The Copper Mines of Ely, Nevada

Four Mines Will Have a Capacity for Producing 60,000,000 Pounds of Copper Per Annum When the Smelting Works Are Completed

BY WALTER RENTON INGALLS

A sleeping car runs through from Salt Lake City to Ely, leaving the former late in the evening, lying over at Ogden and going west with Union Pacific train No. 3 from Chicago, lying over again at Cobre, Nev., leaving the latter place per Nevada Northern Railway at 1:30 p.m. and arriving at Ely at 6:05 p.m. This is if the train is on time, which frequently it is not. Passengers from Chicago obtain practically a through sleeper by going west on train No. 3 and changing cars between Ogden and Cobre. By any other train there is a connection to be made at Cobre, which is not an interesting place to wait in. The distance from Salt Lake City to Cobre is 176 miles; from Cobre to Ely, 141 miles. The fare from Salt Lake to Ely is $16.60; from Cobre to Ely it is $10. The Nevada Northern is a new line and its rates are high. However, it sells 1000-mile tickets for 5c. per mile.

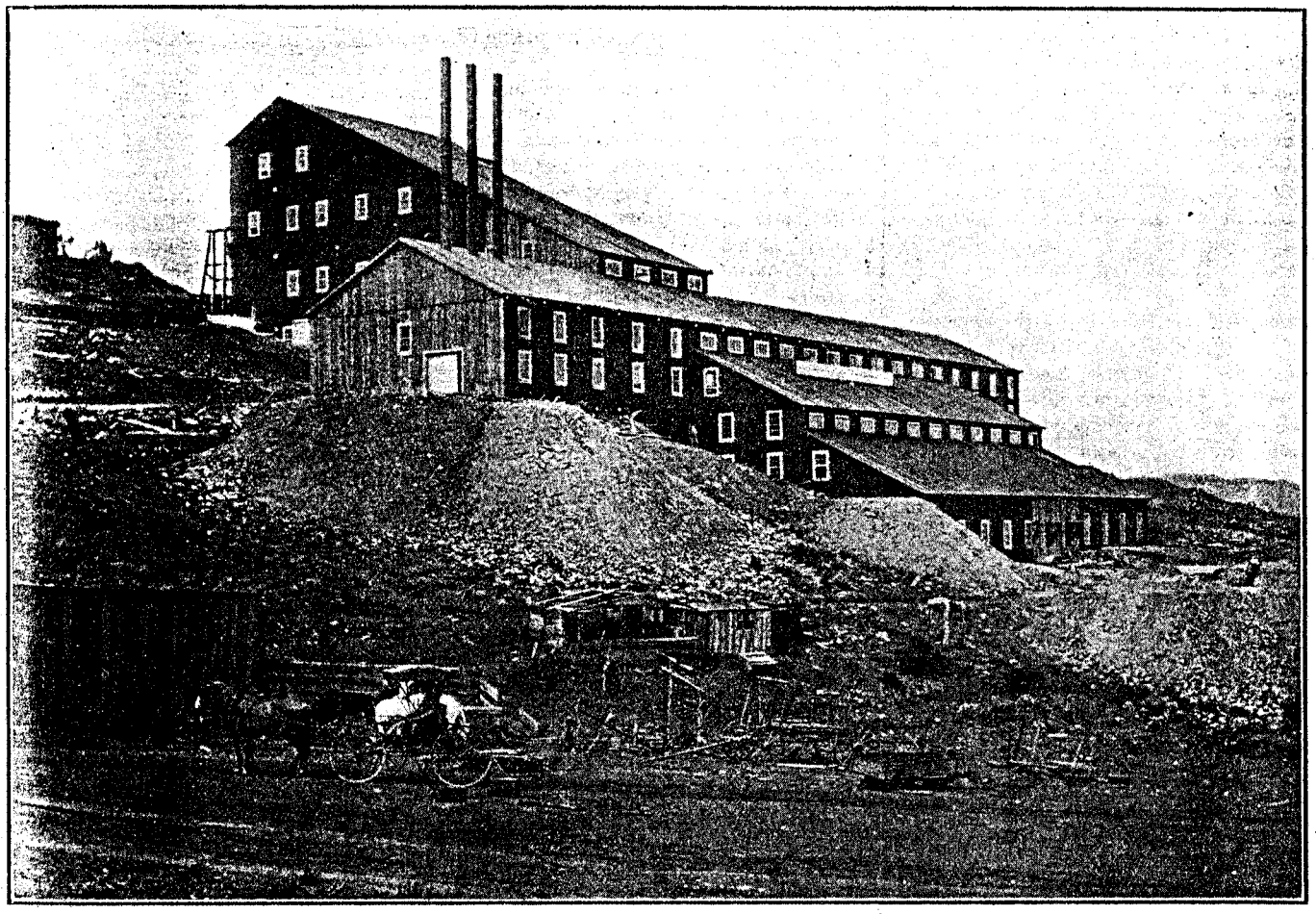
The Nevada Northern Railway

This line was owned by the Nevada Consolidated Copper Company and was built solely for the purposes of that company, but a half-interest has now passed into the hands of the Cumberland-Ely Copper Company. By virtue of the recent mining boom at Ely the road has already developed an outside freight and passenger business which must yield a handsome income. Leaving Cobre the railway runs due south through the broad and level Steptoe valley. The construction of the line was of the easiest. The curves are few, there is not a bridge on the line, only one or two cuts worthy of the name and scarcely any grading. The soil was unusually good for railway construction and the track being laid with 80-lb. rails, the cars run with a smoothness unexpected of a line less than a year old; better, indeed, than on many standard railways of respectable age.

The elevation of Cobre is about 5900 ft.; of Ely about 6800 ft. There is a steady, gentle rise up the valley. The valley is arid and for a considerable distance of semi-desert character, but about 60 miles from Cobre there begin to be grassy places which afford some grazing.

The Town of Ely

Ely lies on the western side of Steptoe valley, at the foot of the Egan range of mountains, and at the mouth of Robinson cañon. It is one of the old camps of Nevada, having been the headquarters of spasmodic and generally unsuccessful attempts at mining during 30 years or so preceding the discovery that it had big and profitable deposits of copper ore. The situation of the town is pleasant, the ground being level and the outlook to the east open. To the west the main street of the town leads directly into Robinson cañon, but after going a short distance



THE GIROUX MILL

through the latter the country opens out again at a slightly higher level and good roads lead to all of the mines. The mines are 3 to 10 miles west of Ely, and the location of the town at such distance from them was apparently dictated by the question of water supply, the cañon being quite dry.

Since the near approach of the railway, Ely has enjoyed a good deal of a boom in real estate and considerable material development. It has some very creditable shops and an uncommonly good hotel (the Northern). It is an active, lively town, but the hopes of the real estate boomers were dashed with cold water by the location of the Steptoe smelter 14 miles down the valley. There appears to be plenty of room in the town for any probable growth in the near future. However, some enthusiastic persons are endeavoring to establish a new town, which rather absurdly they call "Ely City," a mile or two east. The mining population of the district is, of course, bound to live near the mines, the most important of which are seven to nine miles west of Ely, but the town is the basis of supplies. No stage lines yet run out to the mines, wherefore communication is not easy.

Early Mining

In going up Robinson cañon the now amusing relics of early mining and metallurgical failures, characteristic of many old mining camps, are in evidence. There are two ruins of old smelting works, the smallness of their slag dumps betraying the failure of the hopes of their builders. Prominent is the Chainman gold mill, erected only five or six years ago to treat the gold-bearing surface porphyry occurring near by, an imposing mill that looks like new, so little has its lumber weathered, but commercially a failure. At the Ruth mine is the ruins of a mill that was not a failure, for it was therein that Requa and Bradley made their experiments in concentrating the monzonite copper ore that has since then made the Nevada Consolidated Copper Company and the Ely district famous. All this machinery and material had to be brought to Robinson cañon by wagon from Eureka, about 90 miles distant, which was the nearest railway point previous to the advent of the Nevada Northern Railway.

Geology of the District

The geology of the Robinson mining district was studied in 1904 by Prof. Andrew C. Lawson, of the University of California, in behalf of the Nevada Consolidated Copper Company, and the results of his investigations were published in a monograph by the University of California. I regret that in making my observations in the district and in writing this article I did not have that valuable paper before me, and consequently I am able to report only what I saw during my brief visit.

The Robinson district shows essentially a limestone formation, which has suffered laccolitic intrusions of monzonite. In the important portion of the district the limestone summits have been scored away, exposing the monzonite in areas that in many places form confused associations with outcrops of limestone. At some time in the geological history of the district there were flows of rhyolite and rhyolite tuff which appear in extensive areas of the present surface. These formations are developed most distinctly on the south side of the cañon. To the north the formation appears to be chiefly limestone, which is exposed in bold cliffs. It is a formation which would appear to be kindly to lead ore, and indeed small veins of galena are said to have been found in it. Doubtless it was that ore that the early smelters attempted to work.

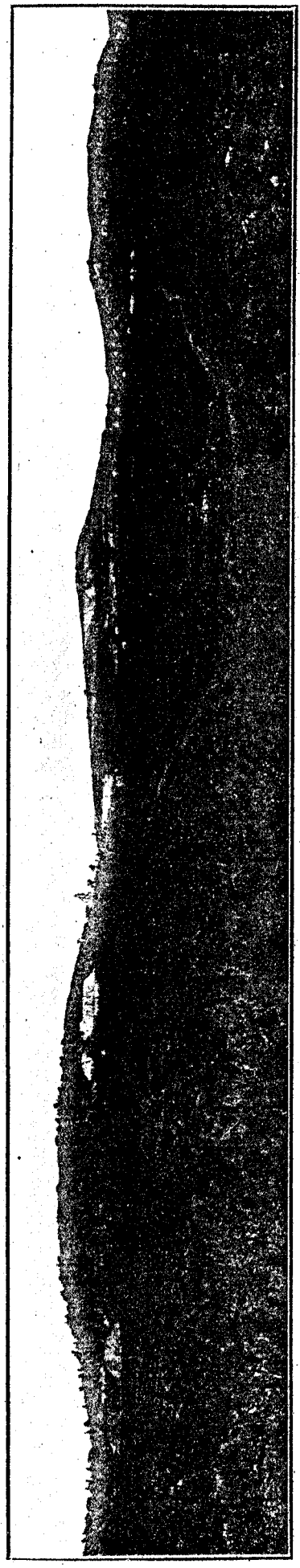
The surface porphyry (monzonite) of the district is frequently brownish from the oxidation of iron and in certain places is gold-bearing to a small extent. Here and there this surface porphyry is slightly copper-stained. In connection with the porphyry and associated limestone at various points there are prominent outcrops of iron ore, sometimes rather heavy iron ore, sometimes ordinary iron gossans. These are so clearly in evidence that they must early have attracted the attention of prospectors. On the Giroux property, just behind its new mill, there is a remarkable gossan of heavy iron ore, into which there is an old slope shaft. The material on the dump at the mouth of that shaft is rather heavily copper-stained. Elsewhere in the district the iron gossans show copper stains, but I did not see any so abundant as at the Giroux. Precisely such outcrops occur in other copper districts, and in the Robinson district there must be some connection between them and the big copper deposits.

It is doubtful if the general form of the big copper deposits of the Robinson district is yet understood, inasmuch as none of them has been delimited. They occur as impregnations of chalcocite and chalcopyrite in cracked and shattered monzonite, lying generally flat under a capping of leached monzonite. The latter is brownish in color; the underlying, mineralized rock is gray. The surface rock was originally copper-bearing, but the copper has been dissolved and reprecipitated lower down in a zone of secondary enrichment. Under the latter there is a zone of primary ore, lower in grade; perhaps too low grade to be workable. Comparatively little development has yet been done in this lower zone.

The limestone adjacent to the porphyry intrusions has been greatly altered by the effect of the latter and the porphyry itself has undergone metamorphism, so that frequently it is difficult to determine where the porphyry ends and the limestone begins. Sometimes there are inclusions of more or less altered limestone in the porphyry. Underground workings in the Veteran and Eureka mines show that the limestone adjacent to the porphyry is mineralized with pyrites, but chalcocite and chalcopyrite are absent. In the extreme westerly drift of the Eureka mine the breast has passed into limestone heavily mineralized with pyrites. It is easy to account by such occurrences for the iron gossans that appear on the surface, these gossans being due to the oxidation of pyrites adjacent to the mineralized monzonite. Consequently the orebody is to be looked for to one side of the gossan, not under it. Early prospectors made the natural mistake of sinking in the gossan, but rarely if ever found anything of value. However, it seems to me that prospecting through the gossan is not in all cases to be neglected. It is hardly to be accepted that the formation of pyrites in the limestone occurred only horizontally around the porphyry. If the intrusion of the latter were a laccolite in limestone, pyrites might be as likely to form in the latter at the upper contact as at the sides. If then the limestone had been scored away only down to the neighborhood of the contact, outcrops of iron ore would be likely to occur above the mineralized porphyry. Something like this condition appears to exist at the Veteran mine. If the above assumptions be correct, the rule may be that when iron outcrops are found in proximity to surface exposures of porphyry, orebodies are to be looked for in the porphyry; but when iron outcrops are found in connection with limestone, especially altered limestone, and there is no near-by exposure of porphyry, the ore may be under the gossan.

The orebodies of the secondary zone as opened in the Ruth, Eureka and Veteran mines do not show any general evidence of faulting. In all of these mines the ore is very much cracked and there are frequent slips and selvages, running in all directions, which may be supposed to be contraction cracks, formed during the cooling of the igneous mass. These countless cracks doubtless made the porphyry easily permeable to the mineralizing solutions. It is to be observed that the chalcopyrite and pyrites, the primary minerals, frequently occur as little threads in the porphyry, while the black chalcocite impregnates the mass in minute specks, the porphyry looking as if it had been peppered. In the Veteran mine some of the westerly cross-cuts have entered a zone of black, unctuous talc, dipping westerly, which shows pronounced slickensides. On the easterly side of this talc zone the porphyry is much broken up and is extensively silicified. There is evidently a plane of shearing here, i.e., a fault, which cuts through an orebody, or against which an orebody is lying.

The Veteran orebody is distinguished



PANORAMA OF THE WORKINGS OF THE GIROUX CONSOLIDATED MINES COMPANY

from those of the Ruth and Eureka mines by a heavier mineralization with chalcocite, chalcopyrite and pyrite, which frequently appear in large blotches, and the presence of magnetite and oxidized copper minerals, even at the depth of 380 ft. With these, and certain minor differences which may be explained as results of the shearing, the Veteran orebody is essentially of the same character as those of the Ruth and Eureka mines.

The Giroux property, adjoining the Veteran, ought to throw considerable light upon the nature of the ore deposits of Ely. Unfortunately I was unable to inspect its underground workings. Judging from its dumps it has disseminated ore of the same class as that of the other big mines of the district, but it has also oxidized ores much heavier in copper. The Alpha shaft, west of the main workings, was sunk 1000 ft. before encountering ore, and then opened some rich oxidized ore.

The Alpha shaft is one of the mysteries of the Ely district. It is described as opening a wide vein of quartz lying between porphyry and limestone and Mr. Giroux holds the theory that it is a mother vein of the district, but it is difficult to reconcile this with the geological conditions of the district. Ore was not encountered in this shaft until the depth of 1000 ft. was reached, and then, strange to say, it was oxidized ore. The orebodies are said now to have been opened to the 1200-ft. level, following the walls of the "vein." The dump shows that sulphides have been found at some places. The length of this vein is said to be 6000 ft. and its width between the limestone and the porphyry 1000 ft. Whether this be a true vein, as Mr. Giroux is firmly convinced, or a development of the quartz blow-outs, which Professor Lawson calls "blouts," is a highly interesting question. It is to be hoped that Professor Lawson will some day revisit Ely and will have an opportunity to study the Alpha workings.

Besides the porphyry orebodies described above, there are said to occur at Ely deposits of copper ore in limestone, but these are said to be small, and not having examined any of them I am unable to outline their character.

The Rejuvenation of Ely

After mining had been fitfully carried on at Ely for many years with only indifferent success, M. L. Requa and F. W. Bradley, of San Francisco, became interested in the Ruth mine, of which they undertook the development. They recognized the possibilities of its deposits of disseminated copper ore and foresaw the magnitude that they would prove to have and their great commercial value. They deserve the highest credit for their persistence in sticking to the enterprise, 90 miles from the nearest railway point, when the price for copper was low, and the scientific manner in which they proceeded is one of the brightest records in the annals of American mining engineering. They recognized that an immense capital would be required to bring the mines to the productive stage; so they developed them in such a way that when the time came to seek capital a large tonnage of ore could be shown blocked out. They recognized, moreover, that it would be important to furnish data as to the milling possibilities of the ore; so they installed a mill that is insignificant in comparison with that which is now being erected for the property but was highly respectable in size as an experimental mill. Finally, they employed Prof. Andrew C. Lawson to make a geological survey of the district, which he did with admirable perception of the requirements and remarkable insight into what must at that time have appeared to be highly confused geological conditions. Professor Lawson fully appreciated the association between the valuable ore deposits and the monzonite intrusions, and prepared a geological map which enabled Requa and Bradley to secure large areas of the most promising ground. They were operating then as the White Pine Copper Company. About that time the New York & Nevada Copper Company, owning the Eureka mine, a large porphyry area, went into the hands of a receiver and Requa and Bradley secured it. All this was done with very little knowledge in the outside world that Nevada possessed deposits of copper ore that would some time make it a large factor in the production of that metal.

To the best of my recollection the first that was heard generally respecting this district was through a prospectus issued by Joseph L. Giroux, which in spite of the previous high reputation of Mr. Giroux was regarded as visionary, extravagant, or what you please, in its statements as to acres of copper ore at and near the surface at a remote place in arid Nevada. Yet Mr. Giroux was not only right, but also was acute in his perception of the conditions of the district, for which he deserves high credit and as a result of which he secured a large area of mineral land that is second in promise only to that of Requa and Bradley; possibly is superior.

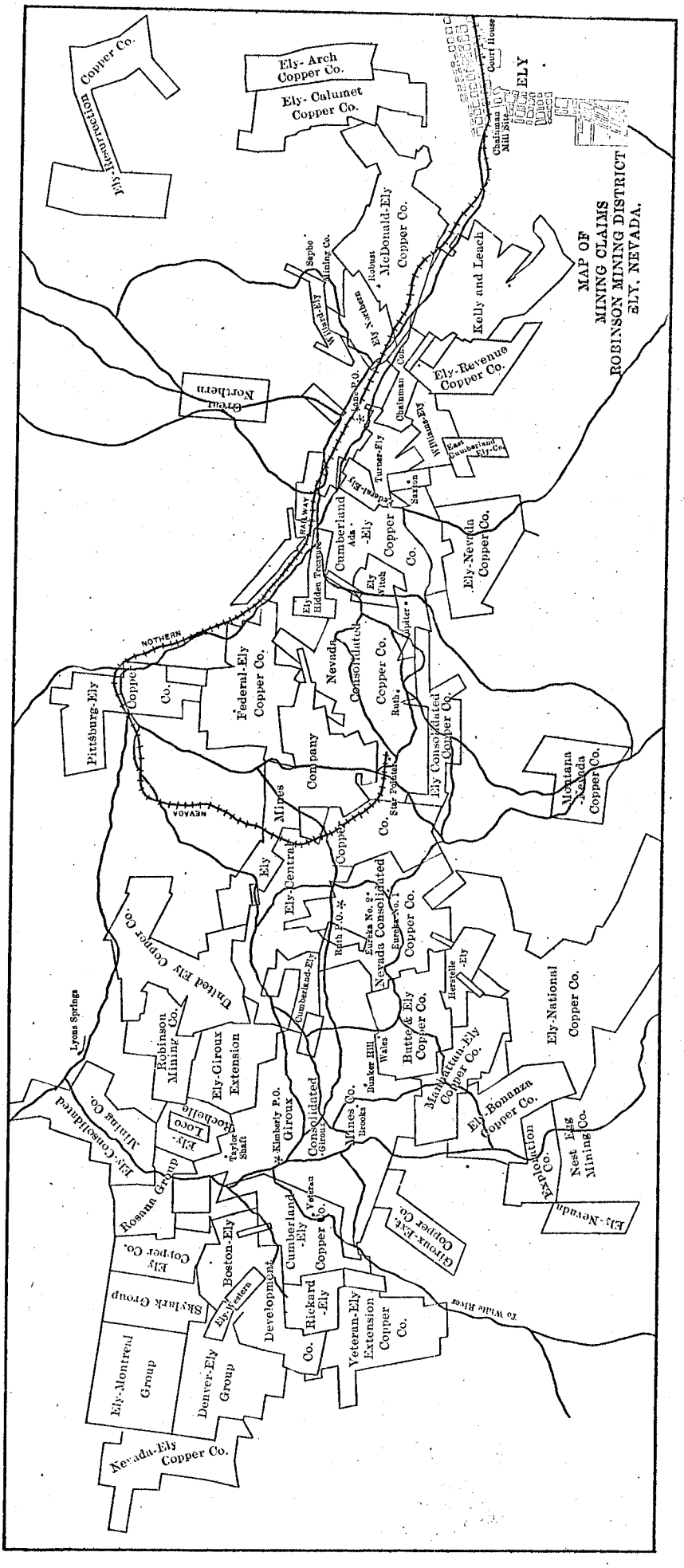
In 1905 the time came for Requa and Bradley, who previously had consolidated their interests as the Nevada Consolidated Copper Company, to seek additional capital. An examination of the property was made by J. Parke Channing, who fully recognized its great value in a report which is a classic in that field of engineering literature; and large blocks of the stock were sold in New York and Boston. After the company had been thus well financed, a controlling interest in it was purchased by the Guggenheims, who paid $12.50 per share for the latter part of their purchases.

The Outside Companies

At the present time the three important mining companies of Ely are the Nevada Consolidated, the Giroux and the Cumberland-Ely. The wide publicity that was given to the reports on the Nevada Consolidated, together with the broad plans for development undertaken by that company, naturally attracted general attention to this new and promising district of which promoters were quick to take advantage. Old mining claims could be purchased cheaply and the stock of Ely companies could be sold at high prices. From a pamphlet called "Ely and Her Mines," recently published locally, I have made the accompanying list of Ely mining companies. There is no reason to doubt the accuracy of the authority in so far as the particulars given in the accompanying table are concerned.

It may be computed from this table that the total capitalization of the Ely companies organized up to date is about $180,000,000, of which that of the three leading companies is only $18,000,000. Of the other companies it will be observed that the vendors or promoters have reserved 60 to 70 per cent. of the capital stock, while the remainder is offered to the public to raise funds for development purposes. If any of the big mining houses should be approached with a proposal of that nature, the result would be a prompt and icy refusal, but the public is not supposed to be so discriminating.

Let us see what chances the public has in these outside Ely companies. The map of the properties which accompanies this article does not, unfortunately, show the geological formations, but it may be sufficient to indicate that the porphyry lies in a narrow belt, extending east and west and nearly coincident with Robinson cañon. This belt begins about at the Chainman property and extends through the Giroux and Veteran. It is not continuous, occurring rather in patches, but from the Eureka mine what is probably a long continuous patch goes through the Giroux property. I have previously referred to the careful work and keen discernment with which Requa and Bradley and later Giroux secured the porphyry areas. They had the pick of the Robinson district long before anyone else dreamed of its value and they made excellent use of their opportunities. When they had finished there was comparatively little good ground, so far as surface indications went, available for anyone else. In this Requa and Bradley were grandly aided by Lawson's geological work. There are various rock exposures in the district which Lawson could not definitely identify as porphyry, but in the construction of his map he gave porphyry the benefit of the doubt in such cases. As a matter of fact the later investigations of the engineers of the Nevada Consolidated have materially reduced the porphyry areas shown on Lawson's map.



The later companies were able to secure very little of the porphyry. The Ely Witch has a little and the Butte & Ely has some adjoining the Giroux property. The Ely Central was widely advertised as possessing a large area of land directly adjoining and between the two great mines of the Nevada Consolidated. The orebodies of the latter lie flat and are of unknown extent. What was more plausible than the argument that they might connect through the Ely Central property? Doubtless the promoters advanced that argument in good faith, but with ignorance as to the geological conditions. As a matter of fact the area of the Ely Central company between the Eureka and Ruth mines is limestone and rhyolite, chiefly a large flow of the latter. Of course the Nevada Consolidated had ample opportunity to secure this property if it had thought worth while to do so. The Ely Central has done a good deal of drilling in the rhyolite but has not yet discovered ore so far as there is common information.

So it is with most of the outside companies of Ely. Their properties are chiefly upon formations other than the ore-bearing porphyry, some of which may prove to contain ore deposits, but not ore deposits of the kind that the three big companies possess. The three big companies are the only ones at Ely which have "developed" orebodies. There is nothing else at Ely which is more than a prospect. Among them there is little evidence of activity in exploration, although the orebodies of the kind they are especially seeking are capable of location by the cheap and effective method of churn drilling. Some of these companies are indeed prospecting, but in some cases it appears as if there were no anxiety even to do that.

General Mining Conditions

The general mining conditions in the Robinson district are favorable, except for the scarcity of water and timber. The district is very sparsely wooded and the cord-wood heretofore used chiefly for fuel has had to be brought in from long distances and has been correspondingly costly, while the quality is inferior. Since the advent of the railway, coal has been available, the cost being $10 per ton at Ely. The water supply in the district is very small. There is a stream in Robinson cañon only when the snow is melting. The Giroux company is contemplating pumping water to its mine from beyond Ely, a distance of 13 miles, while the Nevada Consolidated is going to pump it from Ward mountain, nine miles away.

The country is open, with broad valleys and hills that are comparatively low and of moderate slopes. The roads are excellent. From Ely to the Giroux mine, nine miles, the rise is only about 500 ft. The Nevada Northern Railway is running right up the valley with grades of only 3 per cent. at the maximum and only two tunnels, both of them short ones. The climate is the same as elsewhere in eastern Nevada. There is a heavy snowfall in winter, the snow beginning in the late fall and continuing until April.

The mines are dry at the moderate depths to which yet opened.[1] The Veteran mine is dry at depth of 380 ft.; the Ruth is dry at 307 ft. and the Eureka at 170 ft., but below those levels water is standing in the shafts. The Giroux mine is wetter. In all of the porphyry mines the ground is soft and easily excavated. Comparatively little powder is required. Drilling is done chiefly by hand; there are but few machine drills in the whole district. Two shifts of eight hours each are able to advance a 6x4-ft. drift 7 to 8 ft. per day. Comparatively little timber is used or required in drifts of those dimensions that are not intended to be permanent. Good miners are scarce, as is apt to be the case in low-grade districts at present. Miners are paid $3.50 per eight hours, and muckers and trammers, $3.

The Ruth Mine

The Ruth mine of the Nevada Consolidated is about six miles west of Ely. It was originally opened by an incline shaft, at an angle of 41 deg., with levels at vertical depths of 125 ft. + 65 ft. + 117 ft. + 111 ft., the fourth level being therefore 420 ft. below the surface at the location of the shaft. From this shaft development work was done chiefly in an easterly-westerly direction with cross-cuts connecting the main drifts and blocking out the ground. The shaft passed through the leached porphyry into ore at the depth of 90 ft. and passed through the zone of secondary enrichment a short distance below the third level. A good deal of development work was done on each level, the largest portion being on the third, where the orebody was proved to be most extensive horizontally. On the second level the horizontal section is smaller, and on the first level smaller still. As shown by these workings, there is in the Ruth mine a block of ore averaging approximately 650 ft. east and west, 200 ft. north and south and 250 ft. thick vertically. This corresponds to 32,500,000 cu. ft., or 2,320,000 tons, reckoning 14 cu.ft. to the ton. Mr. Channing's estimate of this orebody was 2,400,000 tons, averaging 2.6 per cent. copper. But little additional development work has been done since he made his examination.

The Ruth orebody has been commonly assumed to be dipping northwesterly at an angle of 39 or 40 deg. The evidence upon this point is quite inconclusive, however, being based chiefly upon the manner in which it lies against limestone on the southerly side, but it may prove that a cross-section through the orebody is elliptical, or trough shape. This will be determined when further explorations are made in a northerly or northwesterly direction in which the mine has good possibilities, there being a large surface exposure of porphyry in that direction. The chances for the development of important extensions of the orebody in that direction are excellent, but as yet no drilling has been done in that direction, or indeed anywhere around the Ruth orebody to prove the extension.

[1]This of course does not refer to the Alpha shaft of the Giroux company which is 1200 ft. deep.

The Star Pointer Shaft

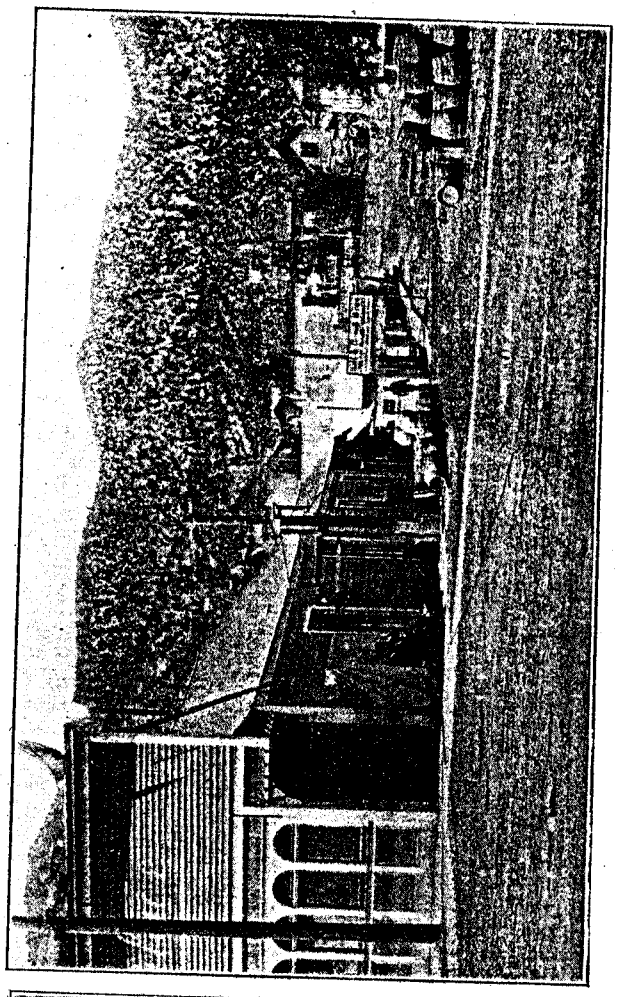
The Ruth mine will be worked through a new shaft on the Star Pointer claim to which a branch of the railway extends. The Star Pointer shaft is 24½x5½ ft., inside measurements. It is timbered with 12x12-in. sets, hung at 4-ft. centers, and is lagged with 2-in. plank. The shaft is divided into four compartments, two for hoisting ore, one for lowering timber and one for a ladder way. It is 460 ft. deep, 343 ft. to the present working level, the additional depth being for the purpose of commanding the lower portion of the orebody, which, however, will not be attacked for some time to come. The shaft is situated a long distance from the orebody, its location being selected with a view to the railway connection and also to keep the shaft far out of the way of caving of the mine, by which system the latter will be worked. The shaft will be surmounted by a steel gallows frame, erection of which has not yet been commenced (July 25).

The shaft is designed for the delivery of 2000 tons of ore per day. At the 343-ft. level the ore is to be received from a 100-ton pocket by two 5-ton skips, balanced.

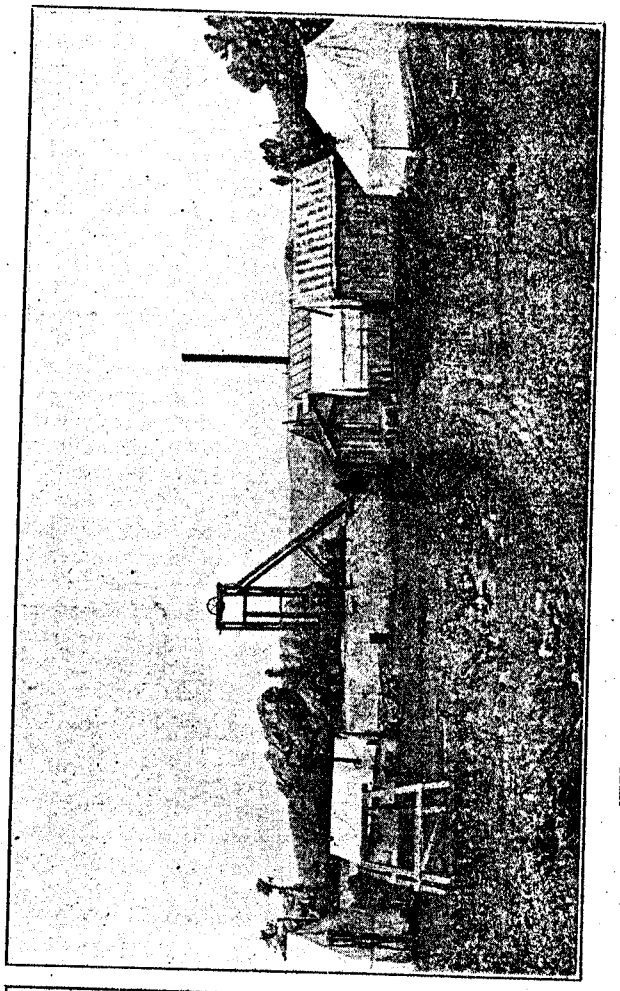
From the shaft a main gallery, 8 ft. wide at the bottom, 7 ft. wide at the top, and 8 ft. high, timbered with 12x12-in. sets at 4-ft. centers and lagged with 2-in. plank, extends easterly to the orebody, which it enters at 1300 ft. from the shaft. The main gallery is laid with 40-lb. rails at 0.3 per cent. grade and the ore is to be moved through it in trains of side-dumping cars, each of 2¼ tons capacity, drawn by an electric locomotive. Midway in the gallery there is a double track for 200 ft. Entering the orebody the main gallery continues easterly for 1000 ft., upward of 900 ft. through ore, and then loops around and comes back on a parallel course, uniting with the easterly drive at a point 1300 ft. from the shaft. At the loop there are two passageways so that trains may pass there if necessary. The haulage system is so laid out that it will have large capacity and elasticity.

The Caving System

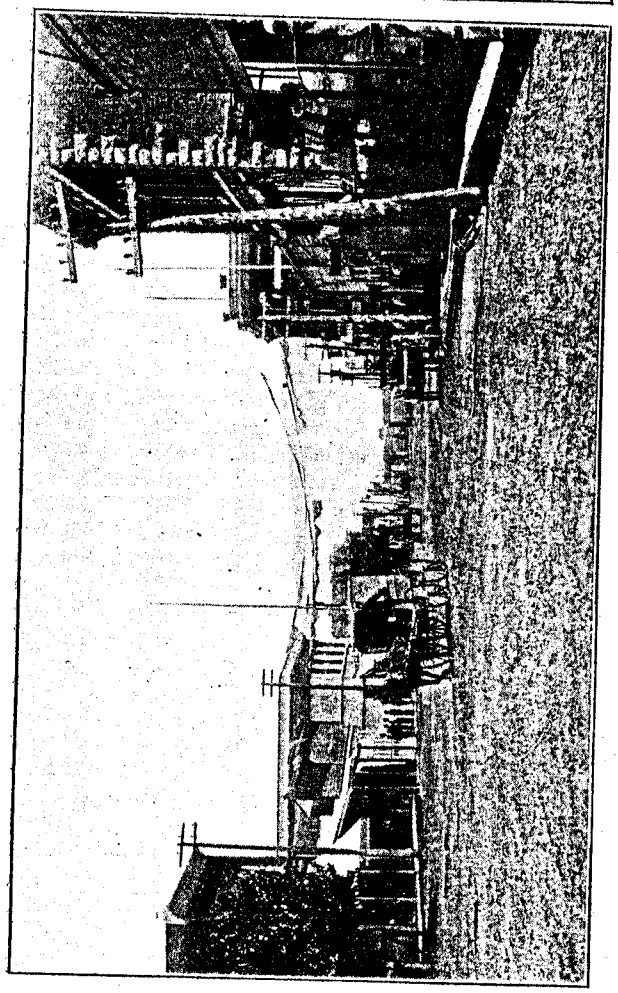
The capping at the Ruth mine is too thick to enable that mine to be worked economically by steam shovel, and consequently the ore will be extracted by the



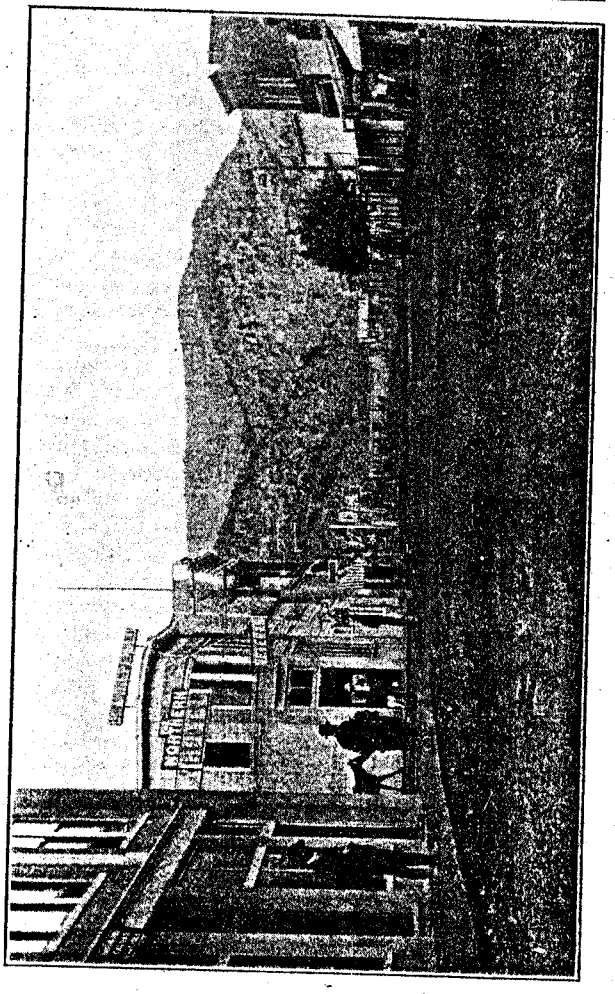
A SIDE STREET IN ELY, NEV.



VETERAN MINE, CUMBERLAND-ELY COPPER COMPANY



THE MAIN STREET IN ELY, NEV.



ELY, NEV., LOOKING TOWARD ROBINSON CANYON

caving system. The latter will be substantially the same as adopted by the Utah Copper Company, which I have described in a previous article. The ground will be opened in blocks 50 ft. square by sub-levels about 30 ft. apart, but above the highest sub-level the ore will be stoped out cleanly under the capping and the latter will be caved upon a layer of timber. The function of the latter is to keep the crushed capping separate from the ore upon which it is brought down; and by taking out a top-slice of the ore directly under the capping, practically the whole of the ore is got without intermixture of worthless material. After the removal of the top-slice, raises are put up from the sub-level next below and the ore crushing under its own weight is drawn off, the gob following it down.

As compared with the method employed by the Utah Copper Company, stoping is done in this only above the highest sub-level, but on the other hand there is a greater consumption of timber in connection with the gob. I have made no detailed estimate of the probable cost of extracting ore by this method at the Ruth mine, but considering that all the ore must be hoisted and that labor, fuel and supplies are more costly than at Bingham, it would appear likely that the ore will cost in the neighborhood of 75c. per ton, i.e., for actual extraction alone.

The Eureka Mine

The Eureka mine is at Copper Flat, about a mile west of the Ruth. It is opened by a shaft about 400 ft. deep with a first level at 170 ft. and a second at 390 ft. On the same level with the latter there are some workings from the old shaft of the New York & Nevada company. All the workings on the 390-ft. level are now under water and were so at the time of Mr. Channing's examination. The old assay plans show that they were in low-grade ore and they were probably below the zone of secondary enrichment, although the occurrence of some high assays indicates that perhaps they were not greatly below it. However, the bulk of the development of the Eureka mine is on the plane of the 170-ft. level, on which a main drift extends about 750 ft. northerly and southerly, while cross-cuts go to a maximum of about 400 ft. east and 400 ft. west. Parallel drifts and cross-cuts roughly block out the ground and there are eight raises, which show 70 ft. of ore overhead.

Mr. Channing assumed that the ore extended only 30 ft. below the 170-ft. level. This was merely an assumption, and was intended to be a conservative one, because there were no winzes or other guides to the probable extent of the ore downward. His estimate of the ore developed in this mine on the basis of 100 ft. thickness was 3,200,000 tons, averaging 2.2 per cent. copper. The ore had been cut into rather large blocks, but the uniformity of its character and mineral content caused the estimate of area to be amply justified, while that of thickness was conservative. Since Mr. Channing's examination comparatively little development work has been done, but several drill holes have been put down outside the orebody, which roughly square up the latter as an area about 800x750 ft., which at 100-ft. thickness and 14 cu.ft. to the ton would give about 4,300,000 tons.

The company has also put down four drill holes in the extension of the porphyry to the west-southwest, the two nearer ones showing low-grade ore and the two remoter ones showing good ore. It may be judged from this that there is probably an important extension of the orebody in that direction, the two nearer drill holes having gone down in lean spots, or the orebody passing in a neck between them. Aside from the matter of at 100-ft. thickness and 14 cu.ft. to the mine are in this direction.

Exploitation

The Eureka mine is to be worked by steam shovels, of which four will probably be installed. Excavation will be begun at the eastern side where the hill slopes down to a small valley.[1] This also is near what is known to be the eastern boundary of the ore deposit, limestone showing on the surface near-by. At this place the stripping to be done is as little as 16 ft., but going up the hill it rapidly increases to 100 ft. and after that more. The average thickness of the capping has not yet been determined. It will probably be rather high, but we may roughly assume one ton of stripping to one ton of ore. It is believed that steam-shovel mining can be done here as cheaply as at Bingham, but while there are some more favorable conditions, I am disposed to consider on the whole that the cost will be something like 10 per cent. higher. If then we assume an actual excavating cost of 22c. per ton, and one ton of stripping per ton of ore, the cost per ton of ore will be 44c.

The Giroux Mines

This property is about nine miles west of Ely, at an elevation of about 7300 ft. The railway will pass through it on the way to the Veteran mine, which is just beyond the Giroux. The Giroux property has been developed through five shafts, viz., the Giroux, Morris, Brooks and Bunker Hill, which lie approximately in a line northwest and southeast, and the Alpha, which is about 1000 ft. southwest of the Brooks. The distance from the Giroux to the Bunker Hill is 2800 ft. The dumps of the Brooks, Morris and Bunker Hill shafts show porphyry ore similar to that of the other large mines of the district, and large bodies of such ore, averaging 3 per cent. copper are said to have been developed by extensive workings underground. I did not go underground at this mine and consequently can not say anything as to its ore resources from my own observation, but judging from the size of the dumps the workings are less extensive than in the two mines of the Nevada Consolidated. I was informed that over 15,000 ft. of development work had been done in the property and that there is connection from the Giroux to the Bunker Hill shaft by drifts.

The Giroux company is erecting a concentrating mill, which will probably be completed about Oct. 1. This mill is designed to treat 500 tons per 24 hours, but it is hoped that it will materially exceed that capacity. It is a side-hill mill of old-fashioned timber construction. The scheme of treatment is substantially as follows: Receiving bin of 600 tons capacity. 10x24-in. breaker. Belt elevator. Trommel, ¼ in.; oversize back to crusher, undersize to bin of 200 tons capacity. From the latter bin the ore goes to to trommel with ¼-in. holes, undersize to elevator, oversize to a set of 42x16-in. rolls, delivering to elevator which delivers to two trommels, 6-mesh and 16-mesh. The 6-mesh product goes to a 6-ft. Huntington mill, which has 16-mesh screens. Consequently all of the ore is reduced to that size. It then goes to hydraulic classifiers which feed 45 Wilfley tables and six Frue vanners. The concentrates are received in a filter bin. The power plant contains three Erie City boilers and two Atlas-Corliss engines of 450 h.p. in the aggregate. It is hoped that adequate supply of water can be obtained from the mines, but it is contemplated to put in a 12-in. pipe line to pump water from beyond Ely, the line being 13 miles long. At the time of my visit (July 24) this pipe-line had not been begun. Of course the operation of the Giroux mill is dependent upon the water-supply, and it is not to be supposed that the management of the company, which is in the hands of experienced mining men, has overlooked that important matter, although opinions may differ as to the advisability of its plans. Such water as may be secured will naturally be used over and over again minus the inevitable loss by leakage, evaporation, etc., and it is generally conducive to good work in ore dressing to be obliged to reduce the use of water to the minimum.

The various shafts of the Giroux company are connected with the mill by a railway of 3-ft. gage, two miles long, operated by small locomotives. The line of the Nevada Northern to the Veteran shaft will pass near the mill, affording the necessary outlet for the shipment of concentrates, etc.

The peculiar system of crushing and screening adopted in this mill is explained by the extraordinary friability of the ore, which is of sugary character and crumbles between the fingers, the mineral being largely released as the ore is delivered from the mine.

[1]The steam-shovels have now been installed at this place and stripping has been begun.

The Giroux company also has a small smelting plant at the mine, which was installed two or three years ago. The principal part of this is a 42x120-in. blast furnace. Contrary to some reports, it is not the intention of the company to put this plant in operation along with the mill. There are no roasting furnaces and it would be impossible to smelt the mill concentrate alone without roasting. However, the company has a certain amount of oxidized ore, which assays well in copper and iron, and a proportion of the sulphide concentrate might be smelted with it, giving a matte product for shipment, but for a while the mill concentrate will be shipped. The Giroux company will doubtless be the first producer in the Robinson district. If it mills 500 tons per day of ore assaying 3 per cent. copper, its annual production will be equivalent to about 8,000,000 lb. of refined copper per annum. It is the intention of the company to mine by the caving system, but plans for this have not yet been formulated and at the outset the ore will be stoped and the ground timbered with square sets. The latter will be an expensive system of mining in this district, where timber is so costly.

LIST OF ELY MINING COMPANIES.

NAME.	NO. OF SHARES.	PAR.	VENDOR'S SHARES.	TREASURY SHARES.
Boston Ely Copper Co.	1,000,000	$ 1	700,000	300,000
Boston-Ely Development Co.	200,000	10	.....	.....
Butte & Ely Copper Co.	500,000	1	250,000	250,000
Chainman Con. Copper Co.	.....	..	.....	.....
Cumberland Ely Copper Co.	1,300,000	5	.....	.....
Dolly Varden Copper Co.	1,000,000	1	700,000	300,000
East Cumberland Ely Co.	500,000	1	260,000	240,000
Ely Amalgamated Copper Co.	500,000	5	250,000	250,000
Ely Arch Copper Co.	1,000,000	5	.....	.....
Ely Bonanza Copper Co.	1,000,000	1	600,000	400,000
Ely Calumet Copper Co.	1,000,000	5	700,000	300,000
Ely Calumet Copper Mining Co.	1,000,000	1	600,000	400,000
Ely Central Copper Co	1,200,000	10	900,000	300,000
Ely Consol. Copper Co.	1,000,000	10	.....	.....
Ely Consol. Mining Co.	1,000,000	5	.....	.....
Ely Copper Queen Mining Co.	2,500,000	5	1,500,000	1,000,000
Ely Copper Co.	1,000,000	5	.....	.....
Ely-Giroux Extension Mining Co.	1,000,000	5	600,000	400,000
Ely Grand Central Copper Mining Co.	1,000,000	1	600,000	400,000
Ely Hidden Treasure Mining Co.	1,500,000	1	900,000	600,000
Ely Jackpot Mining Co.	1,000,000	1	600,000	400,000
Ely Mines Co.	1,000,000	5	.....	.....
Ely National Copper Co.	2,000,000	2½	1,500,000	500,000
Ely Nevada Copper Co.	1,000,000	1	700,000	300,000
Ely Nevada Exploration Co.	50,000	5	27,000	23,000
Ely Northern CopperCo.	1,000,000	1	700,000	300,000
Ely Ogden Mining Co	1,000,000	1	.....	.....
Ely Phoenix Copper Mining Co.	1,000,000	1	750,000	250,000
Ely Resurrection Copper Co	2,000,000	5	716,000	1,284,000
Ely Revenue Copper Co.	1,000,000	1	600,000	400,000
Ely Rochelle Copper Co.	200,000	5	125,000	75,000
Ely Sulphide Copper Co.	1,000,000	1	750,000	250,000
Ely Western Copper Co.	1,000,000	1	700,000	300,000
Ely Witch Copper Co.	1,000,000	2	700,000	300,000
Giroux Cons. Mines Co.	1,000,000	5	600,000	400,000
Giroux Ely Ext. Copper Co.	1,000,000	1	700,000	300,000
Greenwater Ely Cons. Copper Co.	1,000,000	1	.....	.....
Herstelle Ely Copper Co.	1,000,000	1	500,000	500,000
Manhattan Ely Copper Co.	1,000,000	5	600,000	400,000
McDonald Ely Copper Co.	1,000,000	5	600,000	400,000
Montana-Nevada Copper Co.	5,000,000	1	.....	.....
Nevada Cons. Copper Co.	1,300,000	5	.....	.....
Nest Egg Gold and Copper Mining Co.	3,000,000	1	1,500,000	1,500,000
Nevada Ely Copper Co.	3,000,000	1	2,200,000	800,000
Pittsburg Ely Copper Co.	1,000,000	5	600,000	400,000
Rickard Ely Copper Co.	1,000,000	1	.....	.....
Robinson Mining Co.	1,000,000	1	950,000	50,000
Salt Lake Ely Copper Co.	1,000,000	5	600,000	400,000
Sapho Mining Co.	1,000,000	1	600,000	400,000
Ely Mizpah Copper Co.	1,000,000	1	500,000	500,000
Turner Ely Copper Co.	1,000,000	10	700,000	300,000
United Ely Copper Co.	1,000,000	5	700,000	300,000
Veteran Ely Ext. Copper Co.	1,000,000	1	700,000	300,000
Vulcan Ely Copper Co.	1,000,000	5	.....	.....

The Veteran Mine

The Cumberland-Ely Copper Company owns property east of the Nevada Consolidated, in which relatively small bodies of ore are said to have been developed, and the Veteran mine, adjoining the Giroux, where a large body of ore was found last October. Since then this ore has been developed by a main drift, running northwest, for about 1000 ft., and by crosscuts 250 to 300 ft. long. These workings, which are on the level of 380 ft. at the shaft, have not yet defined the limits of the orebody. Very little work to show its thickness vertically has yet been done, but there is reason to believe that this is rather large. There are old workings in the leached zone at the 124-ft. level, which are said to have cut the top of the secondary ore at certain places. The ore exposed in the 380-ft. level is decidedly richer in sulphides than the ore of either the Ruth or Eureka mines, and it is believed that it averages 3 per cent. copper. The Veteran orebody is undoubtedly a large and important one and at the present time is the chief asset of the Cumberland-Ely company. Preparations are being made to sink a main working shaft for its extraction.

Conclusion

The Steptoe Valley Smelting and Mining Company is preparing to mill 4000 tons of ore per day. It is expected to obtain 2000 tons per day from the Eureka mine and 1000 each from the Ruth and the Veteran. These mines are expected to be able to deliver ore by the end of 1907, at which time it is hoped that the first part of the mill will be ready for operation. In subsequent articles I shall describe the Steptoe mill and smelter and discuss the commercial position of the Ely mines.

Iron Mines in Southern Italy

A report in *Eletricita,* through the *Iron Age* (Sept. 12, 1907), makes announcement of the confirmation by the Italian Minister of Finance of an agreement between the Italian Government and a private company with a capital of $4,000,000 for the exploitation of the iron mines in southern Italy. A recent act permits of taking 200,000 tons of ore from the Elba mines. For two years the matter has been held up by an attempt to harmonize the views of ironmasters in northern Italy with those of the southern Italian interests. The signing of the contract is of importance to Naples, as the company will now proceed to erect a large plant for smelting and rolling iron at the port of Bagnoli.

The Gayley Dry-air Blast

According to the *Iron Age,* the Illinois Steel Company, one of the constituents of the United States Steel Corporation, has placed a contract to equip two blast furnaces at its South Works, Chicago, with the Gayley dry air blast. The new plant will be so located that it can be applied to any two of the furnaces of the groups Nos. 1, 2, 3 or 4, or to the bessemer converters at the South Works. The contract for the refrigerating machinery has been placed with the Vilter Manufacturing Company, Milwaukee, and includes four horizontal duplex ammonia compressors of 275 tons capacity each, 100 coils of double-pipe ammonia condensers and 80 coils of double-pipe brine coolers. It is believed that this will be the largest single refigerating plant installed in this country. The dry blast contract will make the installation of the Gayley process available for six furnaces in this country and two in England, the installation of two furnaces at the Cardiff Works of Guest, Keen & Co., being expected to operate in October.

An organized attempt is to be made to exploit the Canterbury Plains for petroleum says the *New Zealand Building and Mining Journal* (July 25, 1907). A syndicate is being formed to acquire boring rights from the landholders in the county of Ashburton, between the Rakaia and Rangitata rivers, and between the main line of railway and the sea beach. The presence of petroleum has been noticed at sea between the Amuri Bluff and Cheviot, along the 100-fathom line, and also in the Waihao river near Waimate.