

COPPER MINING AT ELY, NEVADA.

Written for the MINING AND SCIENTIFIC PRESS
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The name of Ely was not transferred from Vermont to Nevada. The classic little copper mine in the Green mountains, never large, but never exhausted, had nothing to do with naming the spot in the Steptoe valley that has risen suddenly to fame. Many years ago, the abundant water and excellent pasturage in this valley led to the establishment of a cattle ranch by one Ely from "down in Maine," and Ely's Ranch became simple Ely. In course of time, minerals were discovered. First came lead ore, containing silver. Lead is still mined in the district and is shipped to Salt Lake City. Next gold attracted notice. The Chainman mine once gave promise of acquiring a reputation, but the mill, dragged 140 miles from the railroad, has succumbed to rust instead of wear. This is at Lane City, on the road up the gorge to Copper Flat, the scene today of magnificent operations in the gigantic modern way. Close to this great open-cut is the Keystone copper mine, memorable only for a tragedy in which a mine manager shot four menacing workmen several years ago. This mine, like others around it, was a failure. A large dump betokens extensive workings underground; to the Nevada Consolidated Copper Co. this dump of gray slacking monzonite is commercial ore, and will one day go to the mill, when the excavations extend that far; to the Keystone capitalists it was 'waste,' and typified discouragement. It depends on the point of view what kind of an enterprise is set in motion. The disseminated ores of Ely to the first group of miners signified the possibility of enriched veins, from which they hoped a product might be obtained that would pay the enormous costs of old-time methods. The second group, urged by the courage and inspired by the foresight of Mark L. Requa, instead of seeking ore to match a method, adapted a method to the ore available, and the result is one of the greatest copper enterprises in the world. The shares of the Nevada Consolidated, which could be bought during the late panic at \$6, are now close to \$20. The capital stock consists of 1,600,000 shares, of a par value of \$5 each. So clearly was the future greatness of the property proved that the capital stock and other securities realized a sum of \$3,122,710 in excess of par value for the benefit of the company's treasury. The total capital liability on the books today is charged at approximately \$14,400,000. This finds its warrant in a body of developed workable ore of 20,000,000 tons. The reserves blocked at present represent only a fraction of the area available. Prospecting by Keystone drills is proceeding rapidly; this is a swift and exceedingly economical method of prospecting. The ordinary drill, such as is used in testing auriferous gravel, is employed; the prospect holes extend to 300 and 400 ft., according to the topography, but the hole is usually started with a diameter of 10 inches, so as to finish at 6 in. The speed varies from 25 to 40 ft. per diem, and the cost ranges from 75c. to \$1.25 per foot. This work is locally called 'scouting'. The testing already

done shows an average copper content for the 20 million tons developed, of 1.9%, this being the figure stated officially by Pope Yeatman, the consulting engineer for the company.

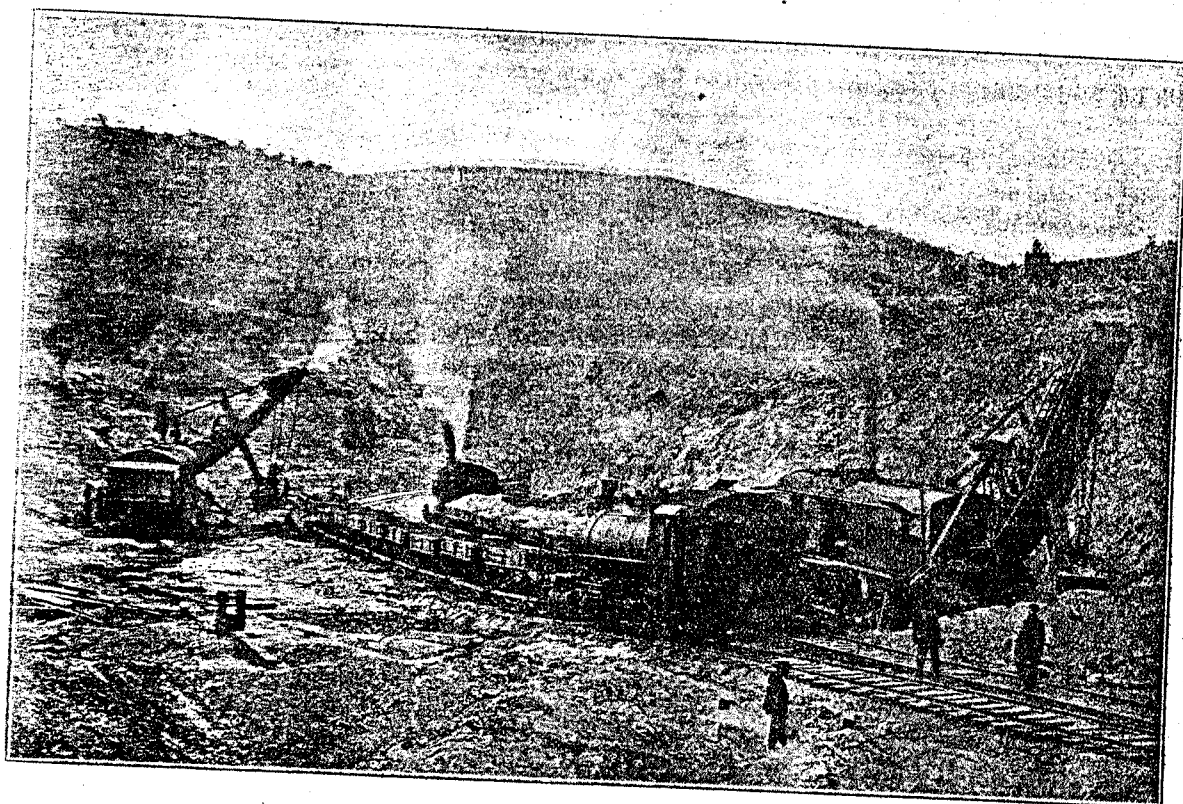
The earlier testing of these deposits was done by the ordinary methods of shaft-sinking and level-driving. This was mainly at the Ruth mine, on the eastern side of the mass of impregnated monzonite. An account of the tests, and the vindication of the churn-drill method by its faithful agreement with sampling in many lots of several hundred tons in the Ruth mine, will be found in an article entitled 'Experimental Mill of the Nevada Consolidated Copper Company', by M. L. Requa, published in the MINING AND SCIENTIFIC PRESS of July 18, 1908.

The area of the ground owned by the Nevada Consolidated Copper Co. is 850 acres, consisting of 63 claims. Closely related for purposes of operation and treatment is the Cumberland-Ely, where 12 claims have been partly developed. The orebody there is narrow, and of higher grade, yielding from 3 to 4% copper. Associated with these companies are the Steptoe Valley Smelting & Mining Co., with magnificent works, still being enlarged, at the new town of Smelter, 22 miles away. Here water is abundant, and ample precautions have been taken not to become involved in legal embarrassments over fume. Finally, the Nevada Northern Ry. Co. was organized, and a line was built to the Southern Pacific at Cobre, 140 miles north of Ely. A ramification of shorter lines around Ely opens up the ore-producing territory and gives access to the works at Smelter. Each corporation is operated on entirely independent lines. Beyond these corporations lie other financial intricacies, the American Smelters Securities Co. holding indirectly a controlling interest on behalf of the American Smelting & Refining Co. Thus the enterprise constitutes a notable enrichment of the holdings of the Guggenheims.

The geology of the ore deposit was studied by Andrew C. Lawson, professor of geology in the University of California; a monograph entitled 'The Copper Deposits of the Robinson Mining District, Nevada', was published in 1906, as a bulletin of the Department of Geology in the State University. No preceding studies had interpreted the interesting phenomena presented at Ely. Under conditions that were practically those of a reconnaissance Mr. Lawson has done work that has stood the test of subsequent development, so that his report on this property has been a splendid example of the practical importance of the economic geologist. In brief, a mass, or batholith, of monzonite porphyry is found intruding Devonian and Carboniferous rocks, the latter consisting of limestone. The intrusive rock appears upon the surface at Copper Flat and at the Ruth mine. The area between is overlaid with limestone, and this covering exists continuously around the porphyry, portions of which are also overlaid by a more recent flow of rhyolite. This has raised the question as to the probable extension of the copper in workable amount beyond the limits of the exposed area, especially under the rhyolite capping. A concentration by secondary enrichment has resulted

from leaching where the monzonite has lain open to meteorological influences. The enrichment has been feeble, to be sure; nevertheless it has made all the difference between ore and valueless rock. The upper portion of the porphyry has been impoverished by leaching, and constitutes an overburden from 50 to 70 ft. thick, containing 0.75% or less of copper. The re-precipitation occurred at a former water-horizon which has since been lowered. Hence the change from the overlying oxidized lean rock, with its prevailing yellowish tinge, to the bluish-gray enriched ore below, is as abrupt as if the two had been artificially severed. Below this line of division, however, the copper content presently shows a decrease in depth, and the quantity gradually sinks to about 1 per cent. The depth to which extraction may continue depends, in consequence, upon the price of cop-

was early foreseen, and it has fulfilled the expectations of those who fathered the enterprise. The cost of the ore in the cars ready for transportation to Smelter is about 40c. per ton, including its proportion of the cost of stripping overburden. The actual digging and loading costs only about 11c. per ton. One 70-ton and three 95-ton Bucyrus steam-shovels are used. The larger shovels, with $3\frac{1}{2}$ cu. yd. dipper, equal to 7 tons of ore per dipper, will dig as much as 800 cu. yd. per day. A shovel-crew comprises an engineer at \$175 per month, a crane-man at \$125, a fireman at \$90, and 6 pitmen at \$2 per day. The cost of explosive used on the overburden will not exceed 4c. per cubic yard. A shovel will comfortably load 2500 tons in 9 hours, and it can fill one car of 55 tons in 4 minutes. The banks worked in the overburden are at present about 50 ft. high, and



Mining With Steam-Shovel at Ely.

per and the extent to which mining and reduction of the ore at Ely can be cheapened. An interesting phenomenon at Copper Flat is the vertical division of the deposit by an almost dike-like zone of silicious ore, out-cropping on the surface and cutting the deeper orebody. This contains copper to the extent of 3%, and even 4%, in the form of silicate and carbonate. It was originally suggested that this so-called 'carbonate' ore would need to be treated by a leaching process, but the metallurgists of the Steptoe Valley S. & M. Co. have done better than that. The proportion of silica is so high, being about 80%, that in this material, donated by Nature as a bonus with the mine, they have an ideal converter-lining. This cupriferous silica, available at certainly no more than 65c. per ton laid down in the works, is an important assistant in the economical treatment of these ores.

The method of mining adopted at Copper Flat is by steam-shovel. The adaptability of the steam-shovel

in the ore 40 ft. The open-cut is 800 ft. long by 400 ft. wide, and is being excavated in two benches, with railroad track making a loop around the head of the cut, so that trains always make the circuit, thus obviating loss of time from switching in and out of the loading places. Much of the ore is soft and requires little or no blasting, but the overburden is hard and needs shattering by heavy blasts. Holes for this purpose are drilled with Keystone churn-drills, using a 6-in. bit. No casing is required. The holes are placed from 25 to 30 ft. from the edge of the bank, and 30 ft. apart. The hole is first 'sprung', or chambered, with dynamite, from $\frac{1}{2}$ to 2 boxes of 40% grade being used, according to the hardness of the rock. If the ground is relatively loose the hole is then charged with 60 kegs, of 25 lb. each, of Dupont FF black powder; if the rock is firm and dense, the hole is loaded with 15 to 20 boxes of 40% dynamite. The volume moved by such a blast is approxi-

mately 2400 cu. yd. Work had been abandoned during the financial crisis, but stripping overburden was resumed in March. Since that time, approximately 300,000 tons of sulphide ore have been mined and shipped to Smelter. This applies only to Copper Flat, and is exclusive of tonnage shipped from the Veteran mine of the Cumberland-Ely. Drilling is proceeding westward to establish the persistence of the orebody in that direction. In horizontal distance these tests have shown its continuance 1800 ft. beyond the present open-cut, and the cut will have several banks or terraces below the existing floor. This will give an idea of the magnitude of the operations. It was hinted that banks 100 ft. high might be attempted, which would, of course, be in disregard of occasional mishaps, when a shovel and crew might be buried by a slide. No extraction of ore is taking place at the Ruth mine. The amount cheaply available at Copper Flat is enough to feed the mill, as it now stands, to its full capacity, and concentration of work and traffic at one point naturally affords superior advantages in regard to economy.

The Veteran mine, which is practically part of the same general scheme of operations in spite of pertaining to a company having a separate corporate existence, is an underground working. The overburden here is too thick to admit of stripping. That form of caving known as 'top-slicing' is being introduced. Enough has been done to demonstrate its applicability to local conditions. The ground is laid out by cross-cuts and lateral drifts in blocks 50 ft. square. Raises are then driven to the overburden at the four corners of the blocks. The slicing is carried across each 50-ft. block, and a floor of boards laid as the work progresses, to serve as a mat to hold the overburden when it settles, and to keep it from mixing with the ore below. The height of face on the upper slice is 8 ft., but the subsequent lower slices will be 10 ft. The next slice will be worked carefully under the broken overburden, the mat being caught and held in place by timber sets of 12 in. square caps, and round stulls of Oregon fir. As the system had only been introduced experimentally, no data concerning costs were available. Fifty experienced cave-miners had just been brought from Minnesota. The output of the Veteran is intended to be 1500 tons daily. Four of the 12 claims on the orebody will be worked from this one shaft. The charge made by the railroad on ore from the Veteran mine to Smelter is 30c. per ton in 300-ton lots.

A vertical 3-compartment main shaft, with manway, serves the Veteran mine. The compartments are $5\frac{1}{2}$ by 6 ft., with one compartment $5\frac{1}{2}$ by 9 ft. for convenience in lowering timbers. The shaft is surmounted by a wooden head-frame 110 ft. high, with 12-ft. sheaves over which run $1\frac{1}{4}$ -in. steel cables. The total height of lift is 600 ft. Hoisting is done in automatic-dumping 5-ton skips made by the Atlas Car & Manufacturing Co. of Cleveland, Ohio. A cage is also used for raising and lowering men; this is operated by a special steam hoisting-engine, designed and built by the Exeter Machine Works of Pittsburg. The ore-skips are operated by a 300-hp. General Electric Co.'s induction motor.

rated as 3-phase, type 1-14, form M, 60 cycle, for 290 amperes and 550 volts. The hoist itself was built by the Denver Engineering Works and has 6-ft. drums, working in counterbalance. A current of 40,000 volts is transmitted from the power-house at Smelter, and is stepped down to 600 volts for the hoist.

The geology of the region is of great interest, but the details are accessible in Mr. Lawson's published report, and will not be reviewed here. Attention, however, may be called to the fact that indications are favorable for the existence of contact copper deposits between the porphyry and the limestone; these possibilities have not been developed. It is expected, however, that ore available for blast-furnace smelting will be found. The limestone contains many large masses of silver-bearing limonite, which would furnish valuable flux for silicious copper ore. That the silver-lead and gold ores will be locally utilized in time seems probable. Developments are disclosing larger amounts of galena than had been previously suspected. These deposits constitute a distinct belt north of the monzonite, and lie in the Ruth limestone, which is the upper member of the Carboniferous rocks occurring in this district. The Ruth limestone is 500 ft. thick, and is underlaid by 1000 ft. of Arcturus shaly limestone, succeeded downward by 1500 ft. of Ely limestone. Thus there may be possibilities for lead-mining at considerable depths below the present known occurrences in the Ruth limestone. Some deposits of lead-ore are also being worked in a small way on the great ridge that separates Steptoe from Duck Creek valley. These small mines, which are now shipping ore to Salt Lake City, are almost directly above the reduction works at Smelter. The gold deposits are confined to the Paleozoic rocks, which are represented by 1000 ft. of White Pine shale, on which the Ely limestone rests conformably. Below this comes the Nevada limestone, at least 1000 ft. thick. These are of Devonian age. The gold ores are often basic, and to some extent may be used as flux if blast-furnace smelting should develop at this point, and it has been hinted that some concentrating gold ore exists.

Surrounding the great mines are others of varying promise. The Giroux Consolidated is well known, having been long before the public. Underground mining is practiced here, and it would seem that the policy of the company has been too much to insist upon the importance of its rich ore rather than to face the larger elements of the problem presented in the utilization of masses of low-grade ore by the cyclopean methods that are now changing the character of copper mining in so many parts of the world. The Giroux undoubtedly has rich ore, but it seems unfortunate that no energetic effort is being made to open what may prove so large a mine that the high-grade masses will only be looked upon as something to sweeten the output. Many prospects are being worked, as always happens around every enterprise of magnitude. Despite their reputation, the Guggenheims have not taken everything in sight at Ely. Combinations of outlying properties may lead to the creation of important neighbors for the Nevada Consolidated and the Cumberland-Ely.