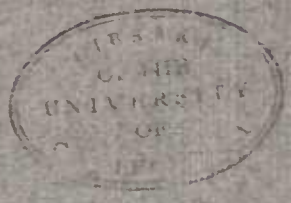
THE NEW

ANACONDA



Eugene Meyer Jr. & Co.
14 Wall Street
New York

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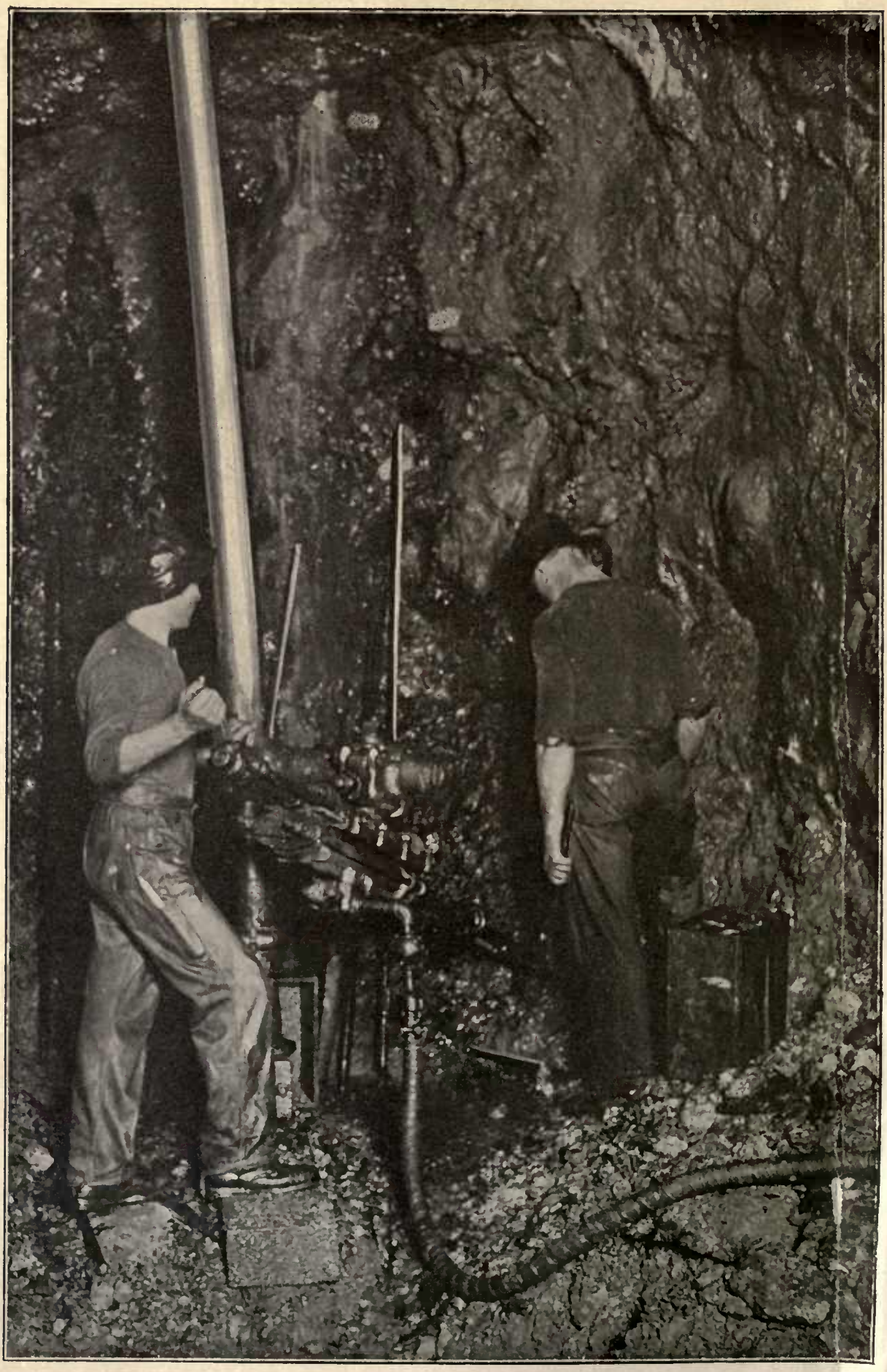
July, 1916

The information and data contained in the following pages are the result of careful investigations by us. While we cannot guarantee the correctness of the statements and figures, we have secured them from sources which we believe to be reliable.

EUGENE MEYER JR. & CO.

New York, July 14, 1916.



Compressed air drill in operation in one of Anaconda's mines. This shows the fundamental operation in mining—the starting-point of the Company's vast business. All of the wealth which Anaconda has produced has had its origin in the ore drilled and blasted as shown here.

THE NEW ANACONDA

For more than a third of a century, the group of mines now owned by Anaconda has produced more copper and more silver, far and away, than any other district in the world; it has produced nearly one-third of all the copper mined in the United States during the past third of a century, and nearly one-sixth of all the copper mined in the world; it has outdone such famous mines as Rio Tinto and Calumet & Hecla during this long period, by a ratio of almost three to one.

It is not in the past, however, that the chief interest in this great property centers—it is rather in Anaconda's present and Anaconda's future—a present and a future which promise to rival even the extraordinary record of Anaconda's past.

* * * * * * *

Anaconda is mining, reducing, and marketing today at the rate of 330,000,000 pounds of copper annually—approximately one-fourth of the copper produced in the United States, and one-seventh of the copper produced in the whole world; in addition, it is refining and selling the mined product of other companies, in some of which it has part ownership to the extent of 240,000,000 pounds; thus making a grand total of 570,000,000 pounds of copper—more than one-third of all the copper product of the United States and nearly one-fourth of the total copper production of the world—which it treats and markets.

Anaconda, besides its copper, is producing annually, 13,000,000 ounces of silver, 150,000 ounces of gold; is smelting and refining at its custom plants an additional 4,000,000 ounces of silver and 100,000,000 pounds of lead; it will, within a few months, be producing at the rate of 70,000,000 pounds per annum of high-profit zinc.

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As a result of the increase in the industrial importance of copper, the past few years have seen marked advances, generally, in mining and reduction processes. The ever growing demand has furnished incentive to perfect methods of treating low-grade copper ores which never had been treated profitably before.

With the discovery of new methods and the opening of new low-grade mines, public interest, during the past few years, has been largely drawn toward properties of the type commonly designated as Porphyries.

Interest in this new type of copper mine has been well founded, for these properties have demonstrated beyond question or doubt their status as economical producers of copper.

Too great credit cannot be given to the enterprising, courageous managers and backers of these properties; without their daring foresight and patient work the price of copper might permanently have ruled so high as to retard, seriously, the rapidly growing application of electricity in all departments of life. Their achievements, therefore, may be regarded as an important step in the march of civilization, because, today, electrical development measures the pace of civilization.

It is quite natural that the eyes and the minds of the industrial world should have been centered on these new and great properties, to the exclusion, almost, of every other copper interest.

It is equally natural, likewise, that the quiet and gradual revolution being brought about in the Anaconda property during the past few years should have escaped general attention.

Yet developments as great and as important as the development of new properties, have been brought to a successful head in Anaconda.

Few realize that, in spite of the remarkable progress of the Porphyry group, Anaconda at the present time is producing each month twice as much copper as the great Utah Copper Company; and that it produces monthly considerably more than one-half as much copper as Utah, Inspiration, Nevada, Ray, Chino, Miami, Chile and Braden, together.

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Only those who have followed it closely, know of the transformation which has been wrought in Anaconda; and few realize that a new Anaconda has been brought into being, which promises to outdo the old Anaconda as the old Anaconda has outdone all of the other mines of the world.

With the consolidation in 1910—by which the old Anaconda, the Boston & Montana, the Butte & Boston, the Parrot Silver & Copper, and a number of other properties in the Butte district were unified—the basis was laid for the New Anaconda. It was the consolidation of these various properties into one great company which permitted and warranted the vast expenditure which has been gradually made during the past few years.

The recent transformation of Anaconda has been made possible partly through the development of the Montana Power Company's hydro-electric power and its scientific application to mining; partly through the invention and perfection of new metallurgical processes.

Not only will Anaconda from now on be a greater producer than ever of copper, silver, and gold, but it promises, for the first time in its history, to become one of the world's important producers of zinc.

The changes which have been wrought in Anaconda have accomplished three things:

(1) Increased the scale of operations;
(2) Prolonged the life of the property;
(3) Increased the annual profit from operations;
    (a) By increasing the proportion of metals recovered from the ores;
    (b) By decreasing the cost of production.

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The work of developing processes and properties in a company like the Anaconda never ceases; but the present moment seems to signalize the fruition of years of interesting and important work; and it is therefore deemed an opportune time to review the progress of the company.

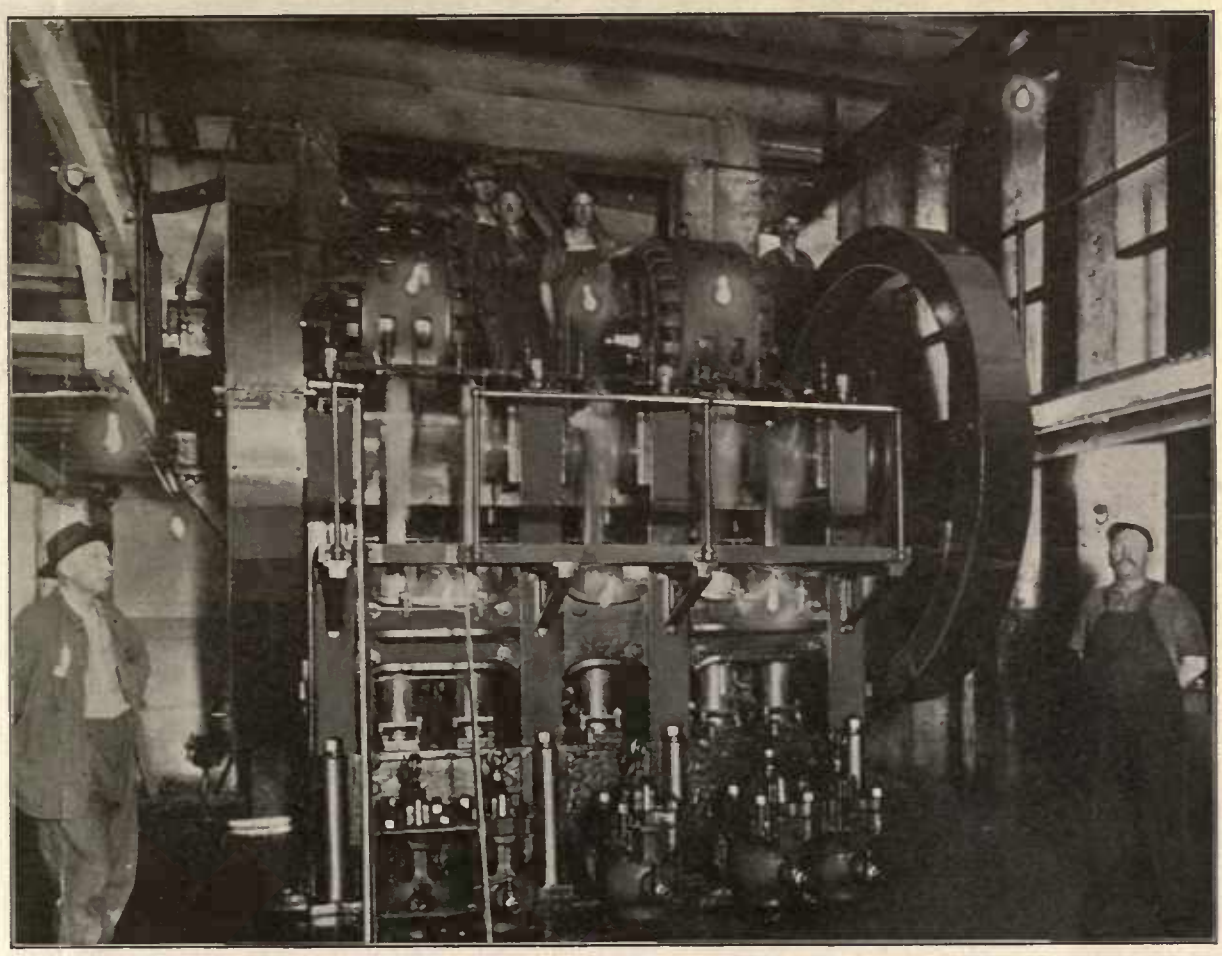
ANACONDA ELECTRIFIED

In mining and metallurgical operations one of the principal factors is power; power to operate the drills; power to transport the ores through the tunnels to the shafts; power to hoist them to the surface; power to transport them to the smelters; power to crush them; power to separate the metals from the valueless portions of the ores; power to refine the metals; power to pump the water from the lowest levels of the mines, and the water needed for metallurgical purposes; power to perform every possible operation in a manner that will save labor, speed up production and reduce costs.

In the early years of its operation, Anaconda depended upon steam power, man power and mule power; steam power for hoisting, transportation and pumping, and for compressed air for the drills; man power and mule power for bringing the ores through the underground workings of the mines to the hoisting shafts.

Gradually its steam power was centralized and improved. Large air compressing plants, operated by steam engines, furnished compressed air as power not only for the operations of the drills underground but also for hoisting and other purposes on the surface.

Anaconda produced its steam power under conditions by no means unfavorable. It owned its own coal properties near Great Falls, Montana, near Billings, Montana, and in the Diamond Fields, Wyoming; the coal was of fair quality, and transportation costs to Butte were not excessive. Yet even under such favorable conditions of

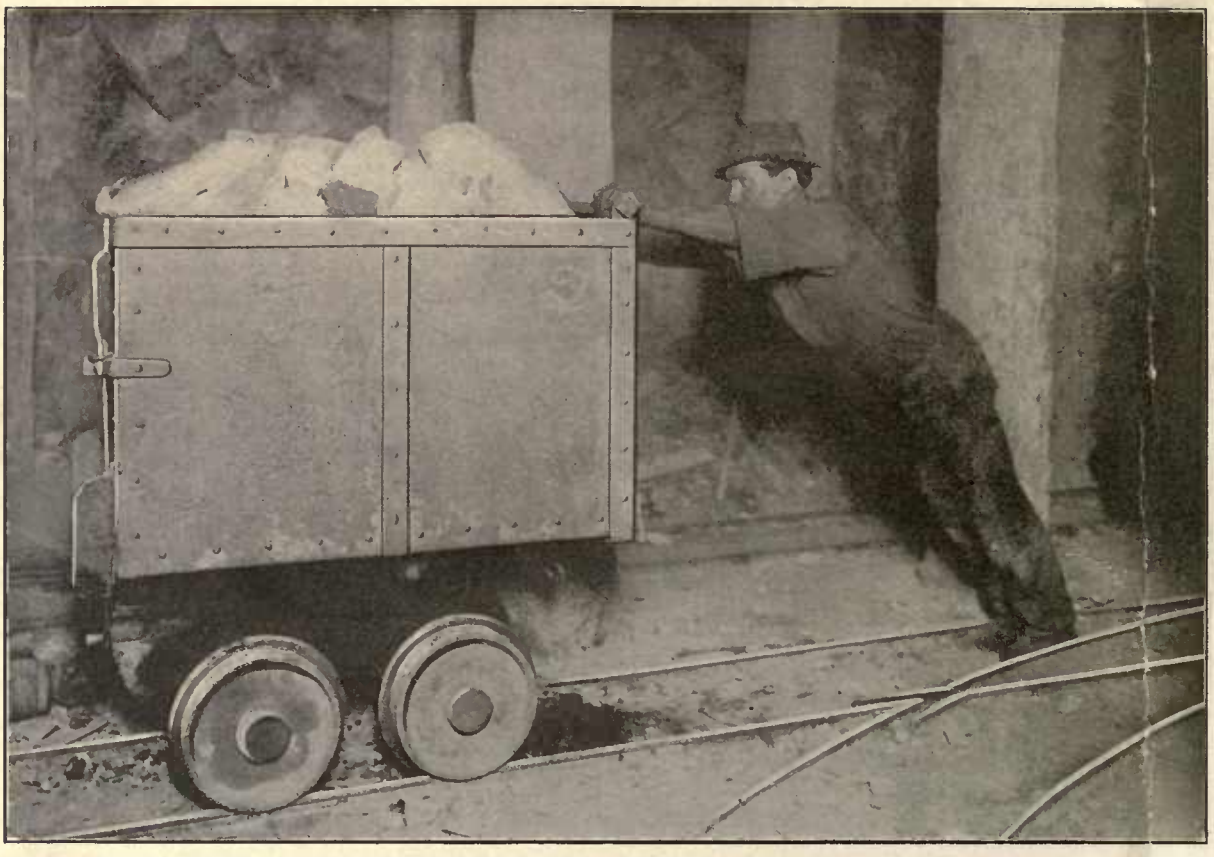


ELECTRIC PUMP ON THE 1800 FOOT LEVEL OF THE TRAMWAY MINE

Six million pounds of copper are recovered annually from the waters pumped from Anaconda's mines. The copper so recovered, at normal prices of the metal, returns a small profit over the entire cost of pumping the water from the properties, and, of course, at the present prices, a very handsome return.

coal supply there is a limit to which the cost of steam power can be reduced, and that limit is by no means a low one; and steam power lacks the flexibility needed in power for mining and milling operations. There is necessarily difficulty in producing economically small quantities at isolated stations; transmission of power either by steam or by compressed air involves a serious loss through friction or through changes in temperature; and in countless ways steam falls far short in producing an ideal source of power for mining and metallurgical operations.

The ideal power supply for Anaconda, it was long ago recognized, would be electricity; electricity which can be carried to any point, with but infinitesimal loss of power, with minimum investment in transmission facilities, involving only stringing of wires instead of laying pipes; a flexible supply of power, available at any point for all operations at the throwing of a switch.



In former years the ores at Anaconda were transported through the workings of the mines by men and mules. In the New Anaconda, electricity has been made to do all of this tramming at a marked saving, both in time and expense.

Anaconda was fortunate in its earlier years in that the foresight of its founders had secured for it an adequate coal supply; but it was still more fortunate, as the ever-increasing scale of its operations demanded more power, and a more flexible power, in finding even nearer at hand an ample natural source of electric power.

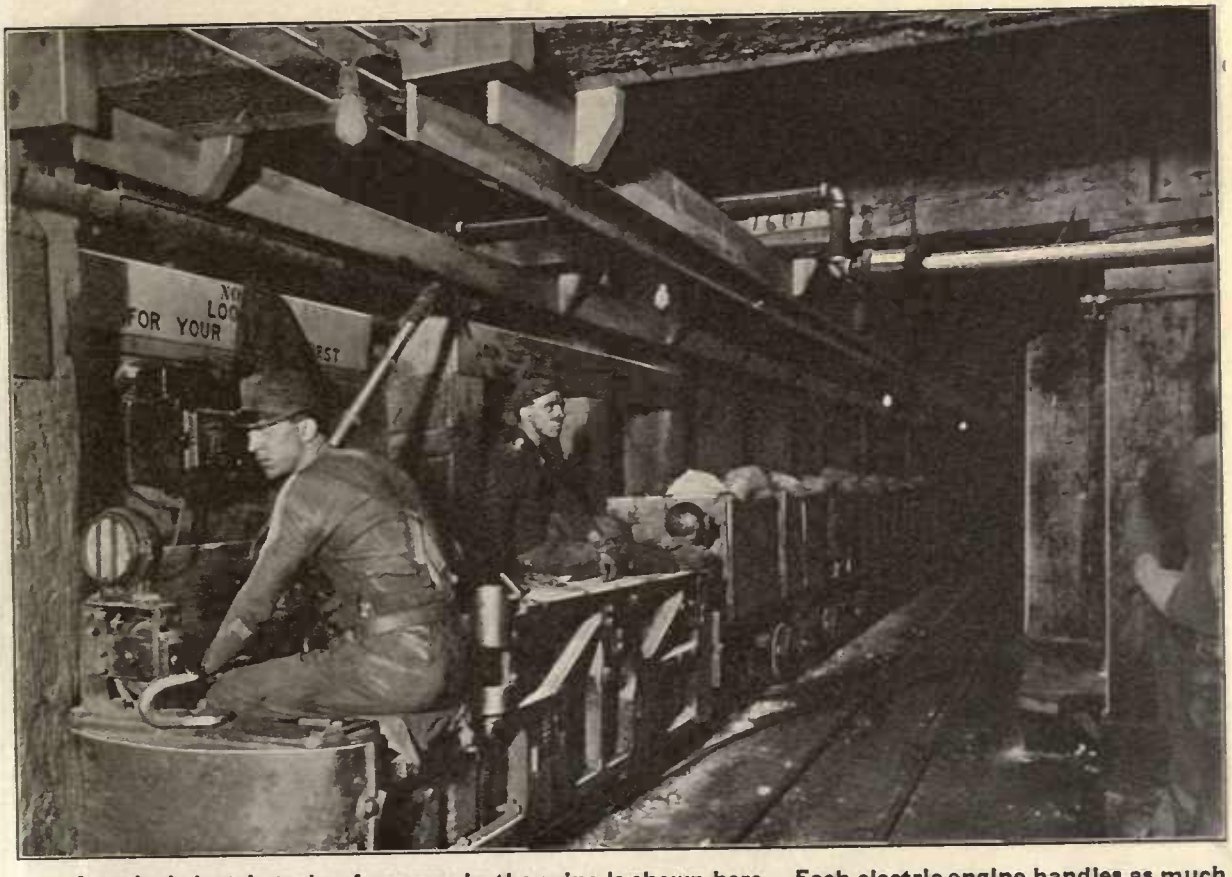
In Montana the streams rise in the mountains at elevations of 5,000 feet to 8,000 feet. These streams leave the State line at elevations of 2,400 feet to 3,500 feet. Many opportunities were, therefore, presented on these streams for the development of electric power, by taking advantage of the natural fall.

Some twenty-five years ago, development of water power in Montana was commenced and Anaconda was one of the first large users. Electric transmission was then in its infancy, and only a minute fraction of the power could at that time be made available. By 1906, the development of electric science was such as to facili-

tate great strides towards carrying power from distant sources to points of consumption. From that time on a number of hydro-electric plants were constructed by various companies, and the Anaconda Copper Mining Company commenced to electrify its operations as far as possible from the scattered power developments available.

With the year 1910 began a new era in Montana's history, for in that year commenced the rounding-up, interlacing and combining of water powers, which resulted in the formation of the Montana Power Company in 1913, through which practically all of the important power developments of this State were welded together into one immense system.

The Montana Power Company operates a series of hydro-electric plants situated along the upper reaches of the Missouri River and its tributaries. Most



A typical electric train of ore cars in the mine is shown here. Each electric engine handles as much as twenty-four men formerly handled and at twice the speed.

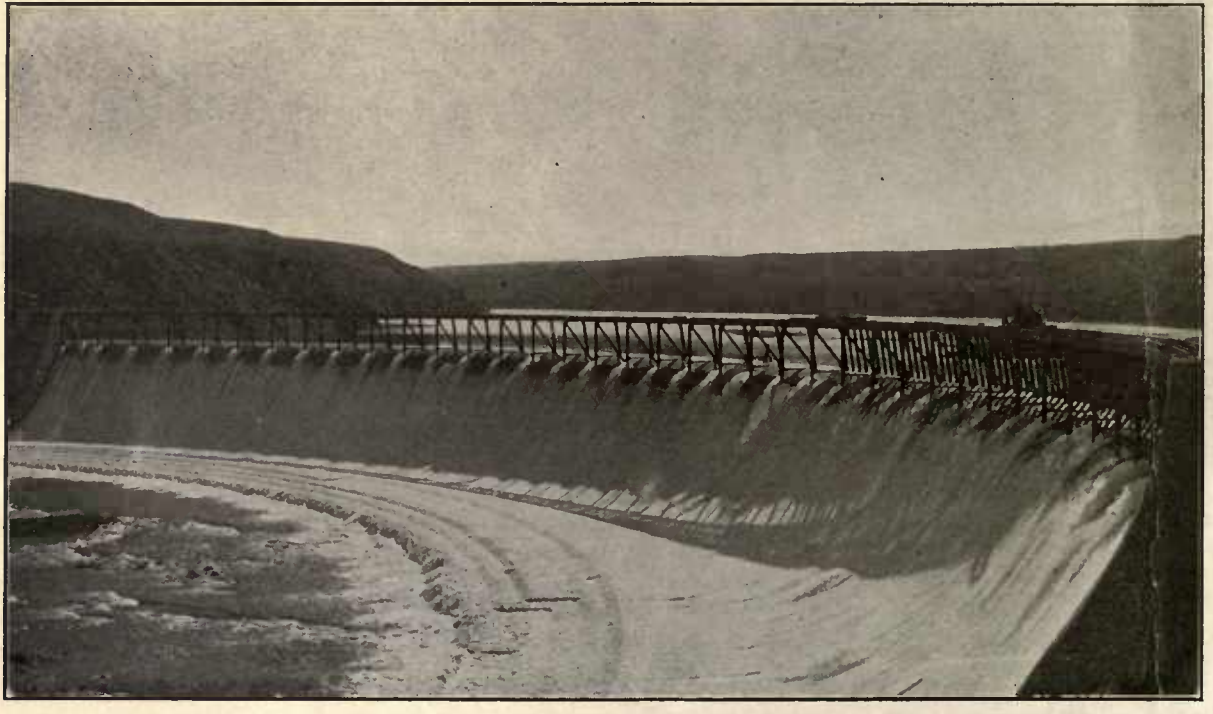
of the plants are so situated that the same flow of water is used over and over again through successive dams and water wheels located along the stream in steps one below the other; and all these are regulated by a great storage reservoir at the headwaters of the Madison River, one of the principal branches of the Missouri.

The dams and transmission lines of the Montana Power Company, ideally designed to supply power for Anaconda's needs, are tied together in such a manner that, in the event of failure at one installation, the load may be readily taken care of with current from other points, thus insuring a service far more reliable even than that which steam could offer.

The power requirements of Anaconda are immense. By the end of 1916, Anaconda will be using in mining, hoisting, pumping, concentrating, smelting, refining, and in the operations of the railroad which transports its ores, 126,000

SCENE AT GREAT FALLS—BEFORE AND AFTER

The upper picture shows Great Falls before copper made electricity available as a source of power. The lower picture shows Great Falls developed, which now makes copper available at lower costs of production.



horse power, or 700,000,000 kilowatt hours annually—an amount of current 50% in excess of the power consumption of New York City's underground and overhead rapid transit lines in Manhattan.

No individual or isolated plants could warrant Anaconda in equipping entirely for electrical operations, but the combination of all available powers by the Montana Power Company furnished such absolute security for continuous service that complete electrification became possible. By the end of 1915, when Anaconda's electrification program was completed, the Montana Power Company had an

installed capacity of 172,800 horse power; with plants under construction, to be completed during the years 1916 and 1917, an additional 106,600 horse power will be furnished; undeveloped water powers, now held in reserve, will furnish, when required, 162,000 additional horse power.

It has been this great consolidation of existing water powers and development and control of new ones that has made the electrification of Anaconda possible; and Anaconda buys current from these at a price one-third of what it formerly cost the company to generate its own power by steam.

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From an economical standpoint, the Anaconda Copper Mining Company has found it advantageous to centralize many of its operations at favorably located points. The ore mined in Butte, for example, is taken for treatment to Anaconda, a distance of twenty-two miles, over the Butte, Anaconda and Pacific Railroad, 51% of whose stock is owned by the company. In 1913 the steam locomotives formerly

Anaconda's ores are transported from Butte to Anaconda over the Butte, Anaconda & Pacific Railway, in which railway the Anaconda Copper Mining Company is a controlling shareholder. The railway is now completely electrified and was a pioneer in this improvement, being followed by the Chicago, Milwaukee & St. Paul and the Norfolk & Western.

operated on this road were replaced with electric engines driven by power from the transmission lines of the Montana Power Company. This improvement resulted in an immense increase in capacity with a great reduction in operating costs.

The electric engines now in use on the Butte, Anaconda & Pacific handle from sixty-five to seventy fifty-ton ore cars to each train, as against fifty of the same cars formerly handled by each steam locomotive, in addition to carrying them at greater speed.

In proportion to their weight, it is found that the electric locomotives do twice the work that the steam engines were capable of, cutting labor and power costs in half, besides effecting a considerable saving in repair expenses. In money, the electrification of the railway saves almost $200,000 a year at the present rate of

operations, and at the same time has increased the amount of tonnage which the road is able to handle without increasing the trackage facilities.

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Another example, illustrating the extent to which electrification has been one of the principal factors in bringing about the New Anaconda, is to be found at the company's refinery at Great Falls, Montana.

As early as 1891 it was recognized that these Falls would furnish a cheap source of electric power, which is so large an item in the electrolytic copper refining process, and a copper refinery was erected immediately beside them.

As the further development of power at Great Falls made available power sufficiently cheap to overcome other factors, especially labor, making for cheaper costs in the Eastern refineries, a large new refining plant was erected at Great Falls during the year 1915. The old refinery here had a capacity of 60,000,000 pounds of copper annually; the new one is of the most modern type, and has a capacity of 180,000,000 pounds annually. All told, the Great Falls plant is now refining at the rate of 240,000,000 pounds of copper annually or around 15% of the entire production of the United States.

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Applied to all the power needed for mining reduction and transportation operations, electrification has meant a saving of from $3,500,000 to $4,000,000 annually, as against what could be done with steam power under present conditions and at the present rate of operation, and much more as against what was done with the isolated steam plants in use before electricity was substituted. Applied to the present rate of production, this means a saving of somewhat more than one cent per pound in the cost of producing copper.

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Everywhere in Anaconda's vast property, electricity is doing steam's work better, cheaper and more reliably.

But if Anaconda owes much to electricity, electricity on the other hand owes much to Anaconda.

More than 50% of all the copper mined in the world is manufactured into electrical equipment.

Without copper, electricity could not have advanced to its present state; and Anaconda being the world's greatest producer of copper, must thus be credited as an important influence in the development of electricity.

In Anaconda's early history there were no hydro-electric plants; the production and long-distance transmission of power was only a vision.

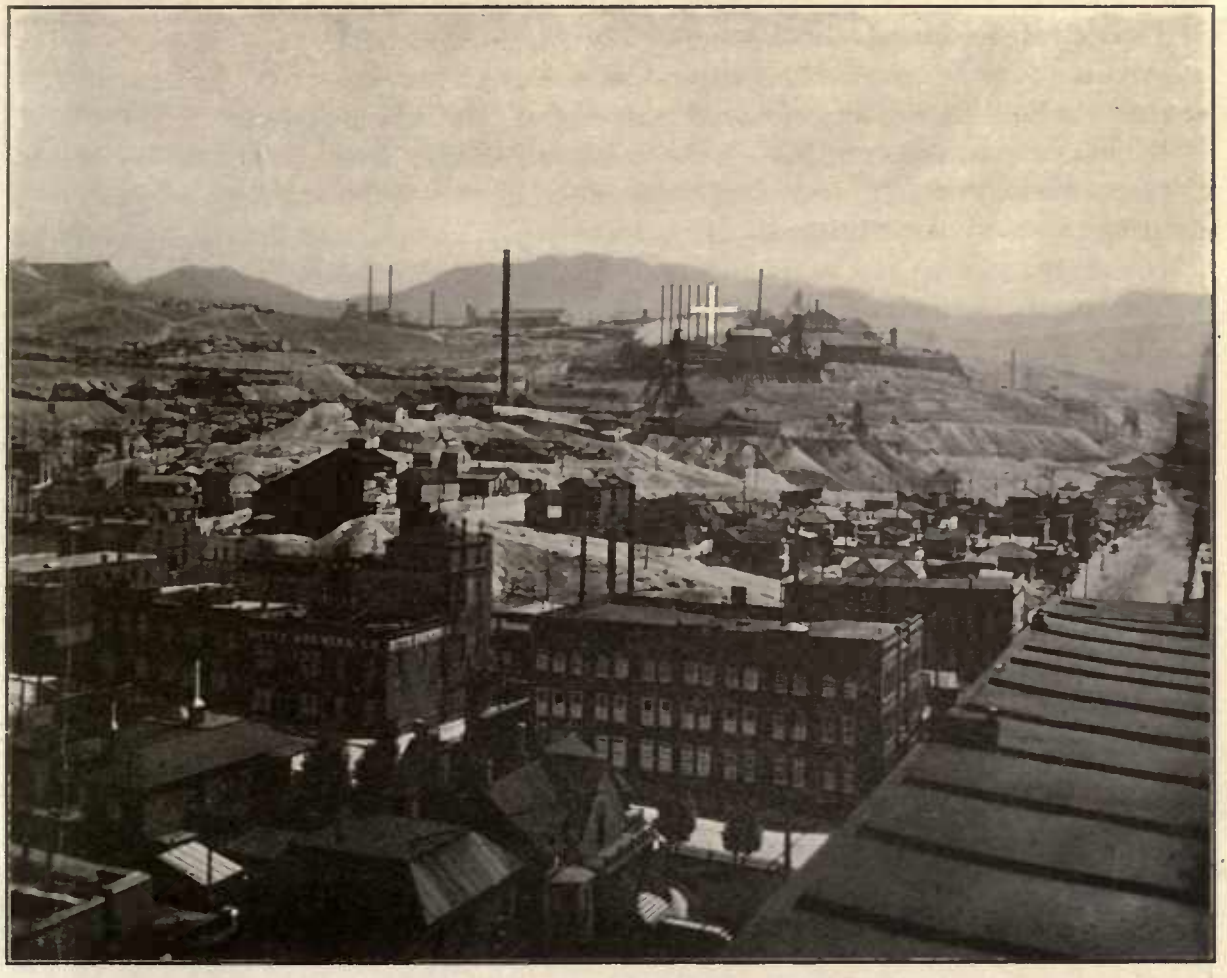
But as Anaconda, chief among the copper mines of the world, produced the material needed for the manufacture and transmission of electricity, electricity, in turn, made available the power which enables Anaconda now to enlarge her operations and reduce her costs.

The very copper dug out of Anaconda's mines, worked up into machinery and instruments and miles of copper wire, now enables Anaconda to enjoy the cheapest, most reliable power possible to produce, whether on the surface or a half mile underground, merely by the throwing of a copper switch.

THE TRANSFORMATION OF ANACONDA'S PROCESSES

In order that Anaconda's chemical and mechanical process-improvements may be made clear, the nature of the mining operations and reduction problems will be briefly summarized.

The properties owned by Anaconda in the Butte District comprise a solid block of ground running two miles east and west and one mile north and south. In this block some twenty-six separate mines are located. The ores occur in veins of from five to two hundred feet in width. These have been actually developed to a depth of 3,400 feet—and are known to extend much deeper—although the bulk of the ore now being extracted is taken from above the 2,400 foot level.



A SCENE IN THE CITY OF BUTTE

Anaconda's twenty-six mines are located in a solid tract, much of which is within the city limits. The large headframe marked with a cross is that of the Neversweat shaft.

The mining operation consists in sinking a central shaft and tunneling out the veins of ore.

The ore itself consists of rock, carrying sulphides (together with a percentage of arsenides), of copper, iron, and silver, with some metallic gold. It averages around 3% copper and two ounces per ton in silver; although in many cases the values are materially higher.

The ores, as hoisted from the mine, consist of irregular pieces of broken rock, most of which are under one cubic foot in measurement.

The first operation, once the ore is above ground and at the mill, is to crush the irregular pieces of ore, in jaw crushers and by roller mills, until it is reduced to the fineness of sand.

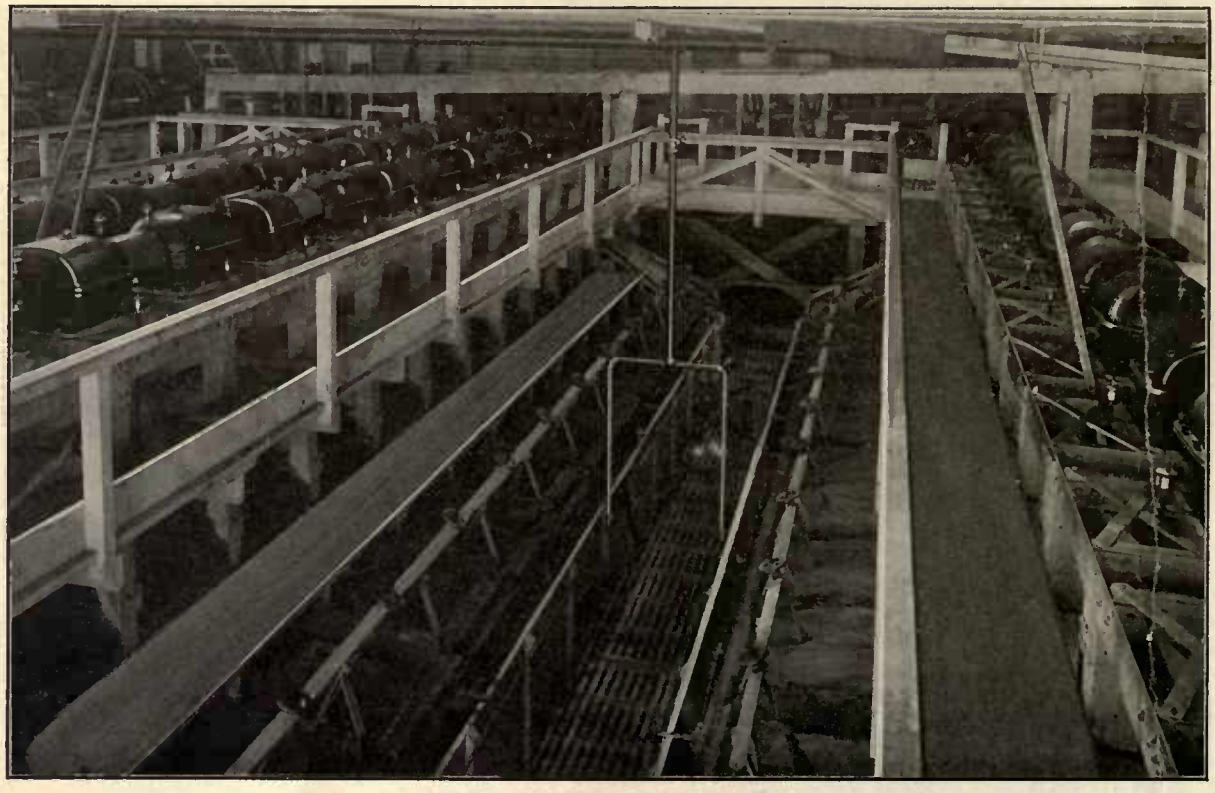
The next operation involves the separation of the metallic sulphides from the quartz and clayey material, called gangue, which comprises the bulk of the ore.

As will be obvious, it is cheaper to remove as much as possible of the worthless gangue before subjecting the ore to the comparatively expensive operation of smelting.

In the early days of copper mining the metal-bearing sulphides and arsenides were picked out of the ore by hand. Later it was found that by washing the ore in water the clayey portions could be floated away, and the heavier metallic portions which were desired to be retained, would sink to the bottom. This process, the one now generally in use, and up till recently the only practicable process known, is called water concentration.

Anaconda, however, has, within the past year, added a new process in concentrating its ores, which, in fact, consists of concentration upside down.

This process involves taking the coarser particles from the water concentration machines, grinding them and treating them with acid and oil. The mixture is then agitated by revolving propellers, whereupon the oil rises to the surface in a froth, carrying with it the finely divided metal sulphides and arsenides while the lighter gangue material sinks to the bottom.



A View in the Slime Flotation Plant

An idea of the importance of this single new method may be gained from the fact that prior to 1915 Anaconda found it impracticable to separate more than eighty-two per cent. of the copper in the ore. With the flotation machines installed, however, the recovery of copper in concentrates has been increased to ninety-six per cent. After allowing for all later losses such as those of smelting, converting, and refining, the net result of the new means of concentrating is that the final

recovery of copper has been increased from seventy-seven per cent. at the beginning of 1915, to ninety per cent. at the present time.

On the basis of ore containing three per cent. copper, this increased recovery, involving slight extra expense, represents about eight pounds of additional copper per ton of ore treated, with proportional increases in the recovery of gold and silver.

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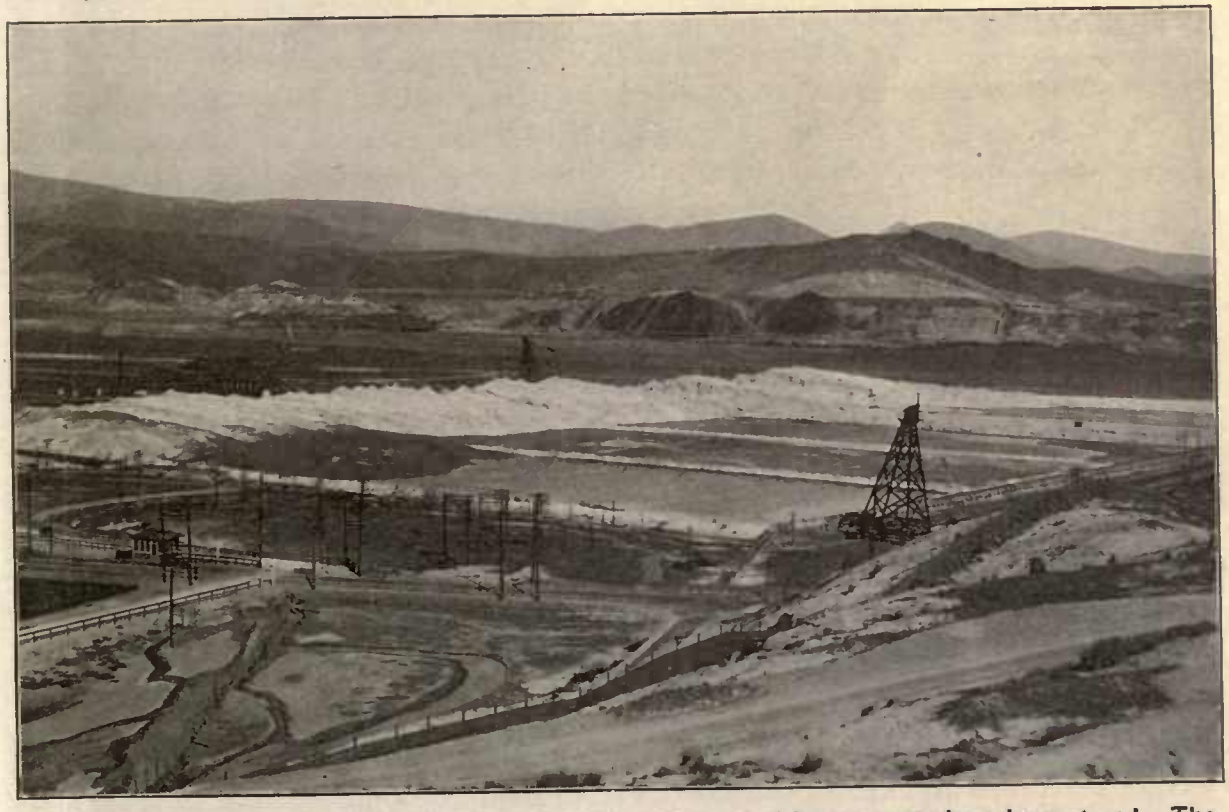
In the process of water concentration there was formerly at Anaconda a large loss of copper in what are known as the slimes. The slimes are those very fine parts of the crushed ores which, because of their fineness, cannot be successfully treated by water concentration. By weight they comprise almost one-fifth of the original ore, and assay approximately 2% copper.

The recovery of copper from the slimes has, in former years, been the subject of continuous experimentation. It has been realized almost from the beginning that these slimes might eventually be capable of treatment, and they have accordingly been run off into large slime ponds where they have been stored. After many efforts, the company's metallurgists finally evolved a process which permitted the recovery of a considerable part of the copper content of the slimes—quite successfully. But the oil flotation process has solved the problem completely; by means of this process the old slime accumulations are being re-treated with a recovery of ninety per cent. of their metal content.



Slime Ponds on the flat below Anaconda, where the slimes of former years have been stored. The metal values in these slimes are now being recovered by the oil flotation process.

The accumulation of slimes of former years now amounts to about 700,000 tons; this is being worked over at the rate of about 1,000 tons a day.

At this rate the operation is adding nearly 1,000,000 pounds of copper per month to production at a cost of about five cents a pound—an operation treating only what had been formerly considered waste material, and which, at the present rate, will continue for more than two years. The total metal value, thus,

which can be recovered from old slimes, amounts to nearly 30,000,000 pounds of copper, with silver and gold proportionately; produced at about one-half the cost of copper produced direct from the crude ore.

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An additional loss in metal values, in former years, arose from the fact that the coarser particles of the material carried off a considerable percentage of the copper and silver. These coarse particles, known as tailings, ran quite uniformly eleven pounds of copper to the ton.

As in the case of the slimes, it was realized that their metal values might some day be recovered and the tailings, accordingly, were stored up separately in large piles.

As will be seen, the oil flotation process, although efficient in the case of the slimes, could not be made available for the recovery of metals from the coarser tailings without regrinding them at additional expense.

To accomplish this recovery, a process, known as sulphuric acid leaching, was perfected.

By means of this process, the tailings are taken up from their old piles and, after roasting, are placed in large vats where the copper and silver contents are dissolved out in a weak solution of sulphuric acid. This acid is then run through tanks containing scrap iron which precipitates the copper and silver in an impure metallic form, from which it can be readily recovered and refined at slight expense.

The first essential in a process of this sort is a cheap supply of sulphuric acid. This, the company has obtained through the construction of a sulphuric acid plant at Anaconda, with a capacity of 150 tons of acid per day. The acid is manufactured from a by-product of the company's own operations—the sulphur gases thrown off in the process of roasting. This plant produces acid at a cost sufficiently low to make the enterprise a profitable one aside from the company's need for acid.

The leaching plant in which the tailings are treated has now a capacity of more than 2,000 tons per day and recovers about eighty-five per cent. of the total metal content of the tailings. Its annual recovery amounts to 7,000,000 pounds of copper at a net cost of eight and one-half cents per pound.

As the old tailing piles contain more than 20,000,000 tons, there is enough of this material available to enable the leaching plant to continue production at the present rate for nearly thirty years. These tailing piles, as will be seen, are capable of being converted into 200,000,000 pounds of copper at less cost than copper can be taken direct from the mines.

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The concentrated ore, whether direct from the mines, or from the slime ponds, having been separated from the worthless material, or gangue, must next be subjected to treatment to eliminate as much as possible of the sulphur and arsenic.

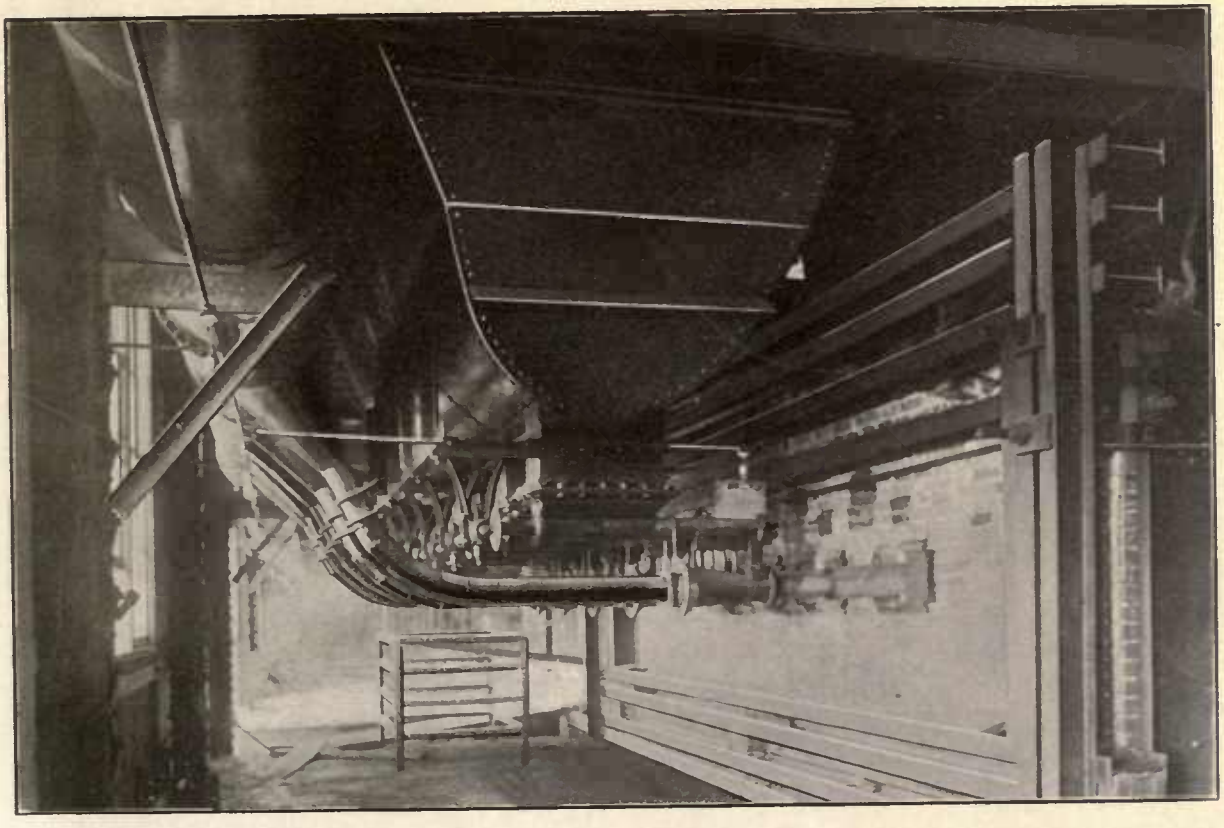
This is done in large roasting ovens. On circular decks twenty-two feet in diameter, the concentrate is roasted at a high temperature, being continually moved in position by automatic rakes.

When the roasting is completed, there comes next the important operation of smelting, by which the concentrates are brought to a point where they contain about one-half copper, silver, and gold, the other half being iron, sulphur and impurities.

For many years Anaconda's smelters have been recognized as pioneers in the art. More than ten years ago the blast furnaces were lengthened from fifteen to fifty feet, with an immense increase in capacity and a consequent cheapening in operation.

The improved blast furnace, however, is now being rapidly supplanted in Anaconda by a highly perfected type of reverberatory furnace. The reverberatories get their name from the fact that, by reason of their shape and construction, the flames are reflected down upon the mass of molten metal. Until recently, the heat for these was furnished by coal shoveled into fire boxes in front by hand. Now, however, a still further improvement has been wrought. Coal from Anaconda's own mines is first dried and ground to a fine powder; it is blown into the reverberatory furnaces burning as a blast, forming a flame similar to that of burning gas.

Under the former practice of hand-firing, each reverberatory treated 225 tons of concentrates a day with a consumption of sixty-two tons of coal. Under the present practice each furnace treats 585 tons of concentrates per day with a consumption of ninety-five tons of coal. Under hand-firing, thus, the plant was using one ton of



Coal Dust Storage and Burners of one of Anaconda's Reverberatory Furnaces.

coal to each four tons of charge, whereas by the new process, 6.8 tons of charge are treated by each ton of coal burned. In addition to an increase of 160 per cent. in the output of the furnaces, lessened operating costs, by reason of the reduction in labor requirements, have resulted in a further saving of fifty cents per ton of concentrates treated.

The saving in smelting under the new practice is more than sufficient to offset the increased cost in concentration by the new oil flotation process, thus reducing the net cost of treatment per ton of ore in the face of a seventeen per cent. increase in recovery.

The product remaining after the smelting operation is called matte. The next problem is to remove the iron and sulphur from the matte, leaving the copper, silver and gold in metallic state.

This is accomplished by the operation of converting.

The molten matte is poured into a large cylindrical receptacle called a converter, through openings in the side of which air is admitted under pressure. The oxygen in the air burns off the sulphur and oxidizes the iron. By the addition of silicious ores, the iron oxide forms a slag which floats on the surface and is skimmed off. At the conclusion of this operation, the copper remains in the converter in an impure metallic form, carrying the gold and silver values.

There have been two important gradual developments in Anaconda's methods of converting.

First, the capacity of each converter has been raised from two and one-half tons of copper per charge to thirty-seven tons of copper per charge, the amount of labor and supervision required being approximately the same. This, as will be seen, has brought about a fifteen fold increase in output with a material reduction in the unit costs of converting.

Second, the earlier practice of converting involved lining the converter with a silicious material which was eaten away as the charge was blown, being intended to furnish a flux to slag the iron oxide during the operation. After five charges had been blown, the lining was eaten away nearly to the outside steel shell and the converter had to be shut down, cooled, and a new lining put in. Under the new converting practice, the converter shell is lined with magnesite brick which has a comparatively long life, and the silicious material to slag the iron oxide is added by dumping it into the top of the converter. Not only has this change saved the material and labor of putting in new linings, but it has brought about a great increase of capacity in each converter by reason of the fact that little time is lost in frequent relining; some 50,000 tons of copper can now be converted before relining is necessary.

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Summing up the operations, from the mine to the refinery, let it be assumed that a start is made with eleven tons of ore from the crushers; resembling in texture a gravelly sand and containing approximately three per cent. copper, silver, and gold, the remaining ninety-seven per cent. being iron, sulphur, arsenic, clay, and worthless material.

By concentration in water and by oil flotation there will be eliminated seven tons, approximately, of the worthless material, leaving four tons of eight per cent. copper.

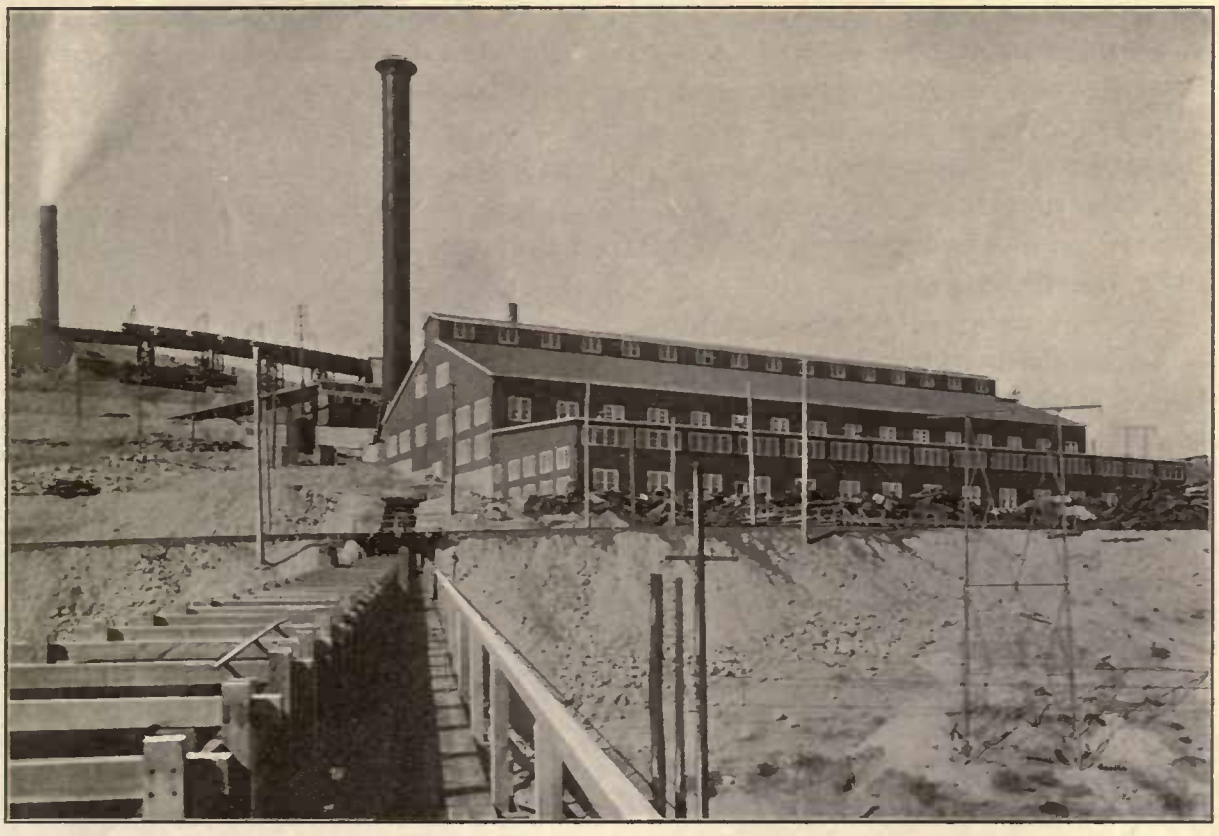
Placing this now in the roaster, a large part of the sulphur is burned off, leaving approximately three and two-tenths tons of material containing ten per cent. copper.

From the roaster, this is placed in the smelter with the result that there is left three-fourths of a ton of matte containing forty per cent. copper.

This matte from the smelter next goes into the converter, leaving three-tenths of a ton which is almost pure copper except for silver and gold and minor impurities.

The copper as it comes from the converter is known as blister copper. In this state it needs but refining—separating out the pure copper, pure silver, and the pure gold, to turn it into articles of commerce.

The process of refining consists of placing castings of blister copper from the converters in lead-lined tanks containing sulphuric acid; at the side of each blister-copper casting is suspended a thin sheet of pure copper. The blister copper castings, now known as anodes, are next connected with the positive side of an electric current, while the thin copper sheets between known as cathodes, are connected with the negative side. By a process, in every respect similar to electro-plating,



A View of the 2,000-Ton Leaching Plant at Anaconda.

the pure copper leaves the anodes and is deposited upon the cathodes. The process, requiring several days, continues until the anodes entirely disappear, all of their copper having been deposited upon the cathodes, while the silver and gold drops to the bottom of the tank in the form of black slime.

The cathodes now are melted and run into ingots, cakes, wire bars, rods and billets of pure copper, while the slimes are smelted for the recovery of their silver and gold contents.

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The improvements in Anaconda's processes may be largely credited to the extensive experimental laboratory which the company has maintained. Here a large staff of metallurgists and research chemists is constantly employed in solving the problems which arise from day to day, and planning improvements for the future.

The laboratories themselves are equipped with machinery similar to the machinery of the main plants, but operating, of course, on a greatly reduced scale.

This department now has under way some research work of the highest importance which gives indications of developing additional returns through the manufacture of chemical by-products from material now discarded.

Within the next few years announcement may be expected of important developments along these lines which, as in the case of the sulphuric acid plant, should bring about considerable additions to the profits of the company.

As yet this experimental work has not sufficiently advanced to permit of any detailed discussion, though it has been carried sufficiently far to justify confident expectations of successful results.

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Anaconda's new processes, summed up, have brought about a net recovery of more than ninety per cent. of the available metals in the ores as against a recovery of only seventy-seven per cent. a year ago—without a penny of extra expense.

Not only have they made possible the recovery of this high percentage from the ores which are now being mined and which are to be mined; they have made possible, in addition, the recovery of the thirteen per cent.—formerly considered impossible to extract—from practically all the ores which Anaconda has mined since the beginning.

Or, to view their results from another standpoint, they have made present reduction methods seventeen per cent. more efficient; and have made available more than 230,000,000 pounds of high profit copper which under the old processes were thrown away.

ANACONDA'S NEW ZINC INDUSTRY

Some of the ores of the Butte District have always been known to contain zinc; but the zinc has been of such a character and so low in percentage that, with a few exceptions, it has been impossible to extract it profitably. In former years the zinc in the ores has, in fact, been a hindrance in Anaconda's processes, causing a loss of part of the other metal content, at the same time adding to the expense of operations.

By a new process made possible by cheap electric power and cheap sulphuric acid, Anaconda's metallurgists have found a way not only to extract high percentages of zinc economically, but also to recover the gold and silver values which occur in the zinc ores and either the lead or copper—whichever may prove more profitable.

The first problem in the extraction of zinc was to develop a means for separating the zinc sulphides and their accompanying precious metal values from the gangue. To accomplish this, the oil flotation process was found well suited; but the concentrate resulting was too low in zinc and too high in iron to be adapted to treatment by a direct zinc smelting process.

The next problem, thus, was to devise a means of separating the zinc, gold, silver, and copper from the concentrate.

It was found that if the zinc concentrates from flotation machines, containing about ninety per cent. of the metal values in the ore, are first roasted and then placed in dilute sulphuric acid, the zinc content is dissolved out; while the iron, lead, silver, gold and most of the copper, remain in the residue from which the valuable metals are recovered by smelting.

The acid solution, then containing the zinc as a sulphate, is next placed in circular drums containing balls of metallic zinc and revolved until any small amounts of copper or cadmium have been precipitated out. The zinc sulphate solution is then clarified in filters, sent to lead-lined tanks for electrical decomposition. Instead of having copper anodes and cathodes, as in copper refining, these tanks are fitted with permanent lead anodes and thin, temporary aluminum cathodes to act as starting sheets to receive the zinc.

The electric current is then turned into the solution and as in the process of refining copper, the metallic zinc is deposited upon the cathode and sulphuric acid set free in the solution. After the zinc is deposited, the sulphuric acid is used again to dissolve fresh zinc from other roasted concentrates.

The zinc deposited on the aluminum sheets is peeled off in layers, melted down in furnaces and cast into ingots or bars for shipment.

Zinc so produced is not only of an exceptionally high degree of chemical purity, but also possesses an exceptionally high degree of ductility and on account of its chemical and physical properties commands a premium over the so-called prime western spelter produced in the middle west.

In this process sulphuric acid from the company's own plant is used, and cheap electricity becomes even more a factor than in the copper refining process; the dissolution of zinc sulphate by electricity requires nearly ten times the amount of power that is required in the process of refining an equal weight of copper. If steam power were required, even with Anaconda's cheap coal resources, zinc could not be refined at a profit.

In addition to Anaconda's large quantities of low-grade zinc, such as can be treated as above, four of Anaconda's twenty-six mines in the Butte District are

distinctively zinc mines, some of them containing zinc of such a character and in such properties as to permit even of direct smelting.

With the opening of a zinc plant, all of Anaconda's zinc resources will now be made available.

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The new zinc concentrator being built at Anaconda is designed to handle 2,000 tons of ore daily and, in connection with the roasting, leaching, and precipitation plant under construction at Great Falls, is expected to turn out 70,000,000 pounds of zinc annually, commencing in the early autumn of 1916. This output represents almost one-fourteenth of the entire zinc production of the United States in 1915, whereas the ores at hand and in sight may be found sufficient to justify the construction of a much larger plant should zinc profits warrant it. Further, by reason of the economy of the process, it may be found profitable to handle other zinc ores purchased in the neighborhood or to treat under contract for other producers. It is well within the bounds of probability that, as the success of the process is determined on a large scale, the capacity of the zinc plant will be enlarged materially.

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In the course of experimentation in treating zinc ores a small plant has already been established and is in operation at Anaconda.

This plant, with a capacity of about eight tons of spelter per day is rapidly being increased up to a capacity of twenty-five tons per day.

The experimental plant, although having served to prove the practicability of the process, is not as economical a producer of spelter as the new plant at Great Falls will be.

Owing to the present high prices of zinc, however, this small operation has been very profitable; the entire product of the experimental plant has been sold ahead for the full year at a profit which will not only pay the total experimentation cost to date, but, in addition will cover the equipment of the twenty-five ton plant at Anaconda, the 2,000 ton zinc concentrator and the 70,000,000-pound plant at Great Falls, leaving a handsome profit beside.

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As to the cost of producing zinc in the new plant or the profit of the operation at normal zinc prices, it is difficult to formulate a definite estimate.

It is, in all probability, a conservative assumption that the Anaconda Copper Mining Company will in the near future, with normal prices of zinc, be able to earn a profit of two cents per pound on its 70,000,000-pound output—an annual net earning of $1,400,000 from this new source.

These earnings should be in full effect in the year 1917, and there is an excellent outlook for much larger profits than this as the rate of operations increase.

ANACONDA'S PLANT AND EQUIPMENT

As has been stated, Anaconda's chief mining operations are confined to a solid tract of ground two square miles in area in the heart of the Butte District. Within this tract it operates twenty-six mines, as follows:

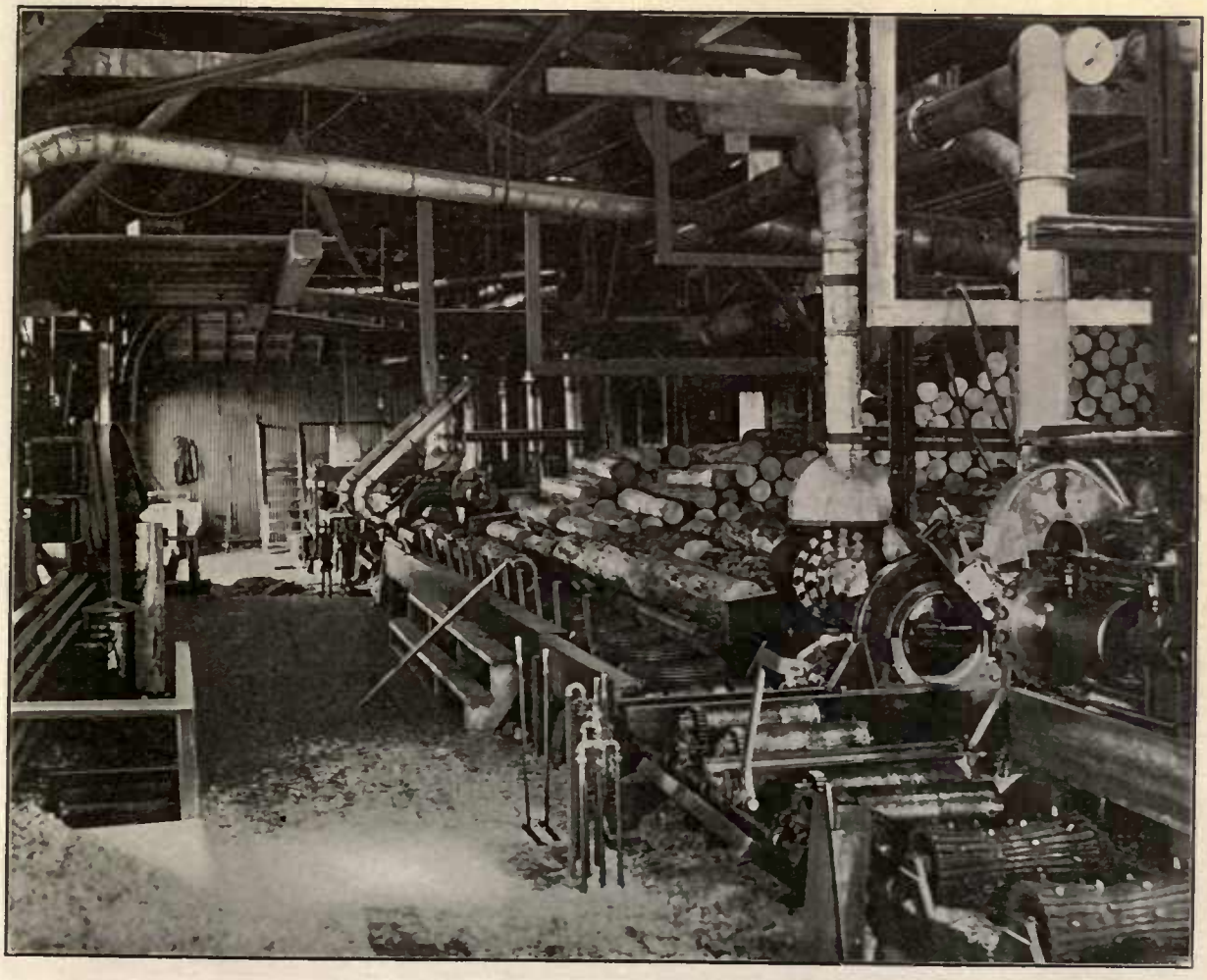
Copper Mines

Anaconda	High Ore	Poulin	Mountain View
Never Sweat	Belmont	Tramway	Pennsylvania
St. Lawrence	Original	Silver Bow	Leonard
Mountain Consolidated	Stewart	Berkeley	West Colusa
Bell	Moonlight	West Gray Rock	Badger State
Tropic			Nettie

Zinc Mines

East Colusa	Emma	Alice	Lexington

The ores taken from these mines are shipped to Anaconda for concentration. The resulting concentrates are smelted, converted, and refined either at the company's large smelting plant in Anaconda or are shipped to the company's smaller smelting plant and copper refinery at Great Falls, a distance of one hundred and seventy miles.



Anaconda's Timber Mill at Rocker, Montana, three miles from Butte; here the timbers for the mines are framed.

The company's concentrating, smelting, converting, and refining plants at Anaconda and at Great Falls handle all of the company's own ores, and also do a certain amount of custom work.

In addition to these plants the company, through subsidiary corporations, operates four other large smelting and refining plants. The first of these is the lead and copper plant of the International Smelting Company at Tooele, near Salt Lake City, Utah. This plant is a custom smelter, so called, treating ores for various copper and lead properties in the Central Rocky Mountain mining district. The Tooele plant has an annual output of 15,000,000 pounds of copper, 100,000,000 pounds of lead, and 4,000,000 ounces of silver.

The International Smelting Company has recently constructed a new smelter of the most modern type, near Miami, Arizona. This plant smelts the concentrates produced by the Inspiration Consolidated Copper Company and the Miami Copper Company, together with smaller amounts from other producers in the district. The smelter at Miami will treat about 1,000 tons of concentrates daily, with an output of 180,000,000 pounds of copper per annum.

Through the International Lead Refining Company, Anaconda owns and operates a large refining plant for lead bullion in East Chicago, Illinois. This plant refines the bullion produced at the Tooele plant of the International Smelting Company, and also treats some foreign ores.

Through the Raritan Copper Works at Perth Amboy, New Jersey, the company operates the largest copper refinery in the world. This refinery had a capacity prior to 1915 of 360,000,000 pounds of copper annually. During 1915, its capacity was increased to 440,000,000 pounds annually. The refinery is well located on tide water and is especially favorably situated for shipments of copper abroad.

A View of the Sulphuric Acid Plant and Brick Plant No. 2 at Anaconda.

The International Smelting Company, the International Lead Refining Company, and the Raritan Copper Works, although operating under their independent names, are owned outright by the Anaconda Copper Mining Company.

COAL HOLDINGS

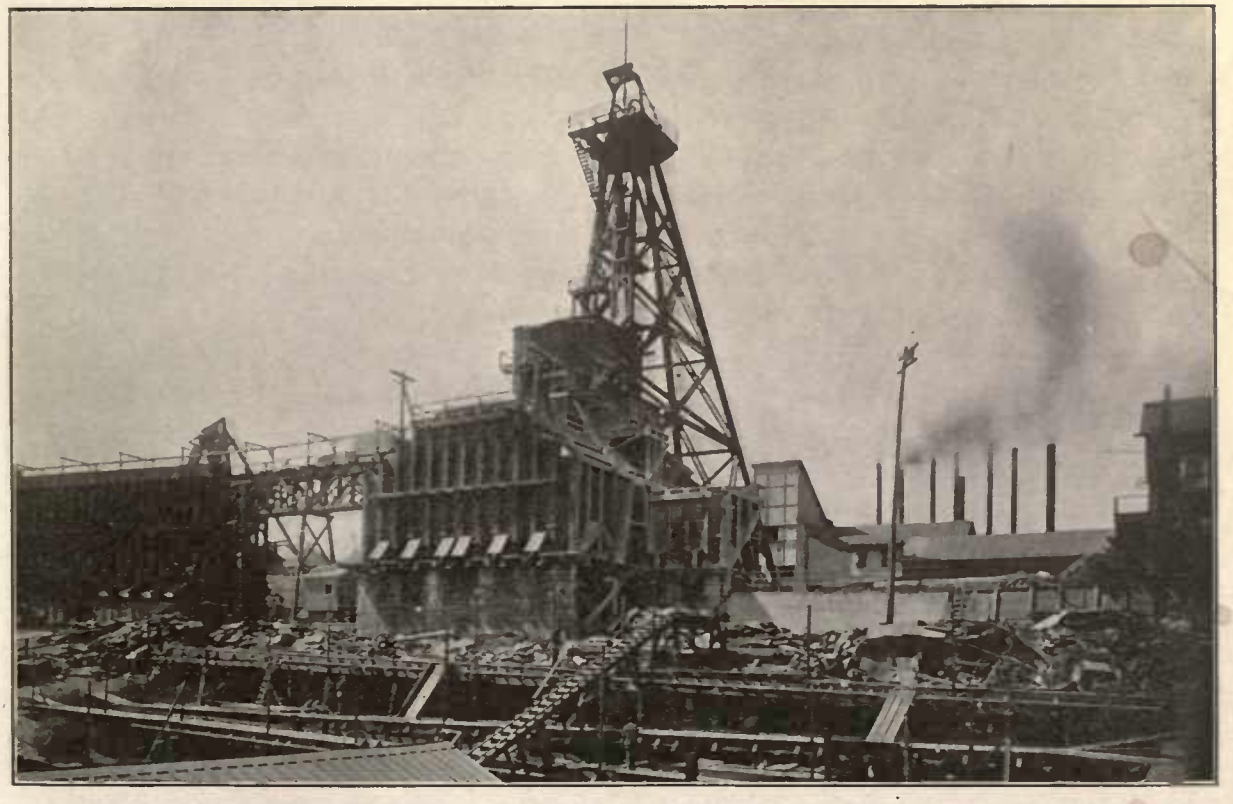
The coal mining department of the Anaconda operates properties in the Diamond field of Wyoming, at Bear Creek, Montana, and also at Sand Coulee near Great Falls. Its coal properties have been estimated to contain in excess of 100,000,000 tons of unmined coal. Coal is much less of an item to the Company than in former years since its power is now purchased from the hydro-elcctric plants of the Montana Power Company, yet for heating and for fuel in smelting a considerable amount of coal is still required. During 1915 Anaconda used 735,000 tons of coal and 193,000 tons of coke.

TIMBER HOLDINGS

The timber holdings of the Anaconda were obtained through the purchase of a part of the Old Northern Pacific land grant in Montana about twenty-three years ago. They are located mostly in the northwestern part of the state. These lands cover over a million acres and are estimated to contain 6,067,000,000 board feet of timber. They furnish the timber for mining operations at Butte which use about 75,000,000 board feet of sawn timber and 300,000 sticks of round timbers annually. The company's own consumption approximates one-half of the annual cut, the remainder being sold commercially.

LIGHT, WATER AND STREET RAILWAYS

The Anaconda Copper Mining Company owns the lighting system, water supply and street railway system of the City of Anaconda, this resulting from



"Original" Mine at Butte, showing the Headframe and Scrap-Iron Precipitation Tanks for recovery of metals from mine waters.

the fact that the town of Anaconda was built in its entirety to serve as a residential district for the operatives at the plant.

AGRICULTURAL LANDS

As the timber from the company's lands is cut off, much of the land becomes of value for agricultural purposes and from time to time this is sold to settlers. The amount of the business done is not great, expressed in dollars and cents, yet it is a contribution of some importance to the agricultural interests of the State of Montana. About 8,000 acres of land is also owned near Anaconda. This was originally purchased to protect the company against suits for damage from smoke and gases, but some of it is now being farmed successfully under the direction of the company.

BRICK PLANTS

At Anaconda a brick plant is operated and another one is operated at Great Falls, both by the Anaconda Copper Mining Company. At these plants, building brick and fire brick for use at the smelters is made, and a very considerable amount of brick is also shipped from these plants and sold profitably in various parts of the country.

FOUNDRY

A large foundry is operated by the Anaconda Copper Mining Company at Anaconda. Though largely employed in the manufacture of machine parts for the company, this foundry does a certain amount of profitable custom work.

SULPHURIC ACID PLANT

This plant, which has already been described, is located at Anaconda and has a daily capacity of 150 tons of 60° Be. sulphuric acid. The acid is manufactured from the gases which result from roasting the concentrates of the copper ores and constitutes, thus, the profitable utilization of a waste product.

MISCELLANEOUS MINING OPERATIONS

The Anaconda maintains an efficient staff of engineers and geologists which is constantly adding to the company's resources through the purchase of small mining properties which could not be efficiently handled except as part of an immense organization. In this class it operates the Southern Cross Mine in the Georgetown District near Anaconda, has taken options on and is developing some silver-zinc properties in the Neihart District of Montana and is also prospecting certain large low grade gold bearing dikes near Helena.

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It will be seen that, in the matter of plant and equipment, Anaconda is singularly independent of outside sources for its principal supplies; that it is not only able to treat all of the ores if its own mines, but to treat a great quantity of custom ores including not only copper, zinc, silver and gold, but lead as well. Its smelting and refining equipment exceeds that of any other company in the world.

ANACONDA'S SECURITY HOLDINGS

As has been stated, Anaconda owns all of the securities (with the exception of directors' qualifying shares) of the following companies:

International Smelting Company
International Lead Refining Company
Raritan Copper Works

It also owns, similarly, the United Metal Selling Company. This company is the sales organization for the Anaconda Copper Mining Company, and it also sells copper for other producers. All told, the United Metal Selling Company sells in excess of 600,000,000 pounds of copper annually—handling, thus, more than one-third of the copper produced in the United States and approximately one-fourth of all the copper produced in the world.

In addition to its ownership of these four important companies, the Anaconda Copper Mining Company also owns the following securities:

Fifty-one per cent. of the stock of the Butte, Anaconda & Pacific Railway Company, which carries its ores from Butte to Anaconda.

One hundred fifty thousand out of a total 1,182,755 shares of the Inspiration Consolidated Copper Company, one of the most profitable low-grade copper properties, operating in the Globe District of Arizona, producing now at the rate of 120,000,000 pounds per annum. Anaconda's interest in Inspiration was acquired at a cost around $20.00 per share some years ago. Inspiration has come rapidly to the forefront during the past year and is now producing copper at a cost of eight cents per pound or less. The first dividend declared by Inspiration amounted to $1.25 per share, quarterly, but this has been raised to $2.00 per share. The mill commenced operations only in the middle of 1915 and was in full operation by February, 1916. It may be reasonably expected that Anaconda's earnings from this source will materially increase.

Thirty thousand eight hundred shares out of a total issue of 488,010 shares of the Greene-Cananea Copper Company producing at the rate of 66,000,000 pounds per annum.

The Anaconda also has holdings in the Andes Exploration Co., which are known to be of great value, but which as yet do not add to the earnings of the Anaconda. Some details concerning this property are to be found on the following page.

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All told, Anaconda will enjoy, under normal metal prices, an income from its security holdings of more than $6,250,000 per annum, $5,000,000 of this being derived from securities of companies which it owns outright. This income, of course, is in addition to the profits which it makes from its direct mining and reduction operations in Montana.

ANACONDA'S SOUTH AMERICAN MINE

Through its subsidiary, the Andes Exploration Company, the Anaconda Copper Mining Company is developing a large deposit of low-grade ore at Potrerillos, Chile, about 100 miles inland from the Port of Chanaral, Province of Atacama, at an elevation about 10,500 feet.

Development here has only been commenced and a great deal of churn drilling is yet to be done.

Already, however, 60,000,000 tons of ore of a profitable grade has been developed and in addition there has been developed approximately 200,000,000 tons of low-grade ore which also may probably be worked at a profit.

The ore body at Potrerillos is not greatly dissimilar to those of some of the leading porphyry copper mines in the southwestern part of the United States. At the surface it is oxidized and changes to sulphides at varying depths. Experimental work in the Anaconda Copper research laboratories at Anaconda indicates that the surface oxidized ores may be treated profitably by sulphuric acid leaching and that from the sulphide ores a very high grade of concentrate can be obtained by the oil flotation process.

The Anaconda Copper Mining Company will own, when the securities have been issued, about seventy-five per cent. of the capital stock of the Andes Copper Company, which in turn will own the operating company at Potrerillos; the Anaconda will therefore profit to the extent of three-fourths of the earnings from that Company's operations.

ANACONDA'S EARNINGS, FINANCES, AND FUTURE

It is too early to forecast the earnings for the calendar year for the property. In the method of keeping its books, the Anaconda Copper Mining Company differs from other copper producers. Other copper companies are accustomed to figure their production for the current month, the sales of their product for that month, and to calculate the difference as the profit for that month.

While this method is above criticism from the standpoint of correctness, yet the profits so calculated are not realized in the cash account until three months later.

The Anaconda, however, contrary to the custom usually followed, considers only profits actually realized in the cash account.

Owing to the fact that metals have been rising, the profits for the earlier part of this year, booked according to Anaconda's methods, are the results of sales made last year at lower prices than now prevail.

The current monthly and quarterly profits shown are the results of sales made earlier in the year, which, likewise were made at lower prices than now prevail.

On the above basis of accounting the Company is probably earning at the present time upwards of $45,000,000 annually.

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Such earnings as these, of course, may be regarded as abnormal and extraordinary; they are due in part to war-time prices and forced production to meet war-time demand.

Without trying to forecast the future, beyond the time for which the Company has made definite contracts in advance for its metals, the Anaconda Copper Mining Company has unquestionably placed itself in a position to pay off all indebtedness now outstanding ($16,000,000, 5% notes due March 1, 1917), and also to complete its entire program of construction, leaving a handsome surplus for further improvements, the purchase of additional properties, and dividends.

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Anaconda, however, is by no means dependent on war-time prices for highly profitable operation. During the partially depressed year of 1915, when the copper market placed operations at half capacity during the early part of the year, and with little benefit from the improved processes now installed and none whatever from the production of zinc, the Anaconda Copper Mining Company earned $16,695,806, after charging off $1,900,578 for depreciation, and paying $984,233 in interest. These earnings represent $7.16 per share on the outstanding 2,331,250 shares.

It may be conservatively estimated that the normal price of copper, after the war, should average fourteen cents for a series of years, and that the normal price of zinc should be five and one-half cents. It must be understood that Anaconda's present production is at high pressure—that because of the present ready market and high prices, it is now profitable to treat ores of a grade lower than that which could ordinarily be profitably treated. Allowing, however, for a probable decrease of production at Anaconda after the war, it appears reasonable to estimate about as follows:

Earnings From Operations In Montana:

300,000,000 pounds of copper produced annually at a cost of 9c per pound, with copper at 14c	$15,000,000.00
70,000,000 pounds of zinc produced annually at a cost of 3½c per pound, with zinc at 5½c per pound	1,400,000.00
	$16,400,000.00

Other Income:

Return from security holdings annually under normal conditions	$6,250,000.00
Total estimated future earnings under normal prices for metals	$22,650,000.00

On this basis—figuring copper prices at a fourteen-cent average and Anaconda's production at eighty-three per cent. of its present scale—earnings would be at the rate of $9.72 per share annually.

In addition to the above earnings, the company should within the next few years begin to realize on its investment in Chile. While the exploration work there is by no means complete, and it is too early to make definite forecasts as to tonnage or rate of operation, it has been shown, nevertheless, that the occurrence of ore at Potrerillos is sufficiently extensive and of such a character as to warrant the expectation of a large and profitable operation. From the data at hand, it is fair to assume a production of 100,000,000 to 150,000,000 pounds of copper annually at a profit around five cents per pound under normal metal prices. Since the Anaconda Copper Mining Company owns seventy-five per cent. of the operating company in control of the Chilean deposits, they should return an amount equivalent to at least $2.00 per share per annum on Anaconda's entire issue of stock; the period when this return will commence is, of course, several years distant.

The financial position of the company is strong. The excess of current assets over current liabilities was, as shown by the company's balance sheet of December 31, 1915, $20,106,910. The value of net current assets, however, may be considered to be materially above that figure, for the item "Metals on Hand and in Process," in the balance sheet amounted to $18,944,074, with copper and lead carried at cost and silver and gold at market. While it is not possible to make an exact separation between copper and lead carried at cost and silver and gold at market in this item, it is probable that the market value of copper and lead on hand at that date was around $17,000,000 above the figures at which they were carried.

At the present time the net balance of current assets should be very materially in excess of the figures for the end of the calendar year.

As to capitalization, The Anaconda Copper Mining Company has outstanding 2,331,250 shares, par value $50 each, which are now receiving dividends at the rate of $8.00 per share annually, and $16,000,000 5% gold notes due March 1, 1917. In considering the future outlook of this company, it may be assumed that the notes will be paid off at maturity, unless the Company chooses to invest its surplus in a more profitable manner. Its ability to pay them off is shown by the fact that the net current assets on December 31, 1915, even on the company's

conservative basis of carrying metals, were over $4,000,000 in excess of the amount of the note issue, and further than this, the value of metals in process and on hand on December 31, 1915 was probably greater than the figure at which these were carried by an amount in excess of the entire issue.

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How long will Anaconda last?

The veins in Anaconda's mines at Butte comprise an intricate system, forming a network of comparatively thick ore bodies extending to great depth, and extending over an area approximately two miles long and one mile wide. In respect to the ore occurrence, the Anaconda group of properties differs from the so-called Porphyries, which latter are masses of disseminated ore occurring, generally, close to the surface.

At the Porphyries it is quite important to determine in advance the shape and grade of these masses of ore in order to lay out the mining system, for if such a course is not pursued, the operations cannot be kept properly under control, whereas at vein mines such as Anaconda the mining practice is generally flexible and the ore may be attacked at any level in accordance with developments there.

It would, of course, be possible in the Butte mines to block out immense ore reserves, as has been done at many of the porphyry properties, but such a course would be impracticable and economically unsound, for the reason that under the existing conditions heavy timbering would be required, with frequent replacements of the same in order to keep the workings open. This necessarily involves great expense, with the inevitable loss of interest on the money so expended.

It is the practice at Anaconda to block out ore in advance only sufficient to meet the requirements for immediate operation; generally speaking approximately two years' supply of ore is carried ahead. If there were indications of diminution of width or impoverishment in depth, there might be grounds for blocking the ore out in advance regardless of the expense involved; but the evidence revealed in the present lower levels is precisely to the contrary.

The bulk of the ore now being mined by Anaconda comes from above the 2400 ft. level. The extensive drifts which have been driven on the veins from a number of shafts at the 2800 ft. level, which is the deepest level on which any large amount of development work has been done, show veins just as strong and just as good as in the upper levels and in some particular cases of unusual width and value. The development work done at the present lowest level—3400 ft.—while not extensive, shows ore of about the same tenor as is now being mined in the upper workings.

The engineering and geological staffs, through the application of the mathematical principles of geology, are constantly locating bodies of ores in parts of the upper levels, formerly overlooked in the course of the cruder mining operations of early days. These add materially to reserves. It must not be forgotten that the expected life of the deposits has been prolonged in an important way through the addition to reserves of ores formerly considered of no value, but which, under new metallurgical methods already described, are now available for profitable treatment.

The question of Anaconda's life, therefore, is one that need not be considered for many years to come.

THE NEW ANACONDA—A SUMMARY

As has been shown, a new Anaconda has gradually supplanted the Anaconda of old.

The new Anaconda may be considered as representing the climax of skill, judgment, and experience as applied to mining, reducing, and marketing copper, silver, gold, and lead.

The New Anaconda finds itself in a strong financial position—with a great excess of current assets over current liabilities, and amply provided with means to take care of all of its undertakings.

Under present prices it is earning this year upwards of forty per cent. of the par value of its entire issued stock; and, at normal prices, it should, for a long period, average to earn approximately twenty per cent. on the par value of its issued stock.

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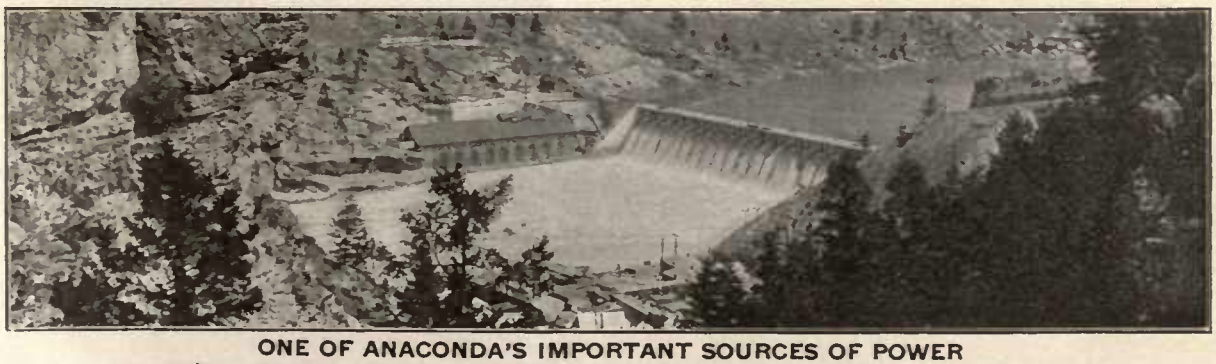
To a great work such as has been accomplished by Anaconda many men must necessarily contribute. No account of the Company, however brief, would be complete without the mention of two names. One is that of the late Marcus Daly, who foresaw the possibilities of Anaconda, who interested capital in it, who laid a blanket of ownership over most of the Butte Hill, who bought extensive coal and timber properties decades in advance of their need, who was instrumental in starting the series of amalgamations which made the New Anaconda possible. The other is that of John D. Ryan, the present head of the Company, who built up Anaconda's efficient mining and metallurgical organization and was the guiding spirit of that organization in the accomplishment of the remarkable developments all too inadequately set forth here.

If Anaconda gained its position of leadership among the mining enterprises of the world by reason of its vast natural resources and advantages, it has held and strengthened that leadership by reason of able management.

The management which saved the tailings piles and slime ponds against the day when a process of recovery might be discovered; which built up the world's foremost research laboratories and so directed their efforts that such a process was found and applied; which, with plenty of cheap coal at hand, looked forward and encouraged the development of a source of power so much more economical and efficient that it saves $3,500,000 to $4,000,000 in the annual power bill; which, by dogged, persistent experimentation with new processes, has evolved a way to recover zinc from Anaconda's ores at an annual profit of $1,400,000; which, by adding improvement to improvement succeeded in raising the net recovery of copper from seventy-seven to ninety per cent; to such a management, as much as, or more than to Anaconda's wonderful natural resources, belongs the credit of bringing about the New Anaconda.



ONE OF ANACONDA'S IMPORTANT SOURCES OF POWER
The Montana Power Company's Hydro-Electric Station at Hauser Lake.