revolving cylinders covered with leather strips thickly set with minute wire teeth. Here the fibers are combed straight and parallel. From the last cylinder they are stripped by a fly-comb and delivered upon a moving apron, where a set of reciprocating scrapers condense them into rovings or unspun yarn. The rovings go next to coiling cans and from there are delivered to the spindles. After spinning, the yarn is woven into cloth, packing, or other fabrics, with machinery of the ordinary weaving types.

The asbestos mines of Arizona are poorly situated geographically for supplying the Eastern markets with the lower grades of fiber in competition with the Canadian mines. As some of the largest American manufacturers of asbestos products also own mines in Canada, from which they secure most of the raw material used, the question of a tariff on imports does not meet with general approval. The future profitable development of the Arizona deposits is contingent, then, upon a number of other developments:

1. It seems essential to foster and develop manufacturing enterprises on the Pacific Coast to utilize the Arizona material. At present the spinning mill at Downey, Calif., is the only one west of the Mississippi, and its consumption of spinning fiber amounts to one or two carloads per month; the consumption of all other grades in Coast industries is about thirty carloads per month.

2. A number of small mills should be erected at the mines, so that all grades of fiber may be saved. No mine can long survive the systematic removal of high-grade ores to the exclusion of lower grades and remain profitable.

3. A more efficient mining technique should be employed. There is no open-quarry nor steam-shovel mining in this district, and the asbestos occurs in relatively thin sheets that lie nearly horizontal, thereby rendering stoping difficult and expensive. The excessive height of drifts and rooms in the mines means the handling of an enormous excess of barren rock. This practice adds considerably to the cost of production and should be abandoned. Trustworthy estimates show that the cost of American Ores asbestos, f.o.b. Globe is \$185 per ton for Crude No. 1 and \$160 for Crude No. 2. The cost of mill fiber should be \$104 for No. 1, \$57 for No. 2, \$23.50 for No. 3, and \$19.50 for No. 4. Ten dollars per ton of the above costs represents freight charges for hauling the fiber to Globe and cannot be materially reduced.

4. Railroad freight rates to Pacific Coast points are too high. The lower grades of fiber can be brought by water from New York cheaper than by rail from Globe. The establishment of lower freight rates will have a stimulating effect on the Arizona asbestos industry.

Prices of the different grades are shown on the graph

(Fig. 3), which represents the average of the general market quotations for the years 1912 to 1925, inclusive. It does not show the prices which have been paid for job lots of exceptionally long chemical fiber. Selected fiber from the American Ores mine has sold at the rate of \$3.50 per pound, or \$7,000 per ton.

It is estimated that the Gila County mines can produce crude No. 1 and 2 at the rate of 100 tons per month over an indefinite period, and double this amount of lower grades. The maximum output for any one year was reached in 1920, when a total of 2,527,000 lb. of fiber was shipped.

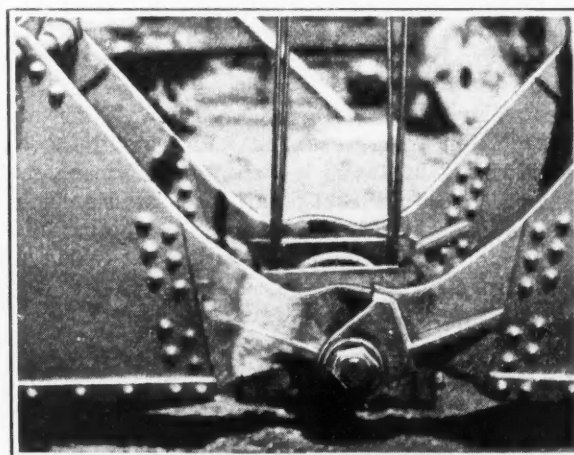
The presentation of the foregoing article was made possible largely through the courtesy of W. G. Shanley, of the International Asbestos, Inc., and John Daniell, engineer of mines, Calumet, Mich., who placed at my disposal every facility and accommodation possible and many valuable data in the way of maps, records, and reports, pertaining to the American Ores and other properties. Further data have been secured from published sources.¹

¹"An Arizona Asbestos Deposit." Alan M. Bateman, *Econ. Geol.*, Vol. XVIII, No. 7; Oct.-Nov., 1923, pp. 663-680. "Asbestos," Sept., 1921; Feb., 1924; July, 1925. U. S. Geol. Surv., Mineral Resources, 1917, 1918, 1919, 1920, and 1921. *Engineering and Mining Journal-Press* for 1924 and 1925.

Repairing a Broken Clamshell Bucket in Two Hours by Welding

Right in the middle of an important unloading job at a manufacturing plant, a clamshell bucket was put out of operation with a broken cast-steel ear. This tied up the unloading crane and embarrassed the plant considerably, both because it held up the supply of needed material and because demurrage on freight cars was threatened. It would have taken several days to secure a new part for this bucket and then considerable time would have been required to install it. However, the plant was equipped with oxy-acetylene welding apparatus, so the welder was called upon to repair the piece.

The casting was about $\frac{3}{4}$ -in. thick with a rib through the center. The parts were put in alignment and prepared for welding by cutting out a "V" with the oxy-acetylene cutting blowpipe. After carefully cleaning away the slag the break was then welded. The total time required for this work, including preparation and welding, was about one and a half hours. Within two hours from the time the break occurred, the crane was back to work.



To repair a broken ear on this clamshell bucket by oxy-acetylene welding took one and a half hours

Ancient Copper Mining and Smelting in Central Africa

*A Huge Tonnage Was Produced Before Coming of the White Men, as Great Excavations Over an Area Stretching from the Transvaal to the Sahara Indicate—
Malachite the Ore Most Generally Used*

George L. Walker

2 Coleherne Road, London, England

MANY MILLION TONS—perhaps in the aggregate ten million or more—of rich copper ore had been mined and smelted in central Africa before the interior of the continent was penetrated by the first white man. Nearly all of the ancient workings, including pits, quarries, trenches, and other excavations, are there today. A few have been obliterated, giving way

been worked at three or more widely separated intervals, quantities of soil having accumulated in them between times, in which trees had grown to considerable size. One observer became convinced, as a result of his study, that at much earlier periods the operations had been conducted systematically and on a considerable scale. Others believe, however, that the vast excavations have



Panoramic view of some of the ancient workings found at the Star of the Congo mine, Union Minière du Haut-Katanga

to vastly greater pits, from which the ore is being scooped by monster steam shovels, but most of these were photographed and studied before being disturbed.

Extensive excavations are to be found wherever copper ore comes to the surface over a stretch of nearly 2,500 miles, the African copper belt extending from Messina, in the Transvaal, to the edge of the Sahara Desert in the Sudan. In the Katanga, which comprises the southeastern corner of the Belgian Congo, and in adjoining Northern Rhodesia and Southern Rhodesia, ancient workings are conspicuous, and there they have been studied by several skilled mining engineers and metallurgists.

When the prospectors of the Tanganyika Concessions, Ltd., entered the Katanga twenty-four years ago, mapped the country, and pegged the copper-ore outcrops where now are the mines of the Union Minière du Haut-Katanga, they located more than 150 separate ore deposits, nearly every one of which was marked by more or less extensive "native" workings. The largest of the many pits is described by a most reliable observer, who was among the first arrivals, as being a great oval, 600 ft. across and 200 ft. deep. This particular pit had no waste dump, all of the vast tonnage of ore taken from it having been carried some seven miles to the bank of the nearest river (the Kafue), there to be dressed and smelted.

The natives, negro savages, were still mining and smelting copper ore then, and for that matter they have continued the work up to the present. Evidence was found that some of the larger pits and trenches had

resulted from intermittent operations on a very small scale by the natives over a period of thousands, perhaps tens of thousands, of years.

Fortunately, it is not necessary in this case to resort wholly, or even largely, to scientific deductions and theory. The methods of mining and ore dressing and the smelting process of the native Africans have been described by several who personally have watched their operations from beginning to end. As it is in this generation, it undoubtedly has been for perhaps hundreds of generations past.

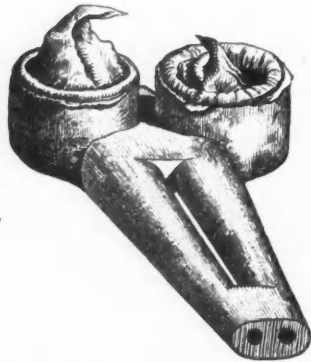
African natives mine, and apparently have always mined, for malachite, the green carbonate of copper. This mineral lends itself to their process of smelting, and it is abundant in the copper ores of central Africa. The several copper oxides would also yield well, but whether the natives knew this fact cannot be ascertained. The art of smelting copper silicates or sulphides was not understood by them.

The method of breaking the ore practised by the ancients as well as by the natives of today was to pound it with a rock held in the hand. Mining was therefore largely confined to the softer deposits. Streaks and veinlets of malachite were followed, and scattered bunches of it dug out wherever the ore was most easily broken. In many places great mounds of waste ore and rock accumulated, these often being found to contain enough copper to warrant their treatment in modern plants.

After the ore was broken down, it was collected in baskets, usually by the women, and taken to a stream

An ingenious bellows of pottery and goatskins.

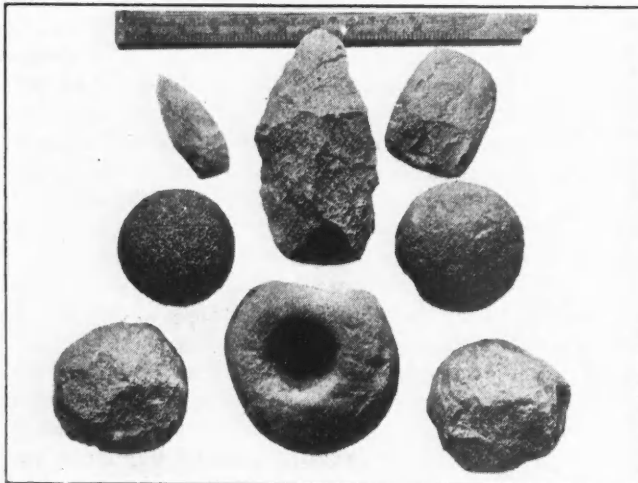
This form is said to be used by natives all over south and central Africa when smelting iron ore. Worked reciprocally with right and left hands, it supplies a continuous blast of air to the iron furnaces, which usually are nothing more than shallow holes dug in the ground. A less elaborate contrivance is used in copper smelting.



to be washed and concentrated. According to one observer of native methods, the baskets of ore were first set down in swiftly running water, where the current soon washed the dirt and the pulverized rock away through the openings between the reeds, the heavier copper mineral remaining. Then the ore was picked over by hand, all pieces of waste were eliminated, and the washing was continued until nothing but the clean copper mineral was left.

The smelting furnace was commonly made of ant-hill clay. It was usually so small, particularly the most modern ones, that only five to ten pounds of copper was recovered from a single charge. Many older furnaces were found in the Katanga region that were somewhat larger, but these no longer were used. There is no evidence, however, upon which to base the belief that furnaces large enough to smelt more than 100 lb. of copper at a charge ever were built, or that the natives knew how to run their furnaces continuously. It has been the custom in more recent times to build a furnace to smelt a small amount of ore, and then to break it down to get the copper out.

In charging the furnace a layer of charcoal was covered with a layer of the carefully cleaned ore, then more charcoal, followed by more ore, until the inside space was well filled. The fire having been kindled, the air blast was supplied by two goat skins, which had been taken from the animals whole, as gloves are stripped from the hands. To the opening at one end were attached two strips of wood, to which the operator's hand was made fast in such a way that by extending and contracting his fingers and turning his wrist he



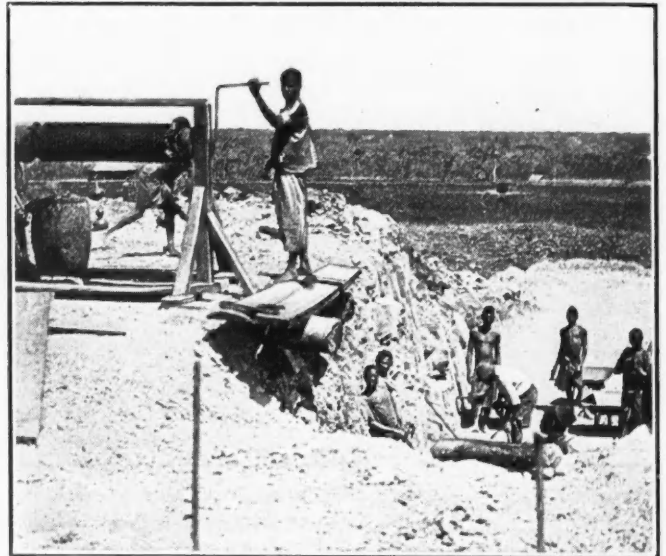
"Stone Age" implements found at Katanga.

The ax head of hematite shown at the upper right was covered by 13 ft. of alluvial drift and discovered when excavating for the foundation of the Union Minière smelter. At the top is a foot rule, included to give an idea of the sizes of the several implements.

could open and close the opening at will. The other ends of the skins were supplied with bamboo tubes, which were connected with the aid of clay to two holes in the bottom of the furnace, these serving as tuyères. One operator worked the two goat-skin bellows by alternate up-and-down movements of the right and left hands, making the air blast continuous.

Interesting in this connection is the fact that when asked the name of an ancient mine the natives almost invariably replied "Kurukuruku." There were so many "Kurukurukus" in the Katanga region that one visitor persisted in his questioning until it developed that the name came from the noise made by the bellows when blowing the charge and melting the ore in the smelting furnaces.

By this process the natives of Africa today produce



Large ancient workings often were found buried under ancient waste dumps

copper that is very pure and ductile. Some of it comes out of the furnace in bad condition and is resmelted. One investigator reported a slag that assayed 45 per cent copper. The amount of slag produced, however, was small.

The copper smelted by African natives in their tiny furnaces formerly was drawn into wire of many sizes, and also was fashioned into axes, lances, and hoes. Quantities of it were made into forms resembling a horseshoe with the ends closed. These were both small and large, some weighing as much as 10 lb., and were used in trade as money. All the products mentioned were of hammered work. Many castings, also for money use, have been found shaped like the capital letter I, some of which contain up to 100 lb. of copper. Forms resembling St. Andrew's cross also are numerous, the bars of these rarely being at right angles.

The African native's custom of wearing spirals of copper wire as armlets and leglets, also heavy rings of the metal as anklets, is probably of remote origin. The natives today cannot explain why these ornaments are worn. Evidently, as so often the case, the superstition which prompted the custom has died, the custom itself remaining. Livingstone came upon a native smith drawing copper into wire by hand, and described his method. This was in a region never previously visited by a white man. I have seen small native African swords of iron, the hilts and sheaths of which were

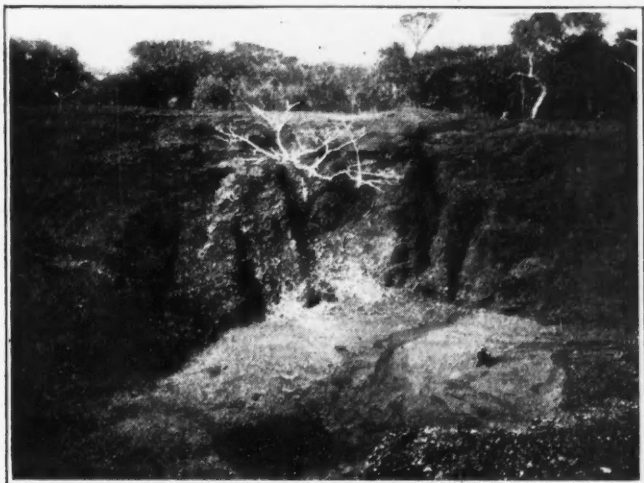
ingeniously covered with closely wound copper wire, as fine as sewing thread. These swords are still made by some of the natives.

NO "BRONZE AGE" IN CENTRAL AFRICA

What properly could be called a "bronze age" never existed in central Africa. Among the numberless copper weapons, tools, and ornaments found all over the southern half of that continent, not one of bronze apparently has been found. Adjacent to the copper mines at Katanga are extensive deposits of tin ore, both in veins and in the alluvial gravels. No native workings, however, neither large nor small, were found in these.

An age of copper likewise apparently never existed in central Africa. The use of stone in mining, and by the smiths as anvils and hammers, appears to have been continued until relatively modern times. In the course of his extensive early explorations, Livingstone became convinced that iron had been smelted in savage Africa from the most remote times. He found fragments of iron furnaces and iron slags almost everywhere, even deep down in the old silts of the Zambesi River. It was his opinion that the Africans were smelting iron to make weapons at a time when the progenitors of the white race were "grubbing up flints to save a miserable existence by the game they might kill."

Acquisition of a knowledge of the art of smelting iron did not cause the smelting of copper to be abandoned. Knowledge of iron smelting undoubtedly prevailed in



Ancient excavation in copper ore at the Kipushi mine (Union Minière du Haut-Katanga), in the Belgian Congo, central Africa.

A portion of the great oval pit which is 600 ft. across and in places 200 ft. deep, as it appeared in 1902.

the Katanga region for centuries, during which the smelting of copper continued. There are extensive deposits of iron ore near the copper mines, and in some cases iron axes and hoes have been found in the ancient copper pits and waste ore dumps.

Where or when the art of copper smelting originated is a matter on which one can only speculate. Copper ores undoubtedly were smelted by the ancients in the southwestern United States and in Central and South America. The Incas of Peru smelted copper quite extensively, and with tools made from it shaped the stones for their numerous immense temples. Some have refused to believe this, because of the softness of copper and the hardness of the stones used by the builders; but, just as lens-glass, by feeding in diamond dust, is



Native workmen cleaning out one of the ancient excavations at the Star of the Congo, preparatory to starting modern mining methods.

cut with soft metal saws, so the Incas probably pounded the stone until their copper hammers were well filled with quartz particles and then used the quartz-laden faces to abrade and polish the blocks of stone to the desired shapes.

That man used stone implements before copper, and then bronze, followed by iron and finally by steel, is a theory which always will be popular because of its plausibility. Of some particular groups of people it probably is true; but it should not be forgotten that M. Frederic Troyon describes certain stone axes found in Bohemia, in what appeared to have been a primitive factory, as the cores from the holes cut through the ax heads were found with them. Troyon wrote:

"These cores when placed in the holes from which they had been taken (easily verified by the corresponding veins of the stone) left so little play-room that it was evident they could only have been detached by a metal point, and not



Another view of the ancient workings at the Kipushi mine.

What here looks like a watercourse is a branch excavation from the great oval.



A portion of the surface at the Luishia mine, Union Minière du Haut-Katanga.

This is only one of scores of vast excavations in copper ore, which were found by the first white men who arrived.

by a hollow cylinder, which could not have given the hole its conical form, now quite apparent. Instead of the soft iron which is employed nowadays in such operations, the ancients used copper or bronze; and, of course, water and siliceous sand were likewise employed in the process."

This eminent antiquarian seems to have believed that the men of the Stone Age used copper tools to make their stone weapons.

Iron weapons are not found in the most ancient cave and lake dwellings, for had they been there rust long ago would have destroyed them. Even had iron weapons preceded those of copper and bronze, discoveries by excavation would make it appear, for this reason, that iron came later than those of the metals which last indefinitely.

It has been suggested that the natives of Africa were taught the arts of copper smelting and iron smelting by the Arab slave traders who began working their way into the interior of the continent 1,400 years ago. If so, why could they not have taught the natives to make steel and bronze, and not merely to smelt iron and



An opening in the "black ore" at the Star of the Congo, which disclosed a unique and valuable deposit of copper-cobalt ore.

The ancients knew nothing of cobalt. They were after the rich bunches of malachite that are found here.

copper? Certainly it was not the Arabs who taught the Indians of Central and South America to smelt copper.

The Arabs had their certain restricted spheres of influence in Africa, whereas iron smelting was practised throughout the length and breadth of the continent, and copper smelting over the vast area where ores of that metal occur. The Katanga copper belt alone is 225 miles long by 30 to 60 miles wide. At the Bwana M'Kubwa mine, farther south, a long and deep artificial canyon was formed by the excavation of a rich belt of ore by ancient and modern miners. There are vast workings at the Kansanshi mine, in Northern Rhodesia. One of the most extensive workings is on what the Southern Rhodesia Base Metals Co. called its "Alaska" property. There the soft ore has been mined down over a very large area, leaving the hard ore standing in high



Gorge-like excavations of this character, showing where the ancients had mined rich veins of malachite, almost covered the surface at the Star of the Congo. The men included in this photograph for comparison of size are almost invisible.

pillars. Far to the south of this in the Transvaal, and also more than 2,000 miles to the north of it in the Sudan, the ancients made extensive openings in copper deposits.

It is probable that the Arab traders after their arrival in the Katanga region quickened the copper producing activities they found there. In "Purchase's Pilgrimes or Hakluyt Posthumous," first published in 1625, an English sailor, recounting his experiences during the many years he was held prisoner by the Portuguese in Angola, tells of the large numbers of slaves who came down from the farthest interior bringing copper for shipment from Benguella. That copper undoubtedly was from Katanga, as there was an old slave trail well worn from Katanga to Benguella, a distance of 1,300 miles. Cameron went out over that trail when he crossed Africa on foot; Arnot went in by the same trail when he got the material, in 1883, for his book, "Garenganze," in which he described some of the copper mines being worked at Katanga by natives, and it is along that old slave route that the Benguella railway is now being constructed to serve the Katanga copper mines.

That the copper mines of central Africa were worked first by the men of the Stone Age, or a stone age, is strongly indicated by a number of stone implements collected by F. E. Studt, who went to Katanga as geologist of Tanganyika Concessions in 1901 and spent many years in that country. He took several of the photographs which illustrate this article. The one showing the implements represent some that were sent to the Terveuren Museum, at Brussels, in 1912. At the upper right in the picture, an ax head is shown which was found at a depth of 13 ft. in alluvial drift when excavating for the smelter foundations at Katanga. Conditions were such as to indicate that a long period had been required for this drift to accumulate. The two spheroidal stones evidently were used as hammers in mining, as they were found in old workings of the Star mine. At the bottom of the picture is a "hole-stone." These have been found over a wide area in Africa, and also in Europe. It is supposed that they were used to weight the pointed sticks with which the soil was dug up by agriculturists before the advent of the plough.

The stone implements shown, though some of them must be extremely old, are all man-size, not pygmy-size. If the pygmies be accepted as the original inhabitants of central Africa—the unvarying conclusion of students—these implements must have been used by their successors. It may be reasonably surmised that the ax head which had lain there until covered by 13 ft. of alluvial drift was used when copper-mining operations in the Katanga region were young. Being of massive hematite, this ax head not unlikely was discarded in favor of a copper one. It hardly can be believed that ax heads would continue to be made of iron ore or to be used by a people who had discovered the art of smelting copper.

Bronze was used in ancient Egypt in the Fourth Dynasty, 4700 to 3800 B.C., and copper objects were found in prehistoric remains which go back to a much earlier period. As to when copper and iron smelting began in Europe and in Asia, knowledge is lacking. Is



This vast artificial canyon was made by mining out a rich belt of ore. It is at the Bwana M'Kubwa mine, in Northern Rhodesia, and is 1,500 ft. long.

it not probable that the knowledge of these arts was carried north, east, and south by a great people who long ago had occupied the then fertile area which is now the Sahara Desert, and who were forced to emigrate by the gradually growing dryness of that region? These arts were known all around the Sahara, much as if they had exuded from it.

Modern man does things quickly, and consequently is prone to reason that all great works of the past were accomplished in brief periods. The observers of the vast excavations in the copper ore deposits of central Africa entertain differing views, but all are of the opinion that productive operations of great magnitude, comparable even to those being carried on today, must have marked some comparatively recent period. The Arab slave traders, or the early Portuguese invaders, or some other people who had the ability to organize the natives industrially, may, they think, have operated the mines and used the copper in internal trade to purchase other things desired.

But copper smelting was known and practiced by the natives over an area nearly 2,500 miles long and hundreds of miles wide. If they had been enslaved and forced to mine and smelt copper, would they have continued afterward to do it as individuals or as tribes? The Indians of Peru never again practiced the industrial arts, once the yoke of servitude of the Inca socialist monarchy was broken. If, on the other hand, copper smelting had been handed down from the most remote times, the art probably would not have been abandoned after a period of even the most galling forced servitude.

Stories and records of the earlier human overseas trade fail to tell of any considerable amount of copper ever coming out of central Africa. The great quantities



Walls and monuments of hard ore left by the ancients when they excavated the soft copper ore.

These pillars and the now widely spread waste dumps are conspicuous over such an extensive area at the Alaska mine (Southern Rhodesia Base Metals) that this has been declared to be "the largest native working in Africa."

of copper ornaments, tools, weapons, and other things scattered everywhere seem satisfactory proof that nearly all of the vast production was disposed of in home trade. In the use of the word "vast" there is no exaggeration. The extent of the ore excavations warrants the estimate that a million tons of copper had been produced in central Africa before the coming of white men. Almost ten and a half million tons of copper was produced in the entire world during the whole of the nineteenth century, by modern miners with their high explosives, steam-power machinery, improved mills, and gigantic smelters.

Had anything like this enormous amount of copper been produced quickly, or even within two or three generations, it hardly could have been disposed of with advantage in trade to a people who at best never had much of exportable materials to give in return. Production on a large scale under the direction of either Arabs or Portuguese hardly could have failed to bring about the development of larger furnaces for smelting than ever have been discovered in central Africa. If the mining and smelting always was done as it was being done when the first white men arrived, however, the immensity of the time required to effect such vast excavations is impressive.

Flotation Process Was Inspired by Champagne?

The printed opinion of District Judge Soper in the recent case of the Wolf Mineral Process Corporation vs. Minerals Separation North American Corporation contains much that is of interest, pertaining to the early history of the flotation process and the work of Sulman, Picard, and Ballot. Champagne, it seems, offered the inspiration or at least the idea to the original discoverers:

According to the chemists [Sulman and Picard] the origin of the successful idea is found in an incident which took place at a dinner at the end of June or the early part of July, 1903. A grape was dropped into a glass of champagne. The bubbles generating from the wine adhered to the surface of the grape and raised it to the top of the wine. They would then break, whereupon the grape would sink and gather fresh bubbles, and the process was repeated. It seemed to the partners that there was a tendency of the bubbles to attach themselves to the slightly greasy surface of the grape where it had been handled by the fingers. They wondered if bubbles of air might not be used in the separation of ores.

The incident of the floating grape was communicated to Ballot, and provisional specifications applying the idea to ore concentration were filed on July 23, 1903. Soon thereafter, however, the partners discovered the publication in a chemical journal of the Froment patent of 1903, which showed that their invention had been anticipated. Subsequently, in August, the Cattermole, Sulman, and Picard application of 1903 was filed. The subject matter of this patent was the use of soap to coat to a very slight degree mineral particles with a layer of an oily substance, accomplished by dissolving and decomposing a small quantity of soap in the pulp containing mineral particles. When the mixture was subjected to the Cattermole method of agitation, the particles became agglomerated into granules. Carbonic acid gas was then liberated into the mixture, which

attached itself to the granules and raised them to the surface. Later in September, Sulman and Picard applied for British Patent 20,419 of 1903, known as the Bubbles Patent, whereby the mineral particles were brought to the surface by bubbles of gas or air blown into the pulp. In these processes a froth was not formed, but such flotation as took place was due to the surface tension of the water. None of these processes was a practical success and all of them were abandoned, but they indicate quite clearly the beginning of the employment of air as a flotation factor.

Building a Tank 1,650 Ft. Underground

Many interesting applications of oxy-acetylene welding and cutting demonstrate strikingly the adaptability of the process to unusual conditions. Being light and easily portable, a welding or cutting outfit can be used in out-of-the-way places and unhandy locations where it would be impossible to employ other methods for joining or severing metal. A spectacular illustration of this is a recent welding job done at a copper mine in the Southwest, according to a recent issue of *Oxy-acetylene Tips*.

In this mine a spring of water was found on the 1,300 level. Unlike most mine water, it was pure enough to be used even as drinking water. For this purpose and for use with various machines, it was desired to run the spring water into a tank. The best location was in a drift from the main tunnel on the 1,650 level. By blasting out the drift at the end, and by raising a few feet a room for the tank was made. The tank was to be of 1,600-gal. capacity, 6 ft. on each side, built of $\frac{1}{2}$ -in. boiler plate. A tank of this size and weight could not be built on the surface and lowered underground—the shaft wasn't big enough. It was therefore necessary to build it in place.

A riveted tank was out of the question; there was not room to work outside and inside all at the same time. The mine, a non-gaseous one, used oxy-acetylene welding and cutting extensively in both surface and underground operations, so it was promptly decided to weld the tank underground.

A platform was first built up in place. Boiler-plate sections were cut to size and prepared for welding in the boiler shop on the surface, and were lowered to the 1,650 level. Here they were put into position on the platform and welded into place. To make the welding as convenient as possible under the cramped conditions (there was a clearance of only $1\frac{1}{2}$ ft. between the side walls of the tank and the drift), the tank was arranged so that it could be swung around in various positions to give the welder as much room to work in as possible. Welding was not a very comfortable job, as on this level of the mine the normal temperature is as high as 112 deg. F.

It took three eight-hour shifts for one welder and helper to do this job. When the tank was completed it was found to be tight in every seam and perfectly square. In addition to the seams, all nipples and pipe connections in the tank were welded. The entire cost was about \$150.

A 2-in. hole was drilled with a diamond drill from the spring on the 1,300 level to the tank, and a pipe was run to the tank from the spring. In this way pure water was made available on the 1,650 level without pumping.

Cyclone Dust Collectors for Recovering Zinc Oxide

Details of Design and Operation—Most of the Solid Particles Can Be Easily Caught—Cooling Area Also Provided

By W. C. Smith

Metallurgist Baltimore Copper Smelting & Rolling Co.,
Baltimore, Md.

SEVERAL YEARS ago, I was confronted with the problem of recovering a large amount of zinc oxide from the gases of converters treating scrap brass. The oxide burden of the gases varied considerably at different stages of the operations, being heaviest soon after the addition of each fresh charge of brass to the converter. The peak dust burden lasted from fifteen to thirty minutes, gradually decreasing for the remainder of the blow.

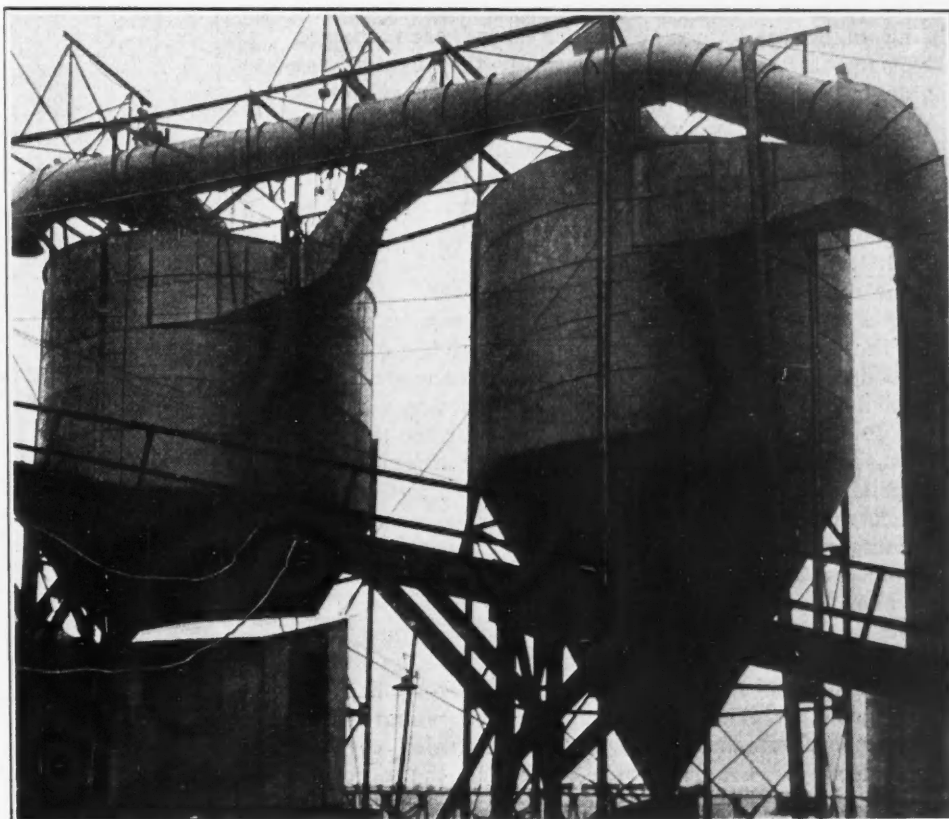
A small experimental baghouse was erected to collect a representative sample of the zinc oxide. This baghouse contained ten cotton bags, 10 in. in diameter and 10 ft. long; the effective bag area was approximately 270 sq.ft. A sample of the converter gas was drawn through a small cooling flue and forced through the bags by a small fan. This equipment would handle from 250 to 300 cu.ft. of clean air per minute with a pressure drop across the bags of $\frac{1}{2}$ in. of water, but, when handling the converter gas, the pressure across the bags increased and the volume of gas filtered decreased rapidly. Tests proved that to obtain a reasonable rate of filtration through the bags, either they must be shaken at short intervals or some of the oxide must be removed from the gases before they passed to the baghouse.

A small dust collector of the tangential or "cyclone" type was placed in the gas line just ahead of the fan. This collector was a gas-tight, sheet-steel cylinder, 3 ft. in diameter and 6 ft. high. The inlet pipe, 6 in. in diameter, was attached tangentially to the side of the cylinder just below the top. The outlet pipe, 6 in. in diameter, extended vertically through the center of the top of the cylinder for a distance of 2 ft. 8 in. A gas-tight clean-out door was provided on the side, near the bottom of the cylinder. Several tests with this arrangement gave discourag-

ing results; little or no oxide was caught in the collector after several hours' operation.

A sheet of mica was substituted for the steel clean-out door and the action of the gas in the collector observed. The swirling action of the gases extended to the bottom of the cylinder and swept all of the oxide to the outlet pipe, so two sheet metal baffles were placed in the collector to form four pockets and to check the swirling action of the gas in the lower portion of the collector. The first test with the modified collector gave surprising results; 55 per cent of the oxide was removed from the collector and 45 per cent from the baghouse. Subsequent tests gave collector recoveries ranging from 40 to 68 per cent of the total oxide carried by the gas.

The data from many tests indicated a direct relation between the efficiency of the collector and the volume of the gas being handled; the oxide burden of the gas also had some bearing on the efficiency of the collector. The best recoveries were made when the apparatus was handling approximately 100 cu.ft. of gas per minute, with a heavy oxide burden, under which condition the collector caught from 58 to 68 per cent of the total oxide. The pressure drop across the collector averaged 3.8 in. of water, and the bags had to be shaken once an hour to hold the bag pressure



Large cyclone separators, taken during construction before dampers and discharge pipe had been completed. Size can be noted by comparing size of man standing on inlet pipe to No. 2

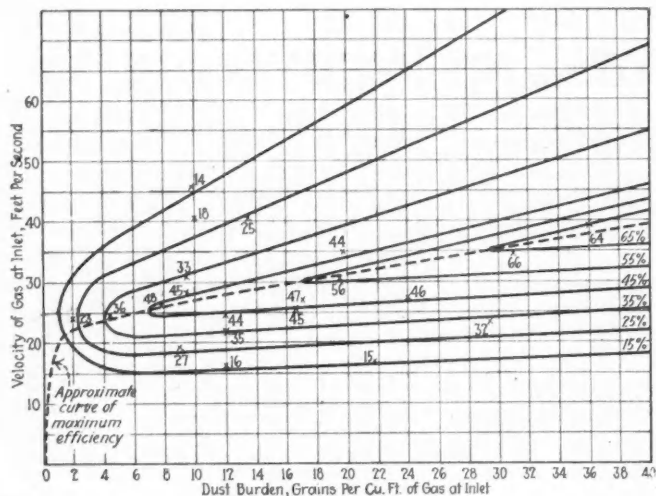


Fig. 1—Relation of dust burden and inlet velocity to the collector efficiency

below 3/4 in. of water. The recoveries made by the 3-ft. collector were so promising that it was decided to erect and test a larger collector.

Wagner¹ gives a considerable number of interesting facts relative to the design of cyclone dust collectors. He says, "The volume of the cylindrical portion or body of a collector should be equal to between 0.75 and 1.50 per cent of the hourly gas volume. The diameter of the body of the collector should be equal to 2.3 of its height." Based on his data, a steel collector 10 ft. in diameter, 6.66 ft. high, having a 60-deg. inverted cone bottom, was constructed. Both inlet and outlet pipes were 10 in. in diameter. A baghouse, cooling flues, and fan of proper capacities were also provided.

Tests with this equipment checked the results obtained with the smaller collector. Changes were made in the size and shape of the inlet connection and in the diameter and length of the outlet pipe, several tests being made to determine the effect of each change. Experiments also were made to study the effect of the oxide burden of the gas upon the collector efficiency. Results showed that a rectangular inlet connection, whose vertical to horizontal dimensions had a ratio of 8 to 1.5, in which the gas velocity was approximately 30 ft. per second, gave the best results. Increasing the diameter of the outlet pipe above that of the inlet had little effect on either the efficiency of the collector or the drop in pressure across the collector. Best efficiencies were obtained when the outlet pipe projected into the collector for 75 to 85 per cent of the depth of the body of the collector. The collector recovered little oxide during periods when the dust burden was less than four to five grains per cubic foot, but the recovery increased rapidly with heavier dust burdens. The material caught in the collector was very light, weighing between 10 and 18 lb. per cubic foot, and had a tendency to build up on the slopes of the 60-deg. cone bottom, probably because the low temperature of the gas allowed moisture to condense with the oxide. The curves in Fig. 1 were plotted from data obtained from many tests and show the approximate relation of the dust burden and inlet velocity to the collector efficiency.

Temperature readings taken at several points in the experimental apparatus gave data on which to base calculations of the rate of cooling for the different

parts of the apparatus. Results indicated that the collector had from 70 to 80 per cent of the cooling value of vertical cooling pipe per unit of surface. The average rate of cooling for the entire system was found to be 0.016 B.t.u. per square foot of surface per degree difference between the average gas and atmospheric temperatures per minute.

A small dust collector, for which the maker claimed remarkable efficiencies, was purchased and tested. The maker rated the collector at much higher gas capacities than we had been able to put through the 10-ft. collector. Tests proved the maker's rating to be much too high, at least for zinc oxide. Best results were obtained at approximately one-quarter of the rated capacity, and even then the collector recovered only 22 per cent of the oxide.

A duplicate 10-ft. diameter collector was then erected adjacent to the original one. The exit gas from the first collector was drawn through the second collector and then through the baghouse. Results of tests with this arrangement are shown in curves (Fig. 2) plotted from the average results of many tests.

The large amount of high-temperature gas from the brass treatment operations to be filtered necessitated a large amount of cooling surface. Tests with the experimental apparatus indicated a cooling value for the collectors of approximately 70 per cent of that of cooling pipe, per unit of surface. Cost estimates per unit of cooling surface favored the collectors; hence it was decided to install two collectors in series to handle all of the gas. Two collectors identical in size were erected, 35.5 ft. in diameter, 24 ft. high in the body

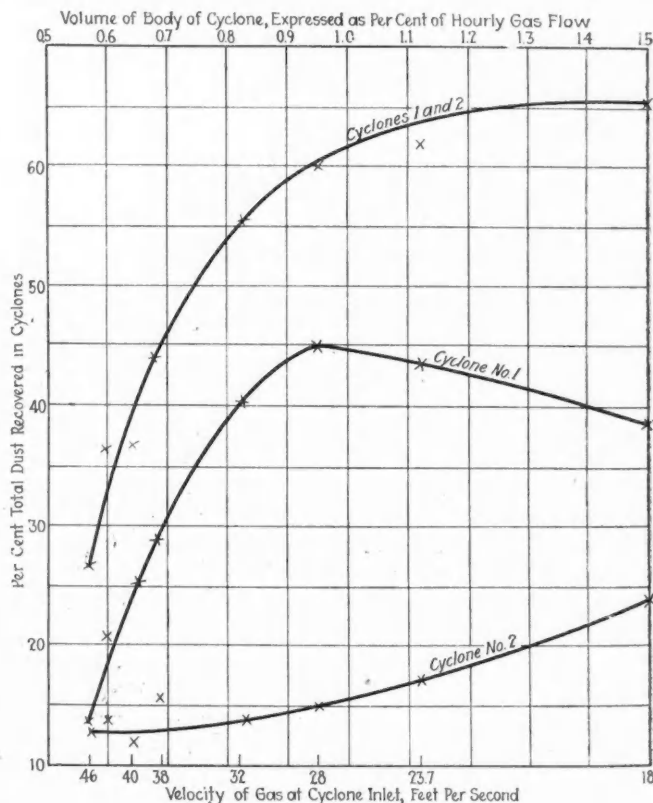


Fig. 2—Results of tests with two separators in series

portion and having cone bottoms 28 ft. high. These are shown in the accompanying photograph. The inlet connection was 10 ft. high by 2 ft. wide; the outlet pipe was 5 ft. in diameter and extended downward

¹"Cleaning of Blast-Furnace Gases."

25 ft. from the top of the collector. A 12-in. diameter rotary dust lock sealed the bottom of the cone and discharged the dust to a belt conveyor.

No provisions were made to weigh or measure the dust collected by the different parts of the flue system, but observations made of the dust discharged to the main collecting conveyor indicated that the collectors caught at least 50 per cent of the total dust. The oxide exhibited no tendency to hang in the cones of the collectors, as the high temperature of the gases allowed no moisture to condense with the oxide.

The flue system was divided into three parts as follows:

	Square Feet
First coolers, 5 ft. diameter vertical pipe.....	8,000
Cyclones, 2, each 35.5 ft. diameter.....	14,000
Second coolers, 5 ft. diameter vertical pipe.....	13,800
Total cooling surface.....	35,800

Temperature readings, after several months' operation, gave the following average results:

	Deg. F.
a. Inlet first coolers	545
b. Inlet first cyclone	371
c. Outlet second cyclone	254
d. Outlet second coolers	153
e. Temperature of atmosphere	72

Average weight of gas passing through flue system, 1,813 lb. per minute. Weight of gas under standard conditions, 32 deg. F. and 29.92 in. of mercury was 0.087 lb. per cubic foot. B.t.u. radiated per minute per square foot of surface per $(t_f - t_a)$ where t_f = average temperature of gas in flue; and t_a = average temperature of atmosphere: First coolers, 0.0223; cyclones, 0.0130; second coolers, 0.0182; over-all, 0.0149. Average pressure drop across two cyclones, $\frac{3}{8}$ in. of water.

CONCLUSION

Complete removal of dust or fume from metallurgical gases by means of cyclone separators is improbable, but under certain conditions the use of cyclones may prove advantageous. The installation of cyclone separators can be justified when (a) the heavy dust burden of gases can be thereby reduced, permitting the installation of a smaller and less expensive secondary collector as a baghouse or Cottrell precipitator; and (b) when a large amount of cooling surface is required for cooling the gases, a portion of this cooling surface then taking the form of a cyclone separator.

Zonolite: Utilizing a Useless Mineral

Commercial Development of a Large Deposit of Altered Phlogopite in Montana Brings Out Many Uses for the Treated Material

By E. N. Alley

Manager, The Zonolite Co., Libby, Mont.

MUCH INTEREST has been aroused by the recent commercial production of what has been termed "zonolite" from a large and heretofore useless deposit of micaceous material in the Kootenai valley of northwestern Montana, near the town of Libby. There has been some curiosity as to just what this mineral was, how it could be treated, and what its applications in industry might be. The story of the commercial development of this deposit may well inspire hope in the minds of many mining men who know of large deposits of apparently useless material, for often it is only a question of bringing the prospective producer and unknown and waiting consumer together. A market lies waiting for many of our unused natural resources, but it takes time and money to develop it.

Two miles from the Kootenai River and nine miles northeast of Libby, Mont., is a moderately high mountain, almost the entire rounded top of which consists of a mineral deposit long known and supposed to be either phlogopite or biotite mica. The U. S. Geological Survey, in making a mineral survey of the district a few years ago, classified it as phlogopite mica and mentioned it as being "exceptionally abundant." It did not appear to have any value or use, but about four year ago tests were run on this material which finally resulted in its present utilization. It was found that when the dark, heavy mineral was roasted it began to swell and turn a beautiful golden color; finally it would become about fifteen times its former size. The final roasted product was a light flaky material composed of tiny golden leaves, each separated by a minute air space—appar-

ently a perfect insulation material. A variation in the treatment makes a product of silver color. Further tests determined that after the expansion process was completed, heat had no further effect on it up to a high temperature—that it was fireproof up to 2,500 deg. F.

Herbert P. Whitlock, Curator of Mineralogy at the American Museum of Natural History in New York, has inspected samples of the mineral from this deposit and characterizes it as an altered phlogopite which would fall in the group of the vermiculites. These are mainly derived from the micas, biotite, phlogopite, and muscovite, by the addition of variable amounts of water. In other words, they are hydrated micas. From time to time, according to Mr. Whitlock, a so-called new mineral has been announced, representing a new analysis of one of these altered micas, but such announcements have almost always been found to represent alteration products of indefinite composition, since the derivation of these minerals is unfavorable to the formation of definite compounds. Zonolite, which the mineral here described has been named, is probably therefore not a definite species any more than a certain clay of a particular analysis would represent a definite mineral species. The optical characters are those of phlogopite, and its excessive increase in bulk when heated is due to the surplus water which it contains. The mineral is a silicate of magnesia and alumina with a little iron, one analysis giving:

Loss on ignition	0.7
Silica	42.8
Iron and aluminum oxides	26.2
Calcium oxide	1.9
Magnesium oxide	24.6
Sodium and potassium oxides	3.8



End of tramway from mine, and chute to ore bins



Treatment plant at Libby

The specific gravity of the heated mineral has been found to be 0.087.

The increase in volume on heating is not a newly discovered property of altered phlogopites, but no commercial uses of the roasted mineral had been developed so far as known.

The first step in opening the deposit was the construction of a good road that could be used for truck transportation. The deposit has a width of 1,800 ft. and a length of about 3,000 ft. with a depth of 100 ft. as a reasonable assumption, though there are no deep shafts nor long tunnels to aid in estimating ore reserves. If there are no intrusions or faults, and the deposit is a deep-seated vein, comparable with other similar mica deposits, the whole top of the hill might be worked off, giving a depth of 400 ft. The specific gravity of the pure ore is 2.5, and a cubic foot of the well-settled material weighs 100 lb. The ore reserves evidently run into the millions of tons, no definite figure being possible with the present limited amount of development.

In the early work a very simple heat-treating plant was used, fuel for which was available from a sawmill, in the form of shavings and sawdust. Funds have recently been provided, however, to provide a rotary kiln for the production of zonolite, and to do some other necessary development work at the mine. No elaborate equipment has so far been installed, as is evident from the accompanying photographs.

The prices received for zonolite may be of interest. The crude material, in car lots, in bulk, is sold at \$10 per ton, f.o.b. Libby. The treated furnace product sells for \$25 per ton in car lots, in bulk. Freight rates on the crude mineral to north Pacific ports are \$5.50 a ton and to Chicago \$12 a ton. On the treated material, the freight is \$17 per ton to north Atlantic ports, \$15 a ton in car lots to Chicago, and \$9 a ton to Seattle, Portland, and Tacoma. These prices enable zonolite to be delivered to most parts of the United States at a cost of about 2c. per lb., and only about 13 lb. are required to make a bushel. Recent operating costs of the Zonolite Co., producing four tons of treated zonolite per twenty-four hours, are:

	Per ton
Mining and tramping to ore bins.....	\$0.50
Hauling from ore bins to treating plant, on contract....	3
Three eight-hour shifts of two men each at plant at a wage of \$4	6
Supervision and office expenses	1.25
Fuel	1.75
Electric power	1.25
Insurance, taxes, telephone and miscellaneous.....	0.12
Total	\$13.77

With a revolving kiln of greater capacity, the same

labor expense, less fuel, and slightly greater expense for electric power, costs of treatment will be materially reduced.

Experimental work has indicated the following uses for the treated material: Insulating material for heat and cold; decorative material for plastered walls; fire-proof roofing material; component of wall paper, wall board, paint, and various cement products, pipe and boiler coverings; and as a fireproof and insulating packing in hollow wall spaces. An Ohio manufacturer is using the material in the packing of safes, filing cabinets, and bank vaults. A New Jersey company is using it on an increasing scale as a decorative material in wall paper. A large paper company in Wisconsin uses the material in car-lot quantities in paper products. One customer is using it in the packing of incubators, and another in fireless cookers. The Standard Oil Co. of Indiana has been carrying out tests with the view of using it in greases and oils as a lubricant. The largest manufacturer of cork products in the United States is carrying on some interesting tests and another concern has perfected a formula for making a beautiful gold-bronze paint out of zonolite. A large number of other experimenters, including several in Europe, are working on adaptations of this product to their industries.

Two New Elements Discovered?

According to *Nature*, the discovery of two new elements in the manganese group is announced by Dr. Noddack and Fräulein Tacke in "Die Naturwissenschaften." From a survey of the properties of the elements related to the missing elements No. 43 and No. 75, the authors were led to examine platinum ores and columbite, and from the former obtained material which gave promising results, but was lost during concentration. Columbite, however, yielded material which was examined spectroscopically by Drs. Berg and Tacke, who found lines which gave excellent numerical agreement with the wave-lengths calculated from Moseley's laws. The actual amount of the new elements in columbite is estimated at from 10^{-5} to 10^{-7} . The authors suggest that the new elements should be called Masurium and Rhenium, in honor of a district of East Prussia and of the Rhine respectively.

More recent reports state that the missing chemical element No. 75 has been discovered by Dr. J. Heyrovsky and Dr. Doleyssek, both of Prague, and is to be named bohemium.

Amount of Flotation Reagents Used in 1923-24

*Recent Changes to Alkaline Circuits, with Xanthate,
Not Then in Effect*

DATA on the consumption of reagents used in flotation during the years 1923 and 1924, in metallurgical plants in the United States, are presented in one of the Bureau of Mines Reports of Investigations (No. 2709), which is written by Thomas Varley. The report covers about 95 per cent of the total tonnage treated by flotation in the United States.

In 1923 returns showed that 37,811,044 tons of ore was treated by flotation, from which 2,132,600 tons of concentrates was produced, showing a concentration ratio of 13.04 tons into one. The 1924 figure is 45,105,101 tons of ore treated, from which 2,298,308 tons of concentrates was produced, a concentration ratio of 15.28 tons into one.

The 1919 figure was 26,545,564 tons ore treated, from which 3,105,343 tons of concentrates was produced, a concentration ratio of 8.55 tons into one.

The total of all oils, acids, and reagents of all kinds used in 1923 was 161,377,789 lb., equivalent to 4.2680 lb. per ton of ore. For 1924 the total reagents used was 178,699,681 lb., equivalent to 3.9618 lb. per ton. This figure for 1919 was 113,510,234 lb. of reagents, equivalent to 4.2384 lb. per ton of ore.

Of gold-silver ores 18,000 tons was reported treated in 1923, yielding 320 tons of concentrates, a concentration ratio of 56.2 into one. Oils used were coal-tar creosote and wood creosote. No reports were received for 1924.

In 1923, 18,688 tons of graphite ores was reported treated, yielding 395 tons of concentrates, a ratio of concentration of 47.3 into one. Reagents used were flotation oil 6,675 lb., gasoline 2,717 lb., and soda ash 4,000 lb. No reports were received for 1924.

By far the greater tonnage of ores treated by flotation were copper ores. In some cases, reports showed combined treatment by gravity concentration followed by flotation, so that, excluding leaching plants, over 95 per cent of the copper ores were treated by flotation.

During 1923 the ore reported as milled by flotation was 35,716,466 tons, with an average calculated head assay of 1.3675 per cent copper. The figure for 1924 was 42,105,335 tons, with a calculated head assay of 1.4127 per cent copper. The concentration ratio in 1923 was 18.57 tons into one, and in 1924, 21.34 tons into one.

The total amount of reagents, including acids, alkaline reagents, oils, etc., averaged 4.6176 lb. per ton for 1923 and 4.1363 lb. for 1924.

Reagents (1923-24), Copper Ores

Reagent	1923		1924	
	Pounds	Equivalent in Pounds per Ton	Pounds	Equivalent in Pounds per Ton
Coal tar.....	11,232,852	0.3145	12,997,405	0.3086
Coal-tar creosotes.....	11,529,889	0.3228	14,717,556	0.3495
Wood creosotes.....	398,002	0.0111	573,350	0.013
Pine oils.....	4,944,574	0.1384	4,264,250	0.1012
Acid sludge.....	13,688,879	0.3829	13,085,461	0.3107
H ₂ SO ₄	115,922,434	3.2456	120,200,469	2.8547
Potassium xanthate.....	63,963	0.0017	252,155	0.0059
Scotch B. F. oil.....	156,420	0.0043	855,427	0.0203
Sodium sulphide.....	4,240,053	0.1187	4,240,000	0.1007
Li ₂ ne.....	2,422,491	0.0678	2,053,600	0.0487
Sulphur.....	137,750	0.0038	135,000	0.0032
X-Y mixture.....	210,531	0.0057	.....	.....
Other oils and reagents (a).....	11,895	0.0003	812,120	0.0192
Totals.....	158,045,194	4.6176	174,186,793	4.1363

(a) These include such reagents as orthotolidine, thioarbanilid, X-cake, reconstructed oils, and small amounts of oils used for experimental purposes. Definite quantities of each are not listed.

In treating lead ores and lead-silver ores, flotation usually supplements gravity concentration, and in some cases a large tonnage of material or tailing low in metal content can be discarded. This is especially true in the southeast Missouri lead district. Returns show that in 1923, 4,658,500 tons of ore was milled, 1,291,844 tons, or 27.7 per cent, by flotation. Tons of concentrates produced by flotation was 98,916 tons, and the concentration ratio was 13.06 into one. Figures for 1924 showed 7,383,600 tons milled, with 2,067,408 tons, or 28.0 per cent, by flotation, producing 188,473 tons of flotation concentrates and a concentration ratio of 10.9 into one.

Reagents used in 1923 totaled 685,520 lb., equivalent to 0.5379 lb. per ton. For 1924 the figures were 1,049,134 lb. of reagents, or equivalent to 0.5071 lb. per ton of ore treated.

Reagents (1923-24), Silver-Lead Ores

Reagent	1923		1924	
	Pounds	Equivalent in Pounds per Ton	Pounds	Equivalent in Pounds per Ton
Wood creosote oil.....	411,928	0.3266	677,671	0.3277
Barrett No. 4.....	26,169	0.0202	18,967	0.0091
Pine oil.....	9,509	0.0073	11,084	0.0053
Pine tar.....	14,008	0.0108	8,625	0.0042
Flotation tar.....	150,575	0.1165	260,398	0.1259
Fuel oil.....	49,025	0.0379	43,125	0.0208
Cresylic acid.....	4,359	0.0033	9,320	0.0045
Turpentine.....	10,044	0.0077	10,350	0.0050
Other oils and reagents (a).....	9,903	0.0076	9,594	0.0046
Totals.....	685,520	0.5379	1,049,134	0.5071

(a) These include reagents which were not itemized by the operators; also small quantities used for experimental purposes.

Zinc ores and lead-zinc ores are grouped because the tonnage of straight zinc ores free from lead is not large and the reagents used are somewhat similar. Gravity concentration usually precedes flotation. Total tonnage reported milled in 1923 was 1,894,609 tons, and by flotation 766,046 tons or 40.4 per cent. There were 88,650 tons of zinc concentrates produced and 22,868 tons of lead concentrates. Concentration ratio was 6.86 tons into one.

In 1924 the total tonnage of ore milled was 2,062,739. Tons treated by flotation totaled 932,358, or 45.2 per cent. Zinc concentrates produced 109,510 tons, and lead concentrates produced 27,544 tons. Concentration ratio was 6.80 tons into one.

Reagents used in 1923 totaled 2,647,075 lb., equivalent to 3.4547 lb. per ton of ore. For 1924 the figures were 3,464,754 lb., equivalent to 3.6829 lb. per ton of ore.

Reagents (1923-24) Zinc and Lead-Zinc Ores

Reagent	1923		1924	
	Pounds	Equivalent in Pounds per Ton	Pounds	Equivalent in Pounds per Ton
Pine oil.....	392,287	0.5120	557,476	0.5979
CuSO ₄	302,524	0.3949	406,512	0.4360
Sulphur.....	699,066	0.9125	1,085,858	1.1646
Wood creosote.....	91,328	0.1192	109,380	0.1173
Cresylic acid.....	45,600	0.0595	77,112	0.0827
Soda ash.....	164,850	0.2151	279,216	0.2994
Nitre cake.....	386,000	0.5038	655,200	0.7027
Sodium silicate.....	153,580	0.2004	259,560	0.2788
Coal tar.....	183,000	0.2388	.....	.....
Naphthalene.....	64,000	0.0835	.....	.....
Sodium sulphite.....	72,450	0.0945	.....	.....
Thioarbanilid.....	33,205	0.0433	33,440	0.0035
Other oils and reagents (a).....	59,185	0.0772	.....	.....
Totals.....	2,647,075	3.4547	3,463,754	3.6829

(a) Includes a variety of miscellaneous chemical compounds and oils used principally for experimental purposes. The particular name of each material used and the amount of each not reported.

By referring to the tabulations it will be noted that the coal tars and coal-tar creosotes are the heavy oils most generally used in the flotation of copper ores, and pine oil for the frothing agent. The general practice has been to use sulphuric acid and petroleum acid sludge to form the acid circuits.

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.

Andalusite and the Geologist

THE EDITOR:

Sir—I have read with personal interest your editorial entitled "Geologist Finds a Mine," which appeared in the Aug. 8 issue, together with the criticism of this editorial by Dr. Jeffrey in the issue of Oct. 24.

In behalf of Dr. Jeffrey I will say that he deserves full credit for the discovery of the Champion mine. While he lays no claim to the title of geologist, he evidently has more than an average understanding of geological literature and knows how to apply geological principles to his prospecting methods. There seems no denying the fact that Dr. Jeffrey was guided in his search by the published reports of Dr. Knopf, of the U. S. Geological Survey, who was the first to call attention to the andalusite deposit in the White Mountains. Also, so far as I am at present informed, it was the published notes of Dr. Knopf on the occurrence of dumortierite in the Rochester, Nev., district, that led to the recent development of this mineral deposit, which now bids fair to replace andalusite in the manufacture of Champion spark plugs.

Although the geologist is rarely ever able to mark an X at the exact spot where a mine may be developed, his survey indicates the kinds of minerals present as well as the geological conditions necessary or responsible for the deposition of such minerals. This service has frequently been of inestimable value to mine operators throughout the world. The business of the geologist is not primarily to find a mine. As a rule he is called upon to survey a district only after it has been quite thoroughly combed by prospectors and the mines have been well developed or exhausted. An exception to this rule may be noted when the geologist is engaged by some company for the express purpose of examining a district with a view to discovering oil or some mineral which has been ignored by the average prospector, and I know of many instances in which he has been successful.

Unless the geologist is employed in this special capacity he seldom has the opportunity of bringing his discoveries directly to the attention of those who may be seeking these minerals, and, again, it may be that such minerals had no commercial value at the time of discovery. For this reason, the publications of the Geological Survey and the files of railroad and other corporations which conduct geological work contain a great many buried mines that are potential producers of metals and minerals.

As for the rest of your editorial, it impresses me as being somewhat fanciful. Sometimes the geologist

is fortunate enough to find his work in a region where a horse or even an automobile may be of service, but in the White Mountains of California, and especially in the andalusite region, I doubt very much that the geologist hampered his movements by taking a horse with him. This region is so very rugged that unless said horse was a reincarnation of Pegasus or was at least of the Spark Plug variety, he could neither be ridden, carried, nor dragged over the landscape. JOHN MELHASE.
Berkeley, Calif.

Crystal Structure and Flotation

THE EDITOR:

Sir—Mr. McLachlan's reply in the Nov. 7 issue of *Mining Journal-Press* to my letter of Oct. 10 (p. 578) shows that his ideas of the importance of structure of crystals in flotation were misunderstood by W. F. de Jong, as shown in his letter in your issue of Oct. 24, p. 662, and by myself. However, Mr. McLachlan misunderstood us if he thought we questioned the accuracy of the diagrams "developed by well-known authorities." The thing I objected to was the positiveness with which he stated in his first article that minerals had only certain atoms in their boundaries. As to that question I refer to a number of papers in the *Zeitschrift für Kristallographie* and *Physikalische Zeitschrift* by Beckenkamp, Wulff, Yamada, and others. Yamada¹ develops some formulas for finding the free surface energy of crystal planes. It seems that this energy would enter into the problem of flotation in some form, though still mysterious and not yet explained by our modern views on "radius of atomic influence and residual valence of the atoms concerned."

Chemical composition at first seems to offer a fairly good explanation for the flotation of metals and sulphides and non-flotation of the carbonates and oxides as advocated by Mr. McLachlan, till one suddenly finds this statement² that Al_2O_3 , Fe_2O_3 , $BaSO_4$, and $FeCO_3$ also float. Especially iron carbonate "upsets the dope," for here we have a mineral that belongs to the same isomorphous series as calcite with the same crystal structure (varying only slightly in dimensions) and with plenty of oxygen in it. Yet it floats,³ while its closest relative does not. By introducing such chemicals as sodium and potassium cyanides, which possibly form complex ions, the reasons for flotation become still more obscured. If oxygen in the air is the important factor, then using other gases such as nitrogen, hydrogen, and carbon dioxide instead of air should produce different results. Such experiments are being tried now at the University of Minnesota.

JOHN W. GRUNER,

Department of Geology and Mineralogy,
Minneapolis. University of Minnesota.

¹Yamada, M., *Phys. Zeitsch.*, Vol. 24, pp. 364-372, 1923.

²Bartsch, Otto, *Beitrag zur Theorie des Schaumschwimmverfahrens, Kolloidchem. Beihefte*, Vol. 20, p. 72, 1924.

³Also tried at the Minnesota School of Mines.

Consultation

Selective Flotation

"During the last four or five months I have endeavored to gain such knowledge of the principles and practice of selective flotation as may be acquired by reading. My chief difficulty has been to locate pertinent published data, due, mainly, to the scattered sources of such data. The second difficulty has been that, even when obtained, the articles and bulletins are concerned, as a rule, with but one special phase of the problem. It occurs to me that perhaps others of your readers have encountered similar trouble in attempts to learn something of this increasingly important field of milling technology. May I request, therefore, that through your Consultation department of *Mining Journal-Press*, if the matter seems likely to be of general interest, you suggest the series of books, magazine articles, and government or society papers, perusal of which should yield, in your opinion, a sound rudimentary knowledge of selective flotation?"

Following is an incomplete list of publications dealing with selective or preferential flotation:

- "Selective Flotation at Timber Butte," by E. H. Robie. *E. & M. J.-P.*, Oct. 31, 1925.
- "Analyzing Concentrates Graphically," by Herbert Rose. *E. & M. J.-P.*, Oct. 10, 1925.
- "Federal M. & S. Co.'s Morning Mill," by A. B. Parsons. *E. & M. J.-P.*, Sept. 12, 1925.
- "Differential Flotation of Copper and Iron Sulphides," by Harmon E. Keyes. *E. & M. J.-P.*, July 25, 1925.
- "Milling and Flotation in 1924," by C. E. Locke. *E. & M. J.-P.*, Jan. 17, 1925.
- "Floating and Leaching Copper-Molybdenum Ores," by H. A. Doerner. *E. & M. J.-P.*, June 6, 1925.
- "Selective Flotation Methods," *E. & M. J.-P.*, Feb. 28, 1925.
- "Selective Flotation at Nacozari," by W. T. McDonald. *E. & M. J.-P.*, Sept. 20, 1924.
- "Selective Flotation of Pyrrhotite From Copper Nickel Ore," Bulletin No. 15, Memorandum Series, Canadian Department of Mines.
- "Selective Flotation at Magistral-Ameca Plant," by H. M. Payne. *E. & M. J.-P.*, Dec. 29, 1923.
- "Selective Flotation at Simon, Nev.," by W. McDonald. *E. & M. J.-P.*, July, 14, 1923.
- "Selective Flotation at the Sullivan Mine," by G. J. Young. *E. & M. J.-P.*, Sept. 15, 1923.
- "Status of Research in Ore Dressing," by E. A. Hersam. Report of Investigations, Serial No. 2669, U. S. Bureau of Mines.
- "Present Trend in Flotation," by A. W. Fahrenwald. Report of Investigations, Serial No. 2694, U. S. Bureau of Mines.
- "Milling Practice at Midvale, Utah," by C. A. Lempke. No. 1484-B, *Transactions A.I.M.E.*
- "Effect of Cyanogen Compounds on Flotability of Sulphide Minerals," by E. L. Tucker and R. E. Head. No. 1487B, *Transactions A.I.M.E.*
- "Concentration of Lead-Zinc Ores in Eastern Canada," by C. S. Parsons. *Canadian Chem. & Met.*, April, 1925.
- "Metallurgical Problems at the Sullivan Mine," by S. G. Blaylock and others. Bulletin Canadian Institute of Mining and Metallurgy, June, 1924; also in Bulletin of Institution of Mining & Metallurgy, October, 1924.
- "Flotation Tests of Idaho Ores," by C. G. Wright and others. Bulletin No. 205, U. S. Bureau of Mines.
- "Flotation Fundamentals," by Thomas Varley. Bulletin No. 16, University of Utah. Engineering Experiment Station, Salt Lake City.
- "Beneficiation of Complex Zinc-Lead Ores," by A. J. Thompson and Thomas Varley, University of Utah. Experiment Station, Salt Lake City. Bulletin No. 15.
- "Present Status of Differential Flotation," by A. W. Fahrenwald. Reports of Investigations, Bureau of Mines. Serial No. 2700.

"Differential Flotation," by A. W. Fahrenwald. Pamphlet No. 4, Idaho Bureau of Mines and Geology, Moscow, Idaho.

"Manual of Flotation Processes," by A. F. Taggart. Published by John Wiley & Sons, New York.

Recent annual volumes of "The Mineral Industry," chapters on ore concentration. Published by McGraw-Hill Book Co., New York.

Treating a Vanadium Concentrate for Elimination of Phosphorus

How to eliminate phosphorus from vanadium concentrate was asked by a subscriber, as published in the *Mining Journal-Press* of Oct. 10, 1925. H. A. Doerner, associate chemist U. S. Bureau of Mines, Reno, Nev., submits the following details from a paper prepared by him and published in *Industrial and Engineering Chemistry*, p. 1014, October, 1923:

"Arsenic and phosphorus are frequently found in vanadium ores, especially those of the vanadate type, such as vanadinite. Since vanadium ores and intermediate products containing even small amounts of these impurities are not salable, tests were made to establish a commercially feasible method of separation.

"It was found that vanadic acid could be precipitated from an acidified vanadate solution containing arsenic and phosphorus. The latter remain in solution and the precipitate may be washed free from these impurities.

"1. Twenty-six grams of vanadium oxide, 0.85 gram of arsenic trioxide, and 4.38 grams of sodium ammonium phosphate were dissolved in sodium hydroxide solution, oxidized with sodium peroxide, and acidified with sulphuric acid. The solution was diluted to a volume of one liter and sulphuric acid was added until the free acid was 0.05 normal in strength as determined by titration with methyl orange. The solution was boiled with live steam for several hours and allowed to stand hot over night. The vanadic acid precipitate was filtered and thoroughly washed. It contained 24.8 grams vanadium pentoxide (95.5 per cent recovery) and not more than a trace of phosphorus or arsenic. The filtrate contained 1.17 grams vanadium pentoxide, and gave a heavy precipitate with magnesia mixture which contained the arsenic and phosphorus.

"2. Five hundred grams of a vanadinite concentrate were fused in a graphite crucible with 150 grams of sodium carbonate, 150 grams of caustic soda, and 10 grams of powdered charcoal. The ore analyzed 10.24 per cent vanadium pentoxide, 53.55 per cent lead, 0.28 per cent arsenic, and 0.27 per cent phosphorus. A lead button of 255.0 grams was obtained. The slag was extracted with hot water in a small pebble mill, filtered, and washed. The solution was treated exactly as described in the first experiment except the volume was two liters and the separation was completed as before. The residue from, or the undissolved part of, the slag weighed 203 grams, and contained 0.27 vanadium pentoxide and much of the phosphorus. The net recovery of vanadium pentoxide was 97.2 per cent free from arsenic or phosphorus."

Or Maybe They Mean "Pyrite"

"We have received an inquiry from the George S. Watanabe Co., 381 Bush St., San Francisco, Calif., who desires to secure quantities of ore for export abroad. They desire Pylite, Zinsite, and Calanite. Perhaps their spelling is wrong and they mean Pryites and Zincite.

"Would you be kind enough to put this party in touch with some concerns who can sell them this ore? They desire to use it for radio crystals."

Many of our subscribers have pyrite and zincite crystals for sale, suitable for radio purposes, and they can get in touch with this San Francisco firm direct.

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

LATE SENATOR CLARK'S estate appraised at \$47,763,508, consisting largely of investments in industrial organizations controlled by the Clark family.

Progress in Tonopah, Nev., and vicinity; total production to close of 1923, \$133,000,000—Gilbert, Nev., a new and active camp—Leasers operating at Goldfield.

High-grading law in California now in operation and first arrests made—California Zinc Co. gives trust deed on mine holdings.

New orebody on Comstock Lode—Chalk Mountain District, Nevada, discoveries reveal promising ore deposits.

Coeur d'Alene operators adopt sliding wage scale—No railroad for Pine Creek district, Idaho.

Only 4,200 men employed underground in Michigan copper mines, compared with 16,500 in 1916, owing largely to mechanical equipment and consolidated operations.

Selukwe Mining & Finance Co., of London, increases its British Columbia holdings—British industry reviving—Tin in demand.

Active development in Joplin-Miami field; old mills remodeled; new mills building; prospecting in new areas.

Calumet and Arizona replacing steam hoist by electric hoist. Shattuck-Denn Corporation elects officers.

Ducktown Sulphur, Copper & Iron Co. purchased by American capital. Iron sinter to be produced.

Progress in Tonopah and Neighboring Mining Districts

Tonopah Extension Completes Diesel Engine Installation—West Tonopah Attracts Attention—Gold Ore Is Developed at Manhattan—Exploration in Progress at Gilbert

By **George J. Young**
Associate Editor

TONOPAH has completed a quarter century of productive life from its discovery in 1900. Few mining camps can show the record for continuous production such as has been attained by the Tonopah area, which produced to the end of 1923, 7,196,631 tons of ore, yielding \$132,458,145. A few years ago when I visited Tonopah I was told that the "camp was on its last legs," but production kept right on. On my last visit, in September, ore production had diminished to some extent. Three mills are in operation: The Tonopah Extension, the West End, and the Tonopah Mining Co.'s mill at Millers. The aggregate tonnage treated in the three mills is slightly over 15,000 tons per month, including more or less custom ore. In spite of this low ore tonnage, mining activity, especially exploration for new orebodies, is quite apparent.

The Tonopah-Belmont is crosscutting into the North Star and Mispah Extension areas and is also working in Jim Butler ground. Three companies are working through the Buckeye shaft—the Buckeye-Belmont, the Red Hill-Florence, and the Rescue-Eula. An area south of the old Halifax shaft is

being explored at depth. Just north of the North Star, the New Montana-Tonopah Mining Co. deepened the Gypsy Queen shaft from the 1,400 to the 1,800 level and started exploration at this point. However, operations by this company are now restricted to maintaining the shaft free from water pend-



Map of southwestern Nevada

ing a reorganization, which is said will include the Montana and Gypsy Queen mines. The Tonopah Mining Co. is continuing its work of mining near the surface, with a nominal production from the old workings. The Tonopah-Divide Mining Co. is prospecting, through a winze on the 1,600 level of the Midway mine, for extensions of the Tonopah Extension vein system. Both to the north and south of Mount Oddie deep exploration work is in progress.

WEST END DEVELOPS ORE ON THE 400 AND 800 LEVELS

The West End Consolidated Mining Co. has opened ore on its 400 and 800 levels close to MacNamara ground and is continuing exploration in this area as well as in the "76" claim. Ore has recently been discovered in part of the MacNamara ground, which is being worked by the West End under a lease. The Ohio ground is producing the bulk of the ore now mined.

Leasers are at work in the Halifax-Tonopah. In the West End Extension, controlled by the West End company, prospecting and development work is in progress outside of the zone which is in litigation with the Extension. About 3,000 tons per month is being handled in the West End Mill, including more or less custom ore.

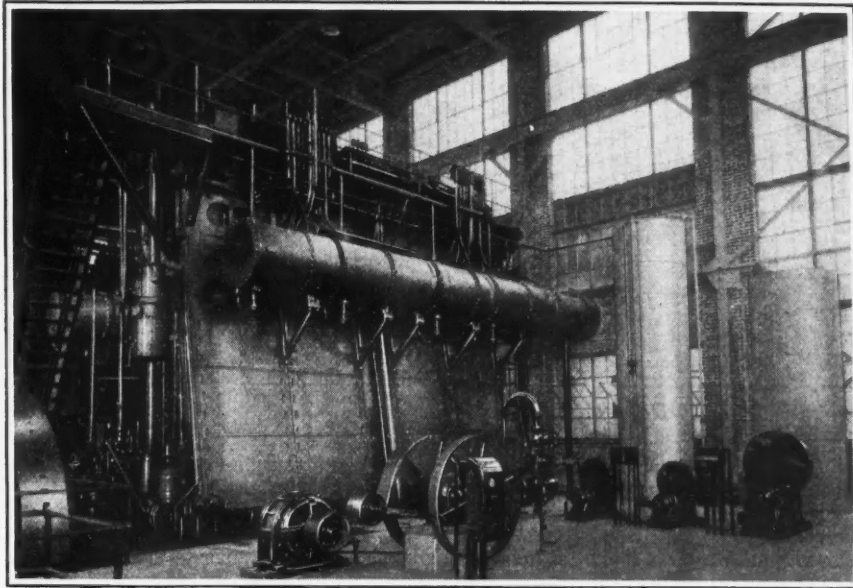
TONOPAH EXTENSION MILLS 8,000 TONS PER MONTH

The Tonopah Extension Mining Co., which is milling ore at the rate of 8,000 tons per month, has worked out a large part of the rich orebodies of the Murray and contiguous veins and is now con-

fronted with an exploration problem. As the company controls an area of 1,149 acres and has an efficient operating staff and an excellent mechanical plant, it is in a position to explore and develop its extensive holdings thoroughly. The principal mining operations are conducted through the Victor and McKane shafts, the former being 2,000 ft. in depth and the latter, 1,650 ft. The Cash Boy, 2,250 ft. deep, is used principally for ventilation. Exploration is complicated by an excess of water, which is characteristic of the western Tonopah area, and additional pumps are to be installed to take care of a greater water flow which it is expected will have to be handled when the lower levels are extended to the west. It is thought that a flow of 1,500 gal. per minute will have to be handled. To guard against sudden flows of water on the lower levels, heavy doors have been constructed at strategic points. The 2,000 level has also been bulkheaded on the west.

In expectation of a serious drainage difficulty in exploring the western area, and to provide ample power for all emergencies, the Tonopah Extension has completed the installation of a new power plant consisting of two Bethlehem Diesel engines, each of 2,000 hp. Each unit is a four-cylinder engine (25½ in. diameter by 48 in. stroke), operating at 116 r.p.m., direct-connected to an a.c. generator operating at 6,600 volts and 60 cycle. This supplies power for pumping and mine operation. The installation includes a 150 hp. waste-heat boiler for each engine, a cooling tower, and a fuel-oil tank of 250,000 gal. capacity.

The exploration of the western Tonopah area will be an extremely interest-



Diesel engine unit, Tonopah Extension power plant

suspended operations in 1918. The Tonopah Western also sunk a 1,100-ft. shaft, but likewise suspended operations. The area under the control of the East Butte is about 2,000 acres adjoining the Tonopah Extension in the west. Repairs are being made on the Great Western shaft, and pumps are to be installed in this shaft.

MANHATTAN, GOLDFIELD, DIVIDE, AND CANDELARIA ALL ACTIVE

At Manhattan, the White Caps Gold Mining Co. is developing an orebody through a winze extending from the 800 to the 1,220 level. What is known as the east orebody was discovered and

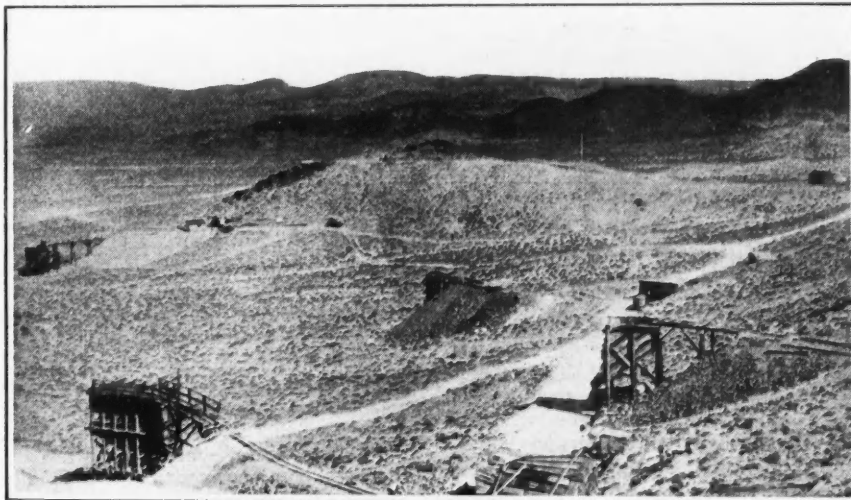
this shaft to a depth of 1,000 ft. from the present 500 ft. The Thomas F. Cole interests are reported to have taken over the Manhattan Union Amalgamated, which has been closed since 1918. Considerable interest is being taken by mining men in the Manhattan district generally, and several of the companies that were unsuccessful in the Divide district are reported to be looking for suitable properties at Manhattan.

A new company, the Nevada Gold Development Co., of which John G. Kirchen is president, Fred Cole, secretary and treasurer, and Tom Wilson, vice-president, is engaged in testing placer ground near Round Mountain. A shaft 270-ft. in depth has been sunk in the area. After passing through 210 ft. of overburden, 60 ft. of gravel was cut before reaching bedrock. The gravel removed from the shaft was washed and yielded \$2 per cu.yd. Bins, headframe, and a larger hoist and washing equipment are being installed. The present plans are to drift, crosscut, and test the gravels for consistency of values. An area of 650 acres is controlled by the company.

At Goldfield, the Deep Mines exploration shaft has reached a depth of 1,940 ft. A number of leasers are working in other properties and several companies are in operation on a reduced scale. At Candelaria operations of the New Candelaria Mining Co. were suspended during September, and it is reported that a reorganization of the company's affairs is to be made. At Divide a few leasers are working.

GILBERT SHIPS NOMINAL ORE TONNAGE

Gilbert, the newest of the mining camps of Nevada, is on the northwest slopes of the Monte Cristo Range, in an area of Tertiary volcanics. The structure is complicated by faults. Deep-seated rocks are absent, although there are two areas of Cambrian metamorphics exposed and the Siebert formation of Tonopah apparently dominates a large part of the area. The district, while similar in some features to Candelaria, Tonopah, Goldfield, and

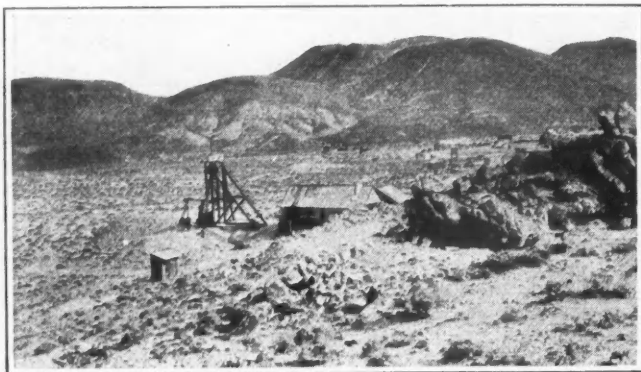


Homestake mine in foreground; Mammoth in distance. Near Gilbert

ing phase in the mining history of the district. The important formations are at depth. Apparently large quantities of water must be handled. Probably the heaviest part of the work involved will fall upon the Tonopah Extension Mining Co. However, another company has started preparations for work in the western area. The holdings of the Great Western, Tonopah Western, and Tonopah Bonanza have been merged under the control of the East Butte Copper Mining Co. The Tonopah Bonanza, after sinking a 1,100-ft. shaft,

is now being developed on the 950, 1,120, and 1,220 levels. When development has been completed on the 1,220 level, the company, according to John G. Kirchen, general manager, will resume the sinking of the main incline shaft. Ore milling has been deferred to some time in 1926.

The Manhattan Merger, which controls the Manhattan Consolidated, is unwatering the shaft of the latter company under the direction of C. D. Wilkinson, and, according to local reports, the intention of the company is to sink



Last Hope mine; outcrop at right



Gilbert, Nev., about one year old

Divide, has its own individuality and will no doubt contribute another chapter to the geology of Tertiary gold and silver deposits.

Two approximately parallel lodes extending a little east of north and west of south outcrop and dip to the west at a fairly steep angle. One is included in the holdings of the Gilbert Mammoth Last Hope Mines Co. and the other is in the Homestake group area.

Other leads have been found in South Gilbert in the area controlled by the original Gilbert Mining Co. The original discovery was made at the north end of the Mammoth Gilbert lode in a bold outcrop of silicified rhyolite. Gold ore was found by F. D. Gilbert in and about this outcrop, which is practically within the town of Gilbert. The Mammoth outcrop, several thousand feet to the south, was discovered shortly afterward by Dick Raycraft.

In the drift extending from the west side of the Mammoth outcrop, a calcite vein is exposed in close association with the quartz lode. The Mammoth outcrop is a conspicuous comb in which quartz is present in considerable quantity. Several rich leads have been found in the outcrop. A winze extending to a depth of 155 ft. below the adit or Mammoth tunnel exposes a vein which has

been followed down. The total depth below the surface is about 200 ft. At the north end of the Gilbert-Mammoth the Last Hope shaft was sunk to a depth of 112 ft. west of the discovery point and a crosscut driven to the east a distance of 125 ft. This is said to have cut a quartz breccia giving low assays.

On the Homestake group a shaft has been sunk to a depth of 135 ft., but no drifting or crosscutting has been done. Below the outcrop on the Homestake hill several crosscut tunnels have been driven into the west side of the hill and have intersected the lode. The lode material is quartz associated with manganese oxides. It is said that ore has been found in some of the crosscuts and work was under way in two of them at the time of my visit. South of these workings at least three shafts are being sunk, the furthest south being the Original Gilbert.

I was informed that the total ore shipments from the Gilbert area were about 250 tons. A. Raycraft gave me the information that the Gilbert-Mammoth company had shipped 180 tons, of a total value of \$10,140. The average of the four lots was \$56.33 per ton in gold and silver. One shipment of

56.24 tons assayed 5.07 oz. gold and 6.03 oz. of silver. Another shipment of 42.43 tons assayed 0.97 oz. gold and 14.75 oz. of silver. The gold and silver ratio is erratic. Ore is at present shipped to Millers and also to the West End mill at Tonopah.

Gilbert is not quite a year old. Already about sixty companies have been incorporated, according to a local count. The exploratory workings probably total several thousand feet. There is the usual division into companies that have merely surface and are sinking shafts with the idea of crosscutting at depth for blind leads and companies that have leads and are trying to find out what is in them. Several companies have found ore in moderate amounts and are developing orebodies. There is also the usual fringe of companies that are interested in selling stock. Along with this is an attempt to create a Gilbert boom. The situation is not an enticing one for the novice but rather one for the experienced mining man who can size up a new situation and can weigh his chances in the light of past experiences.

The Gilbert area is as a whole interesting, but until more work is accomplished its importance from a mining standpoint cannot be estimated.

New Orebody Opened on Comstock Lode

Ore has been found on the 1,650 level of the Consolidated Virginia mine, on the Comstock Lode, Nevada, in promising territory. The orebody is wider than the drift, with values up to \$45 across the entire face. This ore will be used as sweetener with the low-grade dump ore which is to be milled in the new plant now under construction. Company officials believe that by limited sorting a \$5 grade can be maintained and a substantial margin of profit made.

Hilltop Metals Company Making Regular Shipments

The Hilltop Metal Mines Co., Cochise County, Ariz., is making daily shipments of silver-lead ore to the El Paso smelter. Fifty men are employed.

Some new ore has been discovered in the Rheme tunnel which looks promising. In addition to production, a great amount of development work is being done.

Nevada-Ray Merger Delayed by Suit—Stockholders' Meeting Nov. 24

The proposed merger of the Ray Consolidated Copper Co. and the Nevada Consolidated Copper Co. has been delayed due to opposition to the plan on the part of a stockholder who has taken action to block the proposed consolidation. A meeting of the stockholders of both companies was scheduled to be held on Nov. 10, to ratify the consolidation, but the meeting was adjourned until Nov. 24, by which time it is expected that the litigation now in progress will be adjudicated.

According to executives of the company, a suit has been filed by F. C. Armstrong to prevent the sale of the physical assets of the Ray Consolidated Copper Co. to the Nevada Consolidated Copper Co. Executives of the companies assert that the allegations set forth in the restraining order were without foundation, and it is expected that the matter will be promptly disposed of in the courts.

Opening of Humboldt Smelter Delayed

A delay in the proposed blowing in of the smelter of the Southwest Metals Co., at Humboldt, Ariz., was recently announced by G. M. Colvocoresses, general manager, as due to lack of custom ore and the fluctuating metal market. The company is buying all the custom ore it can secure. Ore is being obtained from the company's own mine, the Blue Bell, but shipments which were expected from other mines in the Big Bug district have not materialized.

The Southwest Metals Co. has also taken an option on the lead-silver property of the Signal Mines Co. in the McCracken district, south of Yucca.

Placer Company Reports Pay Gravel, Near Mayer

The Big Bug Placer Mining Co., recently organized for operating on Big Bug Creek, in the Mayer district of Arizona, reports that pay gravel beyond the expectations of the company officials has been found on its claims.

Seneca to Begin Shipments Soon

The Seneca Mining Co., operating in the Michigan copper district, has entered into a contract with the Copper Range railroad to haul Seneca rock, and the necessary connection at the mill will be made at once. Copper Range, which also transports the rock of the Copper Range company and that of the Mohawk Mining Co., has replaced the Mineral Range railroad in the general rock-carrying business in the district, the new Ahmeek railroad of Calumet & Hecla now handling the rock formerly hauled by the Mineral Range. The death of W. J. Uren, general manager of the Seneca Mining Co., came upon the eve of resumption of production at this property, but his program will be carried out. It is expected production will be started soon.

No Surplus Copper at Michigan Smelters

At the smelters of the Michigan copper mines there is no unsold metal surplus. The mines are sold ahead on copper, and the demand exceeds current production. The Mid-West continues to be the big market, absorbing better than 50 per cent of output.

Flotation Mill at Emerald Mine

The Emerald mine, at Tombstone, Ariz., is installing a 70-ton flotation mill to treat 100,000 tons of silver-lead-copper ore already broken in the stopes. The mill when completed will be equipped with a Forrester-Rexman rod mill and Simpson pneumatic flotation cells.

The mine is owned by Ellis Rosenberg, of Long Beach, and T. J. Kane, of San Francisco, Calif. Dan Leedy is in charge of the work.

Encouraging Developments in Kearsarge and Amygdaloid Lodes

Drifting is well under way in the vein recently opened by the exploratory crosscut in the Cliff property of Calumet & Hecla, operating in Michigan. At the point where the lode was cut the formation was mineralized throughout its width of 55 ft.

The rock being taken out of the breast of the drift is not of commercial character, but the fact that the vein is again showing copper is encouraging. A stockpile of copper-bearing rock is being accumulated for a probable mill test later.

Franklin is drifting in the Kearsarge lode to the south at a depth of 400 ft. in its exploratory shaft. This opening is in 50 ft. in vein matter which is mineralized but not commercial.

Mayflower-Old Colony will open the amygdaloid lode recently traversed by the 1,700 level crosscut, drifting both north and south. The vein was only slightly mineralized in the crosscut.

The affairs of the Meadow Copper Co. have been wound up with the purchase of its assets by the Keweenaw Copper Co.

The Indiana Mining Co. has levied an assessment of 25c. per share, payable Nov. 30 on stock of record Nov. 28.

Lake Iron-Ore Shipments to Nov. 1 Totaled 49,816,469 Tons, a Gain of 9,257,944 Over 1924

Iron-ore shipments from Lake Superior ranges this year to Nov. 1 totaled 49,816,469 tons. This is an increase of 9,257,944 tons over the same period last year, and if November is mild the ore movement for the month probably will be from 3,500,000 to 4,000,000 tons, bringing the total for the season to between 53,000,000 and 54,000,000 tons.

There is a demand for much additional ore, and shippers will meet the strenuous conditions which attend thawing the frozen material when necessary to keep the supply moving.

Two railroads, the Great Northern and the Duluth, Mesabi & Northern, moved 57 per cent of the shipments to Nov. 1. The Great Northern moved 12,280,677 tons and the Duluth, Mesabi & Northern 16,426,156 tons.

Increase Smelting Capacity at Hubbell, Mich.

The old Tamarack and Osceola coal dock and smelter at Dollar Bay, Mich., both of which plants are owned by Calumet & Hecla, are being dismantled. Such steel as can be used will be shipped to Hubbell, where important improvements are under way to reduce costs.

One smelting unit, which has a capacity of more than 10,000,000 lb. of mineral per month, has been completed. Another large furnace has been rebuilt for refining and a third refining unit of similar capacity is being constructed.

Shattuck-Denn Mining Corporation Names Officers

Officers and directors of the newly organized Shattuck-Denn Mining Corporation are: Officers, L. C. Shattuck, president; H. L. Mundy, B. M. Pattison, and Thomas Bardon Jr., vice-presidents; A. M. Chisholm, treasurer; Norman E. La Mond, secretary, and T. O. McGrath, general manager. Directors, L. K. Baker, Chicago; Maurice Denn and L. C. Shattuck, Bisbee; Thomas Bardon, Jr., New York; H. L. Mundy, St. Paul; B. M. Pattison, Los Angeles; and A. M. Chisholm, John G. Williams, and R. W. Higgins, Duluth.

Renewed Activity at Gem, Idaho

The United Metals Company, controlled by California capitalists, is developing a group of claims, including the Black Bear mine, near Gem, Idaho. The property lies west of the Star mine, owned by the Hecla and Bunker Hill companies, and is regarded as an important development enterprise.

The Coeur d'Alene Syndicate Mining Co. has resumed development of the Flynn group, near Wallace, Idaho. This company has already spent a large sum in the development of the property, operating under an easement through the Black Bear tunnel. Difficulties involving rights under the easement caused a suspension a year or more ago. These have now been overcome, and the company is proceeding to explore certain ground that promises important disclosures of a lead and zinc.

Labor in Michigan Copper Mines

A total of 8,317 men are employed in the mining industry in the Michigan copper district. Of this number, 7,054 are in Houghton County and 1,263 in Keweenaw County. In Houghton County, the number of men employed underground is 4,216, compared with 4,267 in 1924. The number of men employed in mills, smelters, and on surface in Houghton County is 2,838. Of the 1,263 men in the industry in Keweenaw County, 140 are employed at the Mohawk stamp mill and 1,123 at the Mohawk and Ahmeek mines. No men other than a few watchmen are employed in the industry in Ontonagon County.

In Houghton County, where the industry is centered, the average number of days worked per man shows a material increase over the average of last year.

Only one-quarter the number of men employed are working underground in the Houghton County mines, compared with the peak year of 1916, when 16,520 were at work. This is not astonishing when it is considered that a number of old mines are idle. The adoption of mechanical aids to mining and the consolidation of operations are expected to maintain production without material increase in labor forces.

Calumet & Arizona Install Electric Hoist at Bisbee

The Calumet & Arizona Mining Co. has contracted with the Allis-Chalmers Manufacturing Co. for the purchase of a double-drum electric hoist to be installed some time in April, 1926. It will be the largest electric hoist in operation in the Bisbee district. The apparatus has been designed for a speed of 1,500 ft. per minute at a maximum depth of 3,000 ft. The drums will be of cast iron, 7 ft. in diameter, with a 6-ft. face, grooved for 1½ in. rope. The brakes will be of the post type, and the clutches will be oil operated. The drums will be driven by a 450 hp. direct-current motor through a flexible coupling and single reduction herringbone gears. The flywheel is 7 ft. in diameter and weighs twelve tons. A 10 kw. exciter mounted directly on the generator shaft furnishes low-voltage current for excitation of both the hoist motor and generator field windings.

The hoist will be fully equipped with both mechanical and electrical safety appliances, all interlocking. Another feature will be a speed-limit switch, which will be thrown in when men are being hoisted.

The end compartment of the shaft is being cleared of pump columns which were abandoned when the new electrical pumps were installed on the 2,200 level. When this work is done two compartments will be available for hoisting men, thus permitting a double-drum hoist to be used.

The C. & A. company has been increasing the amount of electrical power generated from waste heat at its Douglas smelter for a number of years, and as fast as the new power has become available electric installations have replaced steam-driven machinery.

Washington News

By Paul Wooton
Special Correspondent

Ceramic Laboratories May Remain With Standards Bureau—Mines to Retain Iron Ore and Fertilizers

All indications are that the ceramic work of the U. S. Department of Commerce will be consolidated in the Bureau of Standards. There is to be a further conference in that connection. Representatives of producers, of the technical societies, of the direct consumers, and of the allied industries will be present, but the probability is that this meeting will be devoted largely to a discussion of the reorganization of the work under the consolidation. Most of the industrial research of the Bureau is carried out in co-operation with technical societies and manufacturers' associations, under the direction of committees on which all interests are represented.

IRON AND STEEL INVESTIGATIONS

Some of the activities now being conducted by the Iron and Steel Division and by the Chemical Division of the Bureau of Foreign and Domestic Commerce probably will be transferred to the Bureau of Mines.

The production of iron ore and of some of the fertilizer raw materials falls distinctly in the field of mining. On the other hand, that part of the work of the Coal and Mineral divisions which deals with foreign trade will remain with the Bureau of Foreign and Domestic Commerce. A Division of Foreign Minerals probably will be created for the purpose.

EXPANSION IN SAND AND GRAVEL INDUSTRY

Overexpansion in the production of stone, sand, and gravel need not be feared, the Bureau of Mines reports. The rapid increase in the output of these aggregate and road-building materials has given rise to statements that this industry is being overdeveloped.

The fact that these activities are essentially local in character is the principal safeguard against overexpansion, such as has taken place in coal, it is declared. Producers are in a position to anticipate the demand because of their first-hand knowledge of the situation surrounding consuming industries. Production of these materials formerly was an unstable industry, owing to the entry into the market of road-side pits and small operations whenever prices became attractive. This "snow-bird" type of producer is being eliminated by the rigid specifications which now must be met. The increased cost of labor also has made it difficult to compete with the large operations with adequate mechanical equipment.

Transportation costs are such, it is believed, that this industry always will retain its local character. The only important instances where these road-building materials are shipped great distances are to supply the demand in alluvial regions where there are no local deposits of gravel or stone.

California Zinc Gives Trust Deed

The California Zinc Co., operating the Bully Hill mine, at Winthrop, Calif., and the Afterthought at Ingot, and other properties in the district, is reported to have given a trust deed to the Union Trust Co., of New York, to secure principal and interest on bonds issued from time to time to provide capital for equipment and facilities for operating. The Bully Hill mine dumps are to be leached for their copper content. Mine water and the leachings from the dumps are to be handled in a system of troughs where the copper is to be precipitated on scrap iron. Troughs are being installed and operations are to begin within thirty days, according to local reports.

High-Graders Held in California

A group of high-graders has been gathered in by Federal Secret Service men, and according to report have confessed. Four persons held, two men and two women, are of Jackson, Calif., and of San Francisco. More than \$1,000 of gold bullion per month was delivered to the San Francisco Mint by one of the women arrested.

At Jackson, the federal agents discovered a small, well-equipped mill which was used in the reduction of the stolen ores. The stolen ore was delivered by men employed in the mines at Jackson. The case is one of the first to come up under the new high-grading law now in operation in California.

Old Mills Being Remodeled and New Mills Built in Joplin-Miami Field—Development Active

Numerous improvements are being made at the Commonwealth Mining Co.'s No. 2 property, south of Baxter Springs, Kan. The mine was closed down recently to permit repairs. Larger rolls will displace the 30-in. ones formerly in use, and an additional pair will be installed for the new sand jig. The sludge plant will have a separate power unit, with seven tables and the sand jig. Larger-size screens and filters will also be installed, and a new 110-hp. Bessemer engine will replace the one formerly used to operate the compressor.

Many other companies are proceeding with improvement and development activities in the Joplin-Miami field. St. Louis Smelting & Refining is sinking two new shafts at its No. 4 property, to be known as shafts No. 15 and 16. The Anna Beaver Co. is preparing to sink a shaft on its Adams lease, which is farther west than any other property in the Picher field by a mile and a half. Kansas Explorations Co. is drilling out the Lucky Jenny and the Choctaw Chief properties, near Hockerville, Okla. Vantage No. 3 mill is being enlarged and improved. The Cortez-King Brand Co. is preparing to sink a second shaft on its Sunnyboy lease, just west of Baxter Springs, and will build a mill. The Beck Mining Co. is rapidly completing its new mill on the old St. Louis No. 2 lease, and the Tri-State Mining Co. will have its

new mill completed by the first of the year.

The Grasselli Chemical Co., through its subsidiary, the Grasselli Mining Co., is carrying on extensive prospect work in the Missouri section of the Joplin-Miami district. The company has more than thirty drill rigs at work in the territory a few miles north of Joplin, near the old Thoms Station camp. In the same section, the Matthiessen & Hegeler Zinc Co. is sinking two shafts on the old Napoleon property, and expects to have a new mill in operation there before many weeks.

The Rialto Mining Co. has taken over the lease developed in this territory by B. E. Brown of Joplin, and will continue development operations. Other companies having leases in this vicinity are the Kansas Explorations Co. and the Admiralty Zinc Co. Fred Childress, who is operating several mines in the Oklahoma field, recently took over the Joe Bob mine, northwest of Joplin, and is rebuilding it. Other operators are planning for increased production.

Bunker Hill & Sullivan Options Tybo Mine

It is reported that the Bunker Hill & Sullivan Mining & Concentrating Co., through F. W. Bradley, of San Francisco, has obtained an option on the old Tybo lead-silver property, 75 miles northeast of Tonopah, Nev. The lower levels are under water and the option grants sufficient time for the removal of the water to permit examination of these levels. W. H. Blackburn, formerly general superintendent for the Tonopah Mining Co. at Tonopah, made the preliminary report on the property and will be in charge of the new work.

The Tybo mine was a large producer of lead and silver in the early mining days of Nevada, but when the oxidized ores were exhausted and water in quantity came in with the sulphide ores profitable operations ceased.

It is generally believed that the mine contains a large tonnage of profitable milling ore, but mining and transportation problems have discouraged smaller operators from attempting to operate the property.

Chalk Mountain Scene of New Ore Discovery

The Chalk Mountain Extension Mining Co., operating in the Chalk Mountain district, 45 miles southeast of Fallon, Nev., has cut silver-lead ore stringers on the 100 level about 70 ft. southeast of the shaft. The main shaft is 200 ft. deep, and crosscutting has been started on the 200 level. It is estimated that the ore stringers should be cut in less than 150 ft. Shaft sinking to the 300 level is to be resumed at an early date.

A new gold strike, 5 miles east of Chalk Mountain, has attracted the attention of prospectors, and resulted in a mild stampede to make locations in that territory. The discovery was made by Ralph Hursh, an employee of the Chalk Mountain Co., who found high-grade gold float and finally traced it to a 4-ft. quartz ledge.

Coeur d'Alene Operators Adopt New Sliding Wage Scale

The mine operators of the Coeur d'Alene district, Idaho, have adopted a new sliding scale of wages which became effective on Nov. 16. A sliding scale was adopted in 1916, but since that time the higher range of the price of lead and the higher cost of living brought about a condition in which the schedule has been practically ignored. The new scale starts with a basic wage for machine miners of \$3.75 per day when lead is under 5½c. per pound and adds a bonus of 25c. per day for each increase of half a cent per pound as determined by the average price of lead during the preceding month.

The scale of wages that took effect on Nov. 16 represents a bonus of \$2.25, the price of lead now being 9½c. per pound. Miners will receive \$6 per day, muckers \$5.50, timbermen \$6.50, and common labor \$5.25. This is the highest scale of wages paid in any Western mining district.

Late Senator Clark's Estate Appraised at \$47,763,508

The estate of the late Senator William Andrew Clark, who made his real start in life in the mining industry, has been appraised at \$47,763,508.49, according to report of Messrs. Heslet, Phillips, and Goodwin, appraisers, filed with the Silver Bow County District Court, in Montana.

Valuation by states is as follows: Montana, \$16,123,061.85; New York, \$11,593,320.52; Delaware, \$8,178,436.00; New Jersey, \$3,219,917.52; California, \$2,916,442.11; Pennsylvania, \$2,709,008.66; Arizona, \$1,346,509.35; Utah, \$845,000.00; Washington, \$655,733.16; Nevada, \$129,981.64; Colorado, \$24,732.00; and, District of Columbia, \$21,315.68.

According to appraisal, at Mr. Clark's death he owned 64,041 shares of United Verde Copper Co., with a value of \$6,300,354. United Verde Copper has outstanding 300,000 shares, which according to the appraisal recorded have a value of close to \$30,000,000. Most of the outstanding stock is owned by the Clark family.

Mr. Clark's investments included many municipal, county, state, and government bonds, among the items being over \$8,000,000 first Liberty Loan bonds, over \$5,000,000 of City of New York securities, and over \$2,500,000 of the securities of the City of Rochester, N. Y. Outside of stock investments in several of the country's largest banks, his stock investments were mainly in corporations which he or his immediate family controlled and operated, these consisting of ventures in cereal and flouring mills, paper plants, lumbering units, electric railways, public utilities, mercantile establishments, cattle ranches, wire and bronze factories, railroads, match factories, sugar estates, farm and orchard lands, mines, smelters, refineries, construction companies, newspapers, and real-estate holdings. In short, he was interested in thirty-four companies, all of which were highly successful and in which he until a few

State Hospital and Home Advocated for Arizona Miners

GOVERNOR G. W. P. HUNT of Arizona has given indorsement to a movement now being pushed by M. M. Mills for the establishment of a miners' hospital in Wickenburg, on the line of the Santa Fe, between Phoenix and Prescott. It is suggested that near Wickenburg are areas of placer ground, from which the inmates might wash gold and thus repay a part of the cost of operating the institution. In the Arizona Statehood Act a grant of 100,000 acres of land was made for such a home.

years ago was the predominant figure from both a financial and managerial standpoint. At the time of his death all his ventures were individually managed, under the supervision of the Senator and his sons, Charles W. and W. A. Clark, Jr. The Clark organization is a large and most efficient one, comprising leading exponents in the fields of law, banking, mining, metallurgy and the various industrial lines in which it holds large interests.

Park-Utah Operating Staff

Organization of the staff of the new Park-Utah Consolidated Mines Co., which took over the Park-Utah, the Park City, and the Ontario properties, at Park City, Utah, has been effected as follows: George W. Lambourne, president and general manager; Moylan C. Fox, vice-president; D. C. Murphy, treasurer; and W. A. Dunn, secretary.

Oscar N. Friendly, formerly manager of the Park City Mining & Smelting Co. mines, heads the engineering department as chief engineer and will make his headquarters in Salt Lake. J. William Stoner and E. A. Hewitt have been appointed assistant engineers; and Leonard Wilson will be consulting engineer.

The operating department is headed by Paul H. Hunt, formerly manager of the Park Utah mine, as manager of mines; George S. Krueger is superintendent of what were formerly the Park City Mining & Smelting properties; H. B. Wallace, superintendent of the Ontario mines; C. C. Cushwa, superintendent of the Park-Utah; B. H. Beveridge, general foreman; W. S. MacFarlane, master mechanic; Richard Hales, mill superintendent; J. T. Ellsworth, metallurgist; H. F. Bradley, chief chemist; and William Osika, chief clerk.

Old New Jersey Iron Mine Sold

Rejuvenation of iron mining around Dover and Rockaway, N. J., is indicated by the incorporation of the Eastern Iron Ore Co., which has bought the abandoned Beach Glen mine, and many acres of surrounding property. The new company has an authorized capital of \$200,000. Harry M. Roche, of Dover, holds 400 shares of the company stock. Martin C. Haven and Dr. J. Willard Farrowes each hold 200 shares.

Ducktown Sulphur, Copper, & Iron Co. Acquired by American Company

Announcement was made on Nov. 5 of the purchase of the Ducktown Sulphur, Copper & Iron Co., Ltd., Ducktown, Tenn., from a British corporation, by Chattanooga and New York bankers, the value of the property being placed at more than \$5,000,000. The new company, incorporated in Delaware, is the Ducktown Chemical & Iron Co., the charter of which was filed at Nashville. The directorate of the new company is composed of H. D. Walbridge, A. E. Walbridge, and Marshall Mask, of New York, and J. P. Hoskins, C. C. Nottingham, and W. A. Sadd, of Chattanooga.

The British company was incorporated on Feb. 16, 1891. The property consists of 7,000 acres of land, on which are the Mary, East Tennessee, Callo-way, Cherokee, and Isabella mines. The equipment includes a smelter, a 300-ton differential flotation plant, and a sulphuric acid plant.

In recent years the production has been approximately 7,000,000 lb. of copper and 35,000 to 40,000 tons of sulphuric acid per annum.

The company plans the immediate installation of machinery for roasting and preparation of iron sinter. This will be of particular interest to the Chattanooga iron industry, in view of the fact that the furnaces in that vicinity have never been able to supply local foundries and consumers of pig iron, by reason of the fact that ores mined in this vicinity contain a very high percentage of phosphorus. The iron sinter, which is a substitute for iron ore, contains no phosphorus and its utilization will enable furnaces in the neighborhood of Chattanooga to supply approximately 1,000 tons per day, which is now being melted in Chattanooga and which has heretofore been purchased at Cincinnati and other points.

Cement Plant at San Andreas, Calif.

A cement plant is being built by the Calaveras Cement Co. about four miles east of San Andreas, Calif. Construction includes a 12-mile standard-gage branch railroad connecting with the Valley Springs branch of the Southern Pacific, a wet process cement plant, shops, a crushing plant, and the installation of quarry equipment.

Mining Corporation Secures Option on Flin Flon

It is officially announced that the Mining Corporation of Canada has concluded a working option for the Flin Flon and other northern Manitoba properties with R. H. Channing, of New York, who is understood to represent Harry Payne Whitney and associates. The option is for two years and calls for large expenditures, and if exercised the purchasers must make an arrangement in which the Mining Corporation will have a substantial interest. A metallurgical process has been worked out which permits recovery of zinc.

Bingo Mines, Ltd., in Voluntary Liquidation

Bingo Mines, Ltd., operating in Manitoba, is going into voluntary liquidation and its assets will be distributed to shareholders. According to a circular sent to the shareholders, the assets consist of 27,787 10 per cent cumulative participating preferred shares carried on the books of the company at 24c. a share. It is proposed to make a partial distribution of cash on the basis of 1/4c. per share. The company also has some cash in the bank and owns 218,750 ordinary shares of the Bingo Gold Mines, Ltd., on which no valuation has been placed.

No Railroad for Pine Creek, Idaho

The directors of the Union Pacific system have announced through Carl Gray, president, that no railroad will be built into the Pine Creek district of the Coeur d'Alene region. The decision was made after two months' deliberation following the investigation of tonnage, in sight and prospective, by Charles A. Boyle, the railroad company's geologist. Pine Creek operators are preparing to provide their own transportation, regardless of the railroad company's decision.

The Sidney Leasing Co., which holds a long time lease on the Sidney mine, is preparing to construct an aerial tramway from the mine to the Star mill, at Kellogg, a distance of three and a half miles, at an estimated cost of \$75,000. This enterprise is being financed by the Bunker Hill & Sullivan company. The Constitution Mining Co. has had a preliminary survey made for a tramway that will serve both the Constitution and Highland-Surprise mines. This will be over 6 miles long, and its construction will probably be taken up early in the spring. The Constitution also has under consideration the construction of a narrow-gauge railroad down the creek from the mine, which would have the advantage of serving several other properties. Definite decision has not been reached regarding these two projects, but one or the other will be adopted.

The ores of Pine Creek are chiefly zinc, associated with more or less lead-silver. Several other properties are approaching the shipping stage.

Platinum-Bearing Placers in Wyoming

Moore's Gulch Mining Co., of Wyoming, has operated its placers at the head of Moore's Gulch during the past five months, recovering several hundred ounces of platinum concentrate. The black sands have not been refined, but are known to contain a fair quantity of platinum.

A vein of copper ore about 30 ft. wide, containing some gold, was discovered during sluicing. This discovery seems to throw light on the source of the gold and platinum in the gulch. It is in the same basin, one mile south-east of the Rambler Mine, that has produced more platinum metals than any other lode mine in the United States.

Swedish Iron-Ore Exports

It is estimated that this year's iron-ore exports from Sweden will reach about 8,000,000 tons, with 60 to 70 per cent of iron. It will be of interest to note that the Swedish State has reserved to itself the right to acquire the entire shares of the mining companies by Dec. 31, 1926, whereby the State would become the owner of the iron mines of the country.

The principal customer of Swedish iron ore is the Ruhr district. Exports to the Ruhr are now larger than ever. During the months from January to August of this year they amounted to no less than 5,648,000 tons, against 3,487,000 tons during the whole of the preceding year.

Ore prices are but a trifle higher than in the year 1913. Dividends paid by the mining companies amounted in 1913 to 32 per cent of a stock capital of 75,600,000 crowns. In 1924 they amounted to 10 per cent on an invested capital of 119,000,000 crowns. At present large contracts with extended periods of delivery are booked, chiefly with Germany.

Armstead Acquires Cromwell Group of Claims

Colonel Henry H. Armstead has recently been issued crown grants for eight claims in the Trout Lake District of British Columbia, known as the Cromwell group. Major Arthur Lakes and Felix E. Wormser have just completed an inspection of the property and report it as a worth-while prospect with attractive surface outcrops, including one vein 30 ft. wide, from which twenty tons of silver-lead ore was shipped, giving net returns of \$125 per ton. Colonel Armstead will handle this venture as an individual and not organize a company for its operation until results of intensive prospecting are known. He has given a contract for a 1,200-ft. tunnel to A. P. Garrett, formerly superintendent of the Silver Cup mine. It is hoped and expected that this tunnel will cut the above-mentioned 30-ft. vein some 1,000 ft. on its dip. Supplies have been sent in and work will be begun at once under the personal direction of Mr. Wormser.

Waite-Montgomery Property to Be Developed During Winter

Preparations are being made to carry on active development on the Waite-Montgomery property in the Rouyn area of northwestern Quebec, during the winter. An active diamond-drilling campaign was begun in the middle of October. The records show that from the original sampling, made up of 61 channel samples, the copper content is high, and in addition the ore carries 2 per cent of zinc. Mr. Waite is in charge of operations.

Financing for the mine will be done privately, it having been agreed that the purchase price must be paid before the incorporation of a company or the shipment of copper. The vendors will retain a substantial interest in the property.

South American Gold & Platinum Co. Resumes Operation

The South American Gold & Platinum Co. has resumed work at its mines in Colombia. Adolph Lewisohn, president of the company, says that a cable dispatch has been received at the New York office from the company's legal representative in Bogota, stating that the Colombian Government has granted permission to begin work on the company's property and that the local authorities have been instructed to protect its representatives in working this property.

The suspension of operations has curtailed earnings, but executives of the company estimate that with the resumption of work earnings will average about \$200,000 monthly, beginning with December.

Selukwe Purchases National Silver Mines

At a special general meeting of the shareholders of National Silver Mines, held at Vancouver, B. C., on Nov. 2, the sale of a controlling interest in the company to the Selukwe Mining & Finance Co., of London and Rhodesia, was ratified. The consideration approximates \$750,000. The National Silver property consists of a large block of claims to the north of the British Columbia Silver Mines property, in the Portland Canal division of British Columbia, and like British Columbia Silver's property is supposed to contain the northern extension of the ore zone that has proved so profitable an investment to the Premier Gold Mining Co. This ore zone has been opened on several horizons on British Columbia Silver's property, and the company is at present driving on an 18-ft. belt of ore on the 700 level, which is said to average \$40 in gold and silver per ton.

A considerable amount of diamond drilling has been done during the present season on National Silver property, but the result has not been announced. The present transaction, however, made by the London company, of which Charles A. Banks is the consulting engineer, would seem to indicate that the continuation of the Premier ore zone has been established on the property. The Selukwe company is the holding company for British Columbia Silver Mines.

Kirkland Rand of Kirkland Lake, Ont., Discovers New Orebody

Reports of a discovery of some consequence on the property of the Kirkland Rand, in the Kirkland Lake area of northern Ontario, are officially confirmed by the following statement issued by the company:

"An important discovery has been made on the 350 level over 6 ft. wide carrying a good grade of commercial ore. The company has authorized the doubling of the working forces for developing purposes, and intends pushing development of this orebody."

London Letter

By W. A. Doman
Special Correspondent

British Industry Shows Signs of Revival—Tin and Copper in Demand

Spassky Copper Shares Offered to Public—Santa Gertrudis and Camp Bird Active—Diamonds Uneasy

London, Nov. 3.—Although only small, there are distinct signs all over the country of a revival of industry and, naturally, with them comes talk of an increased demand for base metals. At the moment all of these are more or less sought, but principal attention is paid to copper and tin. As regards the former, few new companies seem to be on the tapis, but with respect to tin there is a steady flow of new enterprises. This is due largely to the sustained advance in the price of the metal, which is now £285 and which is expected to reach £300, if not to stay there. Stocks are decreasing, and it is a poor property that cannot be made to pay—and pay handsomely—at current rates. Both in Malaya and in Nigeria new companies are coming forward. Though the position and prospects are good, it is noticeable that some of the vendors are taking cash. This may be regarded from their point of view as "safety first," though in other cases consideration is paid partly in shares and partly in options, so that the vendors are not likely to lose. Fortunately, the companies that are appealing for new capital have a certain quantity of tin reserves proved, which naturally gives them a good basis for starting.

In regard to copper, Mr. Joseph Kitchin, a director of the Union Corporation and a leading statistician, has been studying the position and states that the world's production has increased at a rate which is not far short of the amount the world is prepared to pay for, so that the price has not increased much and is now at approximately the level of 1913. He adds: "Notwithstanding the fact that some of the porphyry mines are approaching exhaustion, the production of copper can apparently continue to increase at an exaggerated rate."

SPASSKY COPPER CO. MAY RESUME OPERATIONS

The Spassky Copper Mine, Ltd., is negotiating with the Soviet authorities with a view to resuming possession of the mines and works in Siberia, and with this object is offering 200,000 unissued £1 shares to the shareholders at 20s. per share, 15s. per share being returned as a commission, for the reason that it is illegal in this country to offer shares at a discount. A thorough technical examination is to be undertaken, and provision is made for expenditure in connection with an arrangement for the resumption of occupation of the properties. Formerly the company was a dividend payer, having distributed 25 per cent in 1913 from profits derived entirely from the Spassky smelter. The company also

owns properties at Atbasar, and a coal property, on which its engineers have estimated a deposit of 400,000,000 tons.

With regard to the recent activity in Santa Gertrudis and Camp Bird shares, a financial journal has made an estimate of the value of Camp Bird ordinary shares. The Camp Bird company has a large holding in Santa Gertrudis, but the bulk of any profits derived from the working of the latter must for a considerable time belong to Camp Bird preference shareholders, whose dividends are in arrears since the middle of 1920. Judging by the examination of the position, it would appear that there is a possibility of the Camp Bird capital being reorganized, which will mean the writing down of the old Camp Bird mine and tunnel property, which figures in the balance sheet at £824,691 and which has little value unless further discoveries are made in the mine.

Some flutter has been caused among holders of De Beers shares on account of remarks made by Mr. Warrington Smyth, Secretary for Mines and Industries of the Union of South Africa, in the annual report of his department. He shows that the total possible trade in diamonds in the world today is about £12,000,000 per annum, and of this amount £3,500,000 is produced outside the Union. As South African alluvial fields yield about £2,500,000, the total competition with the four big producers is £6,000,000, or 50 per cent of the total diamond market. As the De Beers' share is only 25 per cent of the total market of the world today, De Beers does not control the market. Possibly this may be an explanation for L. Breitmeyer & Co. not continuing in the Diamond Syndicate, which is now largely in the hands of the Anglo-American Corporation.

American Metal Co. to Build Lead Smelter at Zacatecas

The Cia. de Minerales y Metales, S. A., a subsidiary of the American Metal Co., is to build a lead smelter at Zacatecas, Mexico. The company has a long-time contract for the smelting of the lead-silver ores of the Cia. National Minera. A railroad is being built into the National company's mines at Bilbao, and the smelter will be ready for treatment of these ores by the time the mine is ready for tonnage shipments.

The American Metal Co. is operating a lead-silver mine under lease near Zacatecas, but it will depend mainly on the Bilbao property and custom ores for supplying the new smelter. Just how large the smelter will be has not been decided, but it is planned to have the new plant ready for operation by next fall.

Potosi Mining Co. Completes 200-Ton Mill

The 200-ton mill of the Potosi Mining Co. at Santa Eulalia, Chihuahua, has been completed, and over \$600,000 has been expended in electrifying the narrow-gauge railway connecting the properties with the City of Chihuahua, 20 miles distant.

Mexico City Letter

By W. L. Vail
Special Correspondent

Increased Freight Rates Proposed—Revision of Mining Laws Under Consideration

Mexico City, Nov. 8.—The management of the National Railways proposes to raise freight rates on minerals about 18 per cent, which has called forth a general protest from mine operators. As the control of the railways will probably be returned to the stockholders on Jan. 1, 1926, resulting in a complete change of management, mining men hope that any contemplated changes in the freight rate will be held in abeyance.

The commission appointed by the Secretary of Commerce and Labor to present a complete revision of the present mining laws to conform to Article 27 of the Constitution adopted at Queretaro in 1917, and to some of the advanced ideas on the subject has completed its labors and is ready to present its finding to Congress. It is hardly probable, however, that the new bill will be reached at this session. Discussion will more likely come up early in the coming year.

During the eight months of the present year the mint has coined about three times as much gold as silver. Up to Sept. 1, 26,500,000 pesos in gold coins were turned out and 9,105,000 pesos in silver. With the total suppression of silver coinage there has been a steady rise in the silver peso, which is expected to reach a parity with gold by the first of the new year.

Chihuahua city has an elaborate mining exhibit at the fair which opened on Nov. 15. More than 10,000 mineral specimens were shown, representing the principal camps of the state. The high price of lead and silver has given an unusual impetus to mining operations throughout the State of Chihuahua. Mine operators have also adjusted themselves to the new labor laws and there is very little friction between the men and owners.

It is reported that on Nov. 6 the American Smelting & Refining Co. completed the purchase of the San Juan mine, in the district of Taviche, State of Oaxaca, thus ending litigation which had been going on between claimants for over twelve years. The purchasers plan to erect the first unit of a mill at an early date. It is stated that there are 50,000 tons of milling ore on the dump and about 30,000 tons blocked out. A. W. Edelen, representative of the A. S. & R., is in charge of the development work.

The purchase of the San Juan and the recent sale of the Natividad, in the Sierra Juarez, and the sale of the San Jose Garzona, in the San Martin district, to the Marcus Daly interests, has given an impetus to the mining situation in Oaxaca. Kansas City investors have also recently acquired the Buena Noche and Topada properties, in the same state, and are actively pushing development work.

Societies, Addresses, and Reports

Canadian Institute Meets at Winnipeg

Dominion's Mineral Resources, Production and Trade Discussed by
Prominent Speakers—Promising Areas in Manitoba
Described—Interesting Social Features

ONE of the most successful and instructive meetings ever held by the Canadian Institute of Mining and Metallurgy convened at Winnipeg, Manitoba, on Nov. 3, 4, and 5, with a registration of nearly 150 members and guests.

Welcoming the visiting members, Premier Bracken of Manitoba, in his address, pointed out that whereas Manitoba had hitherto been known as a wheat province, the arable area of the province was less than one-fourth of the total area, and that over three-fourths was composed of lakes and mineral rocks, comprising part of what is known as the Canadian shield, a great Pre-Cambrian rock area well known for its mineral potentialities.

Dr. Allan, of Edmonton University who presided over the meetings of Nov. 3, in a short address on the petroleum fields of Alberta said that oil had been discovered in that province as far back as 1898, but that it was not until 1922 that any important drilling had been done. He described the present results as phenomenal, considering the small amount of drilling done to date. Wells had been sunk in Fort Norman, Pouce Coupé, Wainwright, Sweetgrass, and Turner Valley fields, the latter field producing the well-known Royalite No. 4, which at present produces 400 bbl. daily of high-grade oil running 73 deg. Bé. as well as over 20,000,000 cu.ft. of gas at a pressure of 1,100 lb.

The Wainwright field, where one or two wells are producing, has not yet proved a commercial success, as the oil there, which has an asphaltum base, runs only around 19 deg. Bé. It is however being used by the railways as a fuel oil with some success.

The paper of Dr. Charles Camsell, Deputy Minister of Mines for Canada, on the "Mineral Trade of Canada," was heard with great interest by the members. The speaker pointed out the ever-increasing demands for minerals to meet the needs of our modern civilization and the gradual exhaustion of Old World supplies, which would have the effect of stimulating the early development of the vast mineral resources within the Dominion.

Emphasizing the modern demand for minerals and mineral products, he showed that more minerals had been mined during the last fifty years than in all preceding time, and that the demand was greater today than in the last decade and constantly increasing. "Not only am I convinced," he said, "that Canada possesses great mineral wealth as yet unknown, but I am equally impressed with the force of circumstances which are ceaselessly increasing the world's mineral consumption and which are compelling the older

highly developed countries, through exhaustion of their own natural resources, to look to the newer countries to supply their deficiency. These circumstances will, I believe, greatly hasten the development of Canada's resources."

Dealing with the mineral trade of Canada as a whole, Dr. Camsell stated that Canadian exports were mostly of raw and partly manufactured products, whereas the imports covered the finished article in such fields as structural steel, machinery, copper wire, gasoline, and chinaware.

S. J. Cook, in his paper "The Half Year in Mineral Production in Canada," gave some very interesting figures. Canada's output of metals and non-metallic minerals in the first six months of 1925 reached a total of \$90,347,698, an increase of 7.16 per cent over 1924. The increase in production was general among gold, lead, nickel, copper, silver, zinc, and cobalt. Coal showed a slight decrease owing to the strike in Nova Scotia.

The gold production was 824,043 oz., with a value of \$17,034,480, an increase of \$2,558,739 over 1924. Ontario's output was 701,714 oz., the Porcupine district contributing 81.96 per cent of this and Kirkland Lake 18 per cent.

Lead production was 128,398,836 lb., having a value of \$11,510,955, an increase of \$5,232,145 over 1924. The Sullivan and Premier mines, in British Columbia, and the Mayo district, in the Yukon, were the greatest producers. The output of nickel was 35,756,640 lb., valued at \$11,442,125. Copper produced was valued at \$7,354,535, an increase of \$674,127 over that of 1924. The value of the output of silver was \$6,288,332, compared with \$5,881,196 for the corresponding period of 1924. Zinc showed a huge increase, the value being \$4,002,872, against \$1,832,198 for 1924. The value of asbestos produced was \$3,962,304.

PREDICTIONS FOR PROSPECTORS

At the afternoon sessions Prof. J. S. DeLury, of Manitoba University, spoke on the application of the theory of metallogenesis to the prospecting areas of Manitoba. "From the theory of the origin of metals and their relationship to the granite intrusions, it is possible to predict in Manitoba, where the rock relationships are known, what minerals are likely to occur," said the speaker. The theory limits the commercial production of minerals in Manitoba to gold, copper, tin, molybdenum, tungsten, bismuth, and arsenic. Nickel and platinum are also possible. Silver and zinc may be produced as byproducts from the ores of the other minerals. Lead prospects are not likely to be promising

for development. The best prospecting areas are those in which the granite is relatively less prominent.

Developments in the mining areas east of Lake Winnipeg were reviewed by W. A. Wentworth, of the W. A. D. Syndicate. Undoubtedly the most important operations in this field are in the Long Lake district, where the Kitchener property of the Central Manitoba Mines, Ltd., a subsidiary of the W. A. D. Syndicate, is being developed. A three-compartment shaft, 11 x 14 ft., has been sunk on this property to a depth of 400 ft. with three stations cut at the 125, 250, 375 ft. horizons. Over 600 ft. of lateral work on the first and third levels has shown the property to have great potentialities, the average ore being well over \$12 on a width of 5.5 ft. with a known oreshoot over 900 ft. long, while other shoots have been found running equally high in values. The sinking of the shaft was done by gasoline equipment and took just three months, wonderful time considering the circumstances. This company's program for 1926 calls for extensive development work to put the property in condition for a mill. The Anglo-Canadian Explorers, Ltd., of England, are interested in these properties, having an option on the control at a figure said to be over \$1,000,000, which sum is to be spent on development of the property.

The Anglo-Canadian Explorers, Ltd., is also operating the Oro Grande property, on Bulldog Lake, four miles east of the Kitchener. Some spectacular ore has been uncovered on the surface, and a 50-ft. prospect shaft sunk on a rich lead averaged over \$30 throughout. From the proceeds of ore recovered in this shaft machinery was purchased to make it possible to sink to depth. Another shaft has been sunk to 175 ft. and drifts started at the 125-ft. horizon. Work is still progressing, with the prospect good.

What might be termed the biggest gold strike of the year was found by Russel Cryderman about three and one-half miles north of the Kitchener. The Mining Corporation of Canada is carrying out preliminary prospecting work sinking a shaft to 60 ft. and from appearances it is reported excellent results are likely to be obtained with further work.

In the Point Du Bois district a discovery of lepidolite has been made, the only known body of lithium-bearing ore in Canada. The prospects for this property are good, as it is only 7 miles from a railway and electric power. More than 10,000 tons of ore has been uncovered, with an average lithia content of 4 per cent.

Frank Martin, consulting engineer for the Manitoba Power Co., pointed out how well situated the central Manitoba field was in regard to power, being just fifty miles from his company's plant at Great Falls with a power capacity of 160,000 hp. He stated that arrangements had been made for power for the mining area and thought that before the end of the next year the camp would be supplied with all the power it could use.

Wednesday morning sessions were devoted entirely to the coal industry.

The principal paper being that of Hon. Howard Stutchbury, Trade Commissioner for Alberta.

HUDSON BAY AREA PROMISING PROSPECTING GROUND

Professor Wallace, of Manitoba University, in a paper on the "Mineral Resources of the Hudson Bay Territory," said that this area offered possibly the best prospecting ground in Canada today. Its area was almost entirely Pre-Cambrian, and many important mineral possibilities had been discovered, chief among which were the iron deposits of Belcher Island and the copper sulphides of Chesterfield Inlet.

The Herb Lake district, which is better known as The Pas district, has seen much activity, and much staking for both gold and silver has been done, but the only important bodies already uncovered are the Mandy and Flin Flon, both copper properties. The Flin Flon is a large body of low-grade ore belonging to the Mining Corporation of Canada. Negotiations, however, are understood to have been completed whereby possession of this property will soon pass into the hands of a company controlled by American smelting interests.

A. A. Pauli, engineer for the Canadian Ingersoll-Rand Co., spoke on the selection of mining equipment for development work, outlining the various factors governing such selection and enumerating the equipment.

TWENTY-FOUR POWER SITES ON NELSON RIVER

That the North country is amply blessed with power sites was shown by C. H. Attwood, Dominion Government power engineer, in his paper on the power possibilities of the Nelson River. He described a series of twenty-four possible sites on this river, capable altogether of generating more than 3,000,000 hp.

An excellent paper giving the history and development of building stone in Manitoba as mined at the Tyndall quarries near Winnipeg was read by A. A. Prefontaine, president of the Western Stone Co., St. Boniface. Geologists and engineers from both east and west expressed themselves favorably and urged the local institute to take steps to make this product better known nationally and to have samples included in all exhibits in Canada of a mineral nature.

One of the interesting features of the meeting was an address by G. Johnson, squadron leader of the R. C. A. F., at the smoker held on Tuesday evening. Major Johnson told the story of the Canadian Air Boards' photographic survey of northern Manitoba and Ontario, showing air pictures and explaining the methods of mapping.

The social side of the convention was a huge success. Beginning with a luncheon tendered by the City of Winnipeg and finishing with a banquet and visit to the power plant of the Manitoba Power Co. at Great Falls on the Winnipeg River, there was entertainment to suit everyone and every indication that those attending heartily appreciated the efforts that were made in their behalf.

Recent Technical Publications

Reviews, Abstracts, and References

English Mine Surveying Differs From American Practice

Metalliferous Mine Surveying. By Frederick Winiberg. Mining Publications, Ltd. Salisbury House, London, E. C. 2. Price, post free, 15s. 10d.

One examining this work will naturally make comparisons with American books covering the same ground and have American methods and instruments always in mind. The author is a teacher of mine surveying. His directions are detailed and to the point, giving each step in such a way that the student can understand and use it, but the methods and instruments are not those used in the United States. The American mine surveyor will probably find the chapters on traversing and shaft plumbing the most interesting and will be able to apply many of the ideas there presented in his own work.

The chapter on "Observations for Meridian, Latitude, and Time," aside from obvious errors, gives formulas and methods, especially for solar work, that were discarded twenty-five years ago in the United States, as too cumbersome and liable to error. The author has little to say in favor of the auxiliary telescope, yet much good work is necessarily done with it in the United States. It is somewhat startling to an American surveyor who buys his spads ready made by the thousand and uses a tape 600 ft. long, to be told how to make spads from sheet brass and to be shown the method of making long measurements with a 100-ft. tape.

The chapter on mathematics would seem to be inadequate for a beginner and useless to an experienced surveyor. The beginner needs specimen surveys and calculations, for example for shaft and raise connections or shaft and tunnel, as much as he needs elaborate instructions for making each step in the survey itself. The American surveyor will find the volume chiefly useful for its theoretical presentation of several problems in mine surveying and for the many practical and workable ideas scattered through the book, but he will rarely care to apply in its entirety any of the complete operations presented.

JAMES UNDERHILL.

Patents

Flotation—No. 1,554,216. Sept. 22, 1925. C. H. Keller, San Francisco, assignor to Minerals Separation North American Corporation, New York City. An ore pulp is agitated with a mineral frothing agent to which is added a sulphur derivative of carbonic acid, adapted to form anions and cations in solution.

No. 1,554,220. Sept. 22, 1925. C. P. Lewis, Burlingame, Calif., assignor to Minerals Separation North American Corporation, New York City. A mineral in the form of an alkaline pulp is subjected to a flotation operation in the presence of a xanthate. This is one of the

most important of the flotation patents, and was held up for some time owing to the fact that there was another application for a patent on substantially the same thing.

No. 1,559,504. Oct. 27, 1925. R. B. Crowell, Agnew, Calif., and G. F. Breckenridge, San Jose, Calif., assignors to Western Industries Co., Agnew, Calif. The process of producing alkali metal xanthates which comprises reacting a hydroxide of an alkali metal, alcohol, and carbon bisulphide, in a liquid hydrocarbon medium chemically inert to the remaining ingredients.

Drilling Machinery—No. 1,554,247. Sept. 22, 1925. G. R. Watson, Waterloo, Iowa, assignor to Armstrong Mfg. Co., Waterloo, Iowa. A shaping die for a drill bit.

No. 1,554,766. Sept. 22, 1925. F. M. Slater, Easton, Pa., assignor to Ingersoll-Rand Co., Jersey City, N. J. An air-feed brake for rock drills.

No. 1,554,776. Sept. 22, 1925. L. C. Bayles, Easton, Pa., assigned as above. A cushioning device for hammer drills.

No. 1,554,777. Sept. 22, 1925. L. C. Bayles and F. M. Slater, Easton, Pa., assigned as above. Design for a rock drill.

No. 1,554,446. Sept. 22, 1925. J. W. Loy, Long Beach, Calif. Design for a core drill.

No. 1,558,221. Oct. 20, 1925. L. C. Bayles and F. M. Slater, Easton, Pa., assignors to Ingersoll-Rand Co., Jersey City, N. J. A lubricator for rock drills.

No. 1,558,128. Oct. 20, 1925. Patrick Walsh, Bartlesville, Okla. A dump receptacle for drill cuttings.

Reduction Furnace—No. 1,558,965. Oct. 27, 1925. G. H. Clevenger, Boston, Mass., assignor to Research Corp., New York City. A combination of two cylindrical revolving furnaces placed in a substantially horizontal position, being tipped slightly to facilitate progress of the charge. Between the two furnaces is a combustion chamber through which the discharge from the upper cylinder falls into the lower one, and in which gases from the lower unit are burned. At the head of the upper unit is a pre-heating chamber.

Treatment of Speiss—No. 1,557,879. Oct. 20, 1925. C. G. Richardson, Elizabeth, N. J. Speisses containing nickel, cobalt, arsenic, and antimony are roasted to such a point that an amount of arsenic is eliminated equivalent to the amount necessary for combination with the cobalt.

Filter—No. 1,558,038. Oct. 20, 1925. W. D. Mount, Lynchburg, Va., assignor to one-half to J. E. Mount, Ithaca, N. Y. A method of producing linear travel of a filtering surface, and passing a stream of the magma to be filtered in the same direction and in contact with that surface.

Skip-loading Gate—No. 1,558,121. Oct. 20, 1925. G. N. Simpson, Chicago. Design of an automatic skip-loading gate.

Men You Should Know About

James S. Douglas has returned to Douglas, Ariz., from Paris, after completing his African tour.

H. T. Hamilton, metallurgical engineer of San Francisco, is in New York, where he will remain for three weeks.

Edward T. Moore, president of the Simms Oil Co., has returned to Dallas, Tex., from a four-months' trip through Europe.

John F. Duling, of Los Angeles, has completed a mine examination near Mina, Nev., and has returned to Los Angeles.

W. H. Storer, for some time with the Cons. Amincano, Rio de Janeiro, Brazil, South America, has returned to the United States.

F. Lynwood Garrison and **Lloyd T. Emory** have just returned from a professional visit to Bagdad, Humboldt, and Jerome, Ariz.

R. W. Woods, of Vancouver, B. C., president of the Premier Gold Mining Co., is in Kingman, Ariz., to look over his interests in the Peerless mine.

James McNaughton, general manager of Calumet & Hecla Consolidated, has returned to the Michigan copper district after a business visit in the East.

Nelson Dickerman, who had been in Boston and New York for several weeks, sailed on the S. S. "Voltaire" for Buenos Aires on Nov. 14 to be gone several months.

James F. McCarthy, of Wallace, Idaho, president and manager of the Hecla Mining Co., is in Milwaukee to attend a meeting of the directors of the company.

W. Lee Heidenreich has returned to his home in Santa Monica, Calif., after doing some examination work in Colorado. He expects to leave shortly for Tepic, Mexico.

Hugh Wright, mining engineer, left the United States on Nov. 4 for South America, on professional business which will require his absence for about three months.

J. F. Callbreath, secretary of the American Mining Congress, was recently in San Francisco en route to Phoenix, where the annual meeting of the Mining Congress was held on Nov. 16.

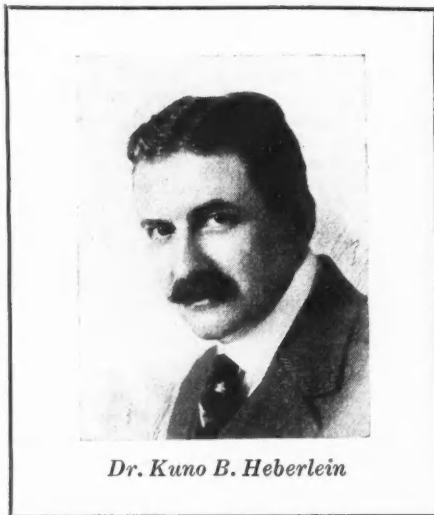
J. G. Goosman, manager of Minas de Gatico, north of Antofagasta, Chile, is in San Francisco en route to New Zealand. He has resigned from his company and expects to remain in New Zealand for three years, after which he will return to South America.

M. J. Gavin, refinery engineer of the U. S. Bureau of Mines, returned from Colorado to the San Francisco office of the Bureau on Oct. 20. He left San Francisco on Oct. 24 for New York, and intends spending a month or more in examining oil shale deposits in Nova Scotia.

C. W. Wright, who has been engaged in mining in Italy for many years, was in the United States recently on a com-

bined business and pleasure trip, visiting Washington and New York. He left Nov. 7 to go back to the Tyrol, where he is engaged in bringing half a dozen mines into profitable producers.

D. N. Fairchild, mining engineer, and member of the firm of Fairchild & Fairchild, mining, metallurgical, and chemical engineers of Chicago, was a recent visitor to the Ajo district, in Arizona, where he examined the copper-mining properties of Joe Hunter, about three miles from the New Cornelia holdings.



Dr. Kuno B. Heberlein

Dr. Kuno B. Heberlein sailed on Oct. 28 for a business trip to Europe.

W. B. Cramer, consulting engineer for the concentrating department of the Phelps Dodge Corporation, with headquarters in Bisbee, Ariz., has been in Globe, making a study of the Old Dominion concentrator, in connection with the contemplated improvements which are to be made at this property. Mr. Cramer recently returned from a trip to the concentrating plants in Mexico and Alaska.

Colonel Henry H. Armstead, of Canadian Mines Merger, Ltd., Kaslo, B. C., has been elected to the advisory council of the International Institute of Economics, Washington, D. C. Other members of the council are **John Callan O'Laughlin**, First Assistant Secretary of State in Roosevelt's Cabinet and owner-editor of the *Army and Navy Journal*; **J. Laurence Laughlin**, economist; **Owen D. Young**, General Electric Co.; **John W. Davis**, statesman and lawyer; **William Loeb Jr.**, of the A. S. & R. Co.; **Reed Smoot**, United States Senator; **Otto Kahn**, banker; **John Hays Hammond**, mining engineer; **James G. Harbord**, of the Radio Corporation of America; and **General George W. Goethals**, builder of the Panama Canal.

Henry T. Chandler has been appointed assistant to the president of the Vanadium Corporation of America. Mr. Chandler has been associated with the Vanadium Corporation since Jan. 1,

1923, in the capacity of metallurgical engineer, with headquarters in Detroit. He has had an extremely wide and varied experience in the iron and steel and automotive fields, and is today one of the foremost metallurgical engineers in the country. From 1914 to 1920, he was in charge of the research laboratory of the Ford Motor Company, investigating alloy steels and their use in applied metallurgy; and from 1920 to 1923, with the C. H. Wills organization as metallurgical engineer. He received his technical education at the University of California (two years), Massachusetts Institute of Technology (three years), Sorbonne, Paris, and the Polytechnic Institute, Zurich, Switzerland (three years), in physics, chemistry and metallurgy. Though Mr. Chandler's headquarters will be continued in Detroit, he will in this broadened field have general supervision of the development and research work in iron and steel at the plants of the Vanadium Corporation of America and its subsidiary, the United States Ferro Alloys Corporation.

Obituary

Charles E. Knox, president of the Montana-Tonopah Mining Co. and associated with the mining industry in various sections of California and Nevada, died at his home in Berkeley, Calif., on Nov. 6.

A. C. Bixby, manager of the Ajax Mining Co., at Burke, in the Coeur d'Alene district, Idaho, died on Nov. 3 after an illness of several months. He came to the Coeur d'Alenes about twelve years ago from Lynn, Mass., where the control of Ajax is held, and under his direction a large amount of development was accomplished and the mine placed on a productive basis. His body was taken to Chicago for burial.

Prof. Frederick Burrett Peck, who had occupied the chair of mineralogy and geology at Lafayette College, at Easton, Pa., for twenty-eight years, died on Nov. 2. He was born in Seneca Castle, N. Y., on Aug. 19, 1860, the son of the late Henry Jones and Mary Diantha Grey Peck, and was graduated from Amherst College in 1896 with the degree of bachelor of arts. He received the degree of doctor of philosophy from the University of Munich, Germany, in 1896. From 1886 to 1891 he was teacher of mathematics and natural sciences of Trinidad College, Colorado. The following three years he spent as assistant in geology at his Alma Mater and at Smith College. He came to Lafayette in 1897. Professor Peck was a fellow of the Geological Society of America, a member of the American Association for the Advancement of Sciences, the American Institute of Mining and Metallurgical Engineers, the American Association of Professors and also of the Delta Upsilon fraternity. Dr. Peck was married to Miss Cora Burr Horton, of Binghamton, N. Y., on June 12, 1901. He is survived by his wife, one daughter and a sister. His brother, Dr. James Ingraham Peck, professor of biology at Williams College, died in 1898.

New Machinery and Inventions

New Large Mine Ventilating Fan Installed on the Rand

Capacity 900,000 Cu.Ft. of Air per Minute on 7-in. Water Gage—Ventilates Government Gold Mining Areas Workings

A new 30-ft. fan built by Walker Brothers, Ltd., of Wigan, England, for the Government Gold Mining Areas, on the Rand, South Africa, was put into operation on Aug. 23. It is 30 ft. in diameter by 10 ft. wide, and has a capacity of 900,000 cu.ft. of air per minute on a 7-in. water gage at 125 r.p.m.

The runner is contained in a masonry casing with a steel hood. After completion on site the runner was found to be within $\frac{1}{8}$ in. of a true circle, according to *Engineering*. It is carried in two main bearings, each fitted with thin oil rings, for which distant indicating thermometers in the engine room are provided.

The discharge of the fan is fitted with an anti-vibration shutter, which is designed to eliminate the pulsations set up by each blade as it passes from the high-pressure zone into the low-pressure one beyond the cut-off. This shutter takes the form of a deep V notch, tapering from the full width of the discharge at the lowest point of the casing to zero at slightly above the horizontal center line, or through rather more than 90 deg. of discharge. The shutter is so constructed that the rate of taper can be increased and the radial discharge angle occupied by the V decreased by removing sections of the plates of which it is constructed. Three different tapers can thus be obtained, and the quickest taper corresponds to the full duty.

The fan is direct-driven by a tandem compound steam engine with cylinders 26 in. and 52 in. diameter by 36 in. stroke, also built by Walker Brothers. The inlet and exhaust valves on both cylinders are of a special drop type, designed to operate quietly and without injurious hammering at a comparatively high speed. The lift is very gradual at the start and is rapidly accelerated to full opening, a similar result in the reverse order being given in closing.

The high-pressure cut-off is governed by a centrifugal spring-loaded governor, and the low-pressure cut-off is hand-adjusted to suit operating conditions from time to time. A tail rod is fitted to the high-pressure cylinder, and all glands, including those for the valve spindles, are fitted with metallic packing.

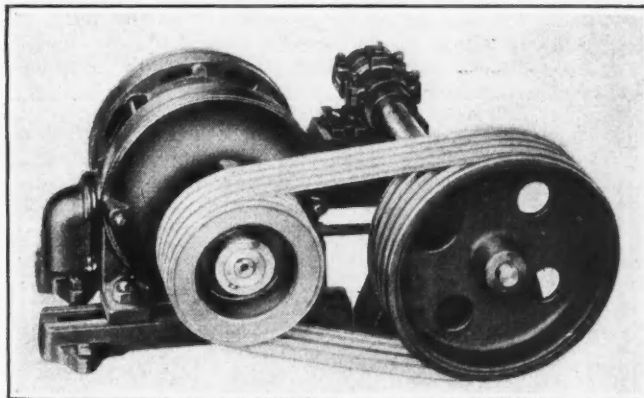
Forced lubrication is provided to the two main engine bearings and to crank and crosshead, and an alarm is fitted which gives warning if the oil pressure falls below 5 lb. per square inch. A hand pump is fitted for flooding the bearings at starting.

For condensing, a Metropolitan-Vickers multiple-jet Le Blanc condenser is fitted, and in this the dolomite water from the shaft will be used. A proportion of the water will be treated in a

softening plant for use as boiler feed, and the major portion of the warm water will be pumped to the reduction works and compounds. When this equipment is supplied with steam at 140 lb. per square inch, superheated 100 deg. F., a steam consumption of 12.5 lb. per horsepower is guaranteed, with an indicated horsepower of 1,425 corresponding to the full duty of the fan.

Steam is supplied from two double-drum land type B. and W. boilers fitted with mechanical chain-gate stokers and superheaters, each boiler capable of delivering 10,000 lb. of steam of the quality above mentioned per hour. The rotating parts of the fan, including engine crank shaft, weigh 36 tons.

The
Texrope
short
center
drive



Electrified Dredges for Russia

The progress of electrification in Russia is indicated by the fact that the Yuba Manufacturing Co., of San Francisco, is building, at its Marysville works, five electrically operated mining dredges for service in the territory of the Ural Mountains, in Russia. These dredges are to be used in the mining of platinum and will be operated by the Platinum Trust of the Soviet Government.

The dredges will be shipped, knocked down and packed for export, to New York, and there consolidated with the electrical equipment for transatlantic shipment to Leningrad. Four of the dredges are of 13½ cu.ft. and one is of 7½ cu.ft. capacity per bucket.

The complete electrical equipment of motors, control, and lighting service is being furnished by the General Electric Co., and the power for operating will be obtained from transmission systems of 40,000 and 10,000 volts, 3-phase, 50-cycles, and stepped down at the dredges to 440 volts.

A commission from the Soviet government visited the United States in the early part of this year to inspect the operation of placer mining dredges, and, after a thorough investigation of designs and operating characteristics, selected designs of the Yuba company's dredge equipments such as have been in operation in California and elsewhere for a number of years.

The electrical equipment includes seventy-eight motors with an aggregate rating of 5,200 hp., 9,250 kva. in transformers, and 110,000 ft. of wire and cable.

New Short-Center Flexible Drive Runs Smoothly, Without Slip

Bearing Pressures Low—Device Claimed to Be Suitable to a Wide Variety of Industrial Applications

An important development in the field of power-transmission machinery has just been announced by the Allis-Chalmers Manufacturing Co., Milwaukee, Wis., which has recently perfected an entirely new type of short-center, flexible drive, known as the Texrope drive. This drive consists of two grooved sheaves and a number of specially constructed endless "V" belts. The sheaves are set just far enough apart so that the belts fit the grooves without either tension or slack.

Previously no short-center drive existed which did not have slip, back lash,

or lost motion, which caused jerky starting and uneven running. Since the Texrope belts just fit the sheaves, there is no slack or lost motion in the drive. Because of the "V" construction, they cannot slip, as the harder the pull the more firmly the belts grip the grooves. Being elastic and stretchable, they cannot jerk, either in starting, acceleration or running, nor can they transmit vibrations, but act as cushions between the driving and driven machines. Therefore the company claims that a smoothness of transmission never attained before is delivered by the new drive, as opposed to the series of linear pulsations delivered by the ordinary short-center drive.

Bearing pressures are low, since no belt tension is employed. The drive occupies very little space. It is silent, perfectly clean, unaffected by moisture or dirt, and is safe, simple, and trouble-proof. Since there is no slip, the speed ratios are fixed and exact. It is durable, and each belt carries its proportional share of the load which the machine must carry.

Drives of this new type from $\frac{1}{2}$ to 250 hp., with ratios up to 7 to 1 and belt speeds from 800-6,000 ft., have already been placed in service. They have been applied to nearly every industry, notably textile machinery, fans and blowers, machine tools, food-manufacturing machines, refrigeration, mining, crushing, wood- and metal-working machinery, elevators and conveyors, paper, flour and rubber mill drives, and numerous other industrial applications.

New Oil-Electric Locomotives Operate Economically

The recent purchase of a 60-ton oil-electric locomotive by the Central Railroad of New Jersey, followed closely by the acquisition of a 100-ton type by the Long Island Railroad, brings this new type of locomotive into the limelight. The oil engine has six cylinders and is of the 4-cycle, single acting, vertical type. Fuel oil is injected directly into each cylinder through two opposite spray nozzles situated in the combustion chamber. This fuel is delivered, under pressure, by a pump directly connected with the main shafting. The heat resulting from sufficient compression ignites the oil and the power stroke is thus started—in other words the action is similar to that of an ordinary automobile engine with the heat of compression doing the work of the spark plug.

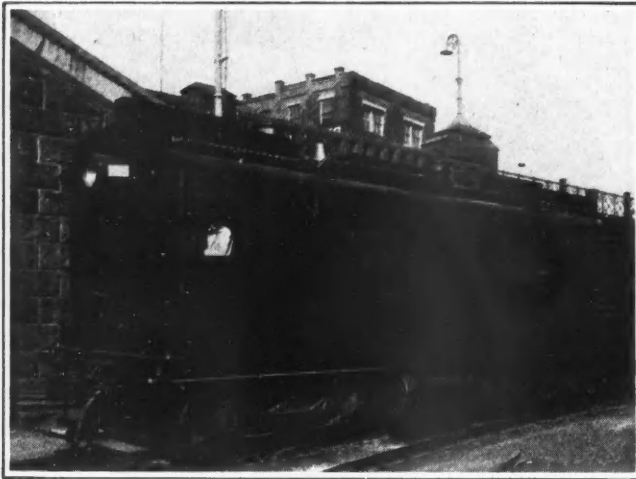
The pump which injects the oil serves all six cylinders and is automatically

erated delivers to the four driving motors the amount of energy necessary to turn the driving wheel at the prescribed speed. The tractive efforts can thus be varied to suit any operating condition.

To date these oil-electric locomotives have been constructed for both slow-speed switching and for road service. Designs have also been developed for two road types. Performance reports disclose that this type of locomotive is far more economical in cost of operating than a steam locomotive of the same capacity. The oil-electric locomotive is the joint product of the American Locomotive, General Electric, and Ingersoll-Rand companies.

Guarding Against Converter Accidents

The safety features of automatic control as applied to the nickel converters at the plant of the Mond Nickel Co., Ltd., at Conniston, Ont., are of considerable technical and general interest.



A
sixty-ton
oil-
electric
locomotive

controlled to feed each chamber as oil is needed. For efficient action the engine requires that the oil have a flash point of not less than 150 deg. F. A forced feed system of lubrication is used and functions through a gear-driven pump in the crank case. Circulating water is distributed to all parts of the engine by a centrifugal pump attached to the crank shaft.

To start the engine, compressed air at a pressure of 200 lb. is admitted successively to each cylinder, through mechanically operated starting valves. That there be a continuous supply of starting air, two small compressors are provided, one driven by an auxiliary engine and the other by the main oil engine. The latter compressor keeps the flasks of starting air continually charged.

Directly connected with the oil engine is a generator, with a voltage ranging from 200 to 750. The output is regulated by throttle to the demands made upon the dynamo by the tractive motors.

To control the locomotive the engineer has only to manipulate two control handles. One serves as a throttle lever to control the output of the engine; the other is a master controller or electric switch which puts the tractive motors either in series or in parallel as circumstances may require. With the throttle lever set at any desired speed, the gen-

erator delivering to the four driving motors the amount of energy necessary to turn the driving wheel at the prescribed speed. The tractive efforts can thus be varied to suit any operating condition. To date these oil-electric locomotives have been constructed for both slow-speed switching and for road service. Designs have also been developed for two road types. Performance reports disclose that this type of locomotive is far more economical in cost of operating than a steam locomotive of the same capacity. The oil-electric locomotive is the joint product of the American Locomotive, General Electric, and Ingersoll-Rand companies.

To prevent the operator rotating the converter too far forward or backward, two limit switches were placed at the two desired limits or motion. Beyond these points the converter will not rotate, for the power is cut off from the motors by these switches. However, to reverse the motor, the operator has only to throw his master switch in the opposite direction, and the motion will be taken care of automatically through the 65 hp. magnetic switch controller.

Under abnormal conditions, as when the power fails, control is taken entirely out of the operator's hands. Upon failure of the blast, each converter is immediately rotated until the tuyères are brought above the level of the liquid matte. Power for this movement is supplied to the manipulator motors by storage batteries which are maintained for this purpose only. The control of this movement is taken care of on the special control board.

When the power fails, the normal circuits on these magnetic switch controllers are opened at once and the master switches are thrown out of control. Spring closing contractors snap shut to throw the motors on to the storage batteries, and the converters are turned down until the tuyères are above the liquid, where a third limit switch on each converter stops them. When the power comes on again it is neces-

sary for the operator to restore his master switch to the "off" position, and the controller can then be operated in a normal manner. The control on this installation was installed by the Electric Controller & Manufacturing Co., Cleveland, Ohio.

A Fuel-Waste Meter

The largest loss in any boiler plant is the heat wasted up the chimney. For measuring this a recording waste meter has been introduced by the Uehling Instrument Co., of Paterson, N. J. With its aid, the fuel wasted may be readily determined either in dollars and cents or in B.t.u. or in per cent of the fuel burned during any time interval. The waste meter records the temperature of the escaping flue gases and their percentage of carbon dioxide on the same chart. The corresponding fuel loss for any CO₂ and temperature may be read directly from a table furnished by the manufacturer.

Trade Catalogs

Voltage Regulators—Bulletin HEA-123 of the General Electric Co., Schenectady, N. Y., is devoted to the subject of automatic voltage regulators and is intended to supersede certain bulletins previously issued.

Explosives—The Dupont Explosives Service Bulletin for November contains an article on Driving Raises, by A. E. Anderson.

Paint—The Goheen Corporation, Newark, N. J., has issued Bulletin 102, giving specifications and standards for painting exterior and interior metal, hot surfaces, exterior and interior wood and concrete building, machinery, and equipment. Another bulletin covers "Rockote," a product for hardening the surfaces of concrete floors.

Rolls—Bulletin 1823 of the Allis-Chalmers Manufacturing Co., Milwaukee, Wis., covers crushing rolls of the Garfield type. Thirty pages, illustrated.

Transmission—Bulletin 1228 of the Allis-Chalmers Manufacturing Co., Milwaukee, Wis., is devoted to the Allis Texrope drive. This drive is described on page 835 of this issue. Sixteen pages, illustrated.

Boilers—Pamphlet 280, Steere Engineering Co., Detroit, Mich., is devoted to a description of the Steere clinker door.

Motors—Polyphase induction motors with cast steel frames and Timken roller bearings are covered in Bulletin 1132, issued by Allis-Chalmers Manufacturing Co., Milwaukee, Wis.

Surveying—C. L. Berger & Sons, Inc., Boston, Mass., have issued a new catalog of engineering, surveying, and mining instruments, this addition marking the beginning of the second half century since the firm was started. The catalog contains 210 pages and is bound in cloth. A price list is inclosed with it.

Gas Meters—The Connersville rotary displacement meter is described in a 12-page bulletin, No. 4 C, issued by the Connersville Blower Co., Connersville, Ind. Bulletin 18 D covers rotary positive blowers for raw water ice systems.

The Market Report

Metal Price Reaction Appears Over

Further Slight Declines Noted, but Consumption Continues Unabated
—London Weakness Affects Domestic Market

New York, Nov. 18, 1925—Prices of copper, tin, lead, silver, and zinc are all slightly lower today than a week ago, but the best opinion seems to be that the reaction is temporary, that the present market is a firmer one than for a week or two, and that the excellent consumption and meager stocks cannot be resisted. Had it not been for the weakness in London in recent weeks, it is unlikely that any decline would have

occurred here, though the unstable condition of the New York stock market would no doubt have caused increasing caution on the part of metal buyers.

Copper Sells at 14½c.

Copper is about a quarter of a cent less than a week ago. Thursday and Friday, good tonnages were sold at the higher freight rate points for 14½c., delivered, and fair amounts were taken

for nearby points at from 14½ to 14¾c. Yesterday and today, however, owing principally to the lack of interest abroad, copper was more insistently offered in the domestic market, and buyers, sensing this, demanded concessions below the 14½c. offered price for Connecticut and nearby points. One buyer in the Valley was able to get a good tonnage for 14½c., delivered, though that probably could not have been done in more than one direction. Most sellers are holding at 14½c., and some are out of the market entirely. Offerings by second-hands in the Middle West have had a bearish effect on the price, and on some days Eastern sellers have been unable to realize more for Middle Western deliveries than for Connecticut. The brass mills have been the principal purchasers, reflecting the record business that most of them are doing. Much wire business is in the offing, however, there being twelve to fourteen million pounds in the market in the form of inquiries yesterday. Buying would no doubt increase considerably if the copper market showed strength, but, even as it is, this week's sales are well above those of last week.

The foreign market has been exceedingly quiet, and has been principally responsible for the depression here. American agencies continue to quote at or close to their recent level of 14.95c., c.i.f., but dealers, who are now offering at around 14.75@14.80c. are getting most of the business.

More Lead Coming Out

Lead continues to be more freely offered, though spot lead is admittedly rather scarce. The situation has been helped in the last two days by one of the principal sellers being advised that his November production will be 1,000 tons greater than expected. Sales have been in good volume during the week and have been well distributed among the various classes of buyers. Most of the metal has been for December or January delivery, though a little lead for February delivery from foreign sources has sold, the smelting to be done in this country. No reputable buyer should have trouble in getting anything but spot lead at the New York price of the American Smelting & Refining Co., which continues at 9.75c. November and December lead has been freely offered at that figure. In St. Louis and Chicago lead is scarcer and as high as 9.80c. has been done, but with the freer supplies, prices are showing a tendency to revert to the level of 9½c., at which the principal producer has been selling limited tonnages.

Zinc Prices More Stable

The reaction in zinc seems to have been pretty well arrested. Sales have been good during the week, but mostly for December or January, the prices for

Daily Prices of Metals

Nov.	Copper N. Y. net refinery*	Tin		Lead		Zinc
	Electrolytic	99 Per Cent	Straits	N. Y.	St. L.	St. L.
12	14.50	63.25	64.50	9.75	9.50@9.75	8.40@8.50
13	14.50	63.125	64.375	9.75	9.50@9.75	8.40@8.45
14	14.50	62.75	64.00	9.75	9.50@9.75	8.40@8.45
16	14.375	62.75	64.00	9.75	9.50@9.75	8.35@8.50
17	14.30	62.125	63.375	9.75	9.50@9.70	8.375@8.45
18	14.30	62.50	63.75	9.75	9.50@9.70	8.375@8.45
Av.	14.413	62.750	64.000	9.750	9.617	8.425

*The prices correspond to the following quotations for copper delivered: Nov. 12th, 13th and 14th, 14.75c.; 16th, 14.625c.; 17th and 18th 14.55c.

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

Nov.	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic	Spot	3M	Spot	3M	Spot	3M
	Spot	3M							
12	61½	62½	68½	285½	282½	37½	36½	38½	38½
13	61¾	62¾	68¾	287½	284½	37½	36½	38½	38½
16	61½	62½	67¾	286½	284½	36¾	36½	38½	37½
17	61	62	67¾	284½	282½	36¾	35½	38	37½
18	61	62	67½	286½	283½	36½	36	38	37½

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

Nov.	Sterling Exchange "Checks"	Silver		Gold London	Nov.	Sterling Exchange "Checks"	Silver		Gold London
		New York	London				New York	London	
12	4.84¾	69½	32¾	84s11½d	16	4.84¼	68½	31½	84s11½d
13	4.84¾	69½	32¾	84s11½d	17	4.84¼	68½	31½	84s11d
14	4.84¾	69½	32¾	....	18	4.84¼	68½	32	84s11½d

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

those deliveries being from \$1 to \$3 per ton less than for prompt, the limited supplies of which are very closely held. Speculative influences seem to have been chiefly responsible for the recent decline in London; it is felt that Europe will soon need American zinc, in which case prices there must react upward or American prices decline further. Smelters have recently been making satisfactory profits, so have sold more freely than when metal prices were unduly low, compared to ore. Brass Special is almost impossible to get and quotations are all the way from 15 to 40 points above Prime Western. High-grade continues at 10½@10¼c. delivered in the East.

Tin Continues Quiet

Very little interest is exhibited in tin these days and the price has fallen slightly, to about 63¼c. today for spot Straits, with forward ½c. less. The 99 per cent grade is only available for shipment, spot prices being entirely nominal.

Exchanges Quiet

Foreign moneys have generally moved within narrow limits. Closing cable quotations on Tuesday, Nov. 17, were as follows: francs, 4.01c.; lire, 4.0025c.; and marks, 23.80c. Canadian dollars, 7/64 per cent premium.

Silver Down to 687/8c.

Nov. 16th saw silver go below the 69c. level for the first time since the early part of July, but on the decline China and India both appeared as buyers with a consequent improvement in price. The market is steady, with no apparent tendency up or down.

Mexican Dollars: Nov. 12th, 53½c.; 13th and 14th, 53¼c.; 16th, 52¾c.; 17th, 52¾c.; 18th, 52¾c.

Other Metals

Quotations cover large wholesale lots unless otherwise specified.

Aluminum—99 per cent grade, 29c. per lb.; 98 per cent, 28c. London, 98 per cent, £118 per long ton. New uses causing increased demand.

Antimony—Per pound, f.o.b. New York: Chinese brands, spot, 20c. December, 19@19¼c. Cookson's "C" grade, spot, 21¼c. Oxide and needle antimony unchanged from Nov. 7.

Bismuth—\$2.65@\$2.70 per lb., in ton lots. London, 10s.

Cadmium—60c. per lb. London, 1s. 9d.

Nickel—Ingot, 34c.; shot, 35c.; electrolytic, 38c.; London, £170@£175 per long ton. Market firm and orders satisfactory.

Platinum—\$120 per oz. refined officially quoted. Sales also at \$115@\$118. Crude, \$113.50@\$114.50. London, £24 for refined; crude £22. Market has recently been good, but supplies are adequate.

Quicksilver—\$89@\$90 for spot; December, \$87@\$89; per 75-lb. flask. San Francisco \$90.33. London, £14½. Good domestic demand, and Spanish production decreased.

The prices of **Cobalt, Germanium Oxide, Iridium, Lithium, Magnesium,**

Molybdenum, Monel Metal, Palladium, Osmium, Radium, Rhodium, Ruthenium, Selenium, Tantalum, Tellurium, Thallium, Tungsten and Zirconium are unchanged from the Nov. 7 issue.

Metallic Ores

Manganese Ore—Per long ton unit of Mn, c.i.f. North Atlantic ports: Brazilian, 42@44c., nominal; Indian, 44c., nominal; Caucasian (unwashed), 42c.; Caucasian (washed), 44c.

Tungsten Ore—Per unit of WO₃, N.Y.: Wolframite, \$11.50@\$12; Western scheelite, \$12@\$12.50.

Chrome Ore, Galena and Pyrite Radio Crystals, Iron Ore, Molybdenum, Tantalum, and Vanadium Ores are unchanged from quotations in the Nov. 7 issue.

Zinc Blende Lower—Lead Ore Unchanged

Joplin, Mo., Nov. 13, 1925

Zinc Blende	Per Ton
High	\$62.70
Premium, basis 60 per cent zinc	\$59.00@\$60.00
Prime Western, 60 per cent zinc	\$58.00
Fines and slimes, 60 per cent zinc	\$56.00@\$53.00
Average settling price, all...	\$56.99

Galena	
High	\$131.80
Basis 80 per cent lead	\$125.00
Average settling price, all...	\$125.28

Shipments for the week: Blende, 15,929; lead, 2,776 tons. Value, all ores the week, \$1,252,320.

Buyers of blende would offer no higher than \$58 basis Prime Western, and sellers declined to sell until today, when 20,000 tons were sold, all of the Prime Western grades on that basis, while about 1,500 tons sold from \$59 to \$60 basis under the classification of premium grade.

Buyers of lead report the basis price \$125 per ton of 80 per cent lead. No sellers have reported a higher price offering this week, and the tonnage sold declined. Approximately 14,000 tons are being held for a higher price level.

Production has climbed to 17,500 tons per week, with 168 mills in operation, 34 of them operating day and night.

Platteville, Wis., Nov. 14, 1925

Zinc Blende	Per Ton
Blende, basis 60 per cent zinc	\$ 61.50
Lead Ore	
Lead, basis 80 per cent lead	\$132.50

Shipments for the week: Blende, 900 tons; lead, 40 tons. Shipments for the year: Blende, 41,132; lead, 2,031 tons. Shipments for the week to separating plants, 1,625 tons blende.

Non-Metallic Minerals

Amblygonite, Andalusite, Asbestos, Barytes, Bauxite, Borax, Celestite, Chalk, China Clay, Diatomaceous Earth, Emery, Feldspar, Fluorspar, Fuller's Earth, Garnet, Gilsonite, Graphite, Greensand, Gypsum, Ilmenite, Iron Oxide, Lepidolite, Limestone, Magnesite, Manjak, Mica, Monazite, Ocher, Phosphate, Potash, Pumice, Pyrites, Quartz Rock Crystals, Rutile, Silica,

Spodumene, Sulphur, Talc, Tripoli, and Zircon are unchanged from prices in the Nov. 7 issue.

Mineral Products

Arsenious Oxide (White arsenic)—3.50c. per lb. Very little demand. London, £15 per long ton.

Copper Sulphate, Sodium Nitrate, Sodium Sulphate, and Zinc Oxide are unchanged from prices in the Nov. 7 issue.

Ferro-Alloys

Ferrocium, Ferrochrome, Ferromanganese, Ferrophosphorus, Ferrosilicon, Ferrotitanium, Ferrotungsten, Ferro-uranium and Ferrovanadium are unchanged from the prices in the Nov. 7 issue.

Metal Products

Rolled Copper—Sheets, 23¼c.; wire, 16¼c. per lb.

Nickel Silver—29¼c. per lb. for 18 per cent nickel Grade A sheets.

Yellow (Muntz) Metal—Sheets, 20¼c. per lb.; rods, 17¼c.

Lead Sheets—Full, 13¼c. per lb.; cut, 13¼c.

Zinc Sheets—12c. per lb., f.o.b. works.

Refractories

Chrome Brick, Firebrick, Magnesite Brick, Silica Brick, and Zirkite are unchanged from prices in the Nov. 7 issue.

Steel Firm—Pig Iron Advances—Coke Lower

Pittsburgh, Nov. 17, 1925

The volume of steel buying continues large and well in excess of current shipments. As much of the rail tonnage allocated in October did not reach formal entry in that month, prospects are that the Steel Corporation will show a larger unfilled tonnage gain for this month than the 291,886 ton increase reported for October. Rails ordered from all mills on this movement, in slightly over sixty days, now exceed 1,500,000 tons, the latest important business being 160,000 tons placed by the Pennsylvania, with options on 40,000 tons more.

Steel mill operations continue at approximately the October rate, which represented almost 45,000,000 tons per annum, or more than actual production in any calendar year.

No further steel price advances have occurred in the week. Sheet and tin plate prices for delivery after Jan. 1 are likely to be announced by the end of this week, with possibilities, though not probabilities, of advances from present levels.

Pig Iron—The Valley market is established at 50c. further advance, making \$2 in two months; Bessemer, \$21, basic, \$20, foundry, \$20.50, with a moderate turnover.

Connellsville Coke—The market has declined farther, spot being now about \$6 for furnace and \$7@\$7.50 for foundry. Coke on track is largely liquidated, and eventually another upward movement is expected.

Company Reports

Santa Gertrudis Looks Forward to Dividends Next Year

According to a bulletin received recently from London, shareholders of the Santa Gertrudis Co. will remember that when the consent of note-holders was recently secured for an extension of the then existing note issue for a further period of three years, assurance was given by the company that no dividends should be paid until the entire note issue had been redeemed. The last six-monthly operating profits of the Santa Gertrudis group of mines have been of such a satisfactory nature, with such encouraging development results both at the Mexican company's properties as well as at the properties operated by the Mexican Corporation S.A., as to enable Mr. Rose, the general manager, to report that remittances from the beginning of 1926 may be anticipated at the rate of £30,000 per month.

The directors, desirous of bringing the company again into a dividend-paying position at the earliest moment, have succeeded in effecting provisional arrangements on favorable terms for sale of a new 7 per cent note issue of £200,000, redeemable in five years, with no restrictive condition as to dividend payments, but carrying conversion rights into Santa Gertrudis shares. The proceeds of this issue with moneys in hand would enable the company to retire at the termination of the necessary three months' notice the entire existing 8½ per cent note issue, so that, from the beginning of next year on the basis of the receipt of monthly remittances, as indicated by the management in Mexico, interim dividends may reasonably be anticipated at the rate of not less than 10 per cent per annum, with the probability of a larger final distribution at the end of the financial year. To enable this operation to be carried out, and to provide the shares necessary to cover the conversion rights which form the condition upon which the new notes are to be taken up, it is necessary to increase the capital of the Santa Gertrudis Co. by 300,000 shares.

Freeport Texas Improving Over 1924

The Freeport Texas Co. reports net income of \$494,194 for the nine months ended Aug. 31, after expenses and reserves for taxes and depreciation. This is equal to 67c. a share, and compares with \$28,195, or 3c. a share, in the same period of last year. In the quarter ended Aug. 31, 1925, the net income was \$161,964, or 22c. a share, compared with 46c. a share in the preceding quarter, and a deficit in the same quarter of 1924.

Noranda Splits Up Stock

The directors of Noranda Mines, Ltd., the principal mining company in the new Rouyn copper-gold district, in the Province of Quebec, at a meeting on Nov. 11, decided to increase the number of outstanding shares by issuing 100 shares of no par value for each share of a par value of \$100 now outstanding. Development of the company's properties has advanced the present stock to \$800 per share, which, in the opinion of the directors, makes it unwieldy to handle in connection with the financing necessary for the proper development of the mine. New financing will be undertaken to provide further facilities and working capital to bring the mine into early production.

The Canadian National Railway now has under construction an extension which will soon reach the property and provide railroad facilities for construction work and the handling of the output.

Noah A. Timmins, president and principal stockholder of the Hollinger Consolidated Gold Mines, the largest in the Canadian field, and in fact the largest single gold mine in the world, was added to the board of directors, which now comprises Percy A. Rockefeller, W. D. Baldwin and Irving W. Bonbright, who were recently elected to the board; and Thomas L. Chadbourne, James Y. Murdoch, H. G. Haskell, S. C. Thomson, and H. W. Chadbourne.

Granby Doing Better Than Last Year

For the quarter ended Sept. 30, Granby Consolidated Mining, Smelting & Power Co., Ltd., operating copper mines in British Columbia, reports net income of \$334,473, after expenses and interest but before depreciation and depletion, compared with \$33,729 in the same period of 1924. Net income for the first nine months of 1925 was \$925,326 before depreciation and depletion, compared with \$512,985 in the first nine months of 1924.

United States Must Increase Zinc Production, Says Sharpe

Following is an abstract of the monthly letter by A. J. M. Sharpe, honorary foreign correspondent of the American Zinc Institute:

Despite high prices, the German and Polish zinc industry is not flourishing, as is evidenced by the fact that only two of ten furnaces are operating at the Duisburg smelter, and the Grillo smelter is limiting its production to the metal it requires itself for rolling. In England, consumption is fully maintained and there is a steady buying by galvanizers and other consumers who are not covered far ahead. Purchasing of American zinc on their account continues and would have been much heavier had it not been for the somewhat freer offerings of October and November metal from the Continent.

Although the Belgian production in September was 1,000 long tons higher than in August, at 13,950 long tons, no significance need be attached thereto, as ore must continue to be the governing factor in European production and there is no sign at this time of any improvement in the supply.

World stocks of zinc on Nov. 1, 1925, are estimated to be as follows:

	Metric Tons
United States	6,800
Germany and Poland	11,400
Canada	900
Great Britain	500
Belgium	1,800
France	800
Scandinavia	200
Australia (including unsold shipments afloat).....	2,200
Far East	500
Elsewhere	500
Total	25,600

Assuming that the United States domestic consumption is maintained at its present level, to prevent an acute famine in the supply of slab zinc developing in Europe at the beginning of 1926 the United States production will need to be increased by a possible 10 per cent. The United States stock itself is below safety level, amounting as it does to only a bare week's consumption, so even if the indicated additional quantity required by Europe is postponed through a prolongation of the political and trade uncertainty on the Continent, the resultant growth in the stock of reserve metal in the United States would not be a disadvantage.

Industrial Diamonds in Better Demand

During October, according to the monthly diamond market report from J. K. Smit & Zonen, Amsterdam, Holland, there was a better demand for industrial diamonds, especially for the United States. This improved condition was caused by the prosperity in the automobile industry. Prices for the larger-sized stones from 3 to 10 carats were about 5 per cent higher, and an insufficient quantity of suitable goods is available. There was a strong demand for Ballas stones, which are always scarce.

For crushing bort and the common industrial goods, prices were somewhat weak, but at this writing the combination has the bort situation well in hand and is reaching the point where it is highly probably that prices will be stabilized.

For carbons the market remains very firm. Only a little really fine material is on the market, and it is difficult for consumers to fill their requirements, particularly as the main demand is for finest carbons.

Mining Stocks—Week Ended November 14, 1925

Table with columns: Stock, Exch., High, Low, Last, Last Div. Includes sections for COPPER, SILVER, LEAD, ZINC, GOLD, NICKEL-COPPER, IRON, VANADIUM, ASBESTOS, SULPHUR, DIAMONDS, PLATINUM, MINING, SMELTING, REFINING AND GENERAL, and LONDON QUOTATIONS, WEEK ENDED NOV. 7, 1925.