

STORY OF NEW CORNELIA

For many years the New Cornelia mine at Ajo, Arizona has been producing copper at the rate of over one hundred million pounds annually, and has been second only to Morenci among the Arizona copper producing companies. Ajo is situated in low mountains in extremely arid desert country. By road it is 42 miles south of Gila Bend and 132 miles west of Tucson.

History*

It is claimed that the first mining of copper by Americans in Arizona was done at Ajo in 1854. The first shipment of ore, consisting of native copper and cuprite (an oxide of copper containing, when pure, 88.8% copper) came from what is now the Eastern end of the New Cornelia workings. It was hauled in ox-carts⁽¹⁾ to San Diego, 400 miles across the desert; later shipments were made only as far as Yuma; whence they were shipped to Swansea, Wales, for smelting.

The mine at Ajo, known successively as the Cornelia⁽²⁾ and the New Cornelia, passed through the usual vicissitudes of fortune until in later days improved mining and metallurgical methods, preceded by diamond-drilling, created conditions favorable to the large scale exploitation of low-grade ore. Several companies and several distinguished engineers failed to bring the enterprise to fruition until, in 1911, on the initiative of John C. Greenway and the recommendation of Ira Joralemon the Cornelia mine passed into the possession of the Calumet & Arizona Mining Company. Greenway, aided by Louis D. Ricketts, as consulting engineer, made a complete success of the venture. As the oxidized material had to be removed before the sulphide ore could be mined, they started a series of experiments in 1912 to determine whether such oxidized material could be beneficiated profitably by some simple leaching process. The tests were made by James Potter and Henry Tobelmann, and after a one-ton plant and a 40-ton plant were operated, a 5,000-ton plant was built in 1917 and proved completely successful. Two years later, in 1919, an experimental mill was built to test the treatment of the sulphide ore by flotation. Then came the erection of a flotation plant of 5000-tons capacity, designed by H. Kenyon Burch. This plant started in 1924. By later remodelling, the tonnage has been stepped up to 29,000 daily capacity. These large-scale operations would have been impracticable if an ample supply of water had not been obtained. This was accomplished by sinking a two-compartment shaft 650 feet deep at a place six miles distant, where the water-table of the region was tapped originally by two pumps, with a combined capacity of 1500 gallons per minute, and ultimately by five pumps with a combined capacity of 5550 gallons per minute delivered to the reservoir at the mine against a total head of 1375 feet. Without an adequate supply of drinking water for the large force of men employed and without plenty of water for metallurgical purposes, the New Cornelia enterprise would have been impossible. The finding, pumping, and distribution of this ample supply of water are not the least of the many engineering features that characterize this successful undertaking in the southwestern desert.

In July 1917, the New Cornelia Company acquired the property of its neighbor, the Ajo Consolidated Company. The Ajo property had been purchased in 1912 from the

* The story of Ajo has been recorded by Rickard in "A History of American Mining", by Parsons in "The Porphyry Coppers", by Joralemon in "Romantic Copper", and in U. S. Bureau of Mines Bulletin # 405.

(1) Tom Childs says mules and horses were used.

(2) Named in 1900 for John Boddie's wife.

Randall Ore Reduction Co. by Briggs and Gaskill for James Phillips, Jr. Diamond-drilling was started in 1913 by E. J. Longyear & Co., and in due course 12,845,026 tons of 2 percent ore were proved. When the New Cornelia acquired the property the assured tonnage had increased to 21,000,000 tons of $1\frac{1}{2}$ percent ore. The diamond-drilling on the consolidated property was continued until 59,000,000 tons of $1\frac{1}{2}$ percent ore had been proved. In November 1918 the New Cornelia paid its first dividend. In 1929 it was merged with the Calumet & Arizona, and in 1931 it became the New Cornelia Branch of the Phelps Dodge Corporation. The leaching plant was abandoned in 1930 after treating 16,812,324 tons of 1.355 percent ore, from which about 345,000,000 pounds of copper had been recovered. The New Cornelia Copper Co. from 1918 to the time of its absorption by the Calumet & Arizona in 1929 paid \$18,630,000 in dividends. Operations were suspended early in April 1932 until July 1, 1934. In July, 1950, a five million dollar smelter at Ajo began to treat the New Cornelia concentrates which had hitherto been shipped to Douglas.

Geology and Ore Body*

The ore body occurs almost wholly in monzonite porphyry which has intruded into volcanic lavas and tuffs. Some of the volcanic rocks are also considerably mineralized. The ore body is crudely elliptical in shape, about 3,600 feet long by 2,500 feet across. The average thickness is 425 feet, and the maximum about 1,000 feet. The primary ore consists chiefly of chalcopyrite, with bornite and a little pyrite, and these minerals are distributed both in veinlets and in grains scattered through the altered monzonite.

The ore body was oxidized to a surprisingly level plane near the present water table, at an altitude of about 1,800 feet. Except for local variations of as much as 50 feet, the transition from sulphide to the oxidized zone was about as sharp as could be mined by steam shovel. The depth of oxidized ore ranged from 20 to 190 feet, with an average of about 55 feet. The minerals of the oxidized ore were malachite with a little azurite and cuprite. A little chalcocite occurs close beneath the bottom of the oxidized zone.

The fact that in most of the ore body the tenor of ore was essentially the same in oxidized and subjacent sulphide ore seems to show that there was little migration of copper during weathering but that the sulphides were oxidized in place. In this respect the Ajo ore body differs from the other great disseminated deposits of the Southwest, in each of which supergene chalcocite enrichment was essential to the production of commercial ore.

Mining, Leaching and Concentration

The deposit is mined by open-cut method, with power shovels operating on benches at vertical intervals of 40 feet. Inasmuch as the oxidized part of the ore body was practically as productive as the sulphide part, there was no stripping problem of the sort confronting most of the disseminated deposits of the Southwest. To January, 1931, less than 7,000,000 tons of waste had been moved in the mining of 32,400,000 tons of ore, a ratio of 0.21 tons of waste to 1 ton of ore. Much

* Described in Arizona Bureau of Mines Bulletin # 145, pp 87-89. Also Bureau of Mines Information Circular 6666 written by Geo. Ingham and A. T. Barr.

of this waste occurred within the ore body and was not overburden. As the depth of the pit increased, however, a larger proportion of waste had to be moved in order to maintain a safe angle of slope.

Doubt as to the possibility of successfully treating the oxidized overburden had helped discourage J. Parke Channing and Seeley W. Mudd when they were considering separate parts of the property in 1909 and 1910. Dr. Ricketts has stated the essence of the problem that faced him and Greenway in the following short paragraph:

"Greenway drilled the great ore deposit in 200-ft. squares and about 50,000,000 tons of sulphide ore containing about 30 lb. of copper on a 20-lb minimum were developed. This ore was capped with some 10,000,000 tons of granitic material containing the same amount of copper in the form of malachite and chrysocolla. There was no known method of treating such lean oxidized material. The steam shovel was best adapted to mining the sulphide ore, but even so it was estimated that it would cost, with interest, \$5,000,000 or \$6,000,000 to remove the overburden and throw it away. If, however, a process for treating this oxidized overburden profitably on a large scale could be devised, a large liability would be converted into a much larger asset."

It was easy to dissolve a substantial proportion of the copper contained in a few grams of ore with dilute sulphuric acid in a test-tube; and that the copper could be precipitated on scrap iron or by electrolysis was equally certain. But it took a great deal of painstaking experiment and research to prove that a commercial process for handling 5,000 tons of ore per day would be a success. This work, which continued from 1912 until 1916, finally developed a design for a large-scale plant, which accomplished what it was designed to do from the very start. Virtually no changes in equipment nor modification in procedure were found necessary. For example, during the first full year of operation, the leaching plant at Ajo averaged 5,000 tons per day with a recovery of 81 percent of the total copper content of the ore and 84% of the soluble copper.

The sequence of events from the standpoint of ore treatment, has been just the reverse of that at Inspiration, in that at Ajo the leaching plant has finally given way to a concentrator instead of largely displacing a concentrator.

This concentrator, for treating the sulphide ore, originally had a capacity of 5,000 tons per day, and was put in operation during 1924. For six years both leaching plant and concentrator were operated. During 1928 and 1929 three additional units were constructed, essentially duplicating the five older units except that the rod mills used to crush the ore were longer. Balls replaced the rods in 1934 and in 1935 all mills were speeded up. This change, in conjunction with additions to the intermediate crushing plant, increased the capacity from 8,000 tons per day to 16,000 tons. It is now capable of handling 29,000 tons. The plant has kept up to date in its equipment, and continues to be among the leading concentrators in the country.

Well designed feeders and conveyor-belt systems for moving the ore from one machine to another; electric cranes to facilitate the repair of equipment, and a modern installation of dust-collecting equipment are features of the plant. The gyratory crusher, which eats up chunks of ore as big as can pass through the dipper, weighs more than 40 tons. A crane large enough to lift this machine is

necessary to permit rapid repair work. Individual electric motors for the operation of each piece of equipment is a feature, as is also the use of machinery and devices for the automatic control of operations to the end that the requirements for labor are minimized. Entirely aside from the town itself, from the power plant, the leaching plant and various shops and auxiliaries, the concentrator and crushing plant represent an investment of almost seven million dollars. The new smelter at Ajo, constructed at a cost of over five million dollars, began operations in 1950 and resulted in the saving of many hundreds of thousands of dollars annually in freight charges.

The New Cornelia enterprise has produced two and one-half billion pounds of copper from 151,795,312 million tons of ore, and this production, together with gold and silver values, had a gross value of 404 millions of dollars. As stated before, New Cornelia paid its first dividend in 1918, and from that time to the time of its absorption by Calumet & Arizona Mining Co., in 1929, the company had paid \$18,630,000 in dividends and had produced 620,000,000 lbs of copper. Its subsequent earnings have not been reported separately from the total earnings of the Calumet & Arizona, and the Phelps Dodge Corporation, but based upon the early dividends, which averaged three cents per pound of copper produced, it may be conservatively estimated that the mine has earned at least \$75,000,000 in dividends from 1918 to 1951 inclusive. In addition it has ploughed back many more millions of dollars for additions to, and improvements of plant equipment.. Today the Company has 1392 employees on its payroll. It has built 770 homes for its employees and the taxes which the Company has paid, have provided an excellent school system for the children of the community. The Company also maintains a first class hospital for the community. Ajo is an unincorporated town with a population of 5817, according to the last census, and the livelihood of all these people is dependent in some way or another upon the New Cornelia mine. The Company's 1400 workmen received about \$6,000,000 in wages last year. Based upon the Phelps Dodge 1950 report of the distribution of the parent company's gross sales dollar, New Cornelia's gross value of metal produced in 1951 would be distributed as follows:

Costs	\$ 20,430,000
Taxes	4,850,000
Dividends	3,550,000
Surplus	2,670,000
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	\$ 31,500,000

Most of the above \$20,430,000 was pumped into Arizona industry in some form or other - for wages, for supplies, for other service industries, farm products, etc., etc.

When one considers the many failures in the early attempts to make the mining district pay, (proving that it was no bonanza in its earlier years), New Cornelia is impressive as another example of how vision and capital have converted a mountain of copper into copper metal. It should be a source of pride for all the company employees to be a part of an enterprise which is creating wealth every day. New Cornelia is another Arizona mine that was made, not found - a monument to the memory of Capt. Greenway and Dr. Ricketts and to their worthy successors.

Arizona Department of Mineral Resources

March, 1952