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# ENGINEERING AND MINING JOURNAL-PRESS

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

## Growth of the Mining Industry in the United States

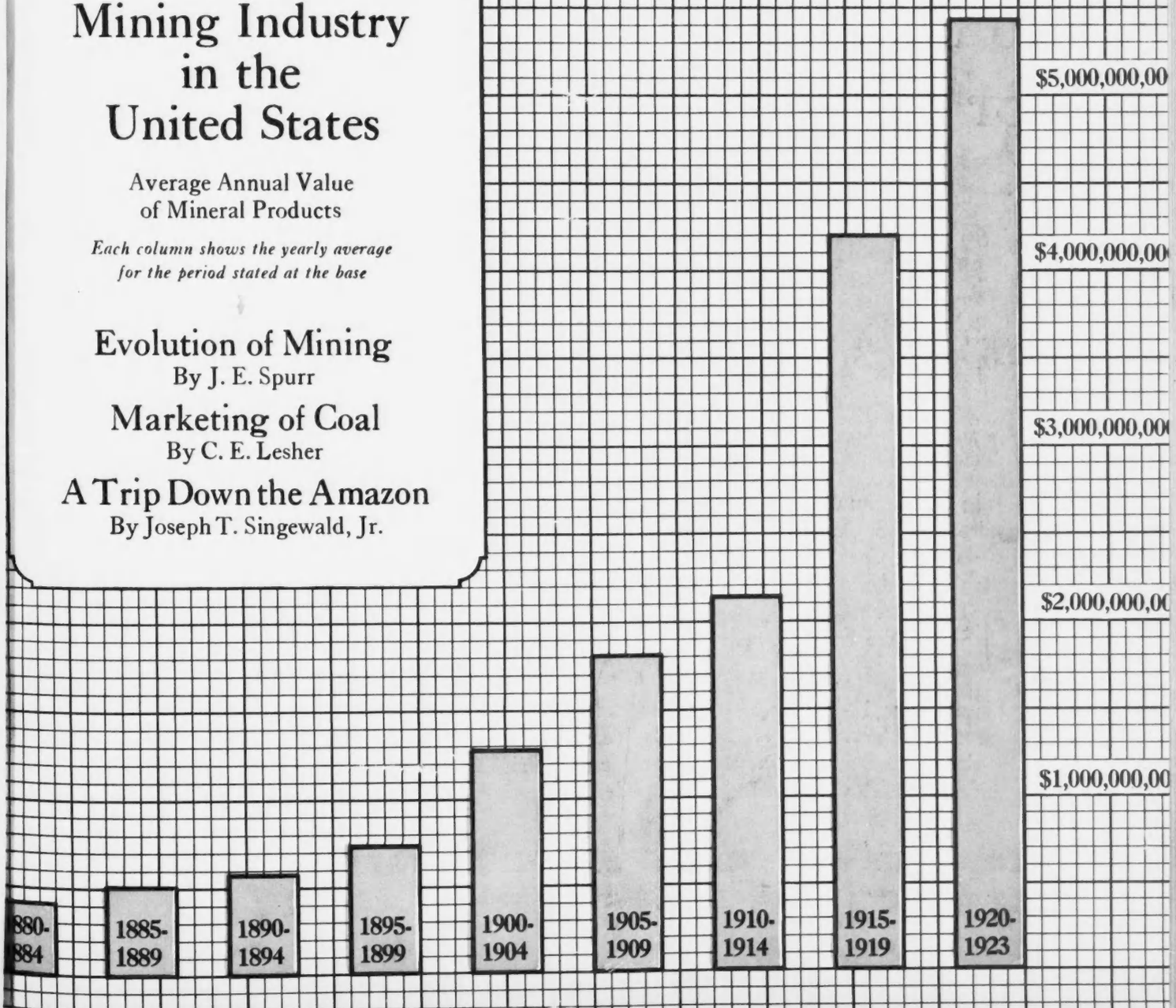
Average Annual Value of Mineral Products

*Each column shows the yearly average for the period stated at the base*

Evolution of Mining
By J. E. Spurr

Marketing of Coal
By C. E. Lesher

A Trip Down the Amazon
By Joseph T. Singewald, Jr.



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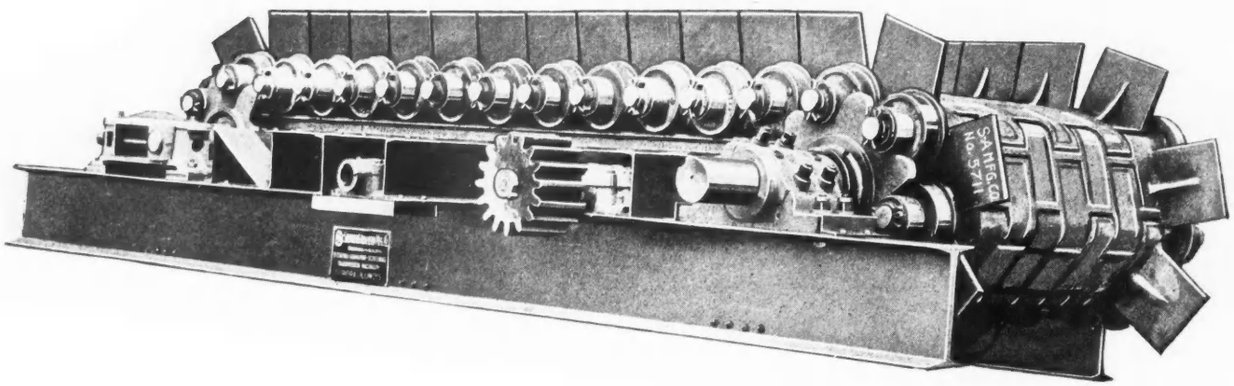


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ENGINEERING AND
MINING JOURNAL-PRESS

JOSIAH EDWARD SPURR, Editor

*Volume* 119 | New York, January 3, 1925 | *Number* 1

## More Copper to Come From South America

BEFORE THE RECENT ELECTION, when the Anaconda Copper Mining Co. was making its unsuccessful fight against a proposed increase in mine taxation in its home state, that company pointed out that its cost of copper production in Montana was already high and insinuated that an added tax burden might be the straw that would break the camel's back, or at least drive it out of the country to some clime where it might shed its hump and perhaps become a llama, as the Andes variety of camel is called. That this was not all pre-election bunk is indicated by the announcement of a bond issue of $40,000,000 for an early development of the Andes Copper Company's property in Chile, which is controlled by the Anaconda company. This, of course, does not spell the end of copper mining in Butte by any means; rather it prolongs it. Operations there will probably be continued at substantially the present scale regardless of the gyrations of the copper market; but, to fill the needs of an almost certainly increasing demand for the metal, the Anaconda company indicates that the resources of South America will be tapped further.

We doubt if Montana is yet in position to feel the pinch that Michigan has experienced, though production costs naturally increase with greater mine depth and the lower grade of ore that most companies find it necessary to treat as they grow older. High mine taxation by states will naturally tend to defeat its own ends, and where it forces mines and treatment plants to cease to operate, or to operate way below capacity, is unjust to the owner or stockholder and to the public of these misguided states.

If copper prices can be maintained at not below current levels, American producers should not feel too much disturbed at the prospect of increasing South American production. With a 15c. copper market, most United States producers are assured of a comfortable measure of prosperity, and what comes from elsewhere now, will leave so much more to come from United States mines in the years to come.

## Prosperity and Inflation

KNOWING that inflation booms invariably are accompanied by an equal and opposite reaction, there is advocacy at this time that measures be taken to check the present upward swing. Such proposals are based on the assumption that the present situation is parallel to that of 1919. There is a feeling that the difficulties which followed the sharp upturn early in that year could have been lessened had proper steps been taken.

There are essential differences, however, between the present situation and that of 1919. Inflation does not begin until the production machine is running at 100 per cent of its capacity. The situation can be judged by the speed of the production machine. In some few instances the 100 per cent point is being approached, but the fundamental industries are not operating at full time. For instance, the iron and steel industry is operating at 80 per cent of full-time capacity; coal production is below 70 per cent of capacity, and the figure for textile manufacture does not exceed 75 per cent. There still is an available reserve of labor. Many of the employed are not working full time.

Since half of the impetus behind active business has its origin in public psychology, the present situation has confidence and optimism contributing to its support, but there are other factors working in the opposite direction. The tide has turned in gold imports, and industry has not forgotten the lessons of years. Industry is inherently cautious. It thinks back, in decided contrast to the stock exchange, where retrospection does not penetrate for more than six months.

In world affairs the swing toward conservatism is likely to continue as long as Russia persists in furnishing Exhibit A. It is apparent that German productivity is reaching a basis which means large surpluses of goods for export. Costs of production there are rising rapidly, as the people demand and obtain higher standards of living.

## Manufactured Minerals

AN INTERESTING DEVELOPMENT in metallurgy is the manufacture of one mineral from others to supply a shortage where Nature was just a little too stingy, or was inclined to plant the supply where inhospitable ice-bound shores make transportation difficult. Cryolite, a sodium-aluminum fluoride, is found in commercial quantities only near the Eskimo hamlet of Ivigtut on the southern coast of Greenland, in latitude 61 deg. N., a region isolated from all means of transportation for more than six months in the year. There has been a demand in the United States for a quantity of cryolite varying from 1,000 to 12,000 tons per annum for the last thirty years. It has been used in the manufacture of sodium salts and alum, for making opaque white glass, and as a flux in the manufacture of white portland cement.

In recent years cryolite has found increasing use as a bath for the electrolysis of alumina to make metallic aluminum. To increase the supply or to overcome the difficulties of transportation, the Aluminum Company of America now manufactures artificial cryolite.

Of course the manufacture of artificial minerals is not new. Synthetic gem stones have been known for years, while calcium carbonate identical with limestone, calcium sulphates similar to gypsum and anhydrite, and other substances corresponding in composition with natural minerals, result from various chemical processes. The unique feature about artificial cryolite is the manufacture on a tonnage basis of a fairly complex material identical with a mineral that occurs sparingly in nature.

Though this circumstances is of academic interest to

the mineralogist, it has economic aspects of some significance. Fluorspar is ore of the chief constituents used in the manufacture of artificial cryolite. Therefore the Aluminum Company of America has recently purchased one large and fifteen small fluorspar properties in the Illinois-Kentucky field, as noted in *Mining Journal-Press* of Nov. 29. While a comparatively small tonnage of fluorspar is now used for artificial cryolite manufacture, the purchase of these properties seems to portend a more extended use. Recent studies of fluorspar reserves have not been particularly reassuring. The supply may be adequate to provide fluxing requirements in the steel trade and for other well-known uses, but what is to be the effect of diverting ever-increasing quantities to a comparatively new and important application? Will the known reserves take care of the new demand, or will the steel industries suffer in consequence of diversion to the new use? Possibly in the kaleidoscopic changes wrought by modern invention some other mineral or chemical product may be found to take the place of fluorspar in steel manufacture, just as artificial cryolite has supplanted natural cryolite in the preparation of aluminum.

## Low-cost Fireproof Dwellings

A CONVENIENT fire- and vermin-proof dwelling of low cost is one of the vital requirements of our times. Nevertheless, in spite of the countless dwellings constructed, the problem of this modern dwelling has only been partly solved. Foundations and basement construction of concrete answer the broad requirement as far as the ground floor is concerned. The superstructure is the nub of the situation. What materials, on the basis of structural and cost considerations, are suitable for this purpose? Brick is used for wall construction, but the interior framework and floors of such buildings are usually timber. A stucco exterior on a wood frame, a slate, or fireproof shingle roof, and a hard plaster interior finish form a combination that is fire retardant. The floors in such a building are not fireproof. They could be made so by the use of magnesite flooring. The fireproofing principle of this construction is obviously the sealing in of all of the timber used in the building. The filling in of the space between studdings with cellular plaster of paris forms an effective and practicable fire retardant and gives sound-deadening construction.

A more expensive type of construction is the reinforced-concrete house. The porous character of the walls and floors is an objection that could possibly be removed by surfacing interior and exterior with waterproofing cements, but these would add to the cost. High cost is the chief obstacle to this type, in spite of efforts to systematize methods of construction.

Recently an important manufacturer of gypsum products has, after considerable research work, developed a form of gypsum cement that shows almost as high a compressive strength as portland cement. This cement when mixed with aggregates forms a "concrete" that sets rapidly and is apparently a cheap and satisfactory wall and floor material that has the added advantage of being a low heat conductor. When used in conjunction with reinforced floor arches and a light steel frame, a combination is obtained that apparently solves the problem. At any rate dwellings are now being constructed, and in a relatively short time the limitations of this form of construction, both in respect to cost and suitability, will be fully known.

If success is attained an important new outlet will be open to the manufacturers of gypsum products and the miners of gypsum. A new market for light structural steel will be opened to the steel manufacturer. There will also be a gain in the conservation of wood, as the use of wood in the "gypsum concrete" and steel dwelling will be restricted to the interior trim. As an accessory there will also be the development of a light cellular form of aggregate for use in floors and roof.

It is obvious that the type of dwelling construction projected will increase the outlet for other materials than those specified. It will not encroach upon the cement industry to a material extent, as it involves a type of structure which has been largely out of the cement field, for various reasons into which we will not here enter.

## The Faculty Theory Versus the Student Theory

IT IS MORE AND MORE A QUESTION whether the general cultural education dispensed by the colleges is well chosen. Significant as to this is the student attitude. In most colleges—even in the largest and best—the student belief is that success in the college course is not half so important as success in "outside activities," which mean anything which is not college work—whether athletics, managing a glee club, college journalism, or what not. An exceedingly popular notion among students in college is that it does not make so much difference what you study, or how much you absorb of these studies: the important thing in a college career is to make acquaintances, to establish contacts which will help you in after life, an exceedingly sycophantic and parasitic philosophy, it appears to us.

On the other hand, those students who take the college theory seriously, who accept the college president's and the college faculty's theory that here is education, are not esteemed by their fellow students—or, truth to tell, very much by the faculty and the president. The general student belief is that devotion to studies will not get a man anywhere. The hard worker, the "grind," is looked down upon as socially below par, as of unsound judgment. Boiled down to words, the American students' theory is that anyone who believes in the theory of education held by the faculty and president is a fool: and, as above noted, the signs are not wanting that the faculty and president, at least as individuals, not infrequently secretly share somewhat of the same belief.

We are discussing now the colleges as institutions of learning and culture: we are excluding for the time being all professional and special schools in the universities or outside—the mining and engineering schools, the other professional schools, the post-graduate work. That is another story. In effect the college proper is an advanced high school. Boys are sent there, as they are to the high or preparatory school: and they retain the same mental defensive attitude toward college and all its works as they did in the high school. They believe that the only thing that will save them from serious mental, moral, and physical bad effects is a strong antidote—hence the intense enthusiasm for athletics, which has developed to a degree that would be abnormal except for this condition. The situation is discouraging to the serious-minded professor. Such men, generally men of culture, of solid worth and common sense, conscious of the depth and dignity of their subject, find that the majority of students take their courses flippantly, even, sometimes, with a certain scorn; and are embar-

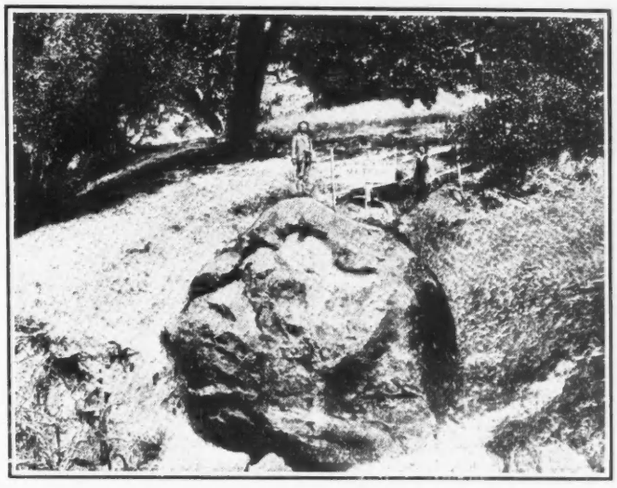
rassed and perplexed by this circumstance and by its significance.

What is the cause of this condition? Why are not our colleges more truly universities, instead of being more or less futile gestures at higher schools for the developing boob? Which is the right theory as to them —that of the typical student, or the faculty theory? Do those men who accept the faculty theory, and devote themselves to excelling in the college curriculum, obtain a valuable training for after life? This is a subject that cannot well be briefly followed further: but is one worthy of statistical investigation. Let some investigator take the five men of highest scholastic standing in each succeeding class in any college: follow their subsequent career: and compare it with the subsequent achievements of the rest of the class. So far, no one seems to have been impious enough to make such an investigation.

## Kempite, a New Manganese Mineral from California

THE ACCOMPANYING PHOTOGRAPH shows a great boulder in Alum Rock Park, near San José, California, which was long labelled as a meteor. It was a high-grade manganese ore, and was broken up and shipped as such in the emergency of 1918. The ore averaged 52.6 per cent manganese. Professor Austin F. Rogers[1] has examined the ore, and found it to contain rare minerals: tephroite, a manganese silicate, otherwise found in this country only in two localities, Franklin Furnace (New Jersey), and central Texas; hausmannite, a manganese oxide, not certainly known otherwise in the United States; ganophyllite, a hydrous silicate of manganese and alumina, known otherwise only from Langban, Sweden; and pyrochroite, a manganese hydrate, which occurs at Franklin Furnace. Professor Rogers found that the earliest mineral to form was the silicate, tephroite: this was followed by the hausmanite ($Mn_3O_4$): then came rhodochrosite and barite. Pyrochroite and psilomelane are relatively late minerals. Besides all these, Professor Rogers found, and named in honor of Professor J. F. Kemp, the new mineral *kempite*,[2] a manganese oxychloride ($Mn_4Cl_2O_6$, $3H_2O$). This occurs in small euhedral orthorhombic crystals, emerald green in color. Professor Rogers believes that the kempite is of about the same age as the pyrochroite.

There is much geological as well as mineralogical interest attached to this isolated boulder, which Professor Rogers states is not a meteorite. He says, "The boulder undoubtedly represents a block detached from its original location in the hills above, in some past, probably remote, period. He regards it as probably of Franciscan age, like all the other manganese deposits of the Coast Ranges. Nevertheless, the explanation is not full and satisfying. Why the combination of a single great isolated boulder with a unique combination of rare minerals? Manganese deposits are found within two or three miles from here, but they differ mineralogically. Some of the rare minerals of the boulder, as noted, such as tephroite, occur at Franklin Furnace, where Spencer has shown that the tephroite is the result of metamorphism under conditions of considerable heat. The material of the Alum Rock Park boulder has then probably at one time been at a relatively high temperature, as Professor Rogers points out. Granted that it is not of extraterrestrial origin, it is still possible that it fell from the heavens—that it was hurled out from a volcano? Professor Rogers remarks that



*Boulder of manganese ore in Alum Rock Park, near San Jose, California*

besides kempite, there are only four other minerals which contain manganese and chlorine as essential constituents. One of these, scacchite, has its sole known habitat at Vesuvius.

[1] *Am. Jour. Sci.*, Dec. 19, p. 443.
[2] *Am. Jour. Sci.*, Aug. 1, 1924, p. 145.

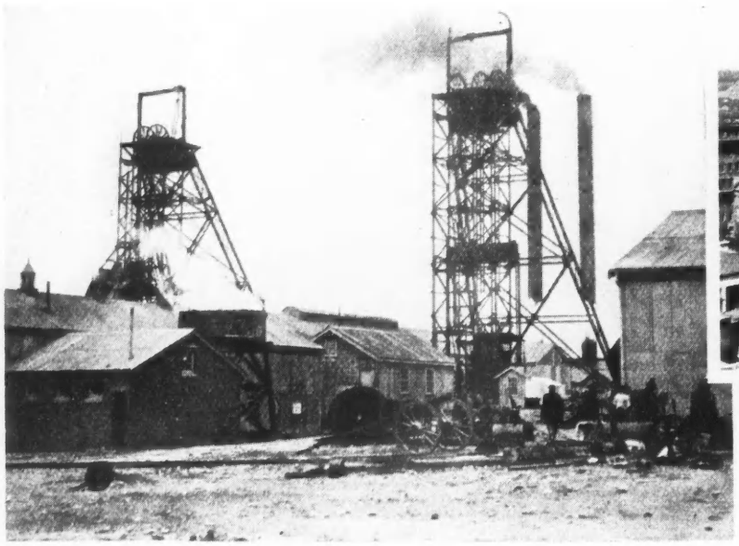
## The Eighth Commandment as Affecting Metallurgical Progress

THE USE OF CORDUROY BLANKETS for catching gold has become common in South Africa, but we have yet to see an example of this practice in the United States or Canada, though this is not to say that there may not be some. In discussing the advantages of corduroy at a recent meeting of the Institution of Mining and Metallurgy, Hugh F. Marriott stated that the blankets produced concentrates of more bulk and less value per unit of weight than the amalgam which they displaced, and that it was not so easy to make away with and dispose of this product. He looked upon blanketing as coming to the fore and gradually displacing amalgam altogether for this if for no other reason.

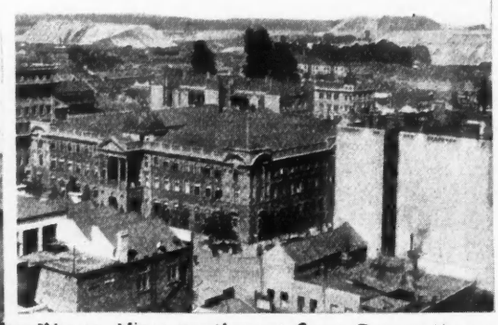
This is a sad commentary on the honesty of workers in African gold mills, and an unjustified one if applied to the class of men employed on this side of the Atlantic. Instances of theft have, of course, been known, and other instances are not known, but it has been our experience that most of the men employed about an amalgamating plant or the refinery of a cyanide plant are 100 per cent honest so far as the precious metal of their employers is concerned. If not, it is largely the fault of the company employing them.

Recoveries can and should be closely checked, only as a matter of routine. And only the very highest grade of men, considered from the standpoint of honesty and conscientiousness, should be selected for positions of trust. Then they should be paid a little more than their knowledge, experience, and cleverness would otherwise command. Honesty should not be entirely its own reward.

# From the RAND TO THE ZAMBESI



Above-Two shafts of the Modder Deep, Far East Rand. The area here is small.

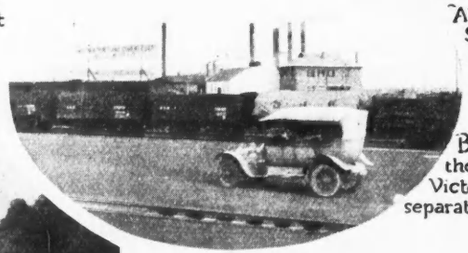


Above-View southwest from Corner House, principal office building of Johannesburg Stock Exchange in center.

Right-Ox teams at Bulawayo, commercial center of Southern Rhodesia.

Above - Wankie Colliery, Southern Rhodesia. Coke for smelting Katanga ores is made here.

Oval-Cement plant at Slurry, 150 miles west of Johannesburg



Below-Railway bridge across the Zambesi River below Victoria Falls The Zambesi here separates Northern & Southern Rhodesia

Above-Victoria Falls, as seen in part from railroad bridge. Not more than a fifth of the falls can be seen from any one position except at times of extreme low water

*Photographs by courtesy of A. W. Newberry.*

# The Evolution of Mining

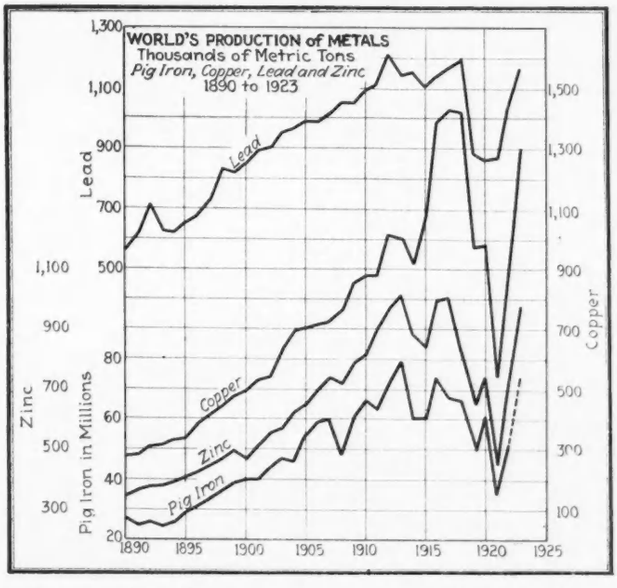
By J. E. Spurr*

MINING ENGINEERS and prospectors and promoters are all painfully aware that a change has taken place, or is in process of taking place, in the mining industries. Many mining engineers find themselves out of a job: many prospectors are unable to get financed: many promoters find it difficult to find anything worth promoting, and difficult to interest capital. "What is the matter with the mining industry?" they ask. "When is mining going to return to normal?" has been asked me many times, hopefully.

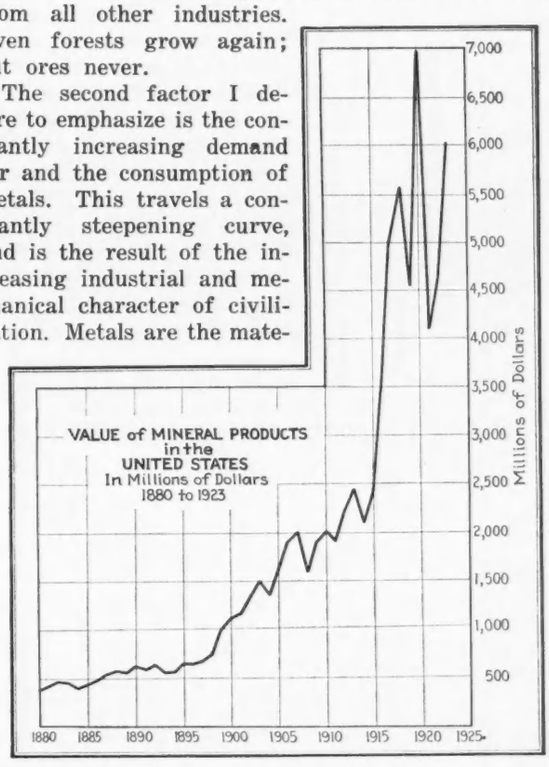
What all these bewildered elements of the mining industry mean is: when is the mining industry going to return to the conditions of fifteen years ago, and continue in them without further jarring interruptions. They are of the opinion that the Great War, the revolutions in Mexico, and the far-reaching consequent economic disturbances resulting from all these upheavals, are responsible for conditions as we find them: and when Europe settles down, and other adjustments are made, we shall go back to the mining days of the 90's or thereabouts.

But aside from political and economic upheavals, there has been taking place a swift evolution in the mining industries, so significant that it is safe to say that conditions in mining never will revert to what they were a quarter of a century ago: that, indeed, they will go forward in changing, rather than backward. Those who wait for old conditions will keep on waiting: the wise man will try to understand past changes and adjust himself to the coming trend of events.

The first governing factor to be considered depends upon the oft-quoted phrase that mining is a wasting industry; that there is but one crop: that ore taken from a mine leaves the mine forever that much poorer. It follows that the normal course of a mining enterprise, no matter how successful and brilliant, ends in exhaustion, ruin, and silence: that the life of a mine is a very limited period. In this mining differs from manufacturing industries, from electrical installations, from shipping and fishing and agricultural industries: indeed, from all other industries. Even forests grow again; but ores never.




The second factor I desire to emphasize is the constantly increasing demand for and the consumption of metals. This travels a constantly steepening curve, and is the result of the increasing industrial and mechanical character of civilization. Metals are the material from which machines are principally made, and which goes largely into equipment of all sorts: and as machines and industrial enterprises of all sorts multiply, more and more of the raw material is required.



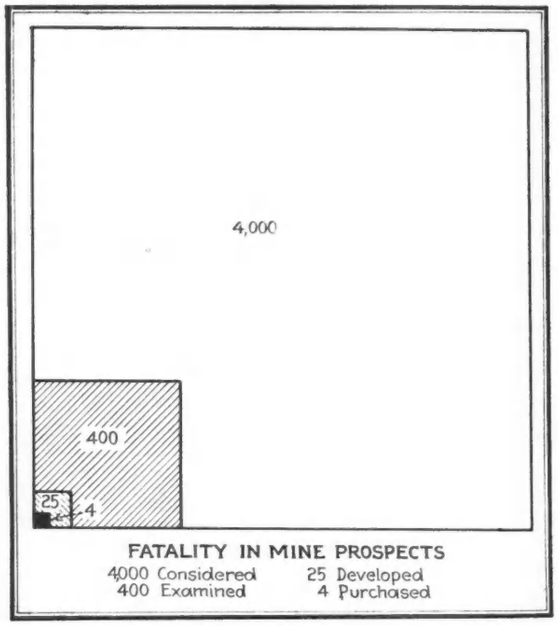

The figures of the total production of the United States for the last forty years show that the total value of mining products in the United States has risen from about one-half billion dollars to five and one-half to six billion dollars, or twelve times. The war produced irregularity in the curve, due to overproduction in the latter part of the war and the consequent paralysis in the year or two following.

The factor of increasing consumption results in speeding up the production from the mine, and shortening its life, so that mine after mine, of the type of those which were worked in Europe, before the modern period of strenuous mechanical development, for many centuries without exhaustion, is opened, turned inside out, figuratively, stripped clean, and abandoned, while the demand for metal fastens itself upon new sources of supply.

The march of mechanical and other industrial invention not only progressively creates more of a market for metals, but progressively finds means to exhaust the mines more quickly and completely. When the old Greeks and Romans advanced their mining drifts and stopes by building fires against the rock and then throwing cold water on the rock so that it cracked, and by similar primitive means, the early working out of such a mine was in no danger. Powder, and especially dynamite, changed the aspect of this, and permitted swift

*An address to the Boston Section of the American Institute of Mining and Metallurgical Engineers at Cambridge, Mass., Nov. 3, 1924.

demolition of any rock or ore. To aid this, powerful machines have been designed to bore into the rock: others have been designed to load the ore into cars, and also swift transportation of the broken ore to the surface has been devised. Similarly, early processes of ore extraction, of which the most ancient was smelting, have been progressively improved on. After amalgamation came cyanidation, for gold and silver ores; after rough gravity concentration came flotation, applicable to nearly all ores; then came leaching, applicable to copper ores, zinc ores, and many others. As the greatest refinement there came processes for the extraction of ore without mining the rock, such as the process by which sulphur is taken from the earth in Louisiana and Texas, and by which copper is leached from low-grade ores in Utah. By all these mechanical and chemical inventions the life even of a rich mine has been shortened so that a mine's life is properly reckoned by decades, rather than by centuries, as in the old times.




### Progressive Exhaustion of United States Mines

The progress of mining in the United States may be likened to a forest fire, which proceeds on an advancing front, blazing furiously as it goes, and completely using up all combustible material, leaving a dead world behind. Since the days of 1849, when gold was discovered in California, mankind has ravaged the treasures of nature on a stupendous scale. The gold, which first was recovered in great quantities from the gravels, was soon exhausted by the hordes which thronged the gulches. Gradually attention was turned to the lodes, and the arrival of mining engineers and metallurgists, most of them trained in Cornwall and Saxony, put them to the fore in place of the original red-shirted bewhiskered miner, who is still the hero of the present-day movies. The richer gold quartz was crushed and the gold recovered by amalgamation. In those early days a little rich smelting ore was sometimes shipped, even from California or Colorado, to Swansea, in Wales, for reduction by fire, an experiment not often repeated. Then European metallurgical science built smelters; and the processes of milling and the recovery of methods in the wet way were also constantly improved. This made it possible to open up and utilize the rich silver and lead ores, such as the Comstock, Eureka, in Nevada; Leadville and Aspen, in Colorado, and the deposits of the Coeur d'Alene and of the Mississippi region. The general utilization of zinc, at first avoided in mining and wasted where it was mixed with ores such as lead and silver, came later, and caused a general revision of many mining industries. But the Comstock, which produced $380,000,000 of silver, vast as it was, was worked out in thirty years; Eureka was abandoned; Leadville was more gradually exhausted only because of its more intricate geology, which forced the miner to grope somewhat slowly.

During this period the rich copper mines were brought to the front, especially Butte, in Montana, and the phenomenal copper mines of Arizona, as well as the longer-known and lower-grade but extensive deposits of Michigan.

From time to time, as rich mining districts were laid waste and practically abandoned, new flames of mineral exploitation broke out in new places, thanks to the prospector. Rich placer gold was discovered in Alaska and the Klondike in the decade 1890-1900: and here a second California produced enormous amounts of gold from gravels; but as the United States geologists who investigated these fields in the early days foretold, there was no subsequent aftermath of gold lode mining. This Alaska gold crop—the only one for mankind—was well harvested in a quarter of a century, so that nothing remains but the gleanings and the gleaners. In Colorado the early glories were revived by the boom of Cripple Creek in 1891: those of Nevada were revived by the opening up of Tonopah in 1901, followed by the near-by camp of Goldfield in 1904. Goldfield produced many millions of gold, and is practically extinct: Tonopah, due again to its intricate and baffling geology, like Leadville, hangs on, but on a diminuendo scale. Cripple Creek also counts its glories in the past.

The number of prospects which are being worked has fallen to very few; and the old-time prospector, once so ubiquitous, has practically disappeared. Many have been the theories advanced to account for this, but the fact is that the ground has been gone over many times and that there are no pickings left. Mr. R. E. Tally, manager of the United Verde, in Arizona, has stated that only one profitable mine emerges from 22,000 locations.

The effort to make a profitable mine from partially developed mines is also a difficult one. In this case, again, the general cry is that capital is the only thing needed. The fact is that it is most difficult to acquire a likely prospect on reasonable terms. Out of 4,000 properties that were submitted to a certain exploration company during a term of years, 90 per cent were eliminated on the basis of the reports submitted. Ten per cent were examined, and in no case did the findings correspond with the reports offered. Development work was done on about 25, and four properties were finally acquired and operated. Three of these were outside the United States in remote parts of Canada and Spanish America, where operating conditions were difficult. Other exploration companies have had exactly the same experience.

Of more lasting import than the successive discovery and successive exhaustion of rich bonanza mines was the development of huge often low-grade deposits that could be mined cheaply, largely by mechanical means, such as the steam shovel. This development early took

place with the gold which was mixed with the gravels. Hand washing of upland gravels in California evolved rapidly to hydraulicking, and thus gold was recovered by mechanical means at an unbelievably small cost till the supplies were diminished and the practice was stopped by the agriculturists. For the recovery of gold in valley gravels the dredge was devised and perfected. This also ate up whole valleys of auriferous gravels and succeeded in making a profit sometimes from material containing 10c. or less to the cubic yard! In California fruit orchards in valleys were bought up, the trees and soil removed, all of the gravels passed through the digestive tract of the great dredges, and spread out evenly behind. Then the original soil was spread on top, fruit trees were planted, and the de-aurated earth (to coin a term) was returned forever to the Kingdom of Ceres. The blazing flame of Pluto had passed—it passes, usually, but once.

But with gravels, which are very superficial and limited, the development of mechanical and manufacturing methods was hardly perfected before the auriferous gravels began to be exhausted: and today the industry must be counted among those which have passed, for North America at least. Only when such methods could be applied to the ore or rock in place, in its undisturbed position in the earth, do they assume a more permanent and prophetic importance. The discovery of the Mesabi soft iron ores in Minnesota was one of the earliest of these bedrock developments—a high-grade iron ore indeed, and a soft ore, which could be stripped and mined by steam shovels. Of even greater significance was the achievement of Jackling and his associates in mining profitably enormous masses of rock containing less than 2 per cent copper, by similar methods to those employed on the Mesabi. These events are historical and epochal: they mark the beginning of the transition of mining into a manufacturing industry. More and more it will be seen that mining will take on this manufacturing aspect.

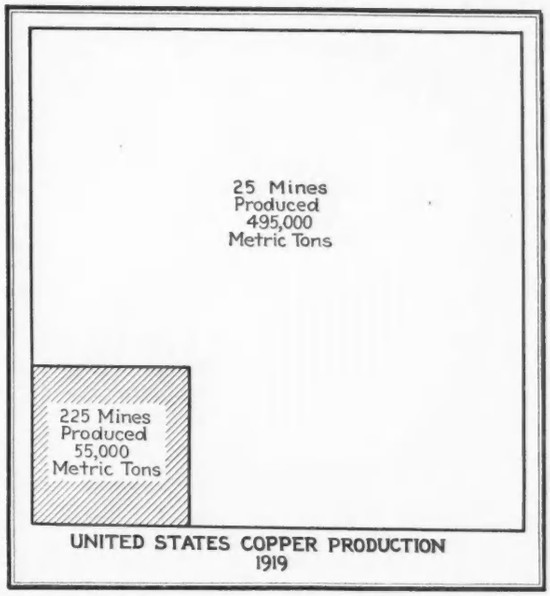
### Shrinkage in Total Number of Mines

The result of all this has been a great shrinkage in the number of mines in the United States, although, as above pointed out, the total production of metals has greatly increased. But the actual number of mining plants is naturally in the decline. California has changed from a state which was chiefly a mining state to one where the predominant interest is agriculture. Colorado languishes as a mining state. The center of mining is constantly shifting, and now lies somewhere in the Mississippi Valley.

Census figures show that while there were in the United States 22,084 mines and quarries in 1889, there were only 13,844 in 1919. For the *producing* nonferrous metal mines—gold, silver, copper, lead, zinc, etc.—there were reported in 1902, 3,695 mines as against only 1,630 in 1919. California had 1,279 mines of this type in 1909, and 357 in 1919; Colorado 1,575 in 1909, and 523 in 1919, and so on. We should, of course, like to have some other year than 1919 as a basis of comparison, for this was not an active year for mining. To bring another set of figures to bear upon the problem: 4,728 mines of gold, silver, copper, lead, and zinc in the Western United States reported to the United States Geological Survey in 1912: by 1919 this had shrunk to 2,911, and in 1922, to 2,864. These figures include placer mines and, in addition, many mines which were not producing.

In 1919, 25 mines produced 52 per cent of the gold of the United States; 25 mines produced 50 per cent of the silver; and 25 mines produced 90 per cent of the copper. This shows what I have sketched above, that mining has become more and more a matter of a few largely productive mines.

At this stage the essential difference was demarked between the two types of mining—the nineteenth cen-




tury as contrasted with the twentieth century types; the treasure-hunting or adventurous century contrasted to the manufacturing or commercial century. Mesabi and Utah Copper (following the significant but ephemeral development of the hydraulic gold placer and the gold dredge) mark, as I have said, the beginning of the transition which was thus accomplished for iron and for copper. The change was most significant for the latter, for it had previously belonged distinctly in the treasure-trove group of mineral riches. Copper could now be definitely determined as existing in the quantity of many millions of tons—a vast, even if a definitely limited, quantity—a huge, even if a wasting, asset: so that the old game of treasure hunting, the give-and-take with fickle Fortune, the competition of geological skill, was thenceforth all but eliminated: the all-important things were business methods, since known processes and factors were to be dealt with. As more and more of these "disseminated" copper mines were discovered in swift succession, competition, which is prominent in all purely business enterprises, came more and more to the fore. The question became not so much about the quantity of the ore, or even the grade, but the relative cost of manufacture and of marketing. Therefore the importance of management, as in all manufacturing businesses, came more and more to the front. For, in addition to their possibilities of large and cheap output, these great shapeless masses of copper-impregnated earth will provide a basis for operations for many years—far longer, as a rule, than in the case of the richer lode mine.

With all these advantages, it was inevitable that mining on the manufacturing scale should take predominance over the nineteenth century type of mines. Thus, Lake Superior and Butte are seeking new business advantages—in one way or another—to enable them to survive; while the future belongs clearly to the

manufacturing copper mines of the earth. The great competition is no longer between these and the lode mines, but among one another: between the manufacturing mines of North America and of South America; or between those of America and of Africa.

The advantages of manufacturing copper mines were so great that those who conceived and carried them forward to success attempted the same thing for "disseminated" gold mines—great masses of rock carrying a little gold—in Alaska. These great mines were the Alaska Juneau and the Alaska Gastineau. Due to various adverse happenings, this campaign was not successful. But this type of mining will probably be revived for gold ores, and will be successfully prosecuted when the general business conditions favor. A midway stage, in the successful working of large, low-grade, low-cost gold mines, had for years proved highly successful—such mines as the Treadwell, in Alaska, and the Homestake, in South Dakota. Even these, however, have demonstrated a quite limited life: the Treadwell was practically worked out when it was accidentally flooded by the sea.

In South Africa much of the same conditions, though on a far larger scale, were encountered in the gold-bearing conglomerate beds, or banket; this industry is also now past its prime and is struggling against rising costs and other adverse economic conditions, the chief of which arises from the exhaustion of the ores within reach of ordinary economical mining.

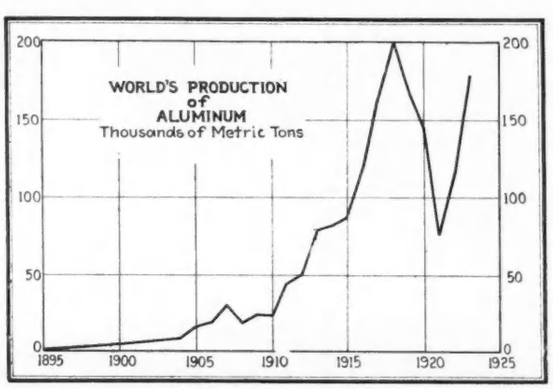
Meanwhile, sporadic flashes of the nineteenth century type of gold mine have helped to postpone the issue—yields like those from the Porcupine gold mines, in Canada, which are great, but which will wane within the usual cycle of a few decades at the most. The demand for gold is not so insistent as for copper. It is used chiefly as money, and mankind has become used to trading with promises to pay in gold, backed up by a small quantity of gold wherewith to make good the promise in case of emergency: from which many, even some economists, have reasoned that the promise would do just as well without any gold at all! This idea will, however, prove visionary: and, indeed, is every day doing so.

As mining becomes more and more on a manufacturing and competitive and business basis (for the most advanced type of manufacturing mines of a given metal sets the standard methods and practices for the whole industry), the two business problems which come to the fore are: to produce the metal or mineral at a low cost: and to sell it at an advantageous figure, so as to make a profit in the end. Thus there has developed the study and the science of marketing: even for standard metals like copper, lead and zinc, the selling is put into the hands of experts, who devote their lives to the problem and who are sharply competing among themselves. Such marketers study supply and demand, the progress of industry, general business conditions, national politics, taxation, the tariff, and the development of the German reparation plans. Such problems did not enter into the head of the nineteenth century mining man: just as, somewhat early in the game, even the question of management did not seem important. A successful early day operator uttered the famous dictum, "To hell with a mine that will not stand bad management!" Those days are gone forever. Not alone the United States, but the world will never see them again. The future of mining is great: but it belongs to those who are shrewd and far-seeing, of broad comprehension and vision, who are good buyers and keen sellers. The manager will need the utmost of technical skill; and those who can make technical advances should not fail to make a special business of such advances, and trade with the real mine organizers and controllers, who at present must essentially be business men, with or without an engineering training: and who more and more in the future must depend on competitive business methods.

The practicing engineer, whose ability and stock in trade is purely technical, loses rank in the twentieth century rearrangement. He was at or near the top of the heap in the nineteenth century, succeeding the "practical miner" who was displaced in the course of evolution. He bossed the technical age of mining, just as the miner bossed the strong-arm age. He is relegated to the rear in the twentieth century—the manufacturing and commercial age of mining. He is necessary, but capable of being produced in quantity; exactly like the civil engineer and the electrical engineer: hence his work will be arduous and his tenure not so sure as formerly: his wage is likely to be as it is now, disappointing. He must recognize the law of supply and demand: if he can find some department of usefulness where his knowledge or special ability is rare or indispensable, he will be sought and respected and paid accordingly. If he has the business sense necessary to make a good manager, or even head of the company, his engineering training will not be held against him; although at times he may be forced to live it down, so to speak, and demonstrate that he has as much commercial acumen as the competing lawyers and accountants and clerks, risen from obscurity, who will contest with him the possession of the highest and most responsible and best-paid executive positions. He will have to keep his eyes open.

A prominent engineer recently observed to me that the most necessary and useful opportunity for an engineer at present seemed to him to be in the handling of tax problems. The tendency, especially on the part of the individual states and municipalities of the United States, appears to be to consider mining industries as legitimate prey; to reflect the half-realized theory that ores belong really to the commonwealth; and to express this by a grasping system of taxation, only desisting in the bleeding when it is feared that the victim will die, and yield up no more. He observed that, while a skillful technical manager might reduce costs three or four cents per ton of ore, by hard work, a good taxation diplomat might save thirty or forty cents! And this situation is true of countries outside the United States.

A striking type of the manufacturing age of mining is found in the contemplation of the metal aluminum.



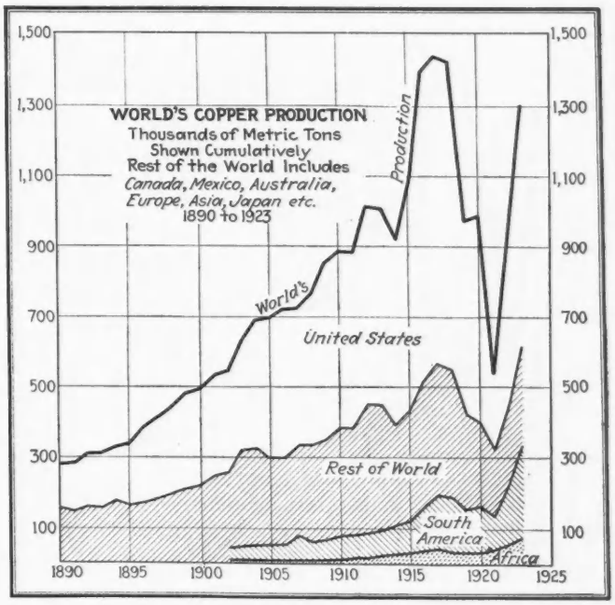
For decades regarded as a curiosity—sold at high prices as a luxury—twentieth century methods have made it one of the commonplaces of the world. Like the iron and copper manufacturing mines, the aluminum (bauxite) mines are operated by the steam shovel and other specially designed machines. Organization management, politics, and marketing are the chief problems. One company—the Aluminum Company of America—produces all the aluminum in the United States, and altogether is said to produce or control 95 per cent of all the aluminum in the world. This is the extreme twentieth century type of a mining industry. The marketing is not only closely controlled and calculated, but extends to the fabrication and the sale of manufactured articles. From the raw ore to the finished article, all is studied, accomplished, co-ordinated, and controlled by this single company

### Mining and Marketing

The linking of mining and reduction with manufacture and marketing of the finished article, referred to above in the type aluminum industry, is one to which the economic conditions of the twentieth century point for other mining industries. In the copper industry, the Anaconda company, whose constructive scheming has progressed furthest among the copper producers, has adopted this among other innovations—producing and marketing many articles of finished copper. The molybdenum industry, a small metal industry the production of which is controlled in the United States by the American Metal Company, has devoted an intensive advertising and commercial campaign to the introduction of the metal. The Johns-Manville Company, which has asbestos mines in Quebec, also manufactures and advertises and markets asbestos products. As a whole, however, the Quebec asbestos mines, the most important in the world, are suffering from a lack of keeping up with the full twentieth century type of mineral organization; hence they languish. Here is a great opportunity for an organizing genius. In the great petroleum industry, the producing companies market their products directly to the consumer, advertising, for example, the superlative merits of this or that gasoline to the automobilist.

### Growth of Big Business in Mining

The development of the competitive, manufacturing, and commercial stage of twentieth-century mining resulted in many changes which the suggestion implies. The steady tendency has been toward larger mining companies, controlling more and larger mining operations. One of the earliest and most successful business combinations in the United States was that of the smelters, whereby a single organization—the American Smelting & Refining Company—bought up a large number of smelters situated at strategic points in the United States and Mexico. This so-called smelter trust was successful, because it stabilized the smelting industry, applied the law of averages, so that poor business in one mining center was offset by prosperous conditions in another, and enabled successful competition with outside smelters. The ownership of mines was no part of this plan: but gradually, for one reason or other, a considerable number of mines were acquired, either under the ownership of this company or by companies controlled by the same interests. The appearance of the porphyry coppers, with their evident control of the copper industry, was inevitably soon followed




by combinations and financial groups, and this marked the second wave of the application of big business conditions to metal mining in the United States. By various combinations of mining and smelting and marketing interests, the copper business of the United States, which through its volume predominated over the whole world, was soon divided up among a few great financial groups. With the development of great low-grade copper mines in South America, this partition of ownership of copper was extended over the whole western hemisphere. The dominant group for long continued to be the so-called Guggenheim group, named after the family who had organized the great smelting combination: later, however, the Anaconda company, after having become dominant in the great camp of Butte, and finding its mines threatened by the lower-cost porphyry copper, purchased from the Guggenheims the Chile Copper Company, of South America, and became the largest of the world's copper companies. Quite lately there have been developed enormous amounts of good copper ore in Central Africa: and the growing installations there have cast a long shadow over the domination of the American companies. It has been reported that American companies have negotiated for a partnership or control of these mines, which are under predominantly Belgian ownership. These negotiations have been without avail. Indeed, I doubt whether they will succeed: I doubt if the Belgian Government would gladly permit these mines to join the American group. Concerning this matter of national mineral policy, also of recent growth, I shall say more later.

There is as yet in the United States no single commercial group directly controlling even a majority of the output, and therefore no trust or monopoly: the different great interests are competitive. Nevertheless, they have acted together on occasion. They have a statistical organization and a sales promotion agency in common: they for some time marketed their export copper through a single organization: and at times in regard to the domestic situation they have probably acted under gentlemen's agreements.

The developments of big business in the copper industry were of course insignificant as compared with those in the petroleum industry, which are well known. Oil was first exploited in the United States, and was

not controlled by any one organization till the genius of Rockefeller effected a monopoly, not of the ownership of oil wells nor its production, but of its refining and distribution. The Standard Oil Company, so organized, became swiftly the type and symbol of the trust. It dominated the petroleum industry, not only in the United States but throughout the world, for some time. Of a similar type was the United States Steel Corporation, which, organized by Andrew Carnegie, effected a consolidation of many iron and steel plants, and so became the greatest corporation of the world, having the largest capital, and dominating, without monopolizing, the iron industry of the United States. The Steel Corporation did not aspire to the control of mines, according to the plans at the inception; the plan was similar to that of the Standard Oil for petroleum, and the American Smelting & Refining Company for the non-ferrous metals; the idea was to play the safer game of controlling the manufacture and sale. In all these cases, subsequent events led to a modification of this policy and a tendency to acquire at least a certain proportion of sources of raw material, as a matter of insurance. The true twentieth century big metal or mineral organization, where the process of evolution has been logically carried out, controls and directs the metal industry from the ore in the ground to the selling of the finished article to the consumer. The type of this is the Aluminum Company of America, to which I have already referred; and which has also developed during this period of big business growth to control the aluminum industry of America, and dominate that of the world.

### World Impulse to Complex Organization

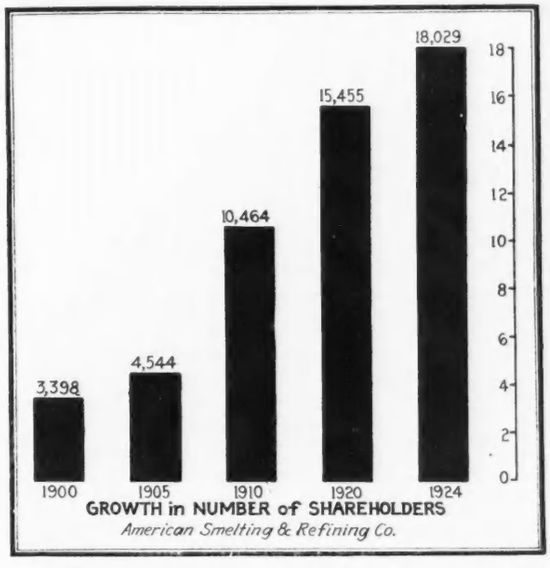
It is clear, of course, that the tendency of the mineral industries to organize and combine more and more into larger and more powerful and more comprehensive groups was only a symptom or example of a general tendency in this direction throughout the country and, indeed, throughout the world. The tendency to organize business into progressively larger and more complex groups has been one of the phenomena which American statesmen have regarded with mixed feelings. The most popular sentiment has been that these were grasping and illegitimate octopi; and that the job of the honest statesman was to dismember them. Free competition of small groups is the ideal of the American government, under the direction of the Sherman law. Nevertheless, the opposite tendency is the spirit of the times; and is as strongly marked in Europe as in America. Indeed, it is not the result of nefarious planning or the monstrous desire to dominate, but the natural result of other conditions which have come upon the world. The cause and impetus has come from the advancement of science and invention. Step by step, as these have tied the world more closely together—a world that hitherto had been forced to live in small and disconnected parcels—through the railroad, the telephone, and telegraph, the newspaper, the steamship and the rest—large groups have evolved by necessity where small groups were before. Where a century or more ago a sailing ship voyaged to Africa or Australia, and came back with strange tales after a year or two, nowadays the cables and the radio flash back and forth between the continents every day; and railroads and steamships make commerce easier between the continents than it used to be between the different states of the American Union. This has brought in the age of universal commerce. National life and thought takes the place of municipal and provincial life and thought; and the developing outlines of world-wide organization already begin to shape themselves out of the mass. The railroads naturally assemble into gigantic groups, and the steamships as well. The telephone and telegraph business of the United States has fallen chiefly to a single company; a few large packing houses provide the meat for the country; department stores largely take the place of little shops; apartment houses of little homes. Light and fuel in the form of electricity and gas are supplied to whole cities from a central station. This is a force which is a logical consequence of the invention of mechanical appliances, and follows as an economic consequence. Hence it is an inevitable force which cannot be legislated back, and which has nothing to do with ethics, but with economics.

Men also have grouped themselves in various ways in obedience to the same process of evolution: for social, legislative, technical, literary, and all other purposes, as well as economic purposes. With the swift march of science, development, knowledge, and literature of all kinds, the individual finds himself ever more hopelessly unable to grasp the trend and events and work of the times, save as a unit in a large group, the members of which are so arranged that their knowledge and capabilities interlock to form a powerful and effective machine. Thus specialists develop in all walks of life; men narrow their field as they dig deeper into it. In great factories men spend their days each doing endlessly a certain simple thing, with a single motion of the hand—one of the hundred things which make a finished product and which a hundred men perform. Engineers become specialists, like all the rest of mankind; the old-time miner, who evolved the mining engineer, is now represented by many different specialists in the art and business of mining, each of which is often quite frankly incompetent in the task of all the rest. It is an age of organizations, of committees, of conferences; of socialization, in short. And this has been made imperative by the fact that civilization has evolved swiftly, while the brain of man evolves very slowly. Advancing civilization has been made possible only by mass organization and action—and this will be more so in the future. The age of individual independence passed before the nineteenth century did: now even the farmers must combine and organize and market as a whole, or be pushed to the wall.

### Public Ownership of Great Corporations

It is proper to point out that the grouping of companies into greater combines does not necessarily mean the domination of and ownership of the industries involved, by a few enormously rich men. Indeed, the modern tendency is for the public in many cases to acquire ownership through stock and bond purchases. The American Telephone & Telegraph Company, a colossus whose capitalization has lately outstripped the U. S. Steel Corporation, has hundreds of thousands of stockholders, and the average stockholding is relatively small. Developments a year or two ago showed that the stockholdings of the Guggenheims in the American Smelting & Refining Company were surprisingly insignificant. The same is true of the officers and directors of the Anaconda company. These companies and hundreds of others are owned by the public in many small parcels. In these cases public ownership of big business becomes an accomplished fact, the public becoming the owners by the simple process of buying into the enterprises. One

of the reasons for this has been the flooding of the country with tax-exempt securities. The rich man finds it better business to buy these than to keep his money in the stocks and bonds even of big corporations. But the investor of moderate means does not have this drawback of high supertaxes, and he hastens to buy the securities which the great capitalist has unloaded, and which yield him a higher rate than would be the case




were they an attractive investment for the capitalist. Armour & Company shares are now held by 77,000 people; American Smelting & Refining shares by 18,000; the American Telephone & Telegraph Company by 345,000!

It is also opportune to point out that these groupings tend to make for greater stabilization and permanency of investments than when each mine and smelter was an independent unit. The stocks and bonds of many of these mining and reduction combinations have a high financial rating; and the corporation yield shows that they are rated by investors as on a par with railroad and industrial securities.

These great combinations have indeed eliminated much of the risk from mining; and if it is hard to get money for small individual risks, it is not so hard to finance a larger mining combination, where the risks are distributed and averaged. Does this possibly suggest anything to those who are finding it difficult to finance mining ventures? In the earlier days of more active individual mining enterprises, the net result of all operations in many districts was a loss, even though some good or even famous mines were developed; and these net losses went without comment. But with a larger mining group, a net loss on all operations would be glaring and disastrous; hence greater caution is used and better business methods: and larger returns result. Although it is harder for the small enterprise to get financed than formerly, the paradox exists that mining investments on the whole are safer than before, even though not so remunerative.

The development of big business, only one of the phases of a compulsory process of socialization, has been world-wide. As exemplified in mining, it has not been confined to the United States. In Germany there arose and developed largely before the war the greatest metal organization of all—the Metallgesellschaft, a great world combination of non-ferrous metals, which spread throughout the world as did the Standard Oil in the petroleum business. This had great branches in many countries, including the principal countries of Continental Europe, England, Australia, and the United States. Since the control was German, the Allies during the war acted the rôle of trust-busters and placed the operating company in each country under the control of Nationals. This, of course, could not prevent the different groups subsequently doing business together, any more than different Standard Oil companies were so inhibited when the Standard Oil was forced to dismember by the United States. Other great mineral combinations arose and flourished in Europe, many of which reached the proportions of great monopolies or trusts, and so became the dominating factor in the production and distribution of various metal and mineral commodities. In Europe these were in most cases formed without opposition from the country in which they were, or even in partnership with it. The resistance to great commercial combinations which had always been displayed in the United States was not re-echoed in Europe. As a great rival to the Standard Oil and other American petroleum companies great European petroleum companies developed, especially the Dutch-Shell, which has contended with American companies for a first grip on the petroleum reserves of the world, and has obtained it.

### Mineral Problem International

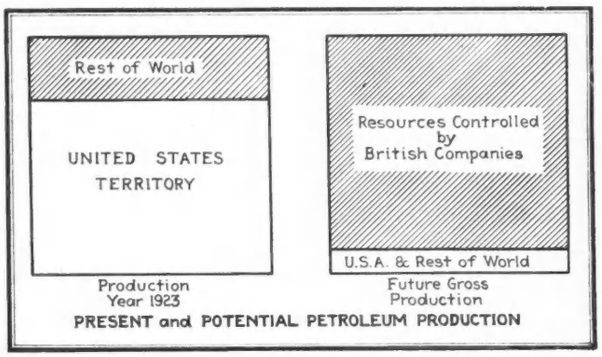
The vision and scope of the mining industry has become not only national but world-wide, and this will be more and more true in the future. Mechanical inventions, quick intercommunications, the rapid march of the twentieth century type of civilization, have shrunk the world very much. Already it is too small for many purposes: there is, or soon will be, not enough to go around. The copper industry is rapidly becoming a world industry. Certain great companies are looking the world over for strategic locations in the copper industry. The petroleum industry is entirely internationalized, and the world is being ransacked by many companies—especially the competitive American and British groups—for new petroleum reserves. The economic evolution is tending toward bringing all the world together on many problems. We already have an International Chamber of Commerce, an international this or that; a league of nations of a sort, and international conferences. The tendency is inevitable; it cannot be avoided.

The erratic distribution of mineral wealth over the earth makes the mineral problem essentially a world question, rather than a national one. Minerals occur where nature has put them, richly in some parts of the crust, sparsely or not at all in others. And the distribution shows a fine disregard for national boundaries or for the race which inhabits the surface. A nation finds it has land enough, perhaps, but not metallic wealth enough to go with it. Shall she trade, intrigue, or obtain by more forcible means?

The effect of the unequal distribution of mineral wealth in certain spots has been at the root of much of the world's history, though never so much, perhaps, as at the present day, when the metals and minerals are imperatively demanded and in large quantities. The Phœnicians and afterward the Romans traveled to Cornwall for tin, and the conquest of England by the Romans was largely on account of the tin to be thus obtained. Thousands of years afterward England con-

quered and annexed the Boer Republic, in South Africa, to secure to herself a free exploitation of the great gold deposits there. Mexico was overthrown by the Spanish, for the gold which it contained. France and Germany many times have engaged in a death struggle on account of the rich coal and iron fields which lie between them —Alsace-Lorraine fields, which have been presented to the world as a sentimental and political question, but which in fact is purely a matter of control of mineral wealth.

The national recognition of the importance of a conscious mineral policy was recognized by Germany,




*A picture of the petroleum situation*

"And British companies, closely connected with the British government, are now in exclusive possession of 90 to 97 per cent of the world's future production"—Pierre la Tramerye in "The World Struggle for Oil," 1924. The diagram shows the estimate at 90 per cent. U. S. Senator Phelan, a number of years ago, estimated that Great Britain held one-half the world's oil and the United States one-sixth; but the proportions have changed much since then.

later by England and France, and for a time, during the war, by the United States.

The most astonishing example of the quest for a mineral forming a main factor in governmental policy, in recent days, is petroleum. Petroleum is the most strategic mineral in the world. On account of Diesel engines, oil-burning boilers, gasoline users like submarines, airplanes, motors, and the like, the lack of petroleum would deprive a nation of military potency. The United States, which first produced petroleum, and still produces more than any other country, has not worried much or consecutively about the matter any more than any other matter of mineral supply. England, however, is the center of a British Empire, built on trading and sea power. As coal in recent decades has been replaced as the most essential factor in transportation by petroleum, England some time ago adopted a forward-looking policy which should put adequate petroleum supplies under her flag in many parts of the world. The British Government owns a majority of the stock of the oil company operating in Persia, and controls the oil company which has a monopoly in Burmah; it, moreover, backs up politically the great Dutch-Shell combination, which has the upper hand on the potential reserves of the wide world. The United States Government could never have such a conscious mineral policy, due to the traditional popular distrust for oil companies and for great business organizations as a class. Nevertheless, much of the history during and since the Great War has been written around the struggle for oil, in which England has taken the aggressive and winning part, and the United States at times an active interest and rôle, as has France, who is painfully aware of the military indispensability of petroleum supplies, and has been exerting her diplomacy against England to that end. It is certain that the mineral consciousness which was awakened in England during the war still exists: in the United States it has not been kept alive to any extent. This is an important factor in future economic emergencies and hence will enter into diplomacy and the making of history. The high-grade minerals, as they near exhaustion, and as the progress of twentieth century civilization demands, will more and more become a subject for lively trading and for sharp practices among the great nations of the earth.

### Future of Mining Industry Secure

The great future of the mining industry is certain. We shall never be deprived of the metals, for as the higher-grade deposits are mined out, we shall mine the lower-grade ores. And as these lower-grade ores diminish in tenor they become more abundant accordingly. Were all the present iron deposits on earth exhausted, as they will be, mankind can—and will—mine the rocks, selecting those richest in iron, like the basalts. This will be a gradual evolution, the manufacturing basis ever becoming more and more accentuated. Similarly, aluminum will be mined from the rocks, when the bauxites are exhausted, as they will be. And, indeed, many if not most other metals eventually can be recovered from rock deposits so great that there never will be complete exhaustion. There will needs be many readjustments, the growing use of one metal in preference to another, due to the difference in price and quantity. This will be, however, a gradual and not a violent change. Some metals, like mercury, will eventually become very rare. Petroleum will become rare; but the oil shales and the other bituminous rocks will furnish mineral fuel thereafter, for many centuries to which we do not see the end.

## Theory of the Flotation Process

An abstract of an article by O. Bartsch in *Kolloidchemische Beihefte* (1924, No. 20, pp. 50-77) recently published in *Chemistry and Industry*, states that "the essential condition for flotation is the formation of flocculent aggregates of air bubbles and solid particles. It is shown that this action depends on special capillary forces and not on the existence of opposite electrical charges. Flocculation experiments on air and cataphoresis experiments on oleic acid showed that both were negatively charged. By electro-endosmotic experiments it was found that gangues and ores, with the exception of heavy spar, were also negatively charged and that the gangues were more negative than the ores. With weaker foam-formers, such as amyl alcohol and caprylic acid, the increased negative charge produced by potassium ferro-cyanide prevented the flocculation of all minerals.

The adsorption of oleic acid by ores and gangues was studied by stalagmometric measurements after the addition of an excess of potassium hydroxide to the oleic and acid solutions. A close parallelism was found between flotation and adsorption of oleic acid. Most ores gave considerable adsorption and gangues but little. The addition of sulphuric acid, and in some cases of copper sulphate, increased the adsorption by sulphide ores but not by gangues. Gelatin considerably reduced the adsorption by ores. The adsorption increased with increasing dispersion of the ores. The oleic acid was readily removed by washing from the gangues but not from the ores.

# Coal Marketing

*A Subject Useful to Those Who Buy and Those Who Sell This Indispensable Commodity*

**By C. E. Lesher**
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COAL marketing is a problem in complex simplicities. Assuredly it is a simple fact that coal, the basic fuel supplying both heat and power, is a necessity; in some form there is a demand for coal at all times. Science and invention have combined to increase and at once decrease the necessity for coal, for while the blast furnace and the bessemer converter opened a tremendous market for coal, progress in the generation and application of power, whereby one ton is made to do the work formerly done by two tons, operates to halt the progress of production. Simple as may be the combination of huge demand prompted by the necessities of modern civilization and of ample reserves of coal in the ground such as we have in the United States, the marketing of coal is complex because of those very facts. Coal is produced in commercial quantities in twenty-six states by more than 6,000 operators from nearly 10,000 mines. These mines are on 140 railroads, and the coal is shipped in carload lots over these and every other railroad and a number of waterways, to between one and two hundred thousand consignees. In these twenty-six states there are more than eighty separate producing fields, each of which has some characteristic peculiar to itself both as regards quality of coal, natural conditions of mining, production cost, and freight rates. Some of these fields have quite limited market territories; others are able to ship coal over wide areas; but each one is in competition with many others.

### Anthracite Mainly Used for Domestic Purposes

About 60 per cent of anthracite and 15 per cent of bituminous coal are consumed by householders and others as domestic and heating fuel; that is to say, this proportion reaches the ultimate consumer as a finished product. The remainder is used as raw material in the production of heat and power for industry and transportation and for special uses, as the manufacture of coke for metallurgical purposes. The distribution between classes of users is indicated in the table in the next column.

Railroads are the largest single consumers of coal, taking about 28 per cent of the total output each year. A portion of the railroad fuel coal is mined directly by the carriers, but the larger part is bought on the market. More than half of the total so used is by railroads with coal mines on their rails, which relationship is important in marketing the coal. Railroads are able to more or less adjust themselves to the use of any coal. Important exceptions are found, where for fast heavy trains a very high-grade gas coal is demanded. For the most part, high volatile bituminous coal is the favorite engine coal. Some anthracite is used, mixed with soft coal, and some low volatile coal is used on the Atlantic seaboard for railroad locomotive fuel.

### Iron Production Takes Much Coal

The iron and steel indutsry is a large and important consumer of coal, both as raw fuel for steam raising and for heating and coke manufacture. This industry has fairly rigid requirements as to quality of the coal it uses. For making coke with which to smelt iron ore, the coal must be relatively low in ash and sulphur and must have in addition the property of coking. A generation ago, the number of coals that would make good iron-furnace coke was limited, with Connellsville ranking first and Pocahontas next. Coke was then made in beehive ovens. The byproduct oven has now largely superseded the beehive oven, and a wider variety of coals can now be successfully coked. It is usually estimated that four tons of coal are consumed in the manufacture of one ton of steel, from the ore to the finished product, as bar, sheet, or ingot.

Public utilities are, perhaps, the most uniform consumers of coal, day by day, from one season to the next.

**Soft Coal Consumed in the United States and Exported in a Year of Active Business (a)**

(F. G. Tryon and W. F. McKenney, *Coal Age*, Jan. 19, 1922.)

| | Net Tons | Per Cent |
|---|---|---|
| Railroads | 153,700,000 | 27.7 |
| Industrials, other than steel and coke | 139,100,000 | 25.1 |
| Steel plants | 35,500,000 | 6.4 |
| Coke: | | |
| Beehive | 36,000,000 | 6.5 |
| Byproduct | 47,740,000 | 8.7 |
| Public utilities | | |
| Electric | 31,700,000 | 5.7 |
| Coal gas (*b*) | 4,960,000 | 0.9 |
| Domestic consumers | 57,100,000 | 10.3 |
| Coal mine fuel | 12,100,000 | 2.2 |
| Exports | | |
| Canada and Mexico | 16,500,000 | 3.0 |
| Sea-borne | 9,500,000 | 1.7 |
| Bunkers | | |
| Foreign trade | 6,700,000 | 1.2 |
| Coastwise and Lake trade | 3,600,000 | 0.6 |
| Totals | 554,200,000 | 100.0 |

(*a*) The figures are for the year 1917, except that the exports are the preliminary figures for 1921, and that the proportions between beehive and byproduct coke are those which obtained in 1920.
(*b*) Excludes coal consumed in byproduct coke ovens supplying gas for city use, which is included under byproduct coke.

Their consumption is mainly of steam coal for the generation of electric power. Gas plants supplying municipalities use between 4,000,000 and 5,000,000 tons of gas coal per year, and a part of the coal now used in byproduct ovens is primarily for this purpose, rather than the manufacture of coke.

The following table gives the distribution of consumption, both geographic and by use, of bituminous coal in 1917, as published by the U. S. Geological Survey in "Coal in 1917, Distribution and Consumption." The table also shows the source of the coal produced and other pertinent data.

## Bituminous Coal of Domestic Origin Consumed in the United States in 1917

In Net Tons

Railroad fuel and bunker fuel for ocean vessels not included in this table

| State or District | Used at Mines for Steam and Heat | Used in Manufacture of Beehive Coke | Used in Manufacture of Byproduct Coke | Used in Manufacture of Coal Gas | Used by Electrical Utilities | Used for Domestic Purposes | Used for Industrial Purposes | Total Coal Consumed | Produced |
|---|---|---|---|---|---|---|---|---|---|
| Alabama | 641,733 | 3,658,598 | 3,980,243 | 90,886 | 299,966 | 651,000 | 2,131,490 | 11,453,916 | 20,068,074 |
| Arizona | ..... | ..... | ..... | ..... | 2,635 | 65,000 | 44,365 | 112,000 | ..... |
| Arkansas | 75,067 | ..... | ..... | 1,330 | 108,116 | 300,000 | 414,955 | 899,468 | 2,143,579 |
| California | 240 | ..... | ..... | 280 | ..... | 355,000 | 535,174 | 890,694 | 6,423 |
| Colorado | 304,492 | 1,784,631 | ..... | 122,494 | 515,243 | 1,450,000 | 3,203,179 | 7,380,039 | 12,483,336 |
| Delaware | ..... | ..... | ..... | 1,009 | 142,542 | 20,000 | 452,617 | 616,168 | ..... |
| District of Columbia | ..... | ..... | ..... | 7,193 | 158,410 | 250,000 | 451,397 | 867,000 | ..... |
| Florida | ..... | ..... | ..... | 33,167 | 32,803 | 90,000 | 147,030 | 303,000 | ..... |
| Georgia | 7,200 | 72,689 | ..... | 78,877 | 195,388 | 871,000 | 1,391,019 | 2,616,173 | 119,028 |
| Idaho | ..... | ..... | ..... | 8,171 | 1,621 | 300,000 | 311,676 | 621,468 | ..... |
| Illinois | 2,374,250 | ..... | 3,233,669 | 275,597 | 4,232,557 | 9,721,000 | 29,061,385 | 42,898,458 | 86,199,387 |
| Indiana | 642,551 | ..... | 4,817,942 | 168,338 | 2,088,978 | 3,500,000 | 9,341,339 | 20,559,148 | 26,539,329 |
| Iowa | 226,394 | ..... | ..... | 62,267 | 1,023,501 | 2,912,000 | 5,221,899 | 9,446,061 | 8,965,830 |
| Kansas | 185,464 | ..... | ..... | 4,728 | 426,043 | 1,800,000 | 1,344,589 | 3,760,824 | 7,184,975 |
| Kentucky | 639,977 | 599,626 | 742,162 | 14,759 | 586,586 | 1,864,000 | 1,966,343 | 6,413,453 | 27,807,971 |
| Louisiana | ..... | ..... | ..... | 3,230 | 160,663 | 370,000 | 1,288,555 | 1,822,448 | ..... |
| Maryland | 58,910 | ..... | 733,184 | 10,976 | 361,746 | 352,000 | 2,785,202 | 4,302,018 | 4,745,924 |
| Michigan | 47,965 | ..... | 1,220,030 | 737,874 | 1,481,854 | 2,974,000 | 8,438,538 | 14,900,261 | 1,374,805 |
| Minnesota | ..... | ..... | 676,881 | 99,959 | 739,483 | 2,637,000 | 2,382,880 | 6,536,203 | ..... |
| Mississippi | ..... | ..... | ..... | 15,907 | 283,835 | 300,000 | 756,258 | 1,356,000 | ..... |
| Missouri | 151,781 | ..... | 351,755 | 564,864 | 1,021,789 | 3,000,000 | 6,921,404 | 12,011,593 | 5,670,549 |
| Montana | 167,704 | ..... | ..... | 12,037 | 106,334 | 885,000 | 895,835 | 2,066,910 | 4,226,689 |
| Nebraska | ..... | ..... | ..... | 1,089 | 511,364 | 1,425,000 | 1,524,389 | 3,461,842 | ..... |
| Nevada | ..... | ..... | ..... | ..... | 2,025 | 100,000 | 259,975 | 362,000 | ..... |
| New England | ..... | ..... | 738,873 | 893,488 | 2,890,733 | 1,655,000 | 12,026,293 | 18,204,387 | ..... |
| New Jersey | ..... | ..... | 621,699 | 125,730 | 1,100,448 | 90,000 | 4,919,631 | 6,857,508 | ..... |
| New Mexico | 36,449 | 936,411 | ..... | 1,803 | 43,453 | 175,000 | 252,881 | 1,445,997 | 4,000,527 |
| New York | ..... | ..... | 1,401,458 | 639,882 | 3,141,311 | 1,242,000 | 13,269,515 | 19,694,166 | ..... |
| North Carolina | ..... | ..... | ..... | 47,583 | 204,016 | 820,000 | 1,026,401 | 2,098,000 | ..... |
| North Dakota | 34,077 | ..... | ..... | 17,612 | 215,141 | 655,000 | 591,658 | 1,513,488 | 790,548 |
| Ohio | 761,032 | 224,952 | 5,141,046 | 30,665 | 3,606,893 | 4,900,000 | (a) 23,344,968 | (a) 38,009,556 | 40,748,734 |
| Oklahoma | 189,190 | ..... | ..... | 950 | 108,995 | 775,000 | 748,878 | 1,823,013 | 4,386,844 |
| Oregon | 5,504 | ..... | ..... | 3,961 | ..... | 225,000 | 373,813 | 608,278 | 28,327 |
| Pennsylvania | 3,499,727 | 36,594,563 | 5,716,221 | 260,743 | 2,486,286 | 1,836,000 | 29,720,070 | 80,113,610 | 172,448,142 |
| South Carolina | ..... | ..... | ..... | 7,430 | 177,138 | 480,000 | 513,432 | 1,178,000 | ..... |
| South Dakota | ..... | ..... | ..... | 2,340 | 185,612 | 570,000 | 329,051 | 1,087,003 | 8,042 |
| Tennessee | 164,698 | 695,841 | 63,793 | 71,128 | 402,825 | 1,211,000 | 1,872,733 | 4,482,018 | 6,194,221 |
| Texas | 49,355 | ..... | ..... | 15,068 | 414,895 | 650,000 | 1,365,249 | 2,494,567 | 2,355,815 |
| Utah | 86,128 | 670,492 | ..... | 35,331 | 9,575 | 815,000 | 596,946 | 2,213,472 | 4,125,236 |
| Virginia | 145,231 | 2,093,943 | ..... | 111,534 | 597,562 | 906,000 | 2,618,748 | 6,473,018 | 10,087,091 |
| Washington | 166,399 | 160,550 | 45,025 | 87,285 | 136,752 | 650,000 | 405,360 | 1,651,371 | 4,009,902 |
| West Virginia | 1,185,200 | 4,754,316 | 727,778 | 2,244 | 495,133 | 475,000 | 3,123,002 | 10,762,673 | 86,441,667 |
| Wisconsin | ..... | ..... | 1,294,000 | 286,897 | 822,369 | 2,532,000 | 3,626,502 | 8,561,768 | ..... |
| Wyoming | 270,441 | ..... | ..... | 2,991 | 170,103 | 250,000 | 60,360 | 753,895 | 8,575,619 |
| Alaska | ..... | ..... | ..... | ..... | ..... | ..... | 53,955 | 53,955 | ..... |
| Miscellaneous, smithing | ..... | ..... | ..... | ..... | ..... | ..... | 255,000 | 255,000 | ..... |
| | 12,117,159 | 52,246,612 | 31,505,759 | 4,959,697 | 31,692,722 | 57,104,000 | 176,365,939 | (b) 365,991,888 | (c) 551,790,563 |

(a) Includes 488,083 tons imports and 1,253,000 tons used out of storage.
(b) Includes 1,643,000 tons vessel fuel for steamships on the Great Lakes.
(c) Difference between this total and total consumed in preceding column is railroad and bunker fuel for ocean vessels.

The striking thing about the comparison of coal produced and consumed by states is the small percentage of the production consumed within the boundaries of such large producers as West Virginia and Kentucky, as compared with Illinois and Pennsylvania. Illinois, for instance, consumed 42,889,000 tons of soft coal in 1917, of which 31,697,000 was produced in the state, the remainder coming from seventeen fields in eight other states. Of the 10,763,000 tons of soft coal consumed in West Virginia in 1917, 9,000,000 tons came from mines within the state, but this represented but 10 per cent of the state's production. The following table shows from how wide an area two states secure their soft coal:

### Coal Consumed in Michigan in 1917

| Source | Net Tons |
|---|---|
| Illinois | 706,000 |
| Indiana | 674,000 |
| Kentucky, Hazard | 295,000 |
| Kentucky, northeastern | 797,000 |
| Kentucky, southeastern | 445,000 |
| Michigan | 1,013,958 |
| Ohio, northern | 810,000 |
| Ohio, southern | 1,969,000 |
| Pennsylvania, central | 25,000 |
| Pennsylvania, Cumberland, Piedmont, Somerset, and Meyersdale | 5,000 |
| Tennessee | 57,000 |
| Virginia, southwestern | 84,000 |
| West Virginia, Fairmont | 261,000 |
| West Virginia, Kanawha and Kenova-Thacker | 3,510,000 |
| West Virginia, Pittsburgh-Panhandle | 290,000 |
| West Virginia, Pocahontas and Tug River | 793,000 |
| West Virginia, New River | 309,000 |
| Lake docks | 2,726,931 |
| | 14,770,889 |
| Coal from storage | 129,000 |
| Imports | 372 |
| Total | 14,900,261 |

### Coal Consumed in Iowa in 1917

| Source | Net Tons |
|---|---|
| Arkansas | 9,000 |
| Colorado | 15,000 |
| Illinois | 4,026,000 |
| Indiana | 247,000 |
| Iowa | 3,887,501 |
| Kansas | 81,000 |
| Kentucky, northeastern | 198,000 |
| Kentucky, southeastern | 36,000 |
| Kentucky, western | 63,000 |
| Missouri | 58,000 |
| Oklahoma | 2,000 |
| Tennessee | 9,000 |
| West Virginia, Kanawha and Kenova-Thacker | 165,000 |
| Montana and northern Wyoming | 324,000 |
| Utah and southern Wyoming | 54,000 |
| Lake docks | 271,560 |
| Total | 9,446,061 |

A rough division of the country, as respects the marketing of coal, would segregate the North Atlantic seaboard and New England, the Southern and Southwest states, the middle Atlantic and central area from the crest of the Alleghenies west to Chicago and between the Ohio and the Great Lakes, the Northwest, and the western half of the country. In the northeastern section, anthracite is the domestic fuel and bituminous coal is taken by industries and the railroads. Overseas exports come largely from this area. The business is centered in New York, Boston, and Philadelphia. The southern group is self-contained as regards coal, very little anthracite and no soft coal being shipped southward across the Potomac and Ohio rivers.

The large industrial area of western Pennsylvania, Ohio, the lower peninsula of Michigan, Indiana, and Illinois draws coal from all the eastern fields as well as from Illinois, Indiana, and western Kentucky. This

market calls for varied kinds of coal; steam, special purpose as gas works and malleable iron coal, coke plants, railroads, and households. In the Northwest, the territory tributary to the upper Lake ports, household coal and railroad fuel are the principal markets, as they are in the Western states. Every large city in these areas is a coal trading center, with Chicago and Pittsburgh leading in tonnage handled.

Production and consumption of coal in this country are measured in millions of tons weekly. The output of anthracite (all from a restricted area in Pennsylvania) has reached 100,000,000 net tons in one year, and for the last decade has averaged nearly 90,000,000 tons. The output of bituminous coal, including the small amount of lignite produced in Texas and the Dakotas, ranges from above 400,000,000 tons per year to a maximum of 579,000,000 tons, in 1918. The rate of production of hard coal, except where interrupted by labor strikes, is quite uniform, the oversupply in summer being stored by households, retail dealers, and the larger producers against the maximum consumption of the winter months. The rate of production of soft coal, however, follows more closely the ups and downs of general business. Some soft coal is normally stored in the summer months by the consumer and by the producers or other coal-handling concerns on docks at the head of the Great Lakes or on the New England coast. For the most part, however, bituminous coal is produced as it is required, and requirements vary with the ebb and flow of industry, the needs of the railroads, and the weather. In recent years as high as 13,000,000 tons of bituminous coal have been produced in one week, and as low as 6,000,000 tons.

**BUYING AND SELLING COAL is a subject with which nearly everyone is distantly or intimately concerned. Coal is so commonly used as a source of power and heat in industry that a knowledge of how various grades are marketed should be helpful to all mineral producers, and not alone to the coal miners themselves.**

The seasonal variation in production is sharpest in those fields that depend largely on domestic or household trade, and least in those that supply industry. Thus, Illinois, Iowa, and Kansas are examples of greatest irregularity in demand and of production; Virginia and Alabama examples of comparative independence of seasonal demand.

The quality of the coal produced, its suitability for certain uses, and, in many instances, cost of production, affect the regularity of production and marketing. A lignite, for instance, that cannot be stocked, can be marketed only when in demand, which is usually during the winter months. Likewise a high-cost operation is most likely operated only during periods of good prices.

Physical character and chemical composition are determining factors in the marketability of coal. The most general use to which coal is put is for steam raising, which includes railroad locomotive use. For this purpose all kinds, grades, and qualities of coal have been and are used, but the preference is, of course, for the higher grades—those with low ash, high heat value, and high fusing point of the ash. Since the invention of the mechanical stoker, the steam-coal consumer has preferred slack coal or screenings—that is, the fine coal about one inch or less in diameter. As a rule, the screenings from coal as it is mined are lower in heat units and contain more ash and sulphur than the lump coal from which screened. The principal market for the fine sizes of anthracite is for steam raising.

Special grades of coal are required for such purposes as gas producers, coke ovens, illuminating-gas plants, malleable-iron furnaces, smelting and brick manufacture. For the most part the essential thing here is low sulphur, around 1 per cent; low ash, under 10 per cent; and for coke manufacture, the property of coking. The proportion of volatile matter is a determining factor in gas manufacture, coal with less than 30 per cent not being suitable; the best gas coals containing 35 per cent volatile matter or more. Under normal conditions, coals that meet the requirements of these special purposes command a premium in price, for their supply is limited as compared with coal that is suitable for steaming.

Considering coals in their order of rank as respects volatile matter, the range is from anthracite with from 2 to 5 per cent, through the several kinds of bituminous coal, to lignite, with between 30 and 40 per cent of volatile matter and moisture. Anthracite is primarily a household fuel, and all sizes down to one-half inch go to that market. The finer sizes, not suitable for ordinary household furnaces, are sold for steam raising. Next in rank is semi-bituminous coal, such as the "smokeless" coals of southern West Virginia, Maryland, and eastern Pennsylvania, with the percentage of volatile matter ranging from 16 to 22. Many of these coals are low in ash—5 to 10 per cent—and with sulphur around 1 per cent. Such coals are in demand for steaming purposes because of high heat values, 14,000 B.t.u. and higher, and smokeless quality. The United States Navy demands the best of this class of coal for its use. The smoke ordinances of large cities, as Chicago and Cincinnati, favor the use of these low-volatile coals. A portion of this low-volatile coal is advantageous in the manufacture of blast-furnace coke in by-product ovens, adding strength to the coke.

Medium volatile bituminous coals, those with volatile matter ranging between 22 and 28 per cent, are used for steam raising and some special purposes. High volatile soft coal, having 28 per cent or more of volatile matter, finds a market for special purposes as well as for steam raising and locomotive use. The greater proportion of bituminous coal falls in this category. The highest grade of high volatile coal is that described as gas coal, in which the sulphur is low—1.25 per cent or less—and the volatile matter is above 30 per cent, usually around 35 per cent.

Physical characteristics are important in the marketing of coal. Nothing adds so much to the appearance of coal to the casual observer as regular sized, blocky, bright lumps. Some coals, as the "splints" of West Virginia and the Pomeroy and Jackson coals of southern Ohio, are known for their blocky appearance. The household trade demands lump coal, and those coals that "mine out" in large lumps are favored in this market. The harder bituminous coals will screen out 60 per cent over 1¼-in. screen, whereas the softer coals, as the smokeless of West Virginia, will make only 40 per cent lump on the same screen.

Sizing of coal has been carried to extremes in the

production of both anthracite and bituminous coal. The hard coal of Pennsylvania is screened to five principal domestic sizes; lump, egg, stove, nut, and pea, and the smaller or steam coal is subdivided into buckwheat, rice, barley (more commonly known as buck 1, buck 2, and buck 3), and boiler. Many efforts have been made to simplify sizing of anthracite, but with little result so far. One large company markets nut and pea combined under the name of range coal. Those soft-coal fields that supply the household market—that is to say, those in the central and western states—offer carefully sized products for this trade. In Illinois, for instance, the operators in the southern fields size their product as minutely as do the anthracite operators of Pennsylvania. The great variety of sizes renders marketing difficult because of variability in demand for the several grades of coal. At certain seasons lump coal output will be in excess of demand, with fine coal or slack at a premium; at other times, as in the fall, when the retail trade is active, slack coal will be in excess of demand and prices correspondingly low. With few exceptions the coal that is shipped over the Great Lakes from eastern Appalachian fields for the northwest trade is screened before it leaves the mines, the lump being shipped up the Lakes and the screened coal sold in local markets. Thus, when the Lake market is active, fine coal is abundant and low priced in eastern markets. The smokeless fields find a market for their fine coal with byproduct coke-oven plants. When the iron business is dull, this market is inactive, and smokeless screenings are in oversupply. Large consumers of fine coal are equipped to crush run-of-mine coal to supply their needs and in this way meet a situation of short supply of fine coal. Screenings are lower priced than lump or run-of-mine coal, the spread in price in normal times being about 25c. per ton between these grades.

**THE LARGEST CONSUMERS of soft coal in the United States are the railroads, which often mine the fuel from properties that they control. Industrial plants are a close second, however, and together with the transportation systems burn more than half the soft coal mined. Anthracite is principally consumed for household use, although it, also, finds wide application in most fields of industry.**

Although there is a wide variation in the actual value to the consumer in point of heat available for useful work in different coals, a comparatively small proportion of the total is marketed on the basis of specifications. In the ten-year period to 1915 there was a definite trend in the direction of coal purchases on specifications, such specifications usually setting a base price for coal of given analysis and providing penalties for deficiencies and bonuses for coal analyzing above the base. In some instances the heat content was the base, in others, the ash; some contracts were very involved, taking into consideration heat content, volatile matter, ash, and sulphur.

The United States Navy formerly bought coal under the most rigid form of specifications. The practice of buying coal under specification was wiped aside during the war period, when coal was just coal and buyers were satisfied with anything black, and it is not coming back with favor with any rapidity. Most large buyers who may scrutinize quality as well as price make tests to determine the most satisfactory coal and then depend on the reliability of the producer and shipper to maintain quality and preparation. Unfortunately, too few buyers of coal give the consideration which the matter warrants to the question of relative worth. The buyer of coal in large quantities is altogether too indifferent to the price he pays for available heat, looking rather to the price per ton delivered at his plant.

Coal is not as a general rule sampled by the buyer or consumer. Large users are exceptions to this rule, particularly in the iron and steel industry and among central-station plants. Large, well-organized consumers of coal watch the quality of coal received both as a check on the shipper and to control their own practice, whether that of steam raising or metallurgical use. Some sample the coal in the railroad cars as it arrives at the plant; others have devices for sampling the coal as it passes over belts or is otherwise handled about the plant. Car sampling is a crude process, generally inadequately done and often unfairly. Fine coal can be sampled much more accurately than lump coal and is, in fact, more often sampled. Many important consumers, and the railroads in particular, depend largely on visual inspection by trained inspectors. Here, the object is to detect unusual or unwarranted proportions of bone, slate, or dirt. Coal is often rejected on the basis of such visual inspections, and the practice has a standing in the trade because physical appearance is so important in the marketing of coal.

Anthracite is inspected by a method that involves both visual inspection and sampling and hand screening and sorting to determine the proportion of slate and bone as well as undersize. Each responsible producer of anthracite has standards of preparation that govern the inspection of its product.

With the exception of an ancient practice in the Connellsville region, where even today coal is sold by the bushel, coal is bought and sold wholesale by the ton. By law in Pennsylvania, the gross ton of 2,240 lb. governs all transactions in anthracite, and in Maryland and the District of Columbia the gross ton is the legal weight in retail sales. In eastern Pennsylvania and in West Virginia much of the soft coal is marketed by the gross ton. East of the Alleghenies, freight rates on coal, both hard and soft, are published with the gross ton as a unit. Elsewhere the net ton of 2,000 lb. is the unit of weight. Invoicing, however, is usually by the hundredweight, and in the East the coal is weighed on railroad-owned and railroad-operated track scales at junction points and yards. In the West track scales are a part of mine equipment.

Shipments are, of course, by carloads, and most of the traffic is in open-top equipment, both solid and drop-bottom types. The coal in the car is the property of the buyer as soon as it leaves the mine, and the customer looks to the carrier for damages in case of loss or confiscation. It is quite general to allow a 2 per cent tolerance on weight at destination against billed weight.

Coal is sold direct by producer to consumer, through affiliated and unaffiliated sales agents and to and through jobbers or brokers. The jobber is a free-lance trader in coal, buying and selling in the open market.

The three functions are often performed by the same concern, and there are few shippers that are doing business entirely in but one way. Even the largest producers buy and sell some coal, and many jobbers own or operate a mine or many mines, the output of which they sell.

About 24 per cent of the domestic sizes of anthracite is sold by producer direct to retail dealer or to consumer; 53 per cent is sold through sales agents, and the remainder is sold through jobbers. Similar data with respect to the distribution of soft coal are not available, but it is known that about 20 per cent of the output of bituminous coal is produced by companies that burn it and that of the remainder a large part is bought and sold by jobbers.

A majority of the soft-coal producers make contracts for the sale of their product. According to data collected by the United States Coal Commission for 1920, a year of heavy production, 91 per cent of the commercial coal shipped was from companies that sold all or part of their tonnage on contracts. These companies shipped 79 per cent of their coal on their contracts. In that year sales agencies took 42 per cent of the tonnage shipped under contract by producers, which is a measure of the extent to which producers, notably small producers, dispose of their product through separately incorporated selling companies.

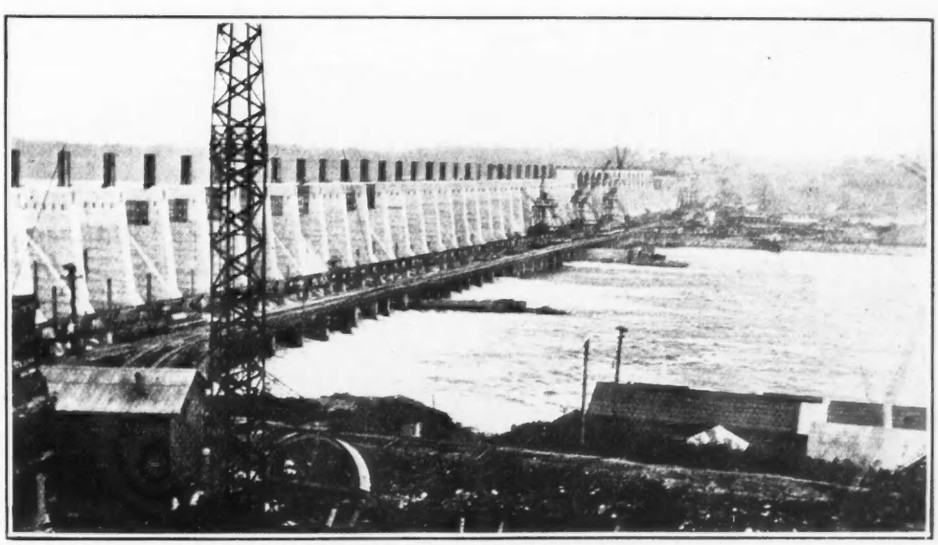
Contracts with consumers are either for definite tonnages or for an indefinite quantity described either as requirement, as surplus, or as mine output contracts. The majority of the soft coal sold through a middleman is on sales-agency contracts that in effect make the agent the selling department of the producer.

The price of anthracite is stabilized by reason of the concentration of production in few large companies. Seven producers represent 70 per cent of the total output, and each of these large companies has fixed prices, particularly in the household sizes. Prices of the anthracite produced by the several hundred smaller concerns, representing 30 per cent of the total, fluctuate with supply and demand. As the steam sizes come into direct competition with soft coal, prices are less stable than of the domestic sizes.

The price of bituminous coal is sensitive to such influences as large stocks, car shortage, and labor trouble only when these influences operate on a large scale. The soft-coal industry has a large measure of surplus capacity, and any local deficiency in production is at once made up by shipments sent in from other fields. Bituminous coal is not stored at the mines in appreciable quantities, but large reserves are often held by consumers. As much as 63,000,000 tons has been recorded in consumers' storage at one time, and when this condition is reached there is slack demand for fresh production. In fact, the size of consumer storage is a large factor influencing the mine price of soft coal. The very large reserve accumulated in 1923 and early in 1924 in anticipation of a possible strike in the unionized fields was a most depressing influence on mine price throughout the spring and summer of 1924.

There are conditions that determine for each field a base level of prices for different grades of coal, and of these the wage scale and natural condition of the coal bed are the most important. Whether the labor is organized or not, is, in turn, the most important factor in the wage level, for union labor has maintained its high level of wage, while wages in non-union fields fluctuate with the activity of the coal market.

Any attempt to insert in this short record a statistical review of prices of coal would be confusing, for the range is wide and the varieties regularly quoted are numerous. An indication of the fluctuations that have been recorded in the last decade is found in the index of spot prices regularly published by *Coal Age*. The average "spot" price—that is, open-market quotation, as differentiated from the contract price—of bituminous coal at the mine in 1913 was $1.23, reaching a maximum of $9.51 in August, 1920, and fell to $2 in June, 1924.



**Wilson Dam, at Muscle Shoals**

# A Trip Down the Amazon River

*An Account of Experiences on the Recent Ellsworth Expedition*

**By Joseph T. Singewald, Jr.**
Professor of Economic Geology, Johns Hopkins University

*Joseph T. Singewald, Jr.*

LAST February, the Johns Hopkins University was enabled, through the generosity of Lincoln Ellsworth, to send an expedition to central Peru to make a geologic cross-section of the Andes. The members of the expedition were Mr. Ellsworth himself, who is a civil engineer and explorer; Quentin D. Singewald, and myself. The work was carried across the three high ranges of the Andes in central Peru. Beginning at Chimbote, the Cordillera Negra, the Cordillera Blanca, and the Cordillera Central, separated respectively by the rivers Santa and Marañon, were successively crossed; and the geologic section was carried to the Huallaga River at the Hacienda Putante, which serves as the port of the small town of Uchiza. Instead of recrossing the Andes to the Pacific Coast, it was decided to come home by continuing downstream to the Atlantic.

The difficult but by far most interesting part of the return journey was from Putante to Yurimaguas, a town on the lower course of the Huallaga River which is the head of steam navigation. Because of frequent stretches of swift current, numerous rapids, and a waterfall on the river between Putante and Yurimaguas, this part of the river is navigated but little. The descent is generally made on rafts.

Yurimaguas lies about 180 miles north of Putante; but along the course of the river the distance between them is about 300 miles. We descended the river during the latter part of August, when it is at its lowest stage; and the low-water level last year was said to have been unusually low. The trip was made in twelve days of actual traveling time. During flood period, the current of the river is more rapid, and the trip is made in two or three days' less time.

The rafts used on the Huallaga River are made of the trunks of the *topa* tree. The wood is light in weight and of porous, cellular texture, so that when dry it has considerable buoyancy. It is not very strong, however, and logs are often broken or shattered in the rough stretches of the river. The rafts have to be rebuilt sometimes, replacing the damaged logs with new ones, at Juanjui, which is a sort of halfway point on the river. Because of their porous nature, the logs also become waterlogged and lose some of their buoyancy, so that by the end of the journey the raft is much lower in the water than at the start.

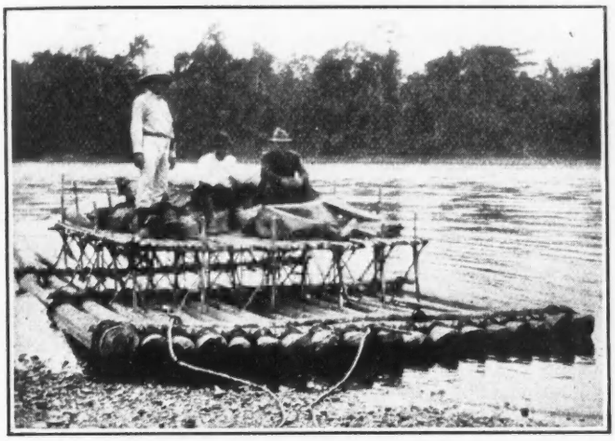
In building the raft, the butt ends of the logs are placed in a straight line that serves as its front, and are lashed to a strong, stout cross-piece by means of the thick rope-like vines that hang from the trees in the tropical forests. In the same way they are lashed to a second cross-piece in the middle of the raft, and to a third in the back. The ends of the logs project beyond the third cross-piece in an irregular manner, according to the shapes of the tree trunks.

A platform, about 2 ft. high, called the *barbacoa*, is built as a superstructure on the raft, leaving about 5 ft. free in front for the use of the paddlers. The platform serves to keep cargo and passengers dry, and is particularly valuable for this purpose in shooting rapids, when the raft itself is frequently submerged. As the raft is pitched about in the rapids and subject to severe bumps on gravel bars and projecting rocks, the *barbacoa* must be strongly built and firmly attached to the raft. The supports are made of strong pointed sticks of hard wood that are driven deep into the soft *topa* wood and are tied together in threes to form rigid tripods. Strong cross poles are tied securely to the tops of the tripods with strips of long-fibre bark. The poles are spaced at intervals of about 3 ft. On this solid framework a flooring of *caña brava*, a sort of bamboo, is laid and tied down with long strips of flexible bark.

The rafts are usually built of sixteen to twenty logs, and are capable of carrying a load of one to two tons in addition to the three Indians who navigate them. Our raft contained eighteen poles and was 18 ft. long from the front to the rear cross-bar, and 12 ft. wide. The floor of the *barbacoa* was 13 ft. long and 9 ft. wide. We carried a half ton of supplies and equipment and three passengers. The Putante Indians go only as far as Juanjui, where a new crew is engaged for the continuation of the trip to Yurimaguas. Both sets of Indians return home on foot by obscure jungle trails.

At Putante the Huallaga River flows with large smooth meanders through a broad valley bordered on the southwest by the high Cordillera Central and on

***The Expedition's raft entering one of the many rapids on the Huallaga River***



*Along the Huallaga, at Putante*
Raft of the Ellsworth Expedition with cargo on board ready for descent of the river.

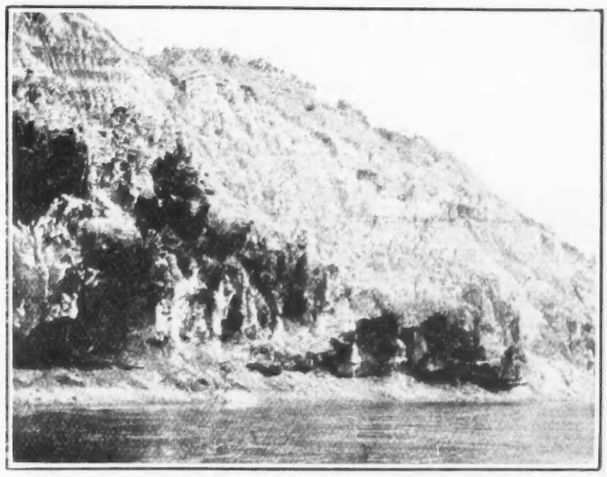
the east by a low range that separates it from the Ucayali River and the Amazon plains. The general direction of the valley is parallel to the northwesterly strike of the geology of the region. Very gradually, however, the strike bends more to the north, and the river swings closer and closer to the mountains on the east. Tributary valleys are marked by great gravel bars over which the debouching river splits into branches that empty independently into the main river. These huge gravel and boulder deltas dam the Huallaga River and crowd it against the opposite bank, which causes these places to be marked by rapids.

On the third day we shot the first of the bad rapids. On the convex side of a bend in the river was a great funnel-like hole into which the river seemed to be pouring. The raft was kept well toward the inner side and we had actually passed the whirlpool when the raft began to turn around despite the efforts of the Indians, and, with increasing speed, was drawn toward the hole. It was sucked under to the floor of the *barbacoa*, whirled around, and slung out again as if it were a floating egg crate. A second time we were caught in the inward suction of the great whirlpool and drawn toward the center of the vortex. This time the raft entered with one corner first, and the force of the water tore the Indian on that corner from his place as the raft was sucked under. Fortunately he was thrown against the *barbacoa*, and as the raft emerged we found him clinging to it. The Indians renewed the fight with their paddles and saved a third entry into the whirlpool.

The following day we passed through a succession of strong rapids as the river was making its way across a series of limestone strata. A thick group of limestone beds is cut through three times in high, vertical-walled canyons, known respectively as the Cajon de Sion, Cajon de Huayruru, and Cayumba. The first two canyons are marked by strong rapids at their approaches and at their ends, but in the canyons themselves the river is a narrow, deep stream with quiet current. Beyond the approach rapids to the third canyon is the Cayumba water fall, where the river takes a plunge of more than 6 ft. over limestone rocks. On approaching Cayumba there is a stretch of strong rapids, then a short course of quiet water, then the fall. The trick here is to pass the rapids in such a position that a landing can be made in the stretch of quieter water between them and the falls. If one fails to make the landing, the raft is swept over the falls with all on board. Before entering the rapids, the crew had cut additional ropes and tied all the baggage to the raft with double lashings. We were told to remove our shoes and all surplus clothing. The raft entered the raging waters, and the paddlers worked frantically to keep it toward the bank on which the landing had to be made. Strenuous work in the short stretch of quieter water brought the raft close enough to shore to enable the paddler on that side to plunge into the water with one of the ropes and gain the bank. The second followed immediately and then the third. Pulling hard on the three ropes they brought the raft alongside the gravel bar forming the river bank. Slowly they allowed it to drift down to the huge limestone blocks at the head of the falls. Then followed the laborious task of carrying the baggage over the rocks around the falls. This accomplished, the raft was freed, shot the falls, and came up slowly close to the bank in a back current near the place where the baggage had been deposited. The crew jumped into the river, with a few strokes reached the raft, brought it to the bank, and soon had it reloaded ready for the continuation of the journey.

### A Deposit of Rock Salt

The courses of the river in the vicinity of the limestone gorges have many high bluffs of coarse, highly indurated, boulder conglomerate. After finally leaving the heavy limestone beds behind, the general direction of the river is northeast. At Cachihuañushca, a thick bed of rock salt is exposed in bluffs on each side of the river. The salt is mined by Indians and taken down the river in dugout canoes. After flowing northeast about fifteen miles, the river has crossed a flat, broad valley, and is again deflected northwestward by a series of long, straight-strike ridges forming the northeastern boundary of the valley. These ridges are formed by thick beds of quartzitic sandstone with intercalations of red shale. Between them are thick horizons of soft red shale. Beyond the sandstone ridges, the river enters a still wider valley and follows a northeasterly course across it. Juanjui lies on the west side of this valley. There we merely had to change crews. Several logs in the raft were shattered in the passage of Cayumba, but the raft was not sufficiently



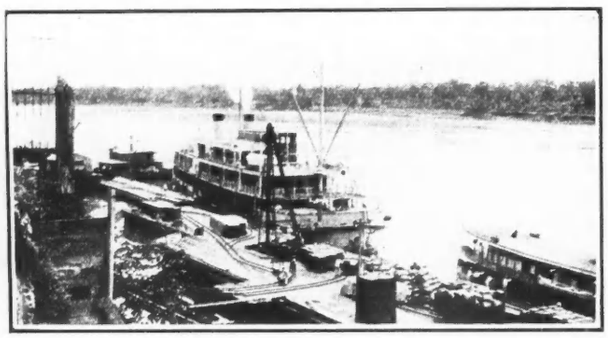
*Rock salt capped by red shale is exposed in bluffs on the Huallaga at Utcubamba*

damaged to make it necessary to rebuild it at that point.

In the vicinity of the small town of Chapaga the river again cuts through thick horizons of cross-bedded sandstones in the red shale series that give rise to strong rapids. Malpaso Estero, below Chapaga, is one of the worst rapids on the river. On entering Malpaso Estero, the paddlers lost control of the raft and we shot those rapids with the raft sideways. The strain on the raft was so great that one of the shattered logs broke in two and others split wider open, and a few of the lashings gave way. Fortunately, this was the last bad place, so that we could continue without delaying to repair the raft.

At Utcubamba, above Chapaga, the river has cut a high bluff in a thick bed of rock salt overlain by red shale. Below Chapaga, at Callanayacu, the salt bed is again exposed on the banks of the river, and is actively worked by the Indians.

Below the Malpaso Estero the rapids are no longer formidable, but a new danger develops through sunken



*The pontoon at Iquitos*

The large steamer is the "Belem" that plies between Iquitos and Para, a distance of 2,500 miles. The small steamer at the right is the type of boat that plies between Iquitos and Yurimaguas.

trees, in places accumulated in large masses, that block the river channel. As Yurimaguas is approached, there are no more thrills. The raft drifts very slowly in the diminishing river current, and the trip becomes a bit monotonous.

The journey from Yurimaguas to the mouth of the Amazon River at Para is made by steamers, a distance of more than 3,000 miles. Between Yurimaguas and Iquitos ply small river steamers with very meager accommodations. The trip takes from three to four days. At Iquitos one changes to larger river steamers that continue down the river to Para. The trip is a slow one, however, because the steamers make many stops, and the cargo, consisting largely of balata and rubber, is loaded in a very leisurely fashion. They are wood-burning boats, and frequent stops are made to take on fuel, some of them as much as six hours in duration. The "Belem," on which we left Iquitos, took eleven days from Iquitos to Manaos, remained in Manaos four days to load and unload cargo, and used six days for the trip from Manaos to Para. The Booth line has a direct passenger service from Liverpool to Manaos that makes the trip from Manaos to Para in less than three days. The handling of a large ocean liner on the river is a wonderful feat of navigation. In the "narrows" above Para, the steamer slowly pushes her bow against one bank of the river, and with it as a pivot, makes a full half turn in an arm of the river hardly twice as wide as the length of the ship. We have been

*The "Belem" making a stop for fuel on the Amazon*

At flood stage these bluffs are completely submerged and the flat terrace back of them is inundated.

taught in our geography that the Amazon is the world's greatest river system, but it is only when one begins at one of its sources in the high Andes and follows it down to the Atlantic Ocean that he grasps the real magnitude of that great body of flowing water.

## Salt Domes Discovered by Artificial Earthquakes

Some time ago *Mining Journal-Press* invited contributions about record mineral discoveries, production, and similar events. A new record in salt-dome discovery has just been made in Texas, where, within the space of a week, two new salt domes were drilled into and proved. During recent years the discovery of even one new dome was a great event in the development of the Gulf Coastal region, for all of these formations that were well marked on the surface had been long since "picked up." When it is considered that each dome is a potential oil field possibly containing up to 100,000,000 bbl. of oil, the discovery of two such domes in one week is an event of great importance to the petroleum industry, and a record in the history of the Gulf Coast.

Will this record stand? Possibly not, for it is due not to chance but to scientific discovery, which has solved the problem of finding these hidden structures. One method of search employs the Eötvös balance,[1] an extremely sensitive instrument that detects small changes in the force of gravity caused by masses, in the earth's crust, of greater or less specific gravity than the surrounding rocks.

A second method of search is conducted with an instrument operating on the principle of the seismograph. Miniature earthquakes are produced by the explosion of large charges of dynamite. The charges are set off singly, at regular intervals along co-ordinate lines, with the instrument placed on the line of firing. The vibrations caused by the detonations are recorded by the instrument. If no dome is present, one set of vibrations is registered; if a dome intervenes between the seismograph and the blast, a second set of vibrations is recorded. From the interpretation of these photographically recorded vibration lines, it is claimed and apparently proved, the position of a salt dome can be determined positively. Not only that, but the depth to the cap of the salt plug can be accurately predicted and the cap-rock contours drawn.

[1]Described in *Mining Journal-Press*, Oct. 6, 1923; pp. 583-589.

# Discussion

## Probability in Relation to Sampling Ores

THE EDITOR:

Sir—Probably there is no subject connected with his work of which the average mining and metallurgical engineer has less complete mastery than he has of the general theory of probability as applied to the sampling of the mineral and metallurgical products with which he has to do. Usually the mining and metallurgical engineer gets his introduction to probability in his surveying course, where one special application of it to the probable error in repeated measurements of distances is sometimes developed more or less completely. If, later on, he has occasion to apply these unused and half-forgotten ideas to probability in relation to sampling, the result commonly is only more confusion of mind. I cannot do better in this connection than to quote the words of A. L. Bowley, before Section F of the British Association for Advancement of Science in 1906.

"When the initial difficulty of appreciating the nature of mathematical probability is overcome (a difficulty which rather grows than diminishes as one works at it), there still remains the greater task of deciding in what cases it can properly be applied and on the method of calculation. It has, in my opinion, often been used where it is not appropriate, where the chances of deviation are not those indicated by a normal curve, where it is a mere numerical value without involving the superstructure that makes the measurement of precision real."

As an example of what has been said above, the article on "Accuracy in Sampling Metallurgical Materials," that appeared in the Nov. 8, 1924, issue of the *Mining Journal-Press*, may be cited. Near the end of the article the author makes the statement "the composite sample is accurate to 10.07 ± 0.25 per cent zinc with reference to the total ore to the plant, which in itself would give an average or expected deviation in the metal balance of ±2.5 per cent"; a statement which is entirely erroneous and misleading. The calculations which he has given throw no light whatever on what discrepancies may be expected between the metal actually recovered in plant operations and the amount of metal indicated by the preliminary analyses.

The article in question offers so much difficulty to the average reader, not only because there are errors of carelessness in it—such as the omission of the square-root sign in the second half of equation (1)—and because the author changes the significance of the symbols he uses from paragraph to paragraph without calling marked attention to the fact that the same letters are being used in a different sense, but also because the whole treatment is so condensed and obscure that it is difficult for the general reader to understand what is meant by the terms employed, that it will perhaps be worth while to restate some of the quantities used in the article, only putting them in a form so that they can be much more easily understood. The tables given herewith, headed respectively "M" and "N," employ exactly the same figures that are given in the article in question, only instead of making the quantities apply to pounds of ore they are made to apply to persons.

"M"

| Lot | Total Persons | Persons Examined | Per Cent Foreign Born | Deviation From Mean Per Cent |
|---|---|---|---|---|
| 1 | 534,105 | 105,300 | 12.5 | 2.33 |
| 2 | 542,619 | 100,500 | 10.0 | 0.17 |
| 3 | 571,725 | 109,400 | 9.5 | 0.67 |
| 4 | 564,795 | 122,200 | 11.1 | 0.93 |
| 5 | 531,210 | 97,100 | 9.3 | 0.87 |
| 6 | 528,710 | 113,400 | 8.9 | 1.27 |
| 7 | 552,585 | 109,300 | 7.7 | 2.47 |
| 8 | 583,358 | 115,800 | 9.9 | 0.27 |
| 9 | 669,438 | 120,900 | 13.1 | 2.93 |
| Total..... | 5,078,545 | 1,003,900 | Aver... 10.17 | Aver... 1.32 |

"N"

| Lot | Total Persons | Persons Examined | Per Cent Foreign Born | Deviation From Mean Per Cent |
|---|---|---|---|---|
| 1 | 559,874 | 203,000 | 6.5 | 0.1 |
| 2 | 574,470 | 193,000 | 7.3 | 0.7 |
| 3 | 551,304 | 177,200 | 8.0 | 1.4 |
| 4 | 571,584 | 192,400 | 6.9 | 0.3 |
| 5 | 597,967 | 206,500 | 6.4 | 0.2 |
| 6 | 621,942 | 219,500 | 7.0 | 0.4 |
| 7 | 588,000 | 202,500 | 6.4 | 0.2 |
| 8 | 571,524 | 185,500 | 4.7 | 1.9 |
| 9 | 606,807 | 198,800 | 7.8 | 1.2 |
| 10 | 574,240 | 203,800 | 5.0 | 1.6 |
| 11 | 578,324 | 195,300 | 9.8 | 3.2 |
| 12 | 624,652 | 191,200 | 5.2 | 1.4 |
| 13 | 287,332 | 100,200 | 9.1 | 2.5 |
| Total ..... | 7,308,020 | 2,560,600 | Aver.... 6.60 | Aver... 1.16 |

Suppose that an observer stood on a street corner and counted the number of persons that went by and stopped every fifth person to ask whether or not he was foreign born. He did this at nine places, or on nine days, and recorded the percentage who were foreign born, thus giving the series of nine lots in Table "M." He repeated the performance at thirteen other places or times, only this time stopping two persons out of every five and getting the series of results shown in Table "N." The tables "M" and "N," in the article referred to above, apply to nine and thirteen lots of ore respectively, one car out of every five being sampled in Table "M" and two cars out of every five being sampled in Table "N," and the results are given in percentages of zinc in the respective lots of ore. By changing over to persons, using the same figures and analysis of the results, it is made much easier to understand, because under these circumstances it is clearly evident that the question of error in sampling is not involved at all. It is assumed that every person who is spoken to replied correctly as to whether he was foreign born, and the results have been set down correctly.

What we actually know about these figures is that in the case of series "M" nine sample lots of about one hundred thousand men each were investigated and found to contain the percentage of foreign born shown opposite each lot. Similarly, in series "N" thirteen sample lots of about two hundred thousand men each were investigated and found to contain the percentage of foreign born shown opposite each. We have no information whatever as to whether the percentage of foreign born shown in these sample lots corresponds exactly with the percentage in the larger lots to which the samples pertains. Perhaps it does and perhaps it

does not. There is no evidence whatever before us. The inference might be drawn from the fact that the percentages found in the case of the second series, where two out of five are taken as a sample, are less variable than the percentages found in the first series, where one out of five is taken as a sample; that this indicates that two out of five gives a better sample than one out of five. It is just as reasonable and more probable, however, that the greater uniformity found in the second series is due to the fact that the second series of thirteen lots were actually more uniform than the first series of nine lots. This, of course, is aside from the general fact that everybody would agree that two out of five ought to give a better sample than one out of five, and is introduced only for the purpose of stressing the fact that the figures in the table do not give us any evidence on the question whether the sample lots accurately represent the respective main lots to which they pertain.

Under series "M" in the article referred to above, the author states "Here $\sqrt{\frac{d^2}{n^2}} = \pm 0.542$ per cent," and under series "N" he states "Similarly, the expected deviation is $\pm 0.416$ per cent." From this it may be inferred that the author considers $\sqrt{\frac{d^2}{n^2}}$ as the expected deviation in series of this character. I am at a loss to understand what the quantity $\sqrt{\frac{d^2}{n^2}}$ is unless it is intended for $\sqrt{\frac{d^2}{n}}$ or the standard deviation of any series.

Possibly the readers of *Mining Journal-Press* are not familiar with the term "standard deviation" that is now so much used in interpreting statistics, and it may be desirable to make a brief simple explanation of it. Suppose that we have a series of five figures, that may represent anything, using for this purpose 6, 8, 2, 4, and 5. The mean of this series of figures is 5. The first differs from the mean or average by 1, the second by 3, and the third by —3, and the fourth by —1, and the fifth by 0. The average deviation is the sum of these deviations divided by 5 (neglecting plus or minus signs) and is obviously 1.6. The standard deviation is obtained by squaring each deviation, adding them together, dividing by the number of deviations and then extracting the square root. In short, it is the $\sqrt{\frac{d^2}{n}}$.

To explain why the statisticians use the standard deviation in preference to the average deviation would require a discussion of frequency curves and various other matters that if introduced here would probably only obscure the application of mathematical methods to sampling, whereas my endeavor is to try to make it clear. I will therefore say nothing more about the standard deviation beyond calling attention to the fact that it gives more weight to the large deviations than the average does.

It should be particularly noticed that the question as to whether the figures 6, 8, 2, 4, and 5 are themselves correct has not been raised at all. All that we know about them is that they are a series, and the purpose of the mathematical reasoning is to investigate the properties of the series. Possibly the figure 2 is incorrect—it might be 3½; but we know absolutely nothing about that, and are not at present concerned with it. The mathematics starts with the series of figures, and considers their relations as a series. The probability of error in the original figures is another matter and requires a different method of analysis.

The foregoing has perhaps made it clear that the mathematics of the article cited above has only to do with a series of figures and not with the sampling operations on which they are based. In the case of series "M" we have a series of nine figures of which the average is 10.17, and each individual lot differs from the average by the amount set opposite it in column 5. The standard deviation in this series would be the square root of the average of the squares of each deviation. For the purposes of a metallurgist this is of little value, because he is not usually interested in the standard deviation. What he is interested in is whether the arithmetical average determinations on a series of samples taken from different lots gives him the correct average figure for the total weight.

In the article cited, the total weight of ore was 16,360,018 lb. and the average metal content computed from the various samples was 10.07 per cent. What the metallurgist wants to know is whether 16,360,018 $\times$ 0.1007 = the actual weight of metal in that weight of ore, and the mathematical analysis of the series of figures obtained through sampling operations throws no light on that problem. Take the same figures and apply them to 16,360,018 people, of whom 10.07 per cent are foreign born, according to the average of the observations. The analysis as to whether this represents a true average of the whole lot has not been attempted; the mathematical analysis deals with the relation of the series of observations to each other, assuming that they are correct in themselves. Possibly a considerable number of the persons asked misunderstood the question and answered incorrectly, or the observer made errors in recording the answers, but we have no information on that subject, and to attempt to extend the relationships of the figures as a series to cover the accuracy of sampling the total quantity is to make a fundamental error of logic. All that the mathematical analysis of a series gives is a measure of the probability that if any one lot is taken at random out of the series, that lot will not differ from the average of all the lots by more than the calculated amount. It does not give any information as to the accuracy with which the sample lot taken from each main lot indicates the composition of the main lot itself.

If the author of the article under discussion had correctly calculated the probable deviation in the two series of results that he gives and inserted the correct values in the final equation on page 732, the result obtained would not be an indication of how closely the results computed from the series of analyses would check with the metal balance. As the equation given is incorrect in form, it does not mean anything, nor would the deviation found in this way be of any value to the metallurgist, because he does not usually care what the mathematical relationship is between the results on one lot and the entire series of lots. What the metallurgist is interested in is how nearly the average of the results obtained by his sampling operations corresponds to the actual composition of the lots of material sampled. This is an entirely different matter, involving the theory of sampling, and will be made the basis of a subsequent article.

T. T. READ.

Washington, D. C.

# News of the Week

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## Summary

*INCREASE in capitalization amounting to $2,000,000 is announced for the Bunker Hill & Sullivan Co. by F. W. Bradley, president. Shares will be sold as needed to finance expansion outside the Coeur d'Alene district, in Idaho, and perhaps the erection of a zinc plant at Kellogg.*

*British mining houses are concerned over the world's lead shortage. They see little immediate increase from Mexico, Australia, Burma, or Spain. A market exists for promising but unequipped properties.*

*Zinc smeltermen foresee a decrease in the supply of concentrate from the Joplin-Miami district within a few years. Production records, however, are being broken as current returns come in.*

*The Talache Mines company has found richer ore in its lower workings and mill heads average 40 oz. of silver.*

*Research by the Bureau of Mines aims to solve the low-grade iron-ore treatment problem, which the industry seems to ignore.*

### Zinc Smeltermen Foresee Possible Market, With Nothing to Sell

**Opinions Differ Regarding Life of Joplin-Miami Field—Abandoned Properties May Revive**

Zinc smeltermen are reported hesitant about coming in on their share of the $100,000 fund for advertising zinc, because of the fear that by the time they have built up a big demand for their product they will find it impossible to obtain sufficient zinc concentrate.

Local mine operators in the Joplin-Miami field are divided in opinion as to whether this field can further increase its output and maintain such an increase for any number of years. The district's production this year will be close to 750,000 tons. In 1915 it was only a little more than 300,000 tons. The opening of the rich Oklahoma section of the field is largely responsible for the increase.

It is admitted by all that the Oklahoma mines are good for several years' output yet, but it is also certain that many of them are approaching depletion. In fact, a number have already been shut down, and the cream of the ore deposit has been skimmed from others.

Most operators believe the district's production might be run up to 16,000 or possibly 18,000 tons a week, should ore prices go to $60 or higher. But whether such a production could be maintained for more than two years, or for that long, is another matter. Some believe it could be; some think not.

If ore prices continue to advance it surely will not be long until there will be a return to the old sheet-ground deposits around Webb City and Duenweg, Mo.

### Fire Destroys Bins and Trestle at Trail

On Dec. 20 fire destroyed the receiving bins of the zinc plant at the Trail smelter of the Consolidated Mining and Smelting Co. in British Columbia and the Canadian Pacific Railway Co's. trestle, connecting the bins with the railway. The loss is estimated at $25,000. S. G. Blaylock, general manager for the Consolidated company, stated that the company's zinc output would not be affected seriously.

### Sulphur Deposits Will Be Included in Federal Leasing Act

The Secretary of the Interior has drafted legislation which will add sulphur to the minerals already covered by the General Leasing Act of Feb. 25, 1920. That act now covers coal, phosphate, oil, oil shale, gas, and sodium. He proposes, however, that the leasing act be amended so as to prohibit "any person, association, or corporation from taking or holding more than three sulphur permits or leases in any one state."

The measure pertaining to sulphur proposes that the Secretary of the Interior be authorized "to grant any qualified applicant a prospecting permit which will give the exclusive right to prospect for sulphur in lands belonging to the United States, for a period not to exceed two years: provided, that the area to be included in such a permit shall not exceed 640 acres of land in reasonably compact form." The royalty is fixed at 5 per cent of the quantity or gross value of the output at the point of shipment to market.

### Excellent Development in Greenwood, B. C., District

**Providence Finds Gold Vein Near Old Lead-Silver Shoots—Strathmore Ships to Trail**

Success seems to have rewarded the efforts of the Providence Mining Co. in reopening the mine at Greenwood, B. C. Exploration of ground below the lower level has disclosed an orebody, on the 500 level of gold ore in a white quartz which lies beside the sulphide shoot from which high-grade silver and lead ore was mined in the early history of the mine.

The Providence mine was reopened last summer after having been idle for years, during which litigation over the ownership was slowly "ground out" in the courts.

The new strike of gold ore was unexpected. The gold is easily seen several feet from the face, shining in its pure white matrix of quartz, and rivals in richness the ores of the I.X.L. of Rossland when that camp was in its glory.

From the neighboring Strathmore Mine, ore carrying 1½ oz. gold, 400 oz. silver, and 10 per cent lead is being shipped to the trail smelter. The Strathmore, like the Providence, has just resumed after being shut down for years, and the two strikes have stimulated mining through the old camp.

The Prince George property, lying south of the Strathmore, has been taken over by a local syndicate and is installing a compressor preparatory to resuming exploration.

The Spotted Horse property is opening up milling ore and the D. A. property is being opened by Belbridge & Graham.

# F. W. Bradley Explains Increase of $2,000,000 in Bunker Hill Capitalization

## Employees May Buy From Current Earnings—"Outside" Development or Zinc-Plant Construction May Require Money—Splendid Outlook for "Parent" Enterprise

By A. J. Dunn
Special Correspondent, Wallace, Idaho

A LETTER of unusual interest was issued on Dec. 10, 1924, by F. W. Bradley, of San Francisco, president of the Bunker Hill & Sullivan Mining & Concentrating Co., to the stockholders of the company. In this he announces the increasing of the capital stock of the company to the extent of $2,000,000, represented by the issuance of 20,000

*F. W. Bradley*
President, Bunker Hill Mining & Concentrating Co.

shares of preferred stock at the par value of $100 per share. The original capital stock was $3,270,000, represented by 327,000 shares of common stock of the par value of $10. The capital stock therefore is now $5,327,000.

### Employees May Participate

Mr. Bradley states that the directors have set aside 3,000 shares of the preferred stock, which will be offered to employees of the company on an installment basis which will permit them to pay for it through their current earnings. The balance of the preferred stock will be offered to present stockholders pro rata from time to time when and if funds are needed to finance various "outside" mining and other enterprises, the practice heretofore having been to take care of these enterprises out of the operating earnings of the "parent mine," the Bunker Hill & Sullivan property at Kellogg, Idaho.

Discussing these outside enterprises, Mr. Bradley explains the joint ownership of the Star mine by the Bunker Hill & Sullivan and the Hecla companies on a 50-50 basis, and adds that commercial ore has been opened on the Star at a depth of about 4,000 ft. below the apex of the vein; that "this and recent developments in the adjoining Morning mine promise to make the Star one of the largest and most important mining properties in the Coeur d'Alene district." Regarding treatment of Star ore, he says if the zinc content justifies it, "we contemplate a zinc addition to your smelting plant, and in such an event plan to secure funds for it by offering stockholders a portion of the recently authorized preferred stock issue."

### Mayo Mill Finished

Of the Mayo property, in Yukon Territory, Mr. Bradley says the Bunker Hill subscribed for 50 per cent, the other 50 being taken by the Alaska Treadwell and other affiliated companies. Shipment of sorted ore from the Mayo to the Bunker Hill smelter at Kellogg in 1923 returned an operating profit of $50 per ton and shipments in 1924 netted $71 per ton. A mill at the Mayo is now nearing completion, which will enable the company to ship high-grade concentrate instead of sorted ore.

Of the Lost Pilgrim property, in central Idaho, upon which the Bunker Hill holds an option, Mr. Bradley says it "promises to be the most important of all your company's various outside mining ventures," and that it may be necessary to offer stockholders preferred stock to complete its equipment, the product of which will be shipped to the Bunker Hill smelter at Kellogg, Idaho.

Mr. Bradley says the Bunker Hill smelter to date has cost $3,736,700, all of which has been paid by the "parent mine" from operating earnings. During the last two years $899,527 has been spent for extension and betterments for the purpose of increasing lead and other metal recoveries. The smelter is now thoroughly up to date and "has the most extensive lead saving devices of any lead smelting plant in the United States." These will largely increase earnings, and "after 1930 with the expiration of the present contract with the American Smelting & Refining Co., these earnings will be still further and substantially increased."

After referring to large expenditures in 1923-24 for improved mining and milling facilities, Mr. Bradley says: "Past operating earnings from the 'parent mine' have totaled over $130 per present outstanding shares of Bunker Hill & Sullivan common stock, and 'parent mine' future operating earnings promises to more than equal their past record, and are to be expected in addition to the earnings now in sight from the above mentioned of your various 'outside' enterprises."

Mr. Bradley is optimistic regarding the price of lead and predicts that the price will "continue at a sustained high figure as compared with pre-war fluctuating figures."

## Two New Concentrators in Joplin-Miami District

TWO NEW MILLS have been completed recently in the Joplin-Miami district. One is that of the American Zinc Co., subsidiary of the American Zinc, Lead & Smelting Co., on a lease near Douthat, Okla., south of Picher. The tract formerly was held by the Skelton Lead & Zinc Co., and was taken over by the present owners some months ago. G. W. Jackson is manager.

The Quapaw Mining Corporation has completed a 350-ton mill on a 120-acre lease of the Davenport land, north of Quapaw, Okla., and will start operating it as soon as the weather permits. Three shafts have been completed, all equipped with hoppers and derricks. Two of the shafts were put down on the southwest forty acres of the lease, where the ore "run" is found at 210 ft. These two shafts are expected to furnish plenty of "dirt," though the mill shaft also is near completion. T. F. Lennan, of Joplin, is president of the company, which is a Schwab concern.

## Open Stemwinder and North Star Mines, Near Sullivan

The Stemwinder and North Star mines at Kimberly, B. C., recently have been reopened, and shaft sinking, drifting, and diamond drilling constitute a development program now under way. Charles C. Starr, of the Porcupine Gold Mining & Development Co., is in charge.

Kimberly is the home of the Sullivan mine, of the Consolidated Mining & Smelting Co., possibly the largest lead-zinc mine in the world.

## Lease Noble Electric Steel Smelter at Heroult, Calif.

Oakland interests are reported to have acquired a lease on the concentrating plant and electric furnaces at Heroult, Calif., belonging to the Noble Electric Steel Co. The company went into the receiver's hands soon after the war, following a period of minor prosperity resulting from the manufacture of ferroalloys. The direct smelting of California iron ore was the aim of the sponsor of the enterprise, H. H. Noble, sometime president of the Northern California Power Co. A lease has also been obtained on iron-ore deposits near by, according to reports.

Luce and associates, the lessees, are conducting experiments with a view of resuming the smelting of iron and steel direct from the ore by the electric process. To facilitate the transportation of ore from the mines to the smelter, the tramline has been repaired and the bunkers destroyed by fire have been restored.

Fifteen men are employed in the smelter and mines. Two carloads of iron ore are shipped weekly to foundries in different parts of the state for use in open-hearth furnaces.

## Talache Mines Opens Rich Ore on Lower Levels

### Idaho Silver Property Increases Mill Heads — New Working Level Probable

Mill heads of the Talache Mines company, operating at Talache, in northern Idaho, are running better than 40 oz. of silver per ton. The improvement in the grade of ore treated has been largely owing to the presence of a silver mineral which was not observed in the ore until last August. The mineral is polybasite, and is found in the lower levels of the mine. It occurs in stopes between the 900 and 1,000 level and has also been observed in quantity on the 1,100 and 1,200 levels. The polybasite is believed to be an enrichment product in fractures of the vein.

A winze has been sunk 50 ft. below the 1,300 level and a station cut on 1,300. The chances are excellent that a shoot of high-grade ore will be cut by the drifts which are now being driven along the 1,300 level. Plans are being made to sink to the 1,400 level. If developments at that depth are favorable, a main working shaft will be raised and a hoist installed. A new haulageway may also be driven from the main tunnel to the location of the hoist room and ore pocket. The work is being done under the direction of A. H. Burroughs, Jr., manager.

The property has been producing silver since the 150-ton mill was built, in the spring of 1922, but heads have averaged far below what they amount to now, generally 15 to 25 oz. per ton. A tunnel 4,000 ft. long provides the main access to the vein being mined and intersects it at the 1,200 level. Ore from stopes above the 1,200 falls by gravity through chutes to an ore pocket on the main tunnel level. The site of the property on Lake Pend Oreille is one of the most delightful in the country. The accompanying photograph shows the mill and surrounding buildings.

# News from Washington

By PAUL WOOTON
Special Correspondent

## Bureau of Mines Looks Ahead for Iron Mining Industry

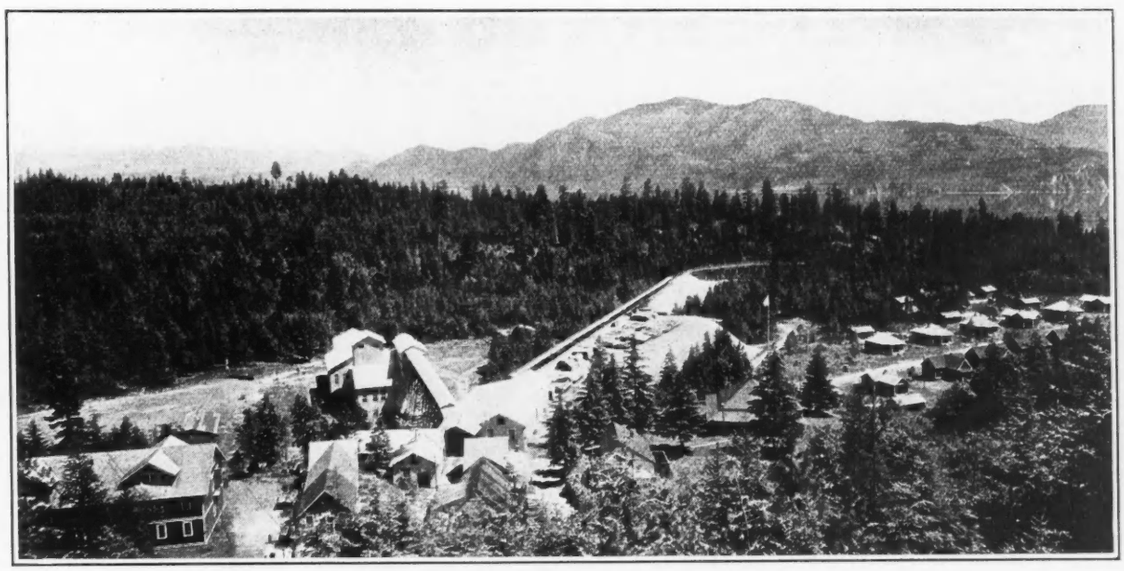
### Studies Problem of Treating Low-Grade Iron Ores— Private Interests Disinclined to Finance Research

BECAUSE of the disinclination of industries to undertake research on problems that will not be faced until some future period, the only immediate hope of securing systematic study of beneficiation of iron ores rests with the government, in the opinion of Bureau of Mines officials. For several years the Bureau has been doing as much research work on this subject as limited appropriations would allow, but there is an increasing demand, especially from the southern states, for more comprehensive work.

Though the depletion of the richer ores is continuing at a constantly increasing rate, the supplies still are sufficient for a considerable number of years. The industry as a whole has given the matter of the utilization of the leaner ores no systematic attention, although some isolated efforts are being carried forward.

The Bureau of Mines has done enough work on the beneficiation of iron ores to make it very clear that the devising of the new metallurgical processes necessary to the successful treating of low-grade ores is no simple task. Some progress has been made with magnetic concentration, but even there the problem is complicated by the alteration of magnetic susceptibility. Extensive tests on roasting and agglomeration have been made and careful study has been made of various methods of table concentration.

Dorsey A. Lyon, the acting director of the Bureau of Mines, believes that this research is not being regarded generally with the importance which it deserves. He is convinced that many years will be required to work out the unusual complexities that surround the utilization of low-grade iron ores, and that it will be greatly to the interest of the public and of the nation to start work on this problem in a large way before the depletion of the richer ores forces intensive experimentation. He is particularly impressed with the possibilities of better preparatory treatment of the high-silica ores of the Southeast, particularly in Alabama and Tennessee, where fuel and flux are abundantly available and where the general situation favors a still higher development of the iron industry. He has much faith in direct processes which may eliminate some of the bad effects caused by nitrogen. The very fact that the action of nitrogen and other elements within the blast furnace is not understood is the best indication, he declares, that more pretentions research work should be started as soon as possible. With the problem goes the utilization of low-grade fuels in connection with the treatment of lean ores. Another related problem deals with the development of better refractories. Work is in progress on that work at the ceramic experiment station at Columbus. It has been found that dolomite, when compounded in a certain manner, produces a strong, non-slacking brick of high refractoriness. A promising super refractory has been produced through the use of artificial sillimanite.



*Plant of the Talache Mines company, in Idaho*

Mill heads have been averaging 40 oz. silver as a consequence of new developments on the lower levels.

## Gold-Silver Commission Story in "Mining Journal-Press" Cited to Keep Postal Rates Down

AN ARTICLE in *Mining Journal-Press* of Dec. 20, 1924, was used as an example before the joint committee of Congress, considering the Sterling bill, to show the educational benefits that offset the public expense involved in the handling of second-class mail. In the course of testimony before the committee, Arthur J. Baldwin, representing the McGraw-Hill publications, cited the article, which presented certain observations by Senator Oddie, as one performing a public service in carrying to the industry concerned the utterances of the chairman of the Senate Committee on Mines and Mining. It happens that Senator Oddie is a member of the joint Postoffice Committee before which the testimony was given.

Senator Oddie, who is thought to oppose higher second-class rates, says he will offer as part of the printed proceedings the article in question as an example of material the circulation of which is of great value to the public. In his statement accompanying the reproduction of the article he will call attention to the fact that through the medium of this one story a message was delivered to the entire mining industry—an activity widely scattered in isolated and sparsely settled regions. By the means of this article, practically all of those who are engaged in the production of metals were kept abreast with the plans and the accomplishments of the commission supported by the Senate to study some of their problems.

## Good Ore Reported in Kay Copper Mine, in Arizona

Ore containing antimony sulphide and "gray" copper, assaying as high as 33 per cent copper, 3.4 oz. silver, and $140.55 gold per ton is reported to have been encountered in the west crosscut of the 1,200 level, shaft No. 4, of the Kay Copper Corporation mine at Canon, Ariz. The strike was made on the downward continuation of the original orebody, previously developed to the 600 level of shaft No. 1, in which a small tonnage of ore has been proved. The crosscut had already passed through 25 ft. of ore averaging around 3.5 per cent copper and still had some distance to go to reach the limits of the orebody as determined by previous diamond-drill work. Between forty and fifty men are at present employed at the property.

## Ontario Gold Production $25,000,000 in 1924; $20,082,000 in 1923

According to the official estimates the gold production of the Province of Ontario will reach an approximate value of $25,000,000 for 1924. The 1923 production was $20,082,000; therefore the increase will amount to 20 per cent. The Hollinger mine will probably produce $13,300,000 worth of gold, or $2,700,000 more than in 1923. The number of regular producers has been increased during the last year from seven to eleven. The new mines are the Vipond, Night Hawk, Consolidated West Dome Lake, Argonaut, and Tough-Oakes-Burnside. They should account for a gold increase of $1,350,000.

The McIntyre mine should show an increase of over $1,000,000, and the Lake Shore about half as much, and the Wright-Hargreaves property will probably show a substantial increase also. New properties that may begin producing gold in 1925 are the Canadian Associated Gold Fields, Crown Reserve, Sylvanite, and Dourdreau mines.

## Commerce Company Realized $300,000 by Holding Concentrate

### Three Joplin-Miami Companies Pass 50,000-Ton Mark on Year's Shipments of "Jack"

What financial independence may mean in the way of increased profits is well illustrated in the Joplin-Miami district, where it is estimated the Commerce Mining & Royalty Co. has obtained an average of probably $6 a ton more for its production this year through ability to refuse to sell when prices were not attractive.

The company has recently been selling heavily, and has brought its total for the year to more than 55,000 tons of zinc ore. If $6 a ton is a fair average of the increased prices that it has obtained, the company is $300,000 better off through ability to hold.

The Commerce and the Federal Mining & Smelting companies are running a close race for the honor of being the year's biggest shipper from the Joplin-Miami field. At this writing the Federal maintains a slight lead, having shipped more than 58,000 tons.

The St. Louis Smelting & Refining Co. also will exceed a 50,000 ton shipment this year, being the third company to get into this class. In preceding years only one company has been able to reach such a shipment.

## Will Develop Arsenopyrite Near The Pas

A syndicate of Des Moines, Iowa, capitalists has bonded the Little Nellie group of seven claims, at Little Bear Lake, Saskatchewan, from A. T. and J. W. Collette, of The Pas, Manitoba. A large body of arsenopyrite has been exposed, and the new owners purpose to develop the deposit and manufacture white arsenic. The terms of the bond call for the payment of $100,000 within two years and the expenditure of $400,000 on development and equipment within the same period.

## Walker Second to Engels in California Copper Output

The Walker Mining Co., operating the Walker copper mines near Portola, Calif., reports that during the year ended July 31, 1924, the company produced 11,301,159 pounds of copper, 170,561 ounces of silver and $138,000 in gold. As the enlarged mill only went into operation in January, the bulk of earnings were gained in the final six months.

A new orebody has been exposed for 600 ft. It ranges from 4 to 7 ft. in width and averages 3 to 4 per cent copper, with important percentages of silver and gold present. Another new orebody has been opened on the fifth level. The Walker will probably close the year as the second largest copper producer in California, surpassed only by its neighbor, the Engels Copper Co. The Walker company is controlled by the Anaconda Copper Mining Co.

## Joplin-Miami District Breaks Ore Records Galore

FIVE weekly or yearly tonnage and valuation records for the Joplin-Miami field were broken by the reports for the week ended Dec. 13, 1924.

The value of the combined zinc and lead ore shipment for the week approximated $1,355,000, a figure $154,000 greater than for any previous week.

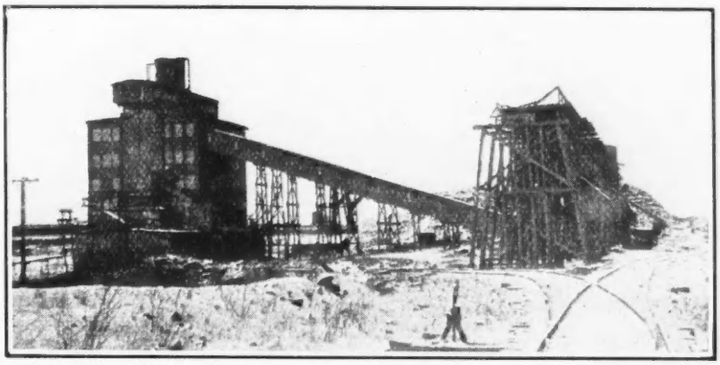
The tonnage of lead ore shipped amounted to 3,629, bettering by about 280 tons that of any preceding week; and the value reached $435,360, which was $57,000 greater than ever before.

For the first time in the history of the field the total shipments of zinc ore during any calendar year exceeded 700,000 tons, reaching 707,700 with the week's reports.

The total lead-ore shipments for the year were also brought to 96,182, which exceeds by about 2,500 tons the shipments for any previous year. The value of the total lead shipments passed the $10,000,000 mark for the first time, $8,614,000 being the previous high mark, established in 1920.

The only district record of consequence left unbroken is that for total value for zinc ore. It is conceded that it will be broken before the end of the year, lacking only $900,000 on Dec. 13 of the high mark of 1916, when war prices sent zinc ore to as high as $135 a ton.

The combined value of zinc and lead ores climbed to $39.868,505 with the reports of Dec. 13, about $2,500,000 above any previous year's best record.



*Quinn-Harrison washing plant*
Experiments in iron-ore beneficiation have been conducted here during the past season.

## Bowl Classifiers Prove Efficient in Iron-Ore Washing

At the Quinn-Harrison iron-ore concentrating plant of Butler Bros., near Nashwauk, Minn., a series of tests were run during the 1924 season to secure a comparison of results between the operation of turbos, tables, chip screens, settling tanks, concentrate pumps and dewaterers, and a Dorr bowl classifier. Results indicate that with ore of grade found in these pits, under the conditions of the test, a saving of 3.93 tons additional concentrates is possible from each 100 tons of crude treated by discarding the turbos and tables and using the bowl classifier. The turbos are standard 18-ft. log machines.

An additional saving is claimed in power and supervision, as all material from the 25-ft. logs is received by the classifier with a production of a clean, deslimed and dewatered concentrate and a tailings too low in recoverable iron to make table concentration necessary or desirable. The classifier requires about 3 hp. for its operation, and the cost, including supervision, power, and maintenance, is about ½c. per ton of concentrate produced.

The classifier is a two-stage automatic baffled return machine. The feed is introduced into the bowl through a shallow feed well at the center. Four revolving arms carrying rakes keep the lighter particles in suspension until these are carried to overflow, and plow the heavier solids that settle on the bowl bottom to the center where they are discharged through a small adjustable size opening into the main classifier tank, and thence are carried to concentrate discharge by reciprocating rakes.

## Ship From Pinos Altos, N. M., to El Paso Smelter

Renewed mining activity is reported at Pinos Altos, N. M. The Langston and Pinos Altos mines, producers of gold and silver years ago, are now being operated by the Rio Grande Mining & Metals Co., of El Paso, Tex. T. F. Russell is in charge of the development work. Shipments are being made from the Langston mine, and returns are said to be satisfactory. Work will be extended and additional men put on the force as fast as development work warrants.

# Toronto Letter

*By Our Special Correspondent for Northern Ontario*

## New Discoveries, Much Development, in Cobalt Silver District

### Castle-Trethewey Has High-Grade Ore —Nipissing Pays Extra Dividend— Crown Reserve Development

**Toronto, Dec. 26.**—Important new discoveries have been made on the 400 level of the Castle-Trethewey property, in Gowganda, where three high-grade veins, varying in width up to 2 in., have been found. Two of these have been drifted on for a length of 70 ft. and in addition to the high-grade ore there is a substantial quantity of good milling ore. During the quarter ended Sept. 30, production from the property was 202,600 oz., an average of 67,500 oz. per month, although it is understood that current production is at the rate of about 80,000 oz. a month.

### Extra Dividend for Nipissing

The Nipissing Mining Co., of Cobalt, has declared a dividend of 3 per cent together with an extra bonus of 3 per cent payable on Jan. 20 to shareholders of record Dec. 31.

Shipments of mill ore are now being made from the Cobalt Contact property, which lies two miles or so northeast of the town of Cobalt. About twenty-five tons of ore a day is being sent to the Mining Corporation mill, and it is understood that the grade is satisfactory. This is the most recent new producer in the district.

Several other development projects are also now under way in the camp. The Clifton Gold Mines has taken over the old Provincial property and will carry on extensive development work. The Penn-Canadian has also recently been taken over by a Toronto syndicate, and operations are to be started immediately. The latter property, which is equipped with a mill, has had a production of about 5,000,000 oz. and there is still twenty-eight acres of promising ground which has never been explored. In the same vicinity is the Meteor property, which is controlled by West Virginian interests identified with coal mining, and it is understood that this property will also be reopened in the near future.

## Another Old Mining Camp Joins the Majority

RECENT announcements from the Consolidated Mining & Smelting Co. are to the effect that the famous Le Roi, Iron Mask, War Eagle, and Center Star will be abandoned at once and the 500 employees who constitute the remaining population of Rossland, B. C., will be released. This announcement brings to the memory of many pioneers the days of '97 when the camp was springing into life and Rossland was a teeming mining town in which substantial brick buildings were lining the main thoroughfare. The mines were producing ores that added many millionaires to the inhabitants of the Northwest and their production was largely responsible for building Spokane, Wash.

The gradual narrowing of the veins, coupled with fading of the values and higher mining costs are the reasons given for abandoning the mines. The Consolidated company and inhabitants of Trail, the smelter town six miles distant and 1,500 ft. lower in elevation, are proposing that the old town of Rossland be made the residential district of Trail by establishing an electric train service between the two points.

At the Crown Reserve property, in the Larder Lake district of Ontario, the new winze being sunk below the 500 level will soon be down 700 ft., where it is expected that ore should be encountered. On the adjoining Associated Goldfields property, which is working on the same vein as the Crown Reserve, development has been carried to a depth of 1,000 ft., and it is understood that the ore encountered on the lowest level is as good as anything before found in the mine.

Some time ago the Crown Reserve diamond drilled a considerable distance east of the shaft and encountered what appeared to be a big oreshoot. The 300 level has now been extended out to this point, and 1,000 ft. east of the shaft ore has been encountered. Assay results are not yet available, but the appearance of the ore is understood to be the same as that found in the main vein.

## Electric-furnace Equipment Burned

All of the electric-furnace equipment of the U. S. Bureau of Mines was completely destroyed by the recent fire which burned the old mines building at the University of Washington. The Bureau's equipment was housed in the building. It is expected that Congress will provide at this session for the replacement of the transformers, the switchboard, and the other electric equipment which is so essential to the work assigned to the Seattle Experiment Station. The fire occurred on Dec. 16 and burned much of the equipment belonging to the university.

# London Letter

By W. A. Doman
*Special Correspondent*

## Lead Shortage Gives Concern in British Mining Circles

### Looking Toward Burma and Australia for Further Supplies—Labor Unions Obstacle in Antipodes

**London, Dec. 16.**—Prospects of a revival of business, not alone in Great Britain but also in other countries, have caused manufacturers to consider the metal position, and, principally at the moment, lead and tin. Consumers of the former are becoming alarmed for their future supplies. Not having been overburdened with orders for a considerable period, they have allowed their stocks to be depleted. The question of replenishment has now to be faced, and a serious problem has arisen. It would be incorrect, perhaps, to say that there is a panic, but from inquiries I have made there is unquestionably a shortage of lead. Consumption has overtaken supply, and some of the largest companies cannot see more than three months ahead. There are no new sources from which the metal can be obtained, and there seems no prospect of the existing mines augmenting their production. Mexico, Australia, Burma, and Spain all seem to be working to full capacity.

It is generally conceded that the Barrier mines of New South Wales could enlarge their output, but owing to labor regulations, the men cannot work overtime. People here fail to understand why, when operations are always conducted at say 1,000 ft. underground, they should not be continued by night as well as by day. But there is the position; the unions will not allow it. In addition, if further men were employed and the price of lead were to rise, the usual troubles would probably occur.

Sir Robert Horne, formerly Chancellor of the British Exchequer, and now a director of various public companies, has gone on private business to Burma. I am credibly informed that his mission is in connection with the supply of lead. After leaving the East he will proceed to Australia, where apparently his object will be somewhat similar. The Burma Corporation is one of the largest producers of lead, and will be for many years, but whether its output can be increased remains to be seen.

The San Francisco Mines of Mexico has made good contracts for lead, and its success is reflected in the final dividend for the past financial year of 2s. per 10s. share, making 3s. 3d. for the year. The Spanish mines apparently are not in a position to produce much more metal. The current shortage and the belief that higher prices will rule have directed renewed attention to the Derbyshire lead mines, in which the Consolidated Gold Fields is interested.

As regards tin, two flotations have taken place within the last few days—the Selayang, in the F.M.S., and the Tingha Hydraulic, in New South Wales. The latter is regarded as the more important, and as having good prospects, seeing that the assays of the ground to be dredged go as high as 2.71 lb. to the cubic yard.

I understand that Mr. Pellew-Harvey has finished his investigations at the Eileen Alannah mine (Rhodesia) and is now on his way home. As the shares are being tipped for a rise, it is supposed that his conclusions are of a favorable nature.

# Johannesburg Letter

By John Watson
*Special Correspondent*

## Trial Shipment of Gold Sent to Pretoria Mint

### Will Be Cast Into Sovereigns—Overseas Shipments May Not Pay Much Longer

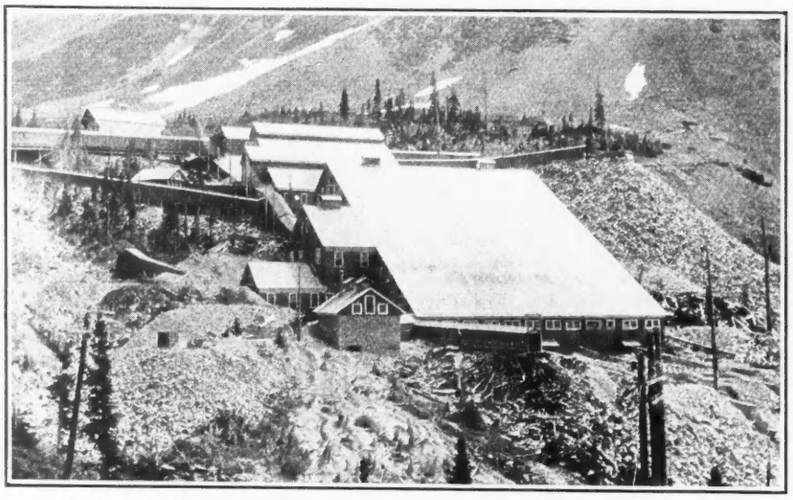
**Johannesburg, Nov. 25.**—The Gold Producers' Committee of the Chamber of Mines has sent about 500 oz. of gold direct to the mint at Pretoria, for the purpose of conversion into sovereigns. This initial step has been taken to enable the industry to find the exact cost of dealing with its gold in this way and so to know the point when gold should be minted at Pretoria instead of being shipped overseas. Many incidental charges and considerations must be taken into account. Approximately, it may be said that the cost of minting will be equivalent to the present procedure when the price of gold has dropped to 86s. 6d. per ounce, with the exchange rate at the present figure.

The annual meeting of the Johnnesburg Consolidated Investment Co., Ltd. ("Barnatoes"), was held in Johannesburg on Nov. 18. The chairman was able to announce that the past year had been a record, with profit larger than ever, the position sounder, and the future full of hope. A dividend of 15 per cent was announced and the sum of £150,000 was carried to the reserve fund. Government Gold Mining Areas, Ltd., had earned profits to the end of 1923 totaling £10,250,126 and of this sum the Union Government had received as its share £4,832,122 and £4,095,000 has been distributed to shareholders. D. C. Greig, after the chairman's speech, said he had calculated that it would cost the gold-mining industry about £120,000 a year to mint the whole of its output. The legal tender of this country, he said, was the gold certificate. Under the Banking and Currency Act, the industry had powers to go to the Treasurer and say "Here is our bullion; give us gold certificates, which are the legal tender of the country, in exchange for it."

The claimholders of the original syndicate have now formed the Marico (Batavia) Gold Mining Co., Ltd., and A. E. Val Davies has been appointed Johannesburg representative. The board is endeavoring to raise capital for further development. Assays at a depth of 126 ft. disclose consistent values of 44 dwt. over 24 in., and in conjunction with the general outcrop along the strike the board is optimistic of the real possibilities of the property.

The Cam & Motor G. M. Co., in southern Rhodesia, states that the No. 8 level drive north from the motor lode to the Petrol lode has now struck the latter. Fifteen feet sampled averaged 174s. per ton over 70 in.

The discovery of a large and rich lode of nickel, together with copper and some platinum, is reported on the farm Vlakfortein, near Mabiskraal, in the Rustenburg district of the Transvaal. Samuel Chudleigh, of Johannesburg, engaged S. C. Harding, about ten years ago, to carry out prospecting and mining operations for copper. Payable quantities of copper were found; but on sinking through these, the copper deposit petered out. Sinking a further 50 ft., a rich lode of nickel was encountered. The property has been visited by engineers and others, who were allowed to take their own samples. Assays carried out showed the presence of nickel, gold, and platinum, in places. Ten shafts were sunk on various parts of the farm, and in each shaft, the copper deposit petered out and rich nickel was found. A lease of the mineral rights of the farm has been obtained from the native chief Solomon Mabi, but this lease has yet to be sanctioned by the government.



*Tomboy mill above Telluride in the San Juan region of Colorado*

# Societies, Addresses, and Reports

## Zinc Institute Branch Officers Elected for 1925

**Founding of Organization Celebrated at Dinner—Howard I. Young Principal Speaker**

George W. Pearson, manager of the Lawyers Mining Co., was elected to head the Tri-State branch of the American Zinc Institute for the year 1925, to succeed Sidney H. Davis, manager of the Vinegar Hill Zinc Co.'s properties in the Missouri-Kansas-Oklahoma field, at a recent meeting of the directors of the Institute, held at Picher, Okla. Charles A. Neal, manager of the Tulsa-Quapaw Mining & Investment Co., was elected first vice-president and H. B. Cobban, manager of the Northeast Railroad, second vice-president. Richard Jenkins was re-elected secretary.

On Dec. 23, a dinner was held celebrating the tenth anniversary of the founding of the Southwest Mine Safety and Sanitation Association, which later took the name of the Tri-State branch of the Zinc Institute. Howard I. Young, of Mascot, Tenn., manager of mines for the American Zinc, Lead & Smelting Co., was principal speaker at the dinner. He was the organization's first president. Other speakers included Richard Jenkins, who has been secretary of the organization since its origin; W. H. Trapp, Temple Chapman, Wade Kurtz, R. V. Ageton, Philip Coldren, and J. D. Conover. James Arbuthnot recited two original poems and R. R. Peterson and Earl Confer sang a song.

## Engineering Foundation Names Local Representatives

The appointment of one hundred and ninety engineers in twenty-seven cities as local representatives of the Engineering Foundation, with national headquarters at 29 West 33d St., New York, has been announced by the chairman, Charles F. Rand, of New York. These engineers, representing industry, education and the public service, are to help the Foundation Board in a nation-wide plan "for the furtherance of research in science and in engineering, or for the advancement in any other manner of the profession of engineering and the good of mankind."

## Needs of Utah's School of Mines Outlined by Dean

Joseph F. Merrill, dean of the University of Utah School of Mines, addressed the mining committee of the Salt Lake City Commercial Club on Dec. 12. He spoke on the needs of the mining school, and its opportunities for useful work. To hold the Salt Lake City station of the U. S. Bureau of Mines at the university, he said, it was necessary for the state to meet the government half way in the matter of expenditures. There were needed, he said, larger quarters for experimental work, at a cost of $50,000, and an appropriation for the salaries of three first-class men to specialize in metallurgy, geology, and mining. The addition of three men of national reputation to the faculty would, Dr. Merrill said, attract the class of students for regular work and for fellowship study, necessary to make the activities of the experiment station a success. A committee consisting of Duncan MacVichie, William F. Hayden, and George H. Watson was appointed to investigate and report on the suggestions.

## California Producers Consider Appointing a Consultant

Problems of state-wide importance, at present inadequately considered or outside the purview of the State Mining Bureau, the Metal Producers' Association and the various other state and federal organizations in California, will be referred to a mining-engineer consultant, if present plans mature. This was the impression created by the discussion at a meeting of California metal producers, 125 in number, held at San Francisco on Dec. 12, under the chairmanship of W. J. Loring, and sponsored by the California Development Association. It was maintained that the appointment of such a mining-engineer consultant would facilitate the work of contact between producer and consumer, by interpreting the needs of the latter and by an understanding of the reserves and facilities at the command of the former. The development of markets for California metals and minerals is a problem for the consideration of a specialist.

The meeting was convened primarily for the purpose of considering the best method of advancing the idea of a state department of mines and minerals, for which Judge John F. Davis, of San Francisco, had drafted a bill which it was hoped might be introduced into the state legislature next month. Consideration of this subject, however, was deferred. Speakers at the meeting included R. E. Fisher, of the Pacific Gas & Electric Co., on "Co-ordination of Industrial Groups in Support of the Mining Industry"; H. H. Van Norman, on "Problems of the Structural Mineral Industry"; Lloyd L. Root, state mineralogist, on "State-wide Problems of the Mining Industry"; and J. Williams, of the Pacific Coast Steel Co., on "The Relation of Manufacturing to Metal Production."

## Utah Engineers Meet

The Utah Society of Engineers held its regular meeting Dec. 17 in the assembly room of the Commercial Club, at Salt Lake City. H. C. Goodrich, chief engineer for the Utah Copper Co., was the chief speaker, and had for his subject "The Status of the Copper Industry." He was of the opinion that the industry was in a healthy condition, and said that if the metal advanced beyond 15c. a pound, production from present sources would be forced, and that small- and high-cost producers would return to production.

## Bentonite: Its Characteristics and Possible Uses

**Discussed in New Bulletin of Dominion Department of Mines**

Much attention is being given to bentonite at the present time. This clay-like substance is discussed at length in a bulletin[1] just issued by the mines branch of the Dominion Department of Mines at Ottawa. Its distribution, character, and origin, as well as the possible uses to which it could be put, are covered within the forty-odd pages of the pamphlet.

The material that commonly goes under the name of bentonite has been known for a number of years, according to the bulletin. It was originally known as taylorite, after William Taylor, of Rock Creek, Wyo., who first drew attention to it. Later it was found that this name had already been allotted in mineralogical nomenclature, and the present name of bentonite was substituted, as the beds occurred in the Fort Benton series of the Upper Cretaceous rocks.

Most of the so-called bentonites carry varying percentages of gritty impurities, and such variations are to be noted not only in the clay from different deposits but in the different parts or levels of the same bed. Disregarding such gritty or sandy material, however, and considering only the very finely divided clay substance, it is found that this varies within wide limits in its ability to form clay-water suspensions. Some deposits yield a bentonite, a large proportion of which disperses readily in water and gives an almost permanent suspension; the material of other deposits gives a comparatively small amount of suspension, while some gives none at all, although the raw clay is to all appearance identical and is found in beds of similar age. These factors, the bulletin points out, are worth keeping in view in sampling bentonite deposits and in determining the colloidal behavior of the material, as it is possible that the surface clay will differ considerably, as to dispersibility, from clay at depth—an important point when it comes to developing a property.

### Character Not Clearly Defined by Analysis

Analyses of crude bentonite show that it is composed essentially of silica, alumina, and water, which make up approximately 90 per cent of the material, in the ratio (mean of fifteen analyses) of 61:18:10. The remaining constituents are chiefly iron, magnesia, lime, and the alkalies. Analyses conducted by A. Sadler, of the Mines Branch, showed that the composition of the suspended material from twenty-four-hour suspensions of bentonite in water approximated very closely to the above figures for crude bentonite, the mean of eight analyses showing ratios of 58:19:12 for silica, alumina, and water respectively. Determination of the relative percentages of these components present in the clay has failed to show whether or not bentonite is a definite mineral com-

[1]Bulletin No. 626, "Bentonite," by Hugh S. Spence. Canada Department of Mines, Mines Branch, Ottawa.

pound (a hydrous silicate of alumina, on the order of the kaolin molecule) or hydrous (colloidal) silica and hydrous (colloidal) alumina in indefinite and variable proportions. E. S. Larsen's opinion is cited that the material is composed mainly of the definite mineral leverrierite, which has the composition 2 $Al_2O_3$, 5S:$O_2$, 5$H_2O$ and crystallizes in the orthorhombic system. Other investigations are said to bear out the crystalline nature of bentonite and indicate its definite mineral character.

Bentonite occurs as a bedded sediment in deposits ranging from a few inches to as much as 10 ft. in thickness. These beds are found at different horizons throughout a considerable thickness of the Cretaceous rocks in the western parts of the United States and Canada, but chiefly in the Upper Cretaceous, in which they occur interbedded with sands, shales, and not infrequently with lignite seams. Deposits also occur in beds of Lower Tertiary age. Since its discovery in the Benton formation of Rock Creek, Wyo., bentonite has been reported from numerous other localities in that state and in South Dakota. Clays showing similar characteristics are also stated to occur in Florida, Tennessee, and other parts of the United States.

### Widespread Occurrence in Prairie Provinces Likely

Occurrences have been investigated by the Mines Branch in localities in Saskatchewan, Alberta, and British Columbia. It seems probable, the bulletin states, that bentonite is widely distributed over a considerable area of southern portions of Saskatchewan and Alberta, as well as of adjacent states to the south. On the prairies, owing to the level terrain and the paucity of deeply cut drainage channels, good sections of the Cretaceous rocks are rare. Consequently it is only in regions of bad land topography, or where the Cretaceous beds outcrop on the tops or sides of knolls, or along coulées, that the bentonite beds are visible. The sticky nature of the prairie gumbo soils is probably due to the presence in them of bentonite, derived either from bentonite beds or bentonite sandstones or shales, and this, the report says, suggests a widespread distribution of bentonitic sediments over the Prairie provinces.

The bulletin then discusses briefly the known occurrences of bentonite, or similar material, in Manitoba, Saskatchewan, Alberta, and British Columbia. Considering nearness to railway transportation, the deposits that show the most promise for immediate cheap development are those at Rosedale, Alberta; Knollys, Saskatchewan; and Princeton, B. C., it states. Occurrences in the United States are also discussed.

### Material Very Sticky When Wet

Bentonites of the western United States and Canada are characterized in the field by their exceedingly sticky nature when wet. Bentonite may be termed "hyper-plastic,"—that is, it does not possess working qualities even when mixed with the minimum amount of water necessary to wet it thoroughly, but passes at once from the "short" state to a sticky, unworkable condition. It is so impervious, however, that rain water does not penetrate very far into the beds.

Outcrops of bentonite always exhibit characteristic weathered surfaces, having a crinkled, coral-like appearance, due to the alternate swelling and shrinkage of the material upon repeated wetting and drying out. Little or no vegetation will grow upon the clay and consequently barren weathered outcrops are conspicuous features of prairie lands. Broken out from beneath the wet surface crust, bentonite often exhibits a characteristic sub-conchoidal fracture and is frequently hard and brittle. Some of the Wyoming material, however, exhibits a laminated or shaly structure. Most bentonites, when dry, are powdery or earthy to the touch, but the so-called otaylite, from California, has a distinctly greasy feel. Bentonites are commonly light in color, ranging from cream to olive green, but in some occurrences are colored darker by carbonaceous material. They generally become darker on wetting. Prolonged air-drying seems to result in a decrease in dispersability, a phenomenon probably closely allied with the well-known property of clays in general to become more plastic ("fat") after being subjected to weathering for a considerable period.

Tests made on four samples showed a water absorption ranging from 4.15 grams to 4.95 grams of water per gram of bentonite. Specific gravity determined by pycnometer on clay dried for two hours at 105 deg. C. ranged from 2.72 to 2.78. Fusion point, determined by Seger cones, varied from 1,330 deg. C. to 1,410 deg. C. Refractive index was 1.557 to 1.558. Other tests were made to determine the amount of clay suspension yielded by certain bentonites and to determine how the degree of dilution of a bentonite-water suspension affected results; also to study the coagulating effect of various reagents upon bentonite-water suspensions.

### Many Possible Uses

Possible uses of bentonite are given as follows: as an absorbent; for cements and plasters; in ceramics; as a dewatering agent; in the manufacture of dyes, emulsions, explosives, fertilizers, lubricants, paints; paste, glue, and size; pencils, crayons, and inks; pharmaceuticals and cosmetics; pulp and paper; putty, soaps, stove polish; also as a filler or loader; in foundry work; horticultural sprays and animal dips; refining of oils and fats; as a suspending agent for water softening and as a wetting agent.

Two British patents and eleven United States patents have been issued covering uses of bentonite.

## Geologists Meet at Ithaca

The thirty-sixth annual meeting of the Geological Society of America was held at Ithaca, N. Y. on Dec. 29 and 30. Three affiliated societies—the Paleontological Society of America, the American Mineralogical Society, and the Association of State Geologists—met during the same period. Details of the proceedings will be published in the next issue.

## Chamber of Mines on Coast Proposed

The Pacific Coast Chamber of Mines and Minerals, now being organized, is to be a federation of existing mining, oil, and allied industrial bodies in Alaska, British Columbia, Washington, Idaho, Oregon, California, Nevada, and Mexico, to work in harmony with and for the American Mining Congress, and to assist that organization in establishing chapters in the Pacific Coast states. It is to be, primarily, a clearing house for the dissemination of accurate information on mineral resources and mining and oil operations. It will encourage and initiate economic surveys of mineral deposits of the Pacific Coast, work to obtain more equable transportation rates on raw materials, and secure extensions of transportation facilities where mineral developments warrant them. Booklets will be issued on mineral resources and mining operations, to be distributed in the mining, financial and industrial centers of the country.

A mine equipment division will be maintained which will keep in touch with the latest developments in mining, oil and structural machinery to afford to the manufacturers a direct contact with their clients.

## To Obviate "Blue-Sky" Danger

The mining committees of the Spokane Chamber of Commerce, the Northwest Mining Association, and the local section of the American Institute of Mining and Metallurgical Engineers have each appointed committees to cooperate with each other in framing a measure to be presented to the state legislature at Olympia, Wash., for the protection of mining investors. The proposed measure is designed to protect, so far as possible, the investor from fraudulent mining promotions and at the same time prevent the appointee of the Secretary of State or a commission from passing on the merits of undeveloped mines.

## Electrical Prospecting Topic at Johannesburg Meeting

At the monthly meeting of the Chemical, Metallurgical and Mining Society, held in Johannesburg on Nov. 15, a paper was read by G. Bergström, on "Electrical Prospecting." A demonstration was given with a working model electrical apparatus, and lantern slide illustrations were shown.

The Governor General has appointed a commission consisting of Advocate G. A. Mulligan (chairman), J. H. Munnik, R. B. Waterston, and J. J. Wessels, with J. H. Rabie as secretary, to inquire into and report upon the following matters: (1) The effect on the accident rate and on safety and health conditions, in the Witwatersrand mines, of the present mining regulations, dealing with supervision of underground working places and the extent to which the present working of these regulations affects the good relations between employers and employees; and (2) the present position on these mines in regard to the respective spheres of work of white and colored persons.

# Men You Should Know About

**Alfred James** was in Mexico City recently. While there he attended the inauguration of President Calles.

**A. J. Moxham,** formerly president of the Virginia Haloid Co., is now with the Electro Co., at Odessa, Del.

**J. E. Spurr** attended the annual meeting of the Geological Society of America at Ithaca on Dec. 29 and 30, 1924.

**C. V. Drew,** vice-president of the Cerro de Pasco Copper Corporation, will sail next Wednesday to visit the company's properties in Peru.

**Fred A. Starkey,** who represented the British Columbia Department of Mines at the British Empire Exhibition, at Wembley, has returned to Nelson, B. C.

**John A. Dresser,** of Montreal, has returned from making an examination of the Bingo mine, in the Herb Lake district of northern Manitoba. He declined to make any statement as to the result of his investigation.

**Dr. G. F. Loughlin,** geologist in charge of the Section of Metalliferous Deposits of the U. S. Geological Survey, on Dec. 9 addressed the members of the Geological Society of the University of Cincinnati on "The Geology of Leadville, Colorado."

**George A. Denny,** who has been in Canada for the last four months visiting the principal mining camps, will return to England within a few days. Early in 1925 he expects to be visiting the Rand and Rhodesia and plans to return to Canada at the end of the year to see his son, who is a student at McGill University.

**W. C. Browning,** general manager of the Magma Copper Co. at Superior, Ariz., for the last twelve years, has resigned his position and will leave for Los Angeles, Calif., where he and Mrs. Browning will make their future home. Mr. Browning will enter business as a consulting engineer, with offices in the Pacific Mutual Building.

**E. Chapin Gard,** of San Francisco, writes to *Mining Journal-Press,* asking us to make corrections to statements to the article on Cripple Creek in our issue of Dec. 13, 1924. Mr. Gard writes that he, not Pottinger, was the founder of the newspaper called *The Crusher,* and that when he gave it up it was not through foreclosure but by a sale.

**H. F. Shepherd** and **Major Kenneth Johnston,** in passing through Vancouver recently on their return from London to New Zealand, addressed the Vancouver Board of Trade, the former on the system of mining schools in New Zealand and the latter on the placer gold deposits of south New Zealand. They sailed from Vancouver Dec. 18, 1924.

**Walter Douglas** and **Cleveland H. Dodge** have been named directors of the Southern Pacific R.R. Co. Mr. Douglas has also been elected a member of the executive committee. Both directors are associated with the Phelps Dodge mining interests, which controlled the El Paso & Southwestern R.R., prior to its acquisition by the Southern Pacific.

**Edward John Dunn,** geologist, of Victoria, Australia, in October last attained his eightieth birthday. He went to that country from England, his native land, when only five years of age, and in the southern hemisphere received the education, training, and much of the field experience which qualified him as a geologist of high rank. In 1864 he first joined the geological survey of Victoria, and remained in it until it was abolished in 1869. Having qualified as a mining surveyor, Mr. Dunn in 1871 went to South Africa, and in that year was on the diamond field when the Kimberley mine was discovered. After two years spent in traveling through Cape Colony, he went

*Edward John Dunn*

to England, where he put in a term at a school of mines studying assaying, and examined and reported on mines in Great Britain. He again did geological work in South Africa, returning to London in 1875. A visit to Australia followed, after which Mr. Dunn once more went to South Africa. During his fifteen years' connection with that country, he traveled from the Limpopo River to Cape Town and from Delagoa Bay to Port Nolloth; and in that period obtained much geological data, besides making interesting discoveries of fossils and of a beautiful mineral which was afterwards named stichtite. In 1884 he was elected fellow of the Geological Society. Returning to Victoria in 1886, Mr. Dunn entered upon private practice as a consulting geologist, and from that date till the end of the last century examined hundreds of mines in Australia, New Zealand, and New Caledonia. In 1904 he was appointed director of the geological survey of Victoria, the reorganization of which had then been started by Professor Gregory; and in the following year was awarded the Murchison medal. In 1912, having reached the official age limit, he was retired from the Victorian Government service, but is still residing in one of the Melbourne suburbs. While in his last official position Mr. Dunn discovered, by means of boring, the well-known Prowlett coal field, and also found and mapped an area of rocks older than Ordovician, the first Cambrian beds discovered in Victoria. In the course of his long professional career he has written many interesting geological and mining publications, and in 1911 published a book on "Pebbles."

**P. D. Wilson,** who has been connected with the Calumet & Arizona Mining Co. for a number of years as chief geologist, is leaving with Mrs. Wilson in the near future for Santiago, Chile, where he will be identified with the American Metals Co.

**Alberto Terrones Benitez** has been appointed a member of the Mines Committee of the Mexican Senate and is conducting an investigation to obtain data and facts that may afford a basis for amending Mexican mining law and mining regulations so as to arrange them to meet the present necessities of the mining industry in Mexico. He will also confer with the Mexican Chamber of Mines at Mexico City.

**John T. Fuller,** who for the last six years has been superintendent of the American Bauxite Co., has been appointed head of the recently organized Franklin Fluorspar Co., a subsidiary of the Aluminum Company of America. Mr. Fuller has completed eleven years of service with the American Bauxite Co. He will assume his new post in June, 1925. He is succeeded as head of the last named company by **L. R. Brantling,** now chief engineer.

## Obituary

**Fred Phillips,** one of the pioneers of the mining industry in the West, died at Los Angeles on Dec. 17. He was ninety-five years old. He was born in England and moved west from New York in 1851. After sundry incursions into mining in northern California and Oregon, he became prominently identified with the development of oil properties in the vicinity of Los Angeles, with particular reference to the exploitation of the Westlake Park and La Brea fields.

**Bret H. Lockling,** mining engineer, slipped from a scaffold while working in the shaft on the 1,200 level of the Moctezuma mine, in Nacozari, Sonora, Mexico, and fell 600 ft. to the bottom. He was killed instantly. Mr. Locking was graduated from the University of Arizona in 1923. He had worked for the Miami and Inspiration copper companies in Miami and at the C. & A. smelter in Douglas before being employed by the Moctezuma Mining Co., for which he was working at the time of his death.

**A. W. Howe,** pioneer editor of Cochise County, Ariz., and founder of the *Bisbee Review,* now owned by the Phelps Dodge interests, died on December 18 in Bisbee, Ariz. Mr. Howe was about fifty years old. Almost his entire life had been spent in Arizona. For many years he was deputy sheriff of Cochise County, but was better known as a newspaper man. He started one of the earliest papers in Bisbee, about a quarter of a century ago. It was printed for a time on coarse brown paper. Later, he was connected with the *Tombstone Epitaph,* and more recently with the *Bisbee Review.*

# Recent Technical Publications

Reviews, Abstracts, and References

**Report of the Canadian Arctic Expedition**, 1913-18, Vol. XI, Geology and Geography. Part A: "The Geology of the Arctic Coast of Canada, West of the Kent Peninsula," by J. J. O'Neill. Part B: "Geographic Notes on the Arctic Coast of Canada," by Kenneth G. Chipman and John R. Cox. Southern Party—1913-16.

In spite of the unwieldy title (a general fault in the geological publications of the Canadian Government) this little volume is a noteworthy one, detailing, as it does, the result of the Canadian expedition investigation of the copper-bearing regions in the vicinity of the Arctic Ocean—a region which was described by George M. Douglas in our issue of July 19, 1924. The volume is well illustrated with fascinating photographs and with valuable maps. The narrative of the trip is not the least interesting part of the book, although geologists are poor spinners of travelogues. Sometime, perhaps, someone will write graphically of the exploration done for geology in North America. It would make an interesting volume in the right hands. The vikings and argonauts of science are too matter-of-fact to interest the emotional public.

As to the copper in this region:

"The general conclusion is that the Bathurst Inlet deposits probably form an important reserve of copper ore, but that is not sufficiently attractive under present conditions of accessibility, transportation, demand, etc., to warrant the large expense necessary to prove and develop the deposits.

"The conditions in the Coppermine River district are decidedly different. There, the flows are not comparatively flat, and are not all piled one immediately on top of the other, but are separated by occasional conglomerates or sandstones, and have a general dip of about 12 deg. The amygdaloidal portions are apparently much better developed than in Bathurst Inlet, and some of them at least carry important percentages of copper. It is also certain that the matrix of some of the conglomerates has been replaced by native copper, and a specimen obtained of this is very rich. It is also known that numerous large masses of copper occur in the drift immediately north of the copper-bearing rocks west of Coppermine River; so that it seems highly probable that parts of this district contain workable and even rich deposits. The district is easily reached from Great Bear Lake, and transportation could be arranged via the Mackenzie River valley." J. E. SPURR.

**Chimney Construction** — "Custodis Chimneys" is the title of an advertising booklet which deserves mention along with that of less commercial publications, for it contains a large amount of information of value to all those who already have or who propose to erect radial brick chimneys. It may be obtained free from the Alphons Custodis Chimney Construction Co., 95 Nassau St., New York City.

**Canadian Mineral Industries** — The Mines Branch, Department of Mines, Ottawa, Canada, has recently published a bulletin on the "Development of Chemical, Metallurgical, and Allied Industries in Canada, in Relation to the Mineral Industry." It is by Alfred W. G. Wilson, and is in two volumes, Vol. 1 covering the chemical industries, and Vol. 2 the metallurgical and allied industries. Much information is given on the possibilities of extending the market for various minerals, their many uses being discussed in the light of the economic situation in Canada. The books contain 311 pages and may be obtained on request.

**Economic Geology** — *Economic Geology* for November (Economic Geology Publishing Co., Lancaster, Pa.; price 65c.), contains the following articles: "The Gold Ores of Grass Valley, California," 28 pages, by Ernest Howe; "California Oil Field Waters," pp. 13, by Chase Palmer; "Magmatic Chalcopyrite, Park County, Montana," pp. 5, by T. S. Lovering; "Some Coals from Sze Chuan, China," pp. 10, by George D. Hubbard; "A Transvaal Silver-lead Deposit," pp. 17, by Percy A. Wagner; and "The Relation of Hardness to the Sequence of the Ore Minerals," pp. 6, by Geoffrey Gilbert.

**Petroleum Reserves**—U. S. Bureau of Mines Bulletin No. 228, 114 pages, is entitled "Estimation of Underground Oil Reserves by Oil-well Production Curves," by Willard W. Cutler, Jr. The author points out the value of production-decline curves and urges operators to pay more attention to the assembling of data on which they can be based. Copies of the bulletin may be obtained, so long as the supply lasts, free of charge from the Bureau at Washington, D. C.; thereafter, for 20c. from the Superintendent of Documents, Washington, D. C.

**Wyoming Petroleum**—Bulletin 756 of the U. S. Geological Survey, Washington, D. C., 55 pages, obtainable on request, discusses "Oil and Gas Fields of the Lost Soldier-Ferris District, Wyoming." It is by A. E. Fath and G. F. Moulton.

**Bureau of Standards**—The annual report of the Director of the U. S. Bureau of Standards for the fiscal year ended June 30, 1924, 38 pages, has been issued and may be obtained on request to the Bureau at Washington. The activities for the year are briefly summarized.

**Mineral Resources** — Separate chapters of "Mineral Resources of the United States," obtainable free from the U. S. Geological Survey, Washington, D. C., and not heretofore reported, include: "Silver, Copper, Lead, and Zinc in the Central States in 1923," 32 pages, by J. P. Dunlop and F. Begeman; "Gypsum in 1923," pp. 6, by K. W. Cottrell; "Tin in 1923," pp. 3, by B. L. Johnson; "Silica in 1923," pp. 3, by Frank J. Katz; "Rare Metals in 1923," pp. 24, by Frank L. Hess; "Stone in 1923," pp. 30, by G. F. Loughlin and A. T. Coons; and "Potash in 1923," pp. 38, by G. R. Mansfield and Leona Boardman.

**Complex-ore Treatment**—An interesting paper of 60 pages on the operations of the Consolidated Mining & Smelting Co. of Canada, at Trail, B. C., is contained in the *Bulletin* of the Institution of Mining and Metallurgy for October. The discovery and development of the Sullivan mine is outlined and the process and equipment used for the treatment of the lead-zinc ore is described. Data are included on the Betts process of electrolytic lead refining, which is also used at Omaha and Grasselli. Eight pages of discussion appear in the November *Bulletin*.

**Crushing and Grinding**—In the Nov. 21 issue of *Chemistry and Industry* (Central House, 46 and 47, Finsbury Sq., London, E. C. 2, England; price 1s. 10d.) is the first installment of an illustrated article on crushing and grinding machinery, as made by British manufacturers, discussing its design and use.

**Clays as Paper Fillers**—Technologic Paper No. 262 of the U. S. Bureau of Standards, Washington, D. C. (44 pages, obtainable for 15c. from the Superintendent of Documents, Washington, D. C.) is entitled "Comparison of American and Foreign Clays as Paper Fillers," by Merle B. Shaw and George W. Bicking. The domestic material tested was found to be as good as the foreign.

**Mine Ventilation**—In the *Bulletin* of the Institution of Mining and Metallurgy for September, appeared a 48-page paper by J. S. Jones on "Hygrometry for Deep Mines." (Price 2s. 3d. each, from the offices of the Institution, Cleveland House, 225, City Road, London, E. C. 1, England.) In the November issue, 11 pages of discussion of this paper appeared. A number of tables dealing with the meteorology, and especially the hygrometry, of the ventilating air in hot and deep metal mines are given, together with the method by which each table has been calculated and the fundamental constants on which they depend.

**Map of Arizona**—An excellent topographic map of Arizona, 43 x 52 in., scale 1:500,000, has recently been published by the Arizona Bureau of Mines in co-operation with the U. S. Geological Survey. The contour interval is 100 meters. It is a good piece of work, and the only fault we have to find with it is that no highways are shown. Unmounted maps can be obtained for 50c., and cloth-mounted ones, with rollers top and bottom, for $2.50 from G. M. Butler, University of Arizona, Tucson, Ariz. A reconnaissance geological map of the state will soon be ready for distribution.

**Silver at Aspen, Colo.**—"Observations on the Rich Silver Ores of Aspen, Colorado," is the title of Bulletin 750-C, 22 pages, by Edson S. Bastin, obtainable from the U. S. Geological Survey, Washington, D C., on request. The paper discusses the geology of the deposits.

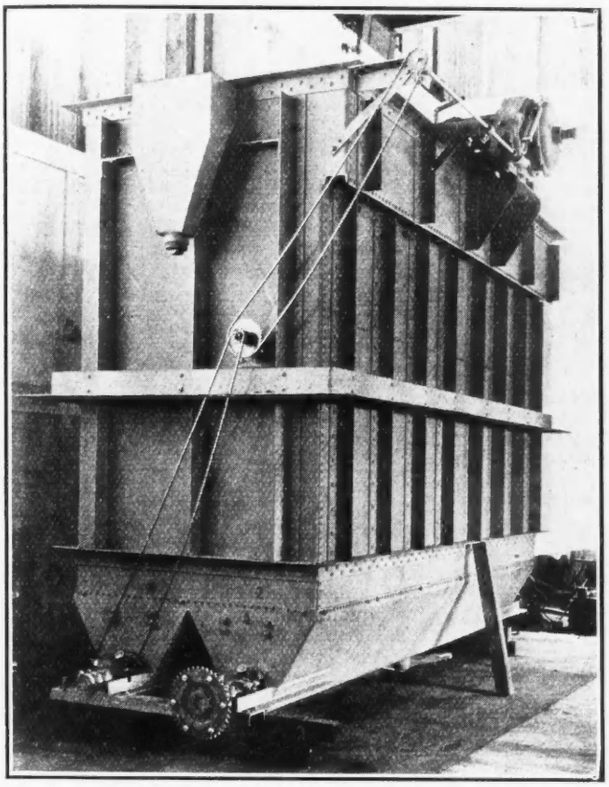
**Queensland Mining**—The annual report of the Under Secretary for Mines, of Queensland, for 1923, 148 pages, is now available from the Department of Mines, Brisbane, Queensland, Australia.

# New Machinery and Inventions

## Oliver-Borden Thickener

The Oliver-Borden thickener, available for a wide variety of purposes in the metallurgical and chemical industries, consists essentially of a steel tank, of rectangular horizontal cross section, about 11 ft. in depth, with V-shaped bottom, equipped with a scroll mixer-conveyor. Suspended vertically in this tank are filter tubes, each 10 in. diameter at the top, 9 in. diameter at the bottom, and 7 ft. high. These tubes have their surfaces, exclusive of the heads, perforated with ¼-in. holes with ⅝-in. centers, and they are covered with filter cloth, which is wrapped with wire in the same manner as is the regular Oliver filter. The tubes are arranged in groups of two, three, or four, or singly, in each thickener. The interior of each tube or group of tubes is connected by header pipe to a valve mechanism that automatically applies vacuum or air pressure. In conjunction with the valve and acting in synchronism with it is an automatic blow-timer, for the control of the application of the air. The automatic valve is connected to a suitable dry-vacuum system, whereas the blow-timer is connected to a source of compressed air. An air receiver is placed in the air line, close to and immediately ahead of the blow-timer, the pressure in which is controlled by an air-pressure regulator. A diaphragm pump, placed near the top of the thickener tank, has its suction connected to a central bottom outlet of the tank. The automatic valve, blow-timer, mixer-conveyor and diaphragm pump are driven by chain drives connecting with a 1½-hp. motor. An overhead trolley is provided for the easy removal of the tubes from the thickener tank.

In operation, the thickener tank is kept full of pulp, the level in the tank being maintained by the proper regulation of the feed and by means of a weir overflow. The overflow also takes care of excessive foam, by allowing it to return to the feed pump, where it is broken up and returned to the thickener. Vacuum suction through the tubes causes a deposition of slime on the cloth with which the tubes are covered. At regular intervals, the suction of each tube or group of tubes is cut off by the action of the automatic valve, and air pressure is then suddenly applied to the pipe headers by means of the blow-timer. The cake then drops from the surface of the cloth to the bottom of the tank, where it is mixed into a thick sludge and conveyed to the tank outlet by the scroll mixer-conveyor previously mentioned.



*Oliver-Borden thickener*

The machine, which has already been applied with success in the beet-sugar industry, is being manufactured by the Oliver Continuous Filter Co., with offices at 503 Market St., San Francisco, and works at Oakland, Calif.

## New Features Mark Design of Locomotive Crane

An improved model of its No. 1 20-ton capacity locomotive crane has been brought out by the Brown Hoisting Machinery Co., of Cleveland, Ohio. The more noticeable changes are: the high boom hitch, the wide truck frame, the extra large diameter rotating ring, and the more pleasing contour of the cab.

The crab has been simplified by the elimination of one shaft, thereby making the remaining parts much more accessible. The drums are independently driven and free-running, with outside band clutches. The worm-gear boom hoist runs in an oil bath, and this, with the high boom hitch, makes booming with loads an easy operation.

An innovation in locomotive crane construction is the specially constructed wide-truck frame with a center sill running the entire length, to which are fastened the friction-type draft gearings. In consequence of the wide truck frame, an extra large rotating ring is made possible, which materially adds to the stability of the crane. The load rollers that support the revolving superstructure are larger and are removed from above without jacking up the superstructure. The vertical rotating shaft can also be removed from above.

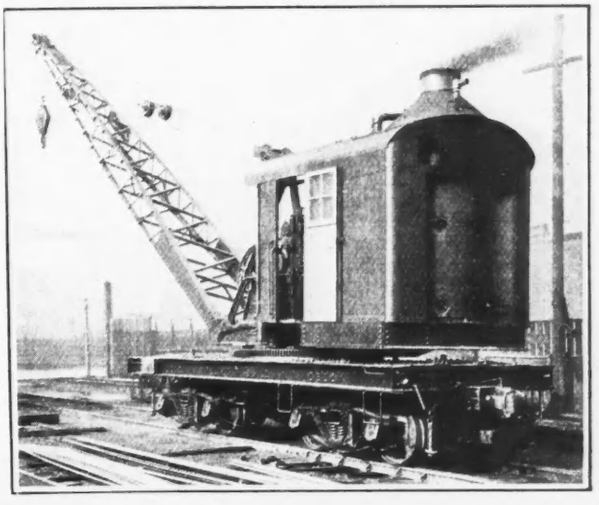
The cumbersome and unsightly counterweight device for retrieving the tag line and electric cable in grab-bucket and magnet work has been discarded and in its place an arrangement that is both compact and novel has been installed. The main hoist shaft is extended through the crab far enough to accommodate a small drum and "niggerhead," the latter being keyed to the shaft. The small drum, upon which the tag line or electric cable is wound, is rotatably mounted on the shaft and is driven by the "niggerhead" through a slip friction device.

## Trade Catalogs

**Steel**—Non-corrosive and heat-resisting steels made by the Crucible Steel Co. of America, and their properties, are described in a 20-page booklet issued by the company. A copy will be sent on request to the company.

*A new model locomotive crane*

The high boom hitch, wide truck frame, rotating ring of extra large diameter and contour of the cab are the more noticeable changes.



# The Market Report

## Daily Prices of Metals

| Dec. | Copper N. Y. net refinery | Tin | | Lead | | Zinc |
|---|---|---|---|---|---|---|
| | Electrolytic | 99 Per Cent | Straits | N. Y. | St. L. | St. L. |
| 25 | ..... | ..... | ..... | .... | 9.45 | ..... |
| 26 | 14.625 | 57.50 | 58.125 | 9.70 | 9.45 | 7.65@7.70 |
| 27 | 14.625 | 57.875 | 58.50 | 9.70 | 9.45 | 7.70 |
| 29 | 14.625@14.75 | 58.375 | 59.00 | 9.70 | 9.45 | 7.75@7.80 |
| 30 | 14.625@14.75 | 58.25 | 58.875 | 9.70 | 9.45 | 7.80 |
| 31 | 14.65 | 58.00 | 58.625 | 9.70 | 9.45 | 7.775 |
| Av. | 14.655 | 58.060 | 58.625 | 9.70 | 9.45 | 7.745 |

*These prices correspond to the following quotations for copper delivered: Dec. 26th and 27th, 14.875c.; 29th and 30th, 14.875@15.00c.; 31st, 14.90c.

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

| Dec. | Copper | | | Tin | | Lead | | Zinc | |
|---|---|---|---|---|---|---|---|---|---|
| | Standard | | Electrolytic | | | | | | |
| | Spot | 3M | | Spot | 3M | Spot | 3M | Spot | 3M |
| 25 | ... | ... | ... | .... | .... | ... | ... | ... | .... |
| 26 | ... | ... | ... | .... | .... | ... | ... | ... | .... |
| 29 | 67 3/8 | 68 1/2 | 72 | 271 1/2 | 274 3/4 | 43 3/4 | 41 3/4 | 39 | 38 1/2 |
| 30 | 67 1/4 | 68 3/8 | 71 1/4 | 272 | 275 1/4 | 44 | 42 1/8 | 39 1/4 | 38 1/2 |
| 31 | 66 7/8 | 67 3/4 | 70 3/4 | 269 3/4 | 273 | 43 3/8 | 41 1/4 | 39 | 38 3/16 |

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

## Silver, Gold, and Sterling Exchange

| Dec. | Sterling Exchange "Checks" | Silver | | Gold London | Dec. | Sterling Exchange "Checks" | Silver | | Gold London |
|---|---|---|---|---|---|---|---|---|---|
| | | New York | London | | | | New York | London | |
| 25 | .... | .... | .... | 24, 88-9 | 29 | 4.72 1/2 | 66 1/2 | 31 1/2 | 88s 1d |
| 26 | 4. 70 1/4 | 66 7/8 | .... | ... ... | 30 | 4.73 | 66 1/2 | 31 9/16 | 88s |
| 27 | 4 71 1/2 | 66 3/4 | .... | ... ... | 31 | 4.72 1/2 | 66 3/4 | 31 13/16 | 88s 2d |

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 one-quarter of a cent premium.

## Holiday Quietness Characterizes Metal Markets

**New York, Dec. 31, 1924**—Sales of the non-ferrous metals have not been large during the last week, the London market being closed on Thursday, Friday, and Saturday, and most of the local consumers being willing to wait until after New Year's Day to enter the market. Copper almost but not quite reached a firm 15c. level, and lead closed the year somewhat short of 10c. Producers view the early months of 1925 with a great deal of confidence and are well satisfied with the trend of metal prices at this time and with fundamental conditions of the market.

### 15c. Copper Only Nominal

In the last two or three days most of the large producers have been quoting 15c., delivered in the East, and 15 1/8 @15 1/4c. in the Middle West, but sales at these prices have been meager and the market cannot yet be said to be established at that level, as small lots, particularly of prompt metal, are available at 14 7/8c. With the slight drop in the European market today, there has been even less a tendency on the part of consumers to pay the even price. Total sales were small.

## Average Metal Prices for December

| | |
|---|---|
| **Copper:** | |
| New York Electrolytic | 14.260 |
| London Standard | 65.295 |
| London Electrolytic | 69.762 |
| **Lead:** | |
| New York | 9.207 |
| St. Louis | 9.106 |
| London | 41.583 |
| **Silver:** | |
| New York | 68.096 |
| London | 32.620 |
| Sterling Exchange | 469.115 |
| **Zinc:** | |
| St. Louis | 7.374 |
| London | 36.932 |
| **Tin:** | |
| 99 per cent | 55.721 |
| Straits | 56.245 |
| London | 261.875 |
| **Quicksilver** | 72.750 |
| **Antimony** | 15.024 |
| **Platinum:** | |
| Refined | 117.000 |
| Crude | 111.000 |

### Lead Slightly Higher

The official contract price of the American Smelting & Refining Co. for New York lead was advanced from 9.50 to 9.60c. on Friday, Dec. 26. Nominal quotations in the outside market also advanced above 10c., and a few hundred tons were sold at various prices between 10 and 10 1/4c., though consumers are in no mood to pay premium prices unless they are absolutely bare of stocks. The same condition exists in the Middle West, where the leading producer has released a few hundred tons at 9.35c., while an occasional carload has been sold by others at as high as 10c.

### Zinc Reaches 7.80c.

Galvanizers bought moderate tonnages of zinc during the week, and a fair export demand was in evidence, prices advancing to 7.80c., St. Louis, which was paid yesterday. Today, a slight recession occurred, one lot selling as low as 7.75c. New York prices are, as usual, 35 points above St. Louis. High-grade is 8 3/4c., delivered.

### Tin Again Advances

Straits tin reached 59c. on Monday, for both spot and futures, but has reacted slightly since, consumers being quick to take advantage of recessions. The 99 per cent grade is slightly easier, particularly for forward deliveries, which are quoted about 1c. below Straits. Arrivals to and including Dec. 30, totaled 4,840 long tons.

### Sterling Touches New High

Sterling reached a new high yesterday, but other exchanges show little variation. Closing quotations on Tuesday, Dec. 30, were: francs, 5.41c.; lire, 4.23c.; marks, 23.82c. Canadian dollars, 5/32 per cent discount.

## Silver Unsteady and Dull

London declined to the low price of the year on Dec. 29. Since that date the market has improved on renewed buying and sellers abroad are reported to be holding back. New York quotations have advanced correspondingly.

**Mexican Dollars:** Dec. 25th, holiday; 26th, 51½c.; 27th, 51⅝c.; 29th and 30th, 51¼c.; 31st, 51⅜c.

## Other Metals

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

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

**Antimony**—Per lb.:
Chinese brands, 16½@17½c.
Cookson's "C" grade, 18¾c.
Chinese needle, lump, nominal, 10c.
**Standard powdered needle, 200 mesh, 11½c.**
**White oxide, Chinese, 99 per cent $Sb_2O_3$, 13@14c.**

**Bismuth**—$1.25@$1.30 per lb. London, 5s.

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

**Cobalt**—$2.50@$3 per lb. Discounts on contracts. Oxide, $2.10@$2.25. London, 10s. for metal; 9s. for black oxide.

**Germanium Oxide—25 to 50 gm. lots, $10 per gm.**

**Iridium**—$325 per oz. Nominal.

**Lithium**[1]—95@96 per cent grade in 1 to 5 lb. lots, $75 per lb.

**Magnesium**—Sticks, 1⅛ in., 99.9 per cent, 90c.@$1 per lb. London quotes 4s. for 99 per cent.

**[1]Molybdenum—99 per cent, $12 per lb.**

**Monel Metal**—32c. per lb.

**Nickel**—Ingot, 29c.; shot, 30c.; electrolytic, 33c. (99.75 per cent grade).

**Osmiridium—Crude, $58.50 per oz.**

**Osmium**—$100@$104 per oz.

**Palladium**—$79@$83 per oz. Crude, $60 per oz. London, £19.

**Platinum**—Refined, $117 per oz.
Crude, $111.

**Quicksilver**—$76@$77 per 75-lb. flask. London, £12½.

**Radium—$70 per mg. radium content.**

**Rhodium—$85@$90 per oz.**

**Ruthenium**—$40@$45 per oz.

**Selenium** — Black powdered, amorphous, 99.5 per cent pure, $2.20 per lb.

**Tantalum**—Metal, $350 per kg.

**Tellurium**—$2 per lb.

**[1]Thallium Metal**—Ingot, 99 per cent pure, $5 per lb.

**Tungsten Metal**—Powder, 97 to 98 per cent, 95c.@$1 per lb. contained tungsten.

**[1]Zirconium Metal—98 per cent grade, per lb., $30.**

## Metallic Ores

**Chrome Ore**—Per ton, c.i.f. Atlantic ports:
Indian, $20.
Rhodesian, $22.
New Caledonian, $24.
Market nominal.

**[1]Galena Radio Crystals—Best quality (50 per cent of sized fragments good) 50c. per lb. in 500-lb. lots, f.o.b. Philadelphia.**

**Iron Ore**—Prices for iron ore and magnetite for 1924 season were published Aug. 9.

**Manganese Ore**—42c. per long ton unit, seaport, plus duty. Market quiet. Chemical grades[1], powdered, coarse or fine, 82@87 per cent $MnO_2$, Brazilian, and Cuban, $70@$80 per ton in carloads.

**Molybdenum Ore**—60@70c. per lb. of $MoS_2$ for 85 per cent $MoS_2$ concentrates. Nominal.

**Tantalum Ore**—Foreign, 30@50c. per lb. of $Ta_2O_5$ contained, c.i.f. New York, according to quality.

**Tungsten Ore—Per unit, N. Y.:**
High-grade wolframite, $9.
High-grade scheelite, $9.50.
Market recently active; contracts placed on most of 1925 production.

**Vanadium** — Minimum 18 per cent $V_2O_5$, $1@$1.25 per lb. Nominal.

## Zinc Ore Advanced to $60—Lead Ore to $135

**Joplin, Mo., Dec. 27, 1924**

| Zinc Blende | Per Ton |
|---|---|
| High | $55.50 |
| Premium, basis 60 per cent zinc | $58.00@$60.00 |
| Prime Western, 60 per cent zinc | $55.00@$57.00 |
| Fines and slimes, 60 per cent zinc | $54.00@$49.00 |
| Average settling price, all. | $49.13 |
| **Lead Ore** | |
| High | $131.20 |
| Basis 80 per cent lead | $135.00 |
| Average settling price, all. | $126.22 |

Shipments for the week: Blende, 10,870; lead, 1,871 tons. Value, all ores the week, $709,320.

Shipment for the year: Blende, 732,280; calamine, 1,530; lead, 98,940 tons. Value, all ores the year, $41,394,890.

Zinc prices were advanced $3 to $4 per ton and lead $5 per ton more than last week. The district remains covered with a two-inch blanket of ice. Ore was blasted from open bins and loaded as rocks. No mines have operated for ten days where pond water is depended upon for milling. About fifty mines are able to operate by the use of mine water for milling.

**Platteville, Wis., Dec. 27, 1924**

| Zinc | Per ton |
|---|---|
| Blende, basis 60 per cent zinc | $55.50 |
| **Lead** | |
| Lead, basis 80 per cent lead | $132.50 |

Shipments for the week: Blende, 758 tons; lead, 170 tons. Shipments for the year: Blende, 32,300; lead, 1,716 tons. Shipments for the week to separating plants: 1,174 tons blende.

## Non-Metallic Minerals

Prices received for non-metallic minerals vary widely and depend upon the physical and chemical characteristics of the commodity. Hence the following quotations can only serve as a general guide as to the prices obtained by producers and dealers in different parts of the United States for their own product. In the last analysis the value of a particular non-metallic mineral can only be ascertained by direct negotiation between buyer and seller.

**[1]Amblygonite**—8@9 per cent lithium oxide, $50@$60 per ton, f.o.b. mines.

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

**Asbestos:**
Crude No. 1—$325@$400.
Crude No. 2—$175@$215.
**Spinning fibers—$90@$125.**
**Magnesia and compressed sheet fibers**—$65@$90.
Shingle stock—$45@$55.
Paper stock—$35@$40.
**Cement stock—$15@$25.**
**Floats—$9@$12.**
**Sand—$6@$8.**
All per short ton, f.o.b. mine, Quebec, tax and bags included.
No. 1 Rhodesian crude, $280; No. 2, $175 per short ton c.i.f. New York.

**Barytes**—f.o.b. Kings Creek, S. C.:
Crude, $6.50@$8 per gross ton.
Ground, off color, $13 per ton.
White, bleached, $17 per ton.
Waterground, 300 mesh, bags included, $21 per ton, Charlotte, N. C.
Crude, $8, f.o.b. Ga.
Crude, $8.50, f.o.b. Mo.
Water ground and floated, bleached, $23@$24, f.o.b. St. Louis.
In Canada, 94@96 per cent $BaSO_4$, $8 per net ton, f.o.b. mine.

**Bauxite** — American, f.o.b. shipping point per gross ton:
**Crushed and dried, $5.50@$8.75.**
**Pulverized and dried, $14.**
**Calcined, crushed, $19@$20.**
Foreign, per metric ton, c.i.f.:
French red, 5 per cent $SiO_2$, $5@$7.
Adriatic, low $SiO_2$, $5@$7.50.

**Beryl**—$65@$80 per ton, hand-sorted crystals, f.o.b. Vermont. Nominal.

**Borax**—Granulated and refined, crystals or powdered, in bags, carloads, 4¾c. per lb.; in bbls., 5c. Boric acid, 10½c.

**[1]Celestite—90 per cent $SrSO_4$, finely powdered, $40 per ton in carload lots.**

**Chalk—F.o.b. New York, per lb.:**
**English, extra light, 5c.**
**Domestic, light, 4½@4¾c.**
**Domestic, heavy, 3½@3¾c.**
**In bulk, $5@$5.50 per ton.**

**China Clay (Kaolin)**—F.o.b. Virginia mines, per short ton:
**Crude No. 1, $7.**
**Crude No. 2, $5.50.**
**Washed, $8.**
**Powdered, $10@$20.**
**Powdered (Blue Ridge), $12@$15.**
Imported English, f.o.b. American ports:
Lump, $12@$20.
**Powdered, $45@$50.**
1A grades, domestic, $16@$17, f.o.b. mines.

**Corundum** — South African, $65 per ton, New York.

**Diatomaceous Earth**—Per short ton, f.o.b. plant, California:
**Kiln-fired brick, $65.**
**Kiln-fired aggregate, ¼ in., $45.**
**Insulating powder, $30.**
**Natural aggregate, ¼ in., $20.**
Air-floated powder, $40.
Business reported satisfactory.

**Emery**—Per lb., f.o.b. plant:
Greek Naxos, 6½c.
Turkish, 6½c.
Khasia, 5½c.
American, 3½@6½c.
Market fair.

**Feldspar**—Per long ton, f.o.b. cars, *North Carolina:*
No. 1 pottery grade, $6.50@$7.50, depending upon quality.

No. 2 pottery grade, $4.50@$5, depending upon quality.

No. 1 soap grade, $6.75@$7.25.

Good market for best grade.

In *Connecticut*, per net ton, f.o.b. mines:

40 to 200 mesh, $17@$30.

Market quiet; some inquiries for 1925. In most cases manufacturers are trying to contract for nearly twice the tonnage used in 1924.

In *New Hampshire*, per net ton, f.o.b. mines:

No. 1, not exceeding 10 per cent $SiO_2$, $7.70.

No. 2 pottery grade, $7.

Ground, $17@$20, f.o.b. mill.

Market fair.

In *New York*, per ton, f.o.b. cars: No. 1, $8. Market still dull.

In *Maine:*

No. 1 ground, $19. Market good.

In *Tennessee:*

Pottery grades, $15.30@$18.

Tile grades, $14@$16.

Enameling grades, $11@$16.

Crude, $7 for ordinary grades. As high as $7.25 offered for exceptional quality.

Market fair.

In *Canada*, f.o.b. mine:

Crude, No. 1, over 12½ per cent potash, less than 5 per cent $SiO_2$, $7.50 per net ton.

Crude, No. 2, 20 to 25 per cent $SiO_2$, $5.50 per net ton.

Ground, No. 1, 180 mesh, $21 per net ton, bags included.

Ground, No. 2, 180 mesh, $16 per net ton, bags included.

Market active for crude but quiet for ground, owing to unsettled policies for 1925.

**Fluorspar** — F.o.b. Middle Western mines, per net ton:

Gravel, not less than 80 per cent $CaF_2$, and not over 5 per cent $SiO_2$, $19.

Gravel, not less than 85 per cent $CaF_2$ and not over 5 per cent $SiO_2$, $20.

Lump, not less than 85 per cent $CaF_2$, not over 5 per cent $SiO_2$, $20.

Ground, 93 to 98.5 per cent $CaF_2$ and not over 3 per cent $SiO_2$, $30@$35 in bulk, $39 in bags or barrels.

Acid, ground, not less than 98½ per cent $CaF_2$ and not over 1 per cent $SiO_2$, $45 in bulk, $49 in packages.

Little change. Large consumers have covered for winter months at low prices offered in liquidating stocks of two of the larger mines. An improvement in demand and prices expected early in 1925.

In Canada, 84@86 per cent $CaF_2$, less than 5 per cent silica, $17 per net ton, f.o.b. mine.

**Fuller's Earth**—Per ton, f.o.b. Midway, Fla.:

16 to 30 mesh, $16.50.

16 to 60 mesh, $18.

30 to 60 mesh, $18.

60 to 100 mesh, $14.

Plus 100 mesh, $7.50.

Powdered, imported, duty paid, $23 @$25 per ton.

**Garnet**—Per short ton:

Spanish grades, $60, c.i.f. port of entry.

Domestic Adirondack, $85, f.o.b. shipping point.

Canadian, $70@$80, f.o.b. mines.

**Gilsonite**—Per ton, f.o.b. Colorado:

Jet asphaltum, $36.

Selects, $33.

Seconds (ordinary grades), $25.50.

**Graphite**—First quality, per lb.:

Ceylon lump, 7c.

Ceylon chip, 5½c.

Ceylon dust, 3@4c.

Crude amorphous, $15@$35 per ton.

Flake, No. 1 and No. 2 from New York, 25@30c.

Advanced prices owing to low production.

Manufactured grades:

No. 1 Flake, lubricating, 10@30c.

No. 2 Flake, lubricating, 10@30c.

Extra fine ground, 12@30c.

Medium fine ground, 6@14c.

Facings, 4@8c.

Market strong. Prices likely to advance. Almost all the stocks left over from war have been used and offerings are limited.

**Gypsum**—Per ton, depending upon source:

Crushed rock, $2.75@$3.

Ground, $4@$6.

Agricultural, $6@$7.

Calcined, $8@$16.

**Ilmenite**—Concentrates, 52 per cent $TiO_2$, 1½c. per lb., f.o.b. Virginia points. $60 per short ton, Florida mines.

**Iron Oxide** (See Ocher) — Ground, 95 per cent through 200 mesh, Standard Spanish red, $40 per ton.

**Kaolin**—See China Clay.

**Lepidolite**—$20@$30 per ton for ordinary grades. Nominal.

**Limestone**—Depending upon source, f.o.b. shipping points; per ton:

Crushed, ¾ in. and less, $1.10@$1.70.

Crushed, 3 in. and larger, 90c.@$1.50.

Agricultural, $1.50@$5.

**Magnesite**—Per ton, f.o.b. California mines:

Calcined lump, 85 per cent MgO, $35.

Calcined ground, 200 mesh, $42.50.

Dead burned, $29@$31, Washington.

Dead burned, $40@$42, Chester, Pa.

Caustic calcined, Grecian, $50@$51, c.i.f., New York.

Demand keeping up.

**Manjak**—Barbados, in 1 to 5 ton lots:

Grade "A," 6c. per lb.

Grade "AC," 7c. per lb.

Grade "AA," fine, 8c. per lb.

Grade "C," fine and lump, 9c.

Grade "C," lump, 12c.

**Mica**—

*North Carolina* prices:

Scrap, $17@$20 per ton.

Sheet, per lb., No. 1 quality, clear:

Punch, 1¼ in., 7c.

| | |
|---|---|
| 1½ x 2 in., 16c. | 3 x 4 in., $1.75. |
| 2 x 2 in., 30c. | 3 x 5 in., $2.35. |
| 2 x 3 in., 75c. | 4 x 6 in., $3. |
| 3 x 3 in., $1.25. | 6 x 8 in., $4.50. |

Ground, 60 mesh, $65 per ton.

Ground, 80 mesh, $70.

Ground, 120 mesh, $120.

Ground, 140 mesh, $125.

Dry ground, roofing, $30.

Dry ground, 80 mesh, $35.

Dry ground, 100 mesh, $67.50.

Dry ground, 160 mesh, $70.00.

In *New Hampshire:*

Washer and disk, $320 per ton.

Scrap, $24 per ton.

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

Madagascar, amber, dark, free from iron, per lb., f.o.b. New York:

| | | | |
|---|---|---|---|
| No. 1..... | $2.75 | No. 4..... | $0.75 |
| No. 2..... | 2.25 | No. 5..... | .50 |
| No. 3..... | 1.35 | No. 6..... | .30 |

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

**Ocher**—"Yellow Peruvian," $25@$30 per ton, Georgia mines. Market good.

**Ozocerite**—Per lb. in bags, New York:

Black, 160 deg. melting point, 24@25c.

Green, 170 deg. melting point, 26@30c.

**Phosphate** — Per long ton, f.o.b., *Florida* export prices:

76@77 per cent, pebble, $5.50.

75 per cent, $5.25.

74@75 per cent, $5.

70 per cent, $3.30.

68 per cent, $3.

In *Tennessee*, per long ton:

78 per cent lump, $8.

75 per cent hand-mined lump, $6.75 @$7.

75 per cent washed lump, $7.

72 per cent washed run of mine, $5 @$5.50.

65 per cent ground 95 per cent through 100 mesh, $7 per short ton.

Ground market good; furnace rock, fair. Fertilizer demand poor.

Stormy weather has stopped nearly all open-pit mining. Comparatively small stocks on hand for winter requirements. Prices expected to advance in January, February and March.

| Potash— | Bags | Bulk |
|---|---|---|
| Muriate of potash 80@85 per cent, basis 80 per cent.... | $34.55 | $33.30 |
| Sulphate of potash 90@95 per cent, basis 90 per cent.... | 45.85 | 44.60 |
| Sulphate of potash-magnesia 48@53 per cent, basis 48 per cent ..... | 26.35 | 25.10 |
| Manure salt 30 per cent..... | 19.03 | 17.33 |
| Manure salt 20 per cent..... | 12.55 | 10.55 |
| Kainit 14 per cent ..... | 10.25 | 8.25 |
| Kainit 12.4 per cent..... | 9.75 | 7.75 |

Two thousand pounds net weight, c.i.f. Atlantic and Gulf ports. German weights, tares and analyses.

For prompt shipment:

5 per cent on minimum quantity of 50 short tons $K_2O$

6 per cent on minimum quantity of 100 short tons $K_2O$

7 per cent on minimum quantity of 300 short tons $K_2O$

10 per cent on minimum quantity of 500 short tons $K_2O$

The calculations are on total quantity of foreign potash salts imported during the present fertilizer year ending on April 30, 1925.

**Pumice Stone**—Imported lump, 3@40c. per lb.

Powdered, in bbl., 3@5c.

Lumps, in bbl., 6@8c.

**Pyrites**—Tharsis, per long ton unit, c.i.f. U. S. ports:

Furnace size, 12c.

Lump, 11c.

Fines, through ½ in., 11½c.

Cinder from ore to remain property of buyers.

An increased price for sulphur, c.i.f., would help the market.

**Quartz Rock Crystals** — Colorless, clear and flawed, pieces ¼ to ½ lb. in weight, 30c. per lb. in ton lots.

For optical purposes, double above prices.

**Rutile**—F.o.b. Virginia points, per lb.:

Granular, 94@96 per cent $TiO_2$, 12@15c.

Pulverized, 100 mesh, 94@96 per cent, 17@30c.

93 per cent $TiO_2$, $200 per ton, Florida.

**Silica**—Water ground and floated, per ton, f.o.b. Illinois:

450 mesh, $31.
350 mesh, $26.
250 mesh, $22.
200 mesh, $20.
100 mesh, $8.

Glass sand, $2@$2.25 per ton; brick and molding sand, $2@$2.25.

**Spodumene** — $20@$30 per ton, depending upon lithium content. Nominal.

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

**Talc**—Per ton, in 50-lb. paper bags, *Vermont* mills, carloads:

Ground, 200 mesh, extra white, $10.50.
Ground, 180 mesh, medium white, $10.
Ground, 160 mesh, medium white, $9.50.

In *New York*, double air-floated, including containers:

200 mesh, $13.75.
325 mesh, $14.75.
100 mesh, $11, not air-floated.
Demand fair.

In *California*, $20@$30 per ton, ground.

In *Georgia*, powdered, per ton:

Gray or yellow, $7.50@$10.
Red or white, $10@$14.
Market good for powders.
White, $12@$15.
Grayish white, $8@$10.
Red, $12@$14.
Yellow, $8@$12.
Roofing, $7.50@$8.

**Tripoli**—Per short ton, burlap bags, paper liners, per minimum carload 30 tons, f.o.b. Missouri:

Once ground:
Rose and cream colored, $16@$25.
White, $18@$27.

Double ground:
Rose and cream, $17@$25.
White, $19@$30.

Air-float:
Rose and cream, $25@$30.
White, $35.

**Zircon**—Freight allowed east of Mississippi River:

99 per cent, 6c. per lb., f.o.b. Florida.
Powdered, 7c. per lb., f.o.b. Florida.

## Mineral Products

**Arsenious Oxide** (white arsenic)—6½c. per lb. delivered.

**Copper Sulphate**—4⅜c. per lb.

**Sodium Nitrate**—$2.40 per 100 lb., ex vessel Atlantic ports.

**Sodium Sulphate**—$16@$17 per ton, New York.

**Zinc Oxide**—Per lb. in bags:

Lead free, 7⅝c.
5 per cent lead sulphate, 6⅞c.
10 to 35 per cent lead sulphate, 6⅝c.
French, red seal, 9⅝c.
French, green seal, 10⅝c.
French, white seal, 11⅞c.

## Ferro-Alloys

[1]**Ferrocerium**—$7 per lb.

**Ferrochrome**—1 to 2 per cent carbon, 30c. per lb.; 4 to 6 per cent carbon, 10¾c. per lb.

**Ferromanganese**—Domestic and foreign, 78@82 per cent, $110 per gross ton. Spiegeleisen, 19@21 per cent, $33 @$35, f.o.b. furnace; 16@19 per cent, $32@$34.

**Ferromolybdenum**—$1.80@$2 per lb. of contained molybdenum for 50 to 55 per cent grades.

**Ferrosilicon**—10 to 12 per cent, $39.50 @$44.50 per gross ton, f.o.b. works; 50 per cent, $82.50 delivered.

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

**Ferrotungsten**—90c. per lb. of contained W, f.o.b. works. Quiet.

[1]**Ferro-uranium**—35 to 40 per cent U, $4.50 per lb. of U contained, f.o.b. works.

**Ferrovanadium**—$3.25@$4 per lb. of V contained, f.o.b. works.

## Metal Products

**Rolled Copper**—Sheets, 22¾c.; wire, 17¼c.

**Lead Sheets**—Full lead sheets, 13c. per lb.; cut lead sheets, 13¼c. in quantity, mill lots.

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

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

**Yellow Metal** — Dimension sheets, 20⅝c. per lb.; rods, 17⅜c. per lb.

**Zinc Sheets** — 11c. per lb., f.o.b. works.

## Refractories

**Bauxite Brick**—$140@$145 per M., Pittsburgh, Pa.

**Chrome Brick**—$45@$47 per net ton, f.o.b. shipping point.

**Firebrick**—First quality, $43@$46 per M., Ohio, Kentucky, Central Pennsylvania; second quality, $36@$40.

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

**Magnesite Cement**—$47@$50 per net ton, f.o.b. Chester, Pa.

**Silica Brick**—$40@$42 per M. Pennsylvania; $45@$47 Alabama.

**Zirkite**—Powdered, 80 per cent $ZrO_2$, 3c. per lb.; 70 per cent, 2½c. per lb. Brick, straights, 80c.@$1 each.

## Iron and Steel Firm

**Pittsburgh, Dec. 30, 1924**

Steel mill operations at the year-end have decreased only a trifle, chiefly on account of labor forces being scant after the holiday. There was no lack of orders. Steel buying in general has been somewhat lighter in the last fortnight, but has kept up unusually well considering the season and there is promise of much activity in January.

The plate market has undergone a definite advance of $2 a ton in the last fortnight, prices of 1.90c. and 1.95c. having gradually faded away, leaving the minimum at 2.00c., f.o.b. mill, Pittsburgh district. Bars and shapes remain firm at 2.10c. and all three of the heavy rolled products are in line for further advances if conditions remain good.

Semi-finished steel has become tighter still, following the stiffening a week ago, and cannot be bought at less than $38 for billets or slabs and $39 for sheet bars, making $2 advance in a fortnight.

**Pig Iron**—Market firm and quiet at recent advances; Bessemer, $22.50@$23; basic, $21.50@$22; foundry, $22@$23, f.o.b. Valley furnaces.

**Connellsville Coke** — Market quiet with asking prices $4.25@$4.50 on spot furnace and $4.50@$5 on spot foundry. No contract negotiations.

# Some British Copper-mining Companies Analyzed

A table showing the principal financial and operating features of copper-mining companies in which British capital is heavily interested was published in the London *Statist* of Dec. 13, 1924, and is reproduced below. The *Statist* states that Australian copper mines have valuable and extensive ore deposits, but "it is impossible to entertain very sanguine hopes as to the future of these undertakings. . . . The success of Spanish and Portuguese copper companies is proof of their ability to produce profitably at present level of prices. . . . Any great increase in the demand for copper should be satisfied by increased output from the African mines."

| | Par | Issued Capital £ | 1923 H. | 1923 L. | 1924 H. | 1924 L. | Year to | Output Tons | Net Profit £ | Carry Forward | Dividend Per Cent | £ | Current Months | Year Output, Tons | Current Price | Yield Per Cent. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Arizona | 5s. | 696,500 | 25/7 | 16/3 | 20/– | 13/9 | 31/3/24 | ..... | 35,442 | 9,800 | 40 | 152,000 | .. | ..... | 16/9 | 11.9 |
| Hampden (*a*) | £1 | 350,000 | 11/– | 4/6 | 7/1 | 4/3 | 29/2/24 | nil | D. 6,382 | nil | .... | ..... | .. | ..... | 4/9 | .... |
| Mason & Barry (*f*) | £1 | 185,200 | 63/– | 43/9 | 55/– | 36/10 | 31/12/23 | 142,500 | 36,404 | 36,200 | 17½ | 32,400 | .. | ..... | 52/6 | 6.7 |
| Messina (*g*) | 5s. | 181,800 | 8/6 | 4/6 | 5/10 | 3/– | 30/6/23 | 2,778 | 17,000 | 359 | .... | ..... | 10 | 4,000 | 3/7½ | .... |
| Mount Lyell (*e*) | £1 | 1,289,200 | 25/9 | 19/6 | 25/6 | 19/3 | 30/9/23 | 8,326 | 151,002 | 419,028 | 10 | 128,920 | 13 | 6,858 | 24/9 | 8.0 |
| Mount Morgan (*e*) | £1 | 1,000,000 | 18/6 | 8/1 | 12/10 | 8/– | 31/5/24 | 4,729 | D.15,300 | 101,960 | .... | ..... | 5 | 2,409 | 9/– | .... |
| Namaqua (*g*) | £2 | 188,700 | 52/6 | 27/6 | 36/10 | 27/6 | 31/12/23 | 2,619 | 21,407 | D. 9,100 | .... | ..... | 6 | 1,335 | 32/– | .... |
| Pilbara Copper (*e*) | 5s. | 58,800 | 13/6 | 2/– | 6/10 | 3/1 | (*a*) 30/6/22 | ..... | D. 5,043 | D. 10,792 | .... | ..... | .. | ..... | 2/7½ | .... |
| Rio Tinto (..)— | | | | | | | | | | | | | | | | |
| Pref. | £5 | 1,625,000 | 88/9 | 78/3 | 85/– | 78/9 | 31/12/23 | (*b*) 2,013,000 | 729,600 | 440,160 | 5 | 81,250 | .. | ..... | 83/1 | 6.0 |
| Ord. | £5 | 1,875,000 | 41¼ | 29¼ | 36⅞ | 28⅞ | | | | | 35 | 656,250 | .. | ..... | 38½ | 4.3 |
| S. Amer. Co. | 2s. | 75,000 | 21/7 | 10/4 | 15/7 | 9/7 | 30/6/23 | 680 | D. 20,536 | nil | .... | ..... | .. | ..... | 10/1 | .... |
| Union Miniere (*g*)— | | | | | | | | | | | | | | | | |
| Pref. | £1 | 1,150,000 | 25/7 | 19/– | 31/3 | 29/– | 31/12/23 | 53,886 | 18,873 | 162,476 | 10*d.* | 72,000 | 10 | 70,014 | 31/6 | 6.3 |
| Ord. | £1 | 2,190,000 | 23/10 | 15/7 | 30/3 | 27/6 | | | | | Nil | ..... | | | 30/9 | .... |
| (Tanganyika Conc.) | | | | | | | | | | | | | | | | |

(*a*) Accounts cover two years; (*b*) production of mineral—copper percentage not given; (*d*) dividend to June 30, 1923; (*e*) Australia; (*f*) Portugal; (*g*) Africa; (*h*) Spain.

# Metal Statistics

## Monthly Average Prices of Metals

### Silver

| | New York | | London | | Sterling Exchange | |
|---|---|---|---|---|---|---|
| | 1923 | 1924 | 1923 | 1924 | 1923 | 1924 |
| January | 65.668 | 63.447 | 31.928 | 33.549 | 465.053 | 425.524 |
| February | 64.313 | 64.359 | 30.875 | 33.565 | 468.631 | 430.457 |
| March | 67.556 | 63.957 | 32.310 | 33.483 | 469.269 | 428.769 |
| April | 66.855 | 64.139 | 32.346 | 33.065 | 465.220 | 434.788 |
| May | 67.043 | 65.524 | 32.611 | 33.870 | 462.252 | 435.716 |
| June | 64.861 | 66.690 | 31.611 | 34.758 | 461.132 | 431.675 |
| July | 63.015 | 67.159 | 30.942 | 34.509 | 458.025 | 436.649 |
| August | 62.793 | 68.519 | 30.952 | 34.213 | 455.714 | 449.510 |
| September | 64.203 | 69.350 | 31.698 | 34.832 | 453.901 | 445.740 |
| October | 63.649 | 70.827 | 31.718 | 35.387 | 452.024 | 448.274 |
| November | 63.818 | 69.299 | 32.774 | 33.775 | 437.839 | 460.543 |
| December | 64.705 | 68.096 | 33.375 | 32.620 | 435.500 | 469.115 |
| Year | 64.873 | 66.781 | 31.929 | 33.969 | 457.047 | 441.397 |

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

### Copper

| | New York | | London | | | |
|---|---|---|---|---|---|---|
| | Electrolytic | | Standard | | Electrolytic | |
| | 1923 | 1924 | 1923 | 1924 | 1923 | 1924 |
| January | 14.510 | 12.401 | 64.494 | 61.273 | 71.409 | 67.193 |
| February | 15.355 | 12.708 | 67.700 | 63.113 | 74.500 | 68.167 |
| March | 16.832 | 13.515 | 73.851 | 66.137 | 81.464 | 72.087 |
| April | 16.663 | 13.206 | 73.169 | 64.338 | 81.331 | 70.150 |
| May | 15.440 | 12.772 | 67.460 | 62.006 | 76.568 | 67.648 |
| June | 14.663 | 12.327 | 66.607 | 61.375 | 73.238 | 66.313 |
| July | 14.321 | 12.390 | 65.278 | 61.652 | 72.364 | 65.815 |
| August | 13.822 | 13.221 | 64.034 | 63.481 | 70.000 | 67.800 |
| September | 13.323 | 12.917 | 63.194 | 62.750 | 68.275 | 67.125 |
| October | 12.574 | 12.933 | 60.614 | 62.641 | 64.250 | 66.620 |
| November | 12.727 | 13.635 | 61.648 | 63.731 | 66.477 | 68.063 |
| December | 12.823 | 14.260 | 62.035 | 65.295 | 67.611 | 69.762 |
| Year | 14.421 | 13.024 | 65.840 | 63.149 | 72.291 | 68.062 |

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

### Lead

| | New York | | St. Louis | | London | |
|---|---|---|---|---|---|---|
| | 1923 | 1924 | 1923 | 1924 | 1923 | 1924 |
| January | 7.633 | 7.972 | 7.571 | 8.002 | 27.119 | 31.528 |
| February | 8.050 | 8.554 | 8.093 | 8.643 | 28.519 | 34.589 |
| March | 8.252 | 9.013 | 8.254 | 8.891 | 28.815 | 37.161 |
| April | 8.101 | 8.263 | 7.996 | 7.932 | 26.956 | 32.819 |
| May | 7.306 | 7.269 | 7.085 | 6.973 | 25.614 | 29.426 |
| June | 7.146 | 7.020 | 6.852 | 6.848 | 25.429 | 32.138 |
| July | 6.237 | 7.117 | 6.126 | 6.886 | 24.188 | 32.916 |
| August | 6.582 | 7.827 | 6.496 | 7.764 | 24.222 | 32.728 |
| September | 6.856 | 8.00 | 6.700 | 7.876 | 25.688 | 33.023 |
| October | 6.831 | 8.235 | 6.570 | 8.118 | 27.815 | 35.715 |
| November | 6.846 | 8.689 | 6.582 | 8.590 | 30.352 | 39.425 |
| December | 7.369 | 9.207 | 7.369 | 9.106 | 31.042 | 41.583 |
| | 7.267 | 8.097 | 7.141 | 7.969 | 27.147 | 34.421 |

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

### Tin

| | New York | | | | London | |
|---|---|---|---|---|---|---|
| | 99% | | Straits | | | |
| | 1923 | 1924 | 1923 | 1924 | 1923 | 1924 |
| January | 37.986 | 48.250 | 39.173 | 48.750 | 181.852 | 246.790 |
| February | 40.693 | 52.772 | 42.011 | 53.272 | 190.513 | 272.399 |
| March | 46.569 | 54.370 | 48.569 | 54.870 | 219.607 | 277.429 |
| April | 44.280 | 49.457 | 45.810 | 49.957 | 213.081 | 250.863 |
| May | 42.346 | 43.611 | 43.135 | 44.111 | 203.097 | 218.511 |
| June | 40.375 | 42.265 | 40.957 | 42.765 | 191.798 | 219.219 |
| July | 37.970 | 45.750 | 38.490 | 46.250 | 181.188 | 233.332 |
| August | 38.841 | 51.409 | 39.269 | 51.909 | 186.705 | 254.638 |
| September | 41.047 | 48.595 | 41.547 | 49.095 | 198.263 | 243.511 |
| October | 41.322 | 50.038 | 41.851 | 50.538 | 203.957 | 248.543 |
| November | 43.495 | 53.848 | 43.995 | 54.348 | 220.710 | 257.738 |
| December | 46.662 | 55.721 | 47.160 | 56.245 | 235.007 | 261.875 |
| Year | 41.799 | 49.674 | 42.664 | 50.176 | 202.148 | 248.737 |

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

### Zinc

| | St. Louis | | London | |
|---|---|---|---|---|
| | 1923 | 1924 | 1923 | 1924 |
| January | 6.815 | 6.426 | 35.733 | 34.761 |
| February | 7.152 | 6.756 | 35.613 | 36.518 |
| March | 7.706 | 6.488 | 36.720 | 35.298 |
| April | 7.197 | 6.121 | 34.275 | 32.588 |
| May | 6.625 | 5.793 | 31.057 | 30.648 |
| June | 6.031 | 5.792 | 29.548 | 31.788 |
| July | 6.089 | 5.898 | 29.335 | 32.193 |
| August | 6.325 | 6.175 | 32.386 | 32.544 |
| September | 6.438 | 6.181 | 33.469 | 32.926 |
| October | 6.293 | 6.324 | 32.995 | 33.514 |
| November | 6.347 | 6.796 | 32.949 | 35.022 |
| December | 6.260 | 7.374 | 32.611 | 36.932 |
| Year | 6.607 | 6.344 | 33.058 | 33.728 |

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

### Antimony, Quicksilver and Platinum

| | Antimony (a) New York | | Quicksilver (b) New York | | Platinum (c) Refined New York | | Platinum (c) Crude New York |
|---|---|---|---|---|---|---|---|
| | 1923 | 1924 | 1923 | 1924 | 1923 | 1924 | 1924 |
| January | 6.884 | 10.279 | 72.731 | 59.500 | 112.462 | 122.115 | 115.500 |
| February | 7.290 | 10.935 | 70.636 | 59.565 | 113.273 | 124.739 | 115.935 |
| March | 8.885 | 11.442 | 70.808 | 64.269 | 110.846 | 121.692 | 113.231 |
| April | 8.380 | 9.952 | 69.200 | 74.308 | 116.840 | 115.577 | 108.077 |
| May | 7.477 | 8.755 | 68.000 | 76.962 | 115.007 | 115.731 | 112.192 |
| June | 6.839 | 8.403 | 67.769 | 73.720 | 115.615 | 116.000 | 113.000 |
| July | 7.097 | 8.477 | 66.980 | 72.173 | 116.000 | 118.231 | 113.865 |
| August | 7.753 | 9.839 | 65.212 | 72.096 | 116.000 | 120.000 | 113.500 |
| September | 7.633 | 11.022 | 63.000 | 72.423 | 116.000 | 118.923 | 113.058 |
| October | 8.005 | 11.519 | 61.769 | 70.654 | 116.923 | 118.000 | 112.423 |
| November | 9.156 | 14.385 | 61.917 | 68.708 | 124.479 | 117.792 | 111.333 |
| December | 9.365 | 15.024 | 60.000 | 72.750 | 125.000 | 117.000 | 111.000 |
| Year | 7.897 | 10.836 | 66.502 | 69.761 | 116.537 | 118.817 | 112.760 |

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

### Pig Iron, Pittsburgh

| | Bessemer | | Basic | | No. 2 Foundry | |
|---|---|---|---|---|---|---|
| | 1923 | 1924 | 1923 | 1924 | 1923 | 1924 |
| January | 29.27 | 24.76 | 27.35 | 23.76 | 28.77 | 23.88 |
| February | 29.79 | 25.26 | 28.15 | 23.76 | 27.21 | 25.06 |
| March | 32.03 | 25.14 | 31.79 | 23.76 | 31.77 | 24.76 |
| April | 32.77 | 24.56 | 32.77 | 23.26 | 32.77 | 23.80 |
| May | 31.87 | 23.89 | 29.83 | 22.08 | 32.46 | 22.91 |
| June | 30.27 | 22.90 | 28.34 | 21.49 | 29.81 | 21.48 |
| July | 28.47 | 21.90 | 26.52 | 20.76 | 27.47 | 20.76 |
| August | 28.27 | 21.76 | 26.77 | 20.76 | 26.77 | 20.99 |
| September | 28.26 | 21.76 | 26.26 | 20.76 | 26.72 | 21.68 |
| October | 26.96 | 21.76 | 25.01 | 20.26 | 25.52 | 21.26 |
| November | 24.79 | 22.08 | 22.57 | 21.44 | 23.60 | 21.17 |
| December | 24.54 | ..... | 22.62 | ..... | 23.72 | ..... |
| Year | 28.94 | ..... | 27.33 | ..... | 28.05 | ..... |

In dollars per long ton.

## Monthly Crude Copper Production

### Domestic

| | 1924 August | September | October | November |
|---|---|---|---|---|
| Alaska shipments | 138,760 | 3,602,468 | 11,651,471 | 8,902,042 |
| Calumet & Arizona | 3,802,000 | 3,448,000 | 4,444,000 | 4,028,000 |
| Miami | 5,108,000 | 4,099,000 | 4,895,000 | 4,732,000 |
| New Cornelia | 5,627,261 | 5,096,158 | 5,069,899 | 5,703,506 |
| Old Dominion | 2,455,000 | 2,495,000 | 3,004,000 | 2,937,000 |
| Phelps Dodge | 12,341,000 | 11,958,000 | 13,156,156 | 12,260,000 |
| United Verde Extension | 4,011,746 | 5,268,896 | 3,539,538 | 3,136,660 |
| A.S. & R. & Tenn. Copper | 12,000,000 | 14,750,000 | 13,500,000 | 11,750,000 |
| Imports: Ore and concentrates, matte | 12,354,191 | 11,759,019 | 4,127,986 | 19,703,976 |
| Partly from . | | | | |
| Chile | 3,687,191 | 5,939,411 | ..... | ..... |
| Cuba | 2,685,000 | 2,560,000 | ..... | ..... |
| Canada | 2,073,966 | 319,724 | ..... | ..... |
| Mexico | 2,128,722 | 1,800,113 | ..... | ..... |
| Imports of black and blister, unrefined | 29,215,759 | 27,024,684 | 33,852,068 | 48,686,075 |
| Partly from | | | | |
| Chile | 4,097,634 | 8,022,886 | ..... | ..... |
| Peru | 6,936,387 | 3,824,548 | ..... | ..... |
| Africa | 8,536,719 | 6,141,793 | ..... | ..... |
| Mexico | 3,843,264 | 4,512,257 | ..... | ..... |
| Imports of refined and old | 16,647,115 | 15,216,096 | 7,055,806 | 17,030,588 |

### Foreign

| | | | | |
|---|---|---|---|---|
| Boleo, Mexico | 1,258,030 | 1,433,148 | 1,572,165 | 1,552,320 |
| Falcon Mines, Rhodesia | 474,000 | 479,200 | ..... | 419,400 |
| Furukawa, Japan | 2,594,205 | 3,936,792 | 3,494,394 | 2,446,745 |
| Cons. M & S., Canada | 416,865 | 270,380 | ..... | ..... |
| Granby Cons., Canada | 2,238,146 | 1,508,786 | 2,312,348 | 3,006,550 |
| Katanga, Africa | 20,411,685 | 17,293,815 | 16,638,930 | 17,386,152 |
| Mount Morgan, Aust | 1,090,000 | 904,000 | ..... | ..... |
| Mount Lyell, Aust | 786,000 | 786,000 | 1,066,000 | ..... |
| Phelps Dodge, Mexican | 3,292,000 | 3,792,000 | 3,487,000 | 3,712,000 |
| Sumitomo, Japan | 2,519,542 | 3,350,001 | 2,997,801 | 2,911,254 |

## Comparative U. S. Copper Mine Production

| | 1921 | 1922 | 1923 | 1924 |
|---|---|---|---|---|
| January | 90,596,597 | 32,010,292 | 112,267,000 | 133,356,000 |
| February | 85,682,941 | 45,957,530 | 102,725,000 | 128,260,000 |
| March | 91,046,345 | 55,705,760 | 121,562,000 | 129,876,000 |
| April | 46,946,523 | 76,601,000 | 118,157,000 | 131,928,000 |
| May | 25,310,511 | 88,714,000 | 125,438,000 | 130,644,000 |
| June | 24,623,693 | 93,740,000 | 125,479,000 | 127,506,000 |
| July | 22,033,739 | 91,000,000 | 125,249,000 | 129,574,000 |
| August | 23,248,398 | 101,188,000 | 131,088,000 | 133,512,000 |
| September | 23,855,316 | 96,408,000 | 124,523,000 | 126,346,000 |
| October | 23,231,572 | 103,273,000 | 132,481,000 | 137,924,000 |
| November | 28,341,442 | 102,845,000 | 127,963,000 | 136,692,000 |
| December | 26,629,137 | 103,003,000 | 129,354,000 | ..... |

# Company Reports

## Sulphide Corporation

**Lead, Zinc; Australia**

A report of the operations of the Sulphide Corporation, Ltd., for the fiscal year ended June 30, 1924, states that the net profit for the year, excluding all expenditure incurred in connection with the Central mine fire, amounted to £84,142, to which has been added a sum of £100,000 overprovided in former years against taxation. The capital expenditure during the year in excess of amortization has been £183,942, and, after debiting this against revenue, there remains a credit balance of £200 to be dealt with in the next account.

The cost to date of combating the fire which broke out in the Central mine on July 10, 1923, has amounted to £187,123, which has been provided out of the reserve for contingencies, reducing that reserve to £92,877.

In consequence of the fire it has been impossible, except for a small tonnage produced before its outbreak, to raise any ore during the last year from the Central mine. This inability still continues, as the fire, although greatly reduced in extent, is not yet finally extinguished. Steps, however, have been taken to establish water curtains cutting off the fire area, and by this means it is hoped that it will be possible before the end of the current financial year to resume the extraction of ore from the northern section of the mine.

The purchase of the Junction mine was completed in November of last year, and mining operations were immediately commenced; 26,294 tons of ore were raised. The tonnage treated by the corporation during the period of working was:

| Tonnage Treated | | Tons | Production |
|---|---|---|---|
| | | 4,779 | lead concentrates |
| Crude ore | 27,913 | 831 | special slimes |
| Dump slimes | 8,494 | 4,363 | zinc concentrates |
| | | 2,543 | zinc slime concentrates |

Recoveries during the period covered by the report, assay results and cost per ton of concentrates were as follows:

| Assay | | | Recoveries | | | Cost per Ton |
|---|---|---|---|---|---|---|
| Ag. Oz. | Pb. Per Cent | Zn. Per Cent | Ag. Oz. | Pb. Per Cent | Zn. Per Cent | Concentrates |
| 41.1 | 61.7 | 10.1 | .... | .... | .... | £17 19 10 |
| 20.4 | 17.8 | 17.3 | .... | .... | .... | .... |
| 12.4 | 7.7 | 44.4 | 83.6 | 86.1 | 88.8 | £1 7 10 |
| 15.6 | 11.4 | 45.4 | .... | .... | .... | .... .. .. |

In addition to the foregoing 1,985 tons of slimes from the dump at the Central mine were treated in the Broken Hill Proprietary Co.'s plant, for the extraction of 373 tons lead concentrates and 649 tons zinc concentrates.

At the Cockle Creek works the sulphuric acid and superphosphate plants were fully employed throughout the year, the former producing 13,560 tons acid (mono), and the latter 19,192 tons of superphosphate, which compares with 11,968 (chamber) and 17,186 tons respectively in the previous year.

The zinc-roasting plant erected by the Electrolytic Zinc Co. of Australasia, Ltd., came into operation in August, to the mutual benefit of both companies.

The installation of a cement plant of 30,000 tons per annum capacity is proceeding satisfactorily, and it is expected that this plant will be started upon a trial run early in the new year.

At Seaton Carew the zinc-smelting and acid plants have worked satisfactorily throughout the year. The operations of the zinc distillation plant have been increased to a seven furnace basis, resulting in the production of the largest tonnage of zinc yet attained. The production of sulphuric acid shows a slight falling off as compared with the previous year. The new unit of acid plant, referred to in the previous report, was approaching completion at the close of this year, and has since been brought into operation.

## Burma Corporation, Ltd.

**Lead, Silver; Upper Burma**

A report of the Burma Corporation for the quarter ended Sept. 30, 1924, follows:

**Development**

| | Feet |
|---|---|
| Total development footage | 619 |
| Total footage in ore | 137 |

A total of 65,173 tons of ore was extracted, having an average assay value of 21.99 oz. of silver, 24.135 per cent lead and 15.64 per cent of zinc. The tonnage extracted is equivalent to an output of 0.333 ton per man-shift employed underground.

**Production**

A total of 64,700 tons of ore was milled, averaging 21.98 oz. of silver, 24.37 per cent lead, and 15.65 per cent zinc; 32,202 tons of lead concentrates was produced, averaging 388.99 oz. of silver, 44.17 per cent lead and 18.37 per cent zinc; 5,074 tons of zinc concentrates was produced in the experimental zinc plant, averaging 10.41 oz. of silver, 8.08 per cent lead, and 45.30 per cent zinc; 35,062 tons of lead-bearing material was smelted for a production of 14,360 tons of hard lead, assaying 94.57 oz. silver per ton.

The refinery produced 12,743 tons of refined lead and 1,316,000 oz. of refined silver.

In addition to the foregoing, 200 tons of antimonial lead was produced. Also 900 tons copper matte, assaying 67.2 oz. silver, 29.56 per cent lead, and 41.48 per cent copper, was also produced and shipped from the treatment of 3,954 tons copper ore and accumulated smelter byproducts.

**Estimated Revenue and Expenditure**

| | | Total |
|---|---|---|
| Estimated gross revenue | Rs.98,98,100 | £659,873 |
| Estimated operating expenditure | 47,87,600 | 319,173 |
| Estimated surplus over working expenditure | Rs51,10,500 | £340,700 |
| Debenture interest | Rs.2,70,000 | £ 18,000 |
| Estimated income tax | 6,50,100 | 43,340 |
| Estimated depreciation on machinery and plant | 6,75,000 | 45,000 |
| Capital expenditure | 9,18,700 | 61,247 |

In No. 7 level, winze 740 ft. south has reached the random of No. 8 level, where a plat is now being cut.

The rainfall at Bawdwin during the quarter was exceptionally heavy, 31.06 inches, and retarded the procuring of fill for the stopes.

The revenue was affected by the rise in exchange, the average rate for the quarter being 1s. 5⅜d. (Rs. 13.81 to £1), the highest for any similar period since the beginning of 1921, and at this rate of exchange the surplus over working expenditure is £369,979.

The sterling figures shown are based on the rate of 1s. 4d. (Rs. 15 to £1).

Issued capital is Rs. 13,54,16,890 in shares and 8 per cent first mortgage debenture stock amounting to Rs. 1,00,00,000.

## Transvaal Gold Output

**The production of gold from the mines of the Transvaal** in November, 1924, was 802,313 fine ounces, and compares with 827,583 ounces in October and 780,639 ounces in November, 1923. The following table gives the monthly outputs since the beginning of 1920:

| | 1920 Fine Oz. | 1921 Fine Oz. | 1922 Fine Oz. | 1923 Fine Oz. | 1924 Fine Oz. |
|---|---|---|---|---|---|
| January | 670,503 | 651,593 | | 764,469 | 796,768 |
| February | 625,330 | 558,137 | 639,728 | 704,970 | 760,617 |
| March | 707,036 | 671,123 | | 761,586 | 795,671 |
| April | 686,979 | 681,382 | 511,338 | 743,651 | 768,923 |
| May | 699,041 | 687,776 | 629,786 | 786,564 | 809,003 |
| June | 715,957 | 678,490 | 675,697 | 755,309 | 773,053 |
| July | 736,099 | 689,555 | 730,635 | 754,306 | 829,437 |
| August | 702,083 | 711,526 | 752,490 | 769,371 | 809,571 |
| September | 682,173 | 691,026 | 747,089 | 739,504 | 799,422 |
| October | 662,472 | 707,825 | 778,159 | 793,842 | 827,583 |
| November | 633,737 | 704,236 | 764,476 | 780,639 | 802,313 |
| December | 632,215 | 681,847 | 790,712 | 778,849 | ..... .. |
| Total (12 months) | 8,153,625 | 8,114,516 | 7,020,110 | 9,133,060 | ..... |

# Mining Stocks

## Week Ended December 27, 1924

| Stock | Exch. | High | Low | Last | Last Div. |
|---|---|---|---|---|---|
| **COPPER** | | | | | |
| Alaska-Br. Col. | N. Y. Curb | | | *6 | |
| Anaconda | New York | 48¾ | 42⅛ | 47⅛ | Ja.17, Fe.16, 0.75 |
| Arcadian Consol. | Boston | 3¼ | 1⅝ | 3 | |
| Ariz. Com'l. | Boston | 15⅝ | 11 | 15⅛ | Jy.19, Jy.31 0.50 |
| Calaveras | N. Y. Curb | | | 2 | |
| Calumet & Arizona | Boston | | | *53 | De.5, De.22 Q 0.50 |
| Calumet & Hecla | Boston | 18 | 16⅜ | 18 | My. 31, Jn. 16 0.50 |
| Canario Copper | N. Y. Curb | 4½ | 4 | 4½ | |
| Cerro de Pasco | New York | 55⅛ | 50½ | 55⅛ | Oc. 23, No. 1 1.00 |
| Chile Copper | New York | 38 | 34¼ | 38 | De.3, De.29, Q 0.62½ |
| Chino | New York | 29 | 26¼ | 29 | Sept., 1920 0.37½ |
| Con. Coppermines | N. Y. Curb | 3¼ | 2 1/32 | 3¼ | |
| Copper Range | Boston | 31 | 26½ | 31 | May, 1923 1.00 |
| Crystal Copper | Boston Curb | *52 | *49 | *50 | |
| Davis-Daly | Boston | | | *45 | Mar., 1920 0.25 |
| East Butte | Boston | 5⅜ | 4⅜ | 5⅜ | Dec., 1919 0.50 |
| First National | Boston Curb | *35 | *31 | *34 | Feb., 1919 0.15 |
| Franklin | Boston | *90 | *50 | *90 | |
| Gadsden Copper | Boston Curb | *63 | *50 | *63 | |
| Granby Consol. | New York | 21⅞ | 18⅜ | 21½ | May, 1919 1.25 |
| Greene-Cananea | New York | 21 | 16½ | 21 | Nov., 1920 0.50 |
| Hancock | Boston | 1⅜ | *98 | 1⅜ | |
| Howe Sound | N. Y. Curb | 3½ | 2¼ | 3 | Ap.1,Ap.15, Q 0.05 |
| Inspiration Consl. | New York | 33⅜ | 29½ | 33¼ | De.20, Ja.7, Q 0.50 |
| Iron Cap | Boston Curb | 2 | 1½ | 2 | May, 1923 0.15 |
| Isle Royale | Boston | *20½ | *16 | *20½ | Se. 1, Se. 15 0.50 |
| Jerome Verde Dev. | N. Y. Curb | *97 | *95 | *95 | |
| Kennecott | New York | 57⅜ | 53⅜ | 57 | De.2, Ja.2, Q 0.75 |
| Keweenaw | Boston | 1¼ | *75 | 1¼ | |
| Lake Copper | Boston | 2⅜ | 1½ | 2¼ | |
| Magma Copper | New York | 45½ | 37½ | 44⅝ | Jan., 1919 0.50 |
| Mason Valley | N. Y. Curb | 2⅜ | 1⅜ | 2¼ | |
| Mass Consolidated | Boston | 1½ | *75 | 1½ | Nov., 1917 1.00 |
| Miami Copper | New York | 24⅜ | 21⅞ | 24 | No.1 No.15 Q 0.50 |
| Mohawk | Boston | 40 | 35 | 40 | Se. 22, Oc. 13 1.00 |
| Mother Lode Coa | New York | 9 | 8¼ | 8⅞ | De. 12, De. 31 0.37½ |
| Nevada Consol. | New York | 16⅞ | 14⅞ | 16⅜ | Sept., 1920 0.25 |
| New Cornelia | Boston | 25 | 22⅜ | 25 | No. 7, No. 24 0.25 |
| New Dominion | N. Y. Curb | | | 2½ | |
| North Butte | Boston | 3⅛ | 2⅜ | 3⅛ | Oct., 1918 0.25 |
| Ohio Copper | N. Y. Curb | 1⅜ | 1 3/16 | 1⅜ | No.14, De.2 0.05 |
| Old Dominion | Boston | 27 | 22½ | 27 | Dec., 1918 1.00 |
| Phelps Dodge | Open Mar. | †107 | †104 | | De.2, Ja.2 Q 1.00 |
| Quincy | Boston | 33½ | 25½ | 33½ | Mar., 1920 1.00 |
| Ray Consolidated | New York | 17½ | 15½ | 17⅜ | Dec., 1920 0.25 |
| Ray Hercules | N. Y. Curb | *10 | *5 | *8 | |
| St. Mary's Min. Ld. | Boston | 41 | 36½ | 41 | Ap.22, My.20 3.00 |
| Seneca Copper | New York | 1⅜ | ⅞ | 1¼ | |
| Shannon | Boston | 1⅜ | 1 | 1¼ | Nov., 1917 0.25 |
| Shattuck Arizona | New York | 8 | 7 | 8 | Jan., 1920 0.25 |
| Superior & Boston | Boston | 1⅞ | 1⅛ | 1⅞ | |
| Tenn. C. & C. | New York | 9¼ | 8⅜ | 9¼ | De.31, Ja.15,Q 0.25 |
| United Verde Ex. | N. Y. Curb | 29½ | 27½ | 29½ | Ja. 2, Fe. 2 0.50 |
| Utah Copper | New York | 88⅜ | 83¼ | 88⅜ | De.12, De.31,Q 1.00 |
| Utah Metal & T. | Boston | *45 | *30 | *45 | Dec., 1917 0.50 |
| Victoria | Boston | 1 | *50 | 1 | |
| Walker Mining | N. Y. Curb | 3⅛ | 3 3/16 | 3⅛ | |
| Winona | Boston | *50 | *20 | *50 | |
| **NICKEL-COPPER** | | | | | |
| Internat. Nickel | New York | 27¼ | 23 | 26⅞ | March, 1919 0.50 |
| Internat. Nickel pfd. | New York | 93 | 93 | 93 | Oc.16, No.1, Q 1.50 |
| **LEAD** | | | | | |
| Carnegie Lead & Zinc | Pittsburgh | 3¼ | 3¼ | 3¼ | |
| National Lead | New York | 162¾ | 158 | 160 | De.12, De.31, Q2.00 |
| National Lead pfd. | New York | 116¼ | 116 | 116 | No.21,De.15, Q 1.75 |
| St. Joseph Lead | New York | 44¾ | 41¼ | 44¾ | De. 9, De. 20 0.50 |
| **ZINC** | | | | | |
| Am. Z. L. & S. | New York | 12 | 10 | 11⅞ | May, 1920 1.00 |
| Am. Z. L. & S. pfd. | New York | 36⅞ | 32½ | 36⅜ | Nov., 1920 1.50 |
| Butte C. & Z. | New York | 9 | 7⅞ | 8⅞ | De.10, De.24 0.50 |
| Butte & Superior | New York | 25½ | 20 | 24⅞ | June, 1924 0.50 |
| Callahan Zn-Ld. | New York | 4½ | 3⅜ | 4½ | Dec., 1920 0.50 |
| New Jersey Zn. | N. Y. Curb | 195 | 185 | 195 | Oc.,No.,'24 QX 4.00 |
| United Zinc | N. Y. Curb | *16 | *15 | *15 | |
| Yellow Pine | Los Angeles | | | *67½ | De.10, De.15 Q 0.4 |
| **SILVER** | | | | | |
| Alvarado | Boston Curb | | | 1⅜ | |
| Beaver Consol. | Toronto | *24¼ | *24 | *24 | May, 1920 0.03 |
| Castle-Trethewey | Toronto | *71⅜ | *71 | *71½ | |
| Coniagas | Toronto | 2.20 | 2.20 | 2.20 | Ap.20, My.1 0.02½ |
| Crown Reserve | Toronto | *49 | *48 | *48½ | Jan., 1917 0.05 |
| Keeley | Toronto | 2.10 | 2.10 | 2.10 | Sept. 15, SA 0.12 |
| Kerr Lake | N. Y. Curb | | | 2 | Oc. 1, Oc. 15, 0.12½ |
| La Rose | Toronto | *7½ | *7 | *7 | Apr., 1922 0.10½ |
| Lorrain Trout Lake | Toronto | 1.35 | 1.35 | 1.35 | |
| McKinley-Dar.-Sav. | Toronto | *15⅓ | *14½ | *15 | Oct., 1920 0.03 |
| Mining Corp. Can. | Toronto | 2.78 | 2.65 | 2.75 | Sept., 1919 0.12½ |
| Nipissing | N. Y. Curb | 6⅝ | 6⅜ | 6½ | Ja.18,Ja.20,QX 0.30 |
| Ontario Silver | New York | 6⅞ | 6⅝ | 6¾ | Jan., 1919 0.50 |
| Temiskaming | Toronto | *20 | *20 | *20 | Jan., 1920 0.40 |
| **GOLD** | | | | | |
| Alaska Gold | New York | *12½ | *5 | *12½ | |
| Alaska Juneau | New York | 1⅛ | 1 | 1⅛ | |
| Argonaut | Toronto | *28 | *27 | *27½ | |
| Carson Hill | Boston | *85 | *50 | *85 | |
| Consol. W. Dome L. | Toronto | *16 | *15½ | *15½ | |
| Cresson Consol. G. | N. Y. Curb | 3⅜ | 3¼ | 3⅜ | De.31, Ja.10 Q 0.50 |

| Stock | Exch. | High | Low | Last | Last Div |
|---|---|---|---|---|---|
| Dome Mines | New York | 13½ | 13 | 13⅜ | De.31, Ja.20, Q 0.50 |
| Golden Cycle | Colo. Springs | 1.38 | 1.38 | 1.38 | Dec.11, 1924 0.03 |
| Hollinger Consol. | Toronto | 14.98 | 14.95 | 14.95 | De.11, De.31, 0.05 |
| Homestake Mining | New York | 42 | 41½ | 41½ | De.11, De.26, M0.50 |
| Jib. Cons 1, | N.Y. Curb | *62 | *53 | *56 | |
| Kirkland Lake | Toronto | *30 | *29½ | *29½ | |
| Lake Shore | Toronto | 4.45 | 4.45 | 4.45 | De.1,De.15,QX 0.10 |
| McIntyre-Porcupine | New York | 15½ | 15⅛ | 15⅛ | No. 1, De. 1 0.25 |
| Newray | Toronto | *24 | *23¼ | *23½ | |
| Night Hawk Pen. | Toronto | | | *4 | |
| Portland | Colo. Springs | *40 | *39 | *39 | Oct., 1920 0.01 |
| Teck-Hughes | Toronto | 1.17 | 1.15 | 1.16 | |
| Tom Reed | Los Angeles | | | *22½ | Dec., 1919 0.02 |
| Tough-Oakes | Toronto | *36 | *35 | *35½ | |
| United Eastern | N. Y. Curb | *36 | *36 | *36 | Jy.18, Jy.31, Q 0.05 |
| Vipond Cons. | Toronto | 1.35 | 1.33 | 1.34 | |
| Wright-Hargreaves | Toronto | 4.00 | 3.93 | 3.95 | De.15, Ja.2,QX 0.05 |
| **GOLD AND SILVER** | | | | | |
| Black Oak | N. Y. Curb | | | *81 | |
| Con. Cortez | N. Y. Curb | *10 | *10 | *10 | |
| Con. Virginia | San Francisco | | | 5½ | |
| Continental Mines | N. Y. Curb | 1¼ | 1¼ | 1¼ | |
| Dolores Esperanza | N. Y. Curb | *26 | *26 | *26 | Jy.1, Jy.10 Q 0.05 |
| Premier Gold | N. Y. Curb | 2⅜ | 2¼ | 2⅜ | De.22, Ja.5,QX 0.10 |
| Tonopah Belmont | N. Y. Curb | *54 | *50 | *54 | Apr., 1923 0.05 |
| Tonopah Divide | N. Y. Curb | *21 | *20 | *20 | Se. 22, Oc. 10 0.10 |
| Tonopah Extension | N. Y. Curb | 3 | 2⅜ | 2 1/16 | De.11, Ja.1 0.05 |
| Tonopah Mining | N. Y. Curb | 1⅜ | 1⅛ | 1⅛ | Se.20, Oc.31 0.07½ |
| Unity Gold | N. Y. Curb | *70 | *65 | *70 | |
| West End Consol. | N. Y. Curb | | | *46 | Mar., 1923 0.05 |
| Yukon Gold | N. Y. Curb | | | *50 | June, 1918 0.02 |
| **SILVER-LEAD** | | | | | |
| Ahumada | Boston Curb | 8⅛ | 7⅞ | 8⅛ | De.15, Ja.2, X 0.15 |
| Bingham Mines | Boston | 27¼ | 26 | 27⅛ | De.20, Ja.2 0.50 |
| Cardiff M. & M. | Salt Lake | 1.10 | 1.10 | 1.10 | De.16, No.18 0.10 |
| Chief Consol. | Boston Curb | 3¾ | 3⅜ | 3⅜ | Ap.19, My.1,Q 0.10 |
| Columbus Rexall | Salt Lake | *26 | *26 | *26 | Aug., 1920 0.03 |
| Consol. M. & S. | Montreal | 47½ | 47½ | 47½ | De.11, Ja.15 0.75 |
| Daly Mining | Salt Lake | | | 1.50 | July, 1920 0.10 |
| Eruption | Boston Curb | 2½ | 2¼ | 2½ | De.15, Ja.2, X 0.15 |
| Federal M. & S. | New York | 23½ | 22 | 23½ | Jan., 1909 1.50 |
| Federal M. & S. pfd. | New York | 64½ | 59½ | 63¾ | No.25, De.15, 1.75 |
| Florence Silver | Spokane | 5¼ | 5 | 5¼ | Apr., 1919, QX 0.01 |
| Hecla Mining | N. Y. Curb | *13⅛ | *10¼ | *12⅜ | No.15, Dn.15 0.25 |
| Iron Blossom Con. | N. Y. Curb | *26 | *26 | *26 | Oc.25, 1924 0.02½ |
| Marsh Mines | N. Y. Curb | | | *5 | June, 1921 0.02½ |
| Park City | Salt Lake | 5 | 5 | 5 | De. 15, Ja.4 0.15 |
| Park Utah | N. Y. Curb | | | 3½ | Mc. 15, Ap. 1 0.15 |
| Prince Consol. | Salt Lake | *18½ | *17½ | *18½ | |
| Silver King Coal | Salt Lake | 5.50 | 5.50 | 5.50 | De.20, Ja.2, Q 0.50 |
| Silversmith | Spokane | *30 | *29 | *30 | Ja. 1, Ja. 10 0.02 |
| Tamarack-Custer | Spokane | 1.02 | *95 | 1.01 | Se. 22, Se. 29 0.25 |
| Tintic Standard | Salt Lake | 9.50 | 7.75 | 9.10 | Ja.2, QX 0.50 |
| Utah-Apex | Boston | 3⅞ | 3⅜ | 3⅜ | Se.5, Se.15, Q 0.25 |
| **IRON** | | | | | |
| Bethlehem Steel | New York | 50⅜ | 48¼ | 50 | Jn.1, Jy.1, Q 1.25 |
| Char. Iron | Detroit | *28 | *25 | *28 | |
| Char. Iron pfd. | Detroit | *80 | *75 | *75 | |
| Colorado Fuel & Iron | New York | 44 | 41 | 43½ | Au.11, Au.25,Q 2.00 |
| Col. Fuel & Iron pfd. | New York | | | 108½ | No.10, No.26 Q 2.00 |
| Gt. North'n Iron Ore | New York | 35 | 33 | 34⅜ | De.10, De.27 2.00 |
| Inland Steel | N. Y. Curb | | | 4 | No.14, De.1, Q 0.62½ |
| Mesabi Iron | N. Y. Curb | | | 2¼ | |
| Replogle Steel | New York | 22⅜ | 20 | 21¼ | |
| Republic I. & S. | New York | 60¼ | 55½ | 60¼ | May, 1921 1.50 |
| Republic I. & S. pfd. | New York | 93 | 91¼ | 92½ | De.16, Ja.2, Q 1.75 |
| Sloss-Sheffield S. & I. | New York | 84 | 81½ | 83½ | Se.11, Se.20, Q 1.50 |
| Sloss-Shef. S.&I. pfd. | New York | 95 | 94 | 95 | De.20, Ja.2, Q 1.75 |
| U. S. Steel | New York | 120½ | 117⅜ | 119⅝ | No.29,De.3, QX 1.75 |
| U. S. Steel pfd. | New York | 122½ | 121⅜ | 122⅜ | No.4, No.29, Q 1.75 |
| Virginia I. C. & C. | New York | | | 41½ | De.15, Ja.2 1.50 |
| Virginia I.C.&C.pfd. | New York | 80 | 79 | 79 | De. 13, Ja. 2, Q 2.50 |
| **VANADIUM** | | | | | |
| Vanadium Corp. | New York | 32⅛ | 29⅜ | 30½ | Jan., 1921 1.00 |
| **ARSENIC** | | | | | |
| Western Utah Copper | N. Y. Curb | | | *15 | |
| **ASBESTOS** | | | | | |
| Asbestos Corp. | Montreal | | | 36 | Se.29, Oc.15 Q 1.00 |
| Asbestos Corp. pfd. | Montreal | 73½ | 73½ | 73½ | Ja.2, Ja.15, Q 1.50 |
| **SULPHUR** | | | | | |
| Freeport Texas | New York | 11⅛ | 9⅞ | 11⅛ | Nov., 1919 1.00 |
| Texas Gulf | New York | 110 | 100 | 108½ | De.1,De.15, QX 2.25 |
| **PLATINUM** | | | | | |
| So. Am. Gold & P. | N. Y. Curb | 3⅞ | 3⅛ | 3⅜ | |
| **MINING, SMELTING AND REFINING** | | | | | |
| Amer. Metal | New York | 53⅜ | 49⅞ | 52⅜ | No.19, De.1 Q 0.75 |
| Amer. Metal pfd. | New York | 115 | 115 | 115 | No.20, De.1, Q 1.75 |
| Amer. Sm. & Ref. | New York | 100⅜ | 89 | 99⅜ | Oc.17, No.1, Q 1.25 |
| Amer.Sm.&Ref.pfd. | New York | 107⅝ | 106⅜ | 107½ | No.17, De.1 Q 1.75 |
| U. S. Sm. R. & M. | New York | 41½ | 36 | 40⅜ | Jan., 1921 0.50 |
| U.S. Sm. R.&M.pfd. | New York | 46½ | 46 | 46½ | Oc.9, Oc.15 Q 0.87 |

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

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