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R E P O R T

COVERING TREATMENT OF THE ORES OF THE
HAMMON COPPER COMPANY, LTD.

By

E. L. SWEENEY.

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Phoenix, Arizona.

October 1, 1930.

To HAMMON COPPER COMPANY, LTD.,
Kirkland, Arizona.

Herewith please find my report covering details of the test work conducted at the French Gulch Test Plant during the past three years, also the manner in which these test plant results may be applied commercially at this location. There are also included estimates of cost of construction of a 600 ton daily capacity leaching plant and of the operating costs of such a plant and a detailed plant layout. Complete plans are now ready for the plant construction as outlined in this report.

GENERAL

Acid leaching of oxidized copper ores has been a commercial process for a long term of years. The two major requirements of a non-soluble gangue, in the weak acid solutions to be used and the solubility of the copper contained in the ore in a commercial length of time have both been definitely determined on your ores. This is clearly shown

by the work done in the test plant, full data on this work being included in this report.

TEST PLANT OPERATIONS

The test work conducted can best be segregated as follows:

(1) Charges No. 1 to No. 49; these charges being more in the nature of preliminary work to point the way in the work to follow.

(2) Charges No. 50 to 73, which covered all other work in the one ton tanks.

(3) Covering all charges run in the large 15 ton tank as well as those run in the agitator tank.

During each of the three cycles mentioned above, ore from each section of the mine, which at that time had definitely known ore reserves, was treated. The character of the ore reserves as now known, as far as the ore is affected by acid leaching, is very constant; that is, the same identical results as to extraction, washing, acid and iron consumption, etc., can be had from ore from the various blocks of ore now taken into the ore reserves or into the probable ore, the only known exception to the above being a small section south of the shaft developed by raises, which is sulphide in character. If this section should be further

development work prove to be large enough to warrant it, this ore can be either be shipped direct, if high enough in grade, or could be treated by flotation methods, as in any event provision is made in the suggested plant layout to provide for this feature if it should ever be needed. This point is here mentioned, not that this ore is particularly refractory as it fits this process, but rather to show that such a condition can be taken care of, IF the quantity of this type of ore should be increased by developments in parts of the ground not yet explored.

The test plant at French Gulch is complete in every necessary detail, to correctly arrive at the results needed for the planning of a commercial sized leaching plant.

Crushing, screening, classification, precipitation, leaching solution advance, discarding of solutions, washing of charges, assaying, weighing of charges and measurement of solutions, agitation of the slimes portion of the charge, acid and iron consumption, types of tank and pump construction and all other such items were performed in the test plant in such a manner that definite data for the design of a commercial plant and its control could be obtained from this plant's operation.

The first series of charges (No. 1 to No. 49) were made on ore taken from surface cuts. This series extended from

August 9, 1927, to September 10, 1927. This first series gave rather poor extractions, but as test plant operation continued, advantage was taken of the data obtained so that at the end of this series much better percentages of extraction were had. Detailed discussion of this series will not be taken up here, as this series was preliminary in nature. However, the tables attached to this report give the more important points of this series and the comparison of these results with those of the later series of tests.

The second series of charges (No. 50 to No. 75) were run between March 21, 1928, and May 8, 1928. The ore treated in this and in the later series all came from underground development. The character of this ore was substantially the same as that treated in the first series - that is, no change in ore character, as it affected leaching results, was noted. The same general leaching conditions were in effect. The ore was treated in the "series" method of solution advance, the same as is in use at two large Arizona plants.

The charge in the tanks in both series (1) and (2) was one ton per leaching tank. From four to six of these tanks were leached in series, in both these sets of charges. In the last part of the first series, and in all of the second series, air was applied underneath the false bottom, to aid

in the solutions getting to all parts of the charge and to prevent clogging at any point. Leach solutions of various grades were tried, and various number of days of leaches as well, to arrive at the most economic point for commercial work. In the last part of the second series, more air but at lower pressure was tried, and the results were as good as when using higher air pressures. Upward percolation of solutions was tried at all times, in order to get better circulation and less by-passing, at all points of the charge.

The highest grade leaching solutions were applied to the oldest ore as is the common practice, in order to aid in the acid consumption. From four to fourteen days of leaching was tried with about six days being the average of the last charges, and which time gave as good extractions as did the longer leaching periods. The fouling of the leach solutions, a matter generally of the utmost importance in acid leaching of copper ores, was found to be very simple on all ores treated from this property. The only correction needed - and this to take care of excess iron building up in the leaching circuit - was the necessity of discarding about one-third of the solutions coming from the precipitation launders, the balance being returned for leaching. Thus, in commercial practice it will only be necessary to completely decopperize one-third of the solution going to precipitation, the balance being brought

down to a low figure as to copper content, and then returned to the leaching circuit.

Charging of the tanks during the second series of tests was done through a wood gate, the same manner now in use at the Inspiration plant in Arizona, the result being that the fines in the ores, when it was all crushed through 3/8 inch screens, were evenly distributed through the entire leaching tank charge.

Different lengths of leach were used, from four to fourteen days being applied during this series, eight days being used in most cases, however, in the second series. It was thought at this time that this leach period might well be cut to six days, surely seven, with this system of charging and the treatment of all sizes at one time.

The acid consumption on the Hammon Copper Company's ores is smaller than that usually had in this type of leaching, even when three per cent. acid solutions are used. The precipitation launders used in the test work were carefully checked and the acid and iron consumption therein definitely determined.

These two points, - the acid and iron consumption - forming as they do a large part of the total leaching plant cost, are very important ones. The figures used in the leaching cost estimates can definitely be obtained in a commercial plant and some savings should be made as plant operations

become standardized. As will be noted from the data attached, even better acid consumption results were obtained in the third series than in this second series. A commercial grade of detinned iron scrap was used for the precipitation, the same grade as is being used in all of the Southwest plants at present, and also a grade that can now be purchased on the coast markets. This detinned iron scrap is far better than scrap iron in odd sizes, as its consumption per pound of copper precipitated is less, and also the grade of precipitates is higher.

Washing used in this series was not as commercial as would have been wished, but better results as to this feature could be and were obtained in the third series when larger charges were available for the washing tests. A shallow quartz filter, placed above the wood tank filter bottom, was used in all tests; this feature may not be needed in commercial work, but was added here as a safety factor and if its use seems necessary it can be cheaply done as quartz for this purpose is available on the property, and especially will the cost of same be as low as these quartz bottoms need be changed but at rare intervals.

Detailed study of the results of the first two test series of charges made it seem possible to greatly better the leaching results in several ways by leaching the slimes portion of the charge separately from the coarser portion.

Having had some experience with the results of taking out the minus 100 mesh portion of a leaching charge, it surely looked as if this idea might be of great value on the ores from this property. Therefore, it was decided to try such a series of charges with agitation of the slimes and still leaching of the coarser portion, but in larger tanks. A Devereaux type agitator of 64-inch inside height and 55-inch inside diameter was erected with a 16-inch impeller installed therein. This impeller, or propeller, was so arranged that it might be operated at different speeds and at different elevations in the agitator tank. At the same time a larger leaching tank that had been formerly used was erected, this tank being $90\frac{1}{2}$ inches inside diameter by $95\frac{1}{2}$ height above the filter bottom. This tank will hold a 15 ton charge.

AGITATION TESTS

Agitation tests were tried on the fines portion of the minus $\frac{3}{8}$ inch ore with all the ore below 14 mesh being agitated at times, and from this grading down to all below 100 mesh only - the idea being that it should be determined just what sizes it was necessary to take out to give a free opening charge in the large leaching tanks, and also so that

data as to the time necessary to agitate these various sizes of sands or slimes might be known.

It was found that even with 14 mesh sands being thus agitated that complete agitation could be had with this type of apparatus, and also that good extractions could be made in four hours on this size, and from down to but a matter of a few minutes when only minus 100 mesh material was agitated. Longer periods of agitation than were necessary were used at times to be certain that this extra time would not increase the extraction, but no extra extraction ever obtained by agitation over a six hour period at any time.

Tests showed that with this ore, as is known to be the case with several other like ores, the troubles of imperfect percolation of the large tank charges were all caused by the slimes that were as fine or finer than 65 mesh; very possibly all the trouble is caused by the minus 100 mesh slimes only. In this connection it might be mentioned that after two years of commercial operation of the Inspiration leaching plant, which also uses the acid process, that in the past few months they have commenced to remove, part only, of the minus 200 mesh portion of the charge, as they have found that this greatly aids them in overcoming their occasional poor extractions, and also, of course, aids in washing. The method of agitation tried at French Gulch was simply a ship's propeller made acid proof. This method, as stated, gave perfect agitation

results when but one part of solution to one part of slimes by weight was used. In the commercial plant design, the Dorr type of acid proof agitator is proposed and for the following reasons: It is the standard machine now on the market for such work; it operates on a low power and upkeep cost, and the rate of flow through the agitators is easily changed. In the test plant work the slimes charges were washed in several different ways, that is, the quantity of wash solutions was greatly varied, and also their time of contact with the leached tailings. In the machine used in the test plant, it was found that a very short agitation would give a good wash; then the charges were allowed to settle and were then decanted; the succeeding washes were then applied in like manner, it being found that four washes gave the best economic result.

Next, tests were being made using Dorr equipment to agitate and wash the slimes. These tests were conducted by the Dorr Company at their Westport, Connecticut, laboratory. The results there obtained were just about as our work at French Gulch had indicated they would be. The net results of the slime leaching and washing tests are reflected in the flowsheet proposed in this report. The equipment, as there shown, will be ample for the treatment of the slime portion of 600 tons of ore daily and will give the best possible extraction

of the copper in the slimes. Such an agitation and counter current washing plant will operate with the minimum of attention and repairs, and is thus very favorable as to operating costs. The extractions made in the slime tests were exactly the same as were made in the large tank tests - in other words, the extraction was as high as it is possible to get on this ore, with leaching processes.

LARGE LEACHING TANK TESTS

Leaching in the 15 ton capacity test tank was carried on after the agitation had proven conclusively that quick extractions could thus be made of the slimes portion of the ore so that the effect of the taking out of these slimes on the remaining charge could be measured. The purpose of these tests was:

(1) To get comparative data on larger tonnage vs that obtained when treating one ton charges in the smaller tanks used in Series (1) and series (2); thus being able to obtain closer checks on such items as tank sizes necessary for a commercial plant; effect of higher leaching column; acid consumption per pound of copper extracted, and many other such items.

(2) To see the effect on time and extraction made by the taking out of the slimes portion of the ore.

(3) To get more accurate washing data.

A seven foot leaching column was used in these tests. It was hoped that by the separation of the slimes and separate treatment thereof to accomplish either one or both of two objectives:

1. To increase the percentage of oxide copper extraction; particularly by this means it was hoped to cut out the low extractions which in all leaching plants treating all sizes of ore at one time, crop up at times and thus keep down the average extraction over a period;
2. To cut the leaching time from the six day MINIMUM time it was found possible to get good extractions in, when all sizes were leached at one time.

The results of the 15 ton charges run were all that was expected, in that the extraction was increased, the leaching time cut down, accurate washing data was obtained and acid consumption and other operating figures of the one ton charges were more carefully checked. The combined results of the ore treatment by the separation of the slimes portion showed more

favorable figures on acid consumption, details of which are shown in the attached tables. The leaching time was cut to between three and four days, thus cutting out one leaching tank that it had previously been thought necessary to include in a commercial plant. Good wash results were obtained with but four washes, each being circulated through the leach tank for a few hours time. Full results of these 15 ton charges are given in the attached tables.

Separation of the slimes portion was done both by wet and by dry screening as well as by a mechanical classifier, the latter being the method suggested in this report for use in a commercial plant.

The factor of the increased operating costs by the use of this method versus the leaching of all sizes at one time, was also carefully studied. As far as the separation of the slimes portion is concerned, this work would all be done by the Dorr Classifier and Dorr Thickener, both of which machines are well known wherever hydro-metallurgical plants are operated. They are long proven units, require little attention after once being adjusted and have very low repair and operating costs and use very little power.

It is felt that as over 85 separate charges have been leached in the test plant and as final results of this test work are based on the 15 ton charges, that enough reliable data is now at hand to allow of the correct design of a

commercial plant to treat this ore. In this connection it might be pointed out that here the expected 600 ton plant is based on 15 ton test results, a multiplier of forty, whereas the largest leaching plants now operating based their plant design on 40 and 80 ton test plants and then erected plants to treat from 5,000 to 9,000 tons daily or a multiplier of 125 and 112 in these two cases, and these plants got results that were expected from the test work indications.

Another point that makes commercial results, based on French Gulch test plant practice, being certain, is that in all cost operating figures given here a liberal factor of safety is had on all the important items and also that the test results here were very uniform, no matter what the ore being treated was, or the method in use at the time, i. e., the ore at this property is very constant as it is affected by this acid leaching process.

APPLICATION OF TEST RESULTS TO A COMMERCIAL PLANT

The flow sheet given below is for 600 tons leached daily, all crushing to be done in eight hours time.

C R U S H I N G

50 ton bin at Headframe of shaft

1 bar Grizzly-s" openings

-3" Ore

Plus 3" Ore

24" x 36" Jaw Crusher

/-----/

1 - 20" x 70' Belt Conveyor No. 1

600 ton capacity Crushed Ore Bin

2- 24" x 3'2" Pan Feeders

1 - 20" x 40' Belt Conveyor No. 2

1 FB-4- Traylor Vibrating Screen

Plus 3/8" Ore

Minus 3/8" Ore

1 - 4' Cone Crusher

1 - 16" x 43' Belt
Conveyor No. 3

1 - 16" x 52' Belt
Conveyor No. 4

/-----/

/

/

/

1-FB-4 Traylor
Vibrating Screen

/ Plus 3/8" Ore

Minus 3/8" Ore

/

1-4 Cone Crusher

1-16" x 43' Belt
Conveyor No. 5

Finished Ore all Minus 3/8"
ready for classification
Sheet page #16

Finished Minus 3/8" Ore

1-16" x 33' Belt Conveyor No. 6

1-16" x 81' Belt Conveyor No. 7

600 Ton Capacity Fine Ore Bin

2-24" x 3'2" Pan Feeders

1-16" x 92' Belt Conveyor No. 8

1-16" x 264' Belt Conveyor No. 9
With Belt Tripper, Movable

1-6' 9" x 14-8" Dorr Acid Proof Classifier

8-26' x 26' Leaching Tanks
for leaching of coarse ore

After Leaching and Washing
Ore discharged to

1-16" x 259' Belt Conveyor #10

1-16" x 200' Belt Conveyor #11

Tailings Disposal

Launders for Slimes
overflowing classifier

1-45' x 12' Dorr Acid
Proof Pre-Thickener

Overflow through slimes
to tank and pump Slimes
to Classifier 2-12' x 10

Dorr Agita-
tors for
leach

Washing of Slimes / in
4-45' x 12 Dorr Acid
Proof Thickeners

Discarded Leach Slimes
to Slimes Pond.

NOTE: Not shown on this flow sheet are such items as Solution Tanks, Piping, Wash Tanks, Samplers, etc.

Copper bearing solutions ready for precipitation will come from both leaching circuits and will be pumped to the precipitation plant. The products being the cement for shipment to the smelter and the barren solutions, part of which will be returned to the leaching circuit.

Each item of the above flow sheet will be discussed in its proper order in the flow sheet. A detailed contour map of the plant site has been made so that it is definitely known that the proposed plant fits the ground selected as the best available, and thus also making it possible to make a definite estimate of the amount of excavation and of concrete needed for the erection of the plant.

CRUSHING

The ore coming from the shaft will be dumped directly from the skips into a 50-ton capacity surge bin and then discharged over a grizzly for removal of minus three inch ore, the over-size going to the 24" x 36 Jaw Type Crusher. The crusher product joining the grizzly product on the No. 1 Conveyor and thus to the Crushed Ore Bin of 700 tons capacity. This will allow of one day's storage of coarse crushed ore in addition to the one day's storage of fine crushed ore as shown later. Tests show that about 33% of the ore as mined will by-pass the coarse crusher. The crushed ore bin will also allow of the operation of the fine crushing plant at different times than the coarse crushing plant, thus cutting down the peak power load, which will give a lower power cost per K. W. hour.

The screening of the ore for preparation for leaching is one of the most important steps. This will be done as shown in the flow sheet in two FB-4 Traylor Vibrating Screens. This particular screen is chosen due to less repair cost and less break down than any other now on the market. By taking out the original minus 3/8" ore from mining and coarse crushing in the first screen and before the first Symons Cone Crusher, less slimes will be produced. Also in this way (with the screens ahead of the fine crushers) the finished ore can be taken off to the fine ore bin at a point higher up on the hillside, and thus in turn more room will be left below the leaching plant for tailings disposal. The Symons Cone Crusher is chosen due to the wonderful work it is doing at many plants in the Southwest.

Large size tests were made at the Los Angeles Cone Crusher factory and so it is definitely known just what these crushers will do on this ore. The Symons Cone Crusher uses less power per ton crushed and also it is far less expensive as to upkeep than any other type of crusher for this work.

ORE STORAGE AND CLASSIFICATION

The minus 3/8" ore will be taken from the fine crushing plant to the fine ore bin and thence by pan feeders and conveyor to the conveyor running over the top of the leaching tanks. This conveyor is equipped with a movable belt tripper. The belt tripper will discharge into the classifier which is also movable with the tripper. The acid proof classifier will overflow the slimes that would otherwise clog the large leaching tank charges. The classifier can be set over a wide range of overflow and only that portion of slimes that will interfere with proper leaching need be separated and leached in the slimes circuit. Plans for the classification and the slimes leaching and washing to follow are all based on the separation being made at 65 mesh. However, this figure can be changed to a finer mesh separation if desired later. By the use of an acid proof classifier and acid proof pre-thickener and pumps, etc., it will not be necessary to introduce any water into the leaching circuits save for the final washings. The clear overflow from the pre-thickener will be in closed circuit with the classifier by means of a surge tank and an acid proof Duriron Pump. This will make the classification circuit easy to operate, and very little attention from the plant operators will be needed.

L E A C H I N G

For the leaching of the coarse ore, in the large leaching tanks, sufficient acid proof lines and valves are provided in the plans so that any possible set of pumping conditions may be met. The matter of acid proof pumps is important. I have selected Duriron pumps, for this purpose as they are really acid-proof, whereas the leadlined type of pump is simply acid-resisting. The Duriron pumps cost no more than the lead-lined variety and will have far less repair cost. Four general classes of acid proof lines and valves and fittings are available, namely, Duriron, Hard Rubber, Lead Lined and Rubber Lined. The relative cost of the various types plus their ability to withstand the copper-acid solutions should be the deciding factors in the proper selection of such equipment. On this basis we have chosen for this plant lead fittings, lead lined iron pipe, and lead-lined valves. One acid-proof pump is provided for each leaching tank, to handle the solutions from and to that tank; also pumps for the handling of wash solutions, make up solutions and rich solution.

Similar equipment is provided in the slimes plant as well. Sufficient solution storage is provided in the plans for all grades of solution that the plant will have to handle. All tanks to be of three inch Douglas fir construction with a good treatment of asphalt within the tank, as well as to the

outside of the tanks and the hoops. I have no hesitation in saying that these tanks will stand up to the work; this is fully proven by the results obtained elsewhere, as well as the results we got from tanks of this construction at the French Gulch Test Plant. The tanks there, after over two years use, are today in perfect condition. Tailings disposal will be direct from the leaching tanks on to conveyors, and thus to the tails site. The site available for tailings disposal is ample for a much larger plant than is provided for in the plans, - 600 tons. Also thus very cheap disposal of tailings may be had without the use of water.

The slimes leaching will be in two Dorr Acid Proof Agitators in series, which will provide plenty of time contact of the solutions with the slimes to be certain to get a complete recovery of the oxide copper that can be leached. After the agitators will follow four Dorr Acid Proof Thickeners which will wash the valuable copper-acid solutions from the slimes, each to be provided with a repulper and a Dorrco Pump. The test work showed that the 93% recovery figure used in the cost figures included with this report can surely be made with this type of slimes and coarse ore treatment. The slimes will be pumped to the slimes pond, and part of the water will later be recovered from this pond; however, the moisture content of the slimes will be low, as they will be thickened by the last thickener in the line before being sent to the slimes disposal site.

P R E C I P I T A T I O N

It is proposed at this plant to take advantage of the many developments made in recent years in the Southwest and in Utah in cement copper precipitation. We have an ideal site for such a plant on a hill just above the leaching plant. By the use of this site it will be possible to get the tails solutions by gravity to any part of the leaching plant. Also it will be easy to get the new iron to the precipitation plant and to ship the cement copper.

Briefly, the plant will consist of two double and five single launders, all of which will be four feet wide and 200 feet long. The rich solution will be stored in a large tank just ahead of the precipitation plant. These launders will be provided with a wood grating and will have a sloping bottom and plugs every two feet on the low side. Thus easy cleaning out of the launders can be accomplished. The amount of launder space provided for in the plans is ample for the amount and grade of solutions that this plant will have to handle. The type of construction is similar to the best plants now running and will allow of the making of the highest possible grade of precipitates and at the lowest possible operating cost. Every successful precipitation plant in the West has been studied so that the plant here proposed may be said to be the result of the taking the best from each of the other plants and combining all these ideas together here. Plenty of drying space is provided

for in the plans so that the driest possible precipitates will be shipped to the smelter.

P L A N T D E S I G N

The matter of enlargement of plant has been carefully taken into consideration in making the plans for this 600 ton unit. Space that fits the needs is available just north of the leaching plant and also of the precipitation plant for further plant expansion. Increase of capacity in the crushing plant, hoisting plant, compressor plant, tailings disposal and other items are taken care of, in that these units will have to operate but eight hours daily to handle the 600 tons for this first unit. In other words, the capacity of the entire plant, save the leaching and precipitation units, is 1800 tons daily. However, this provision of extra capacity is not one that may be considered unnecessary as rather this capacity of plant is necessary in order to have the machines that will stand up under the stress of work that must be done in the handling of ore. Also provision is made in the plant layout for possible flotation treatment of sulphide ore if any such is ever found that will need such treatment, the same crushing plant could be used and the grinding, flotation, filtering units, etc., erected just below the fine crushing plant. On the other hand, if later it should be found that a small percentage of sulphide copper is present in the now undeveloped ore reserves, then a ferric-

iron-sulphuric acid leach can be used on such ores in the present suggested plant. It should be understood, however, that the two provisions above do not apply to any ores now known or now probable in the Cuprite Shaft area; but rather that the sulphuric acid leaching plant as covered in this report will handle all the known ore in the most economical manner now known to copper metallurgy.

COST OF THE 600 TON PLANT.

The cost estimates for the 600 ton plant as here shown are based on the flow sheet as given in this report. This plant to be erected on the site just north of the proposed new shaft and the crushing plant, ore bins, and leaching plant to be all along the west side of the ravine which runs north and south and which is just west of the present Cuprite shaft. A complete survey has been made of this site so that the excavation and concrete and other such figures, which form part of the cost of the plant are based on an actual plant layout on the site as selected. Prices are at hand on all of the machinery needed for the plant as well as for such items as lumber, hardware, pipe, cement, etc. The buildings which are included in the cost estimate are all to be of frame with corrugated iron sides and roof. This type of construction is all that will be needed in this climate, especially as no machinery is supported from roof trusses. The only load off the ground is the classifier support, and this is of steel construction, with wood towers.

The costs as given are felt to be accurate within five per cent and are based on the plant layout as indicated in this report and on the now finished plans for this plant, as well as on actual construction experience of the writer at similar plants in Arizona.

TABLE SHOWING CONSTRUCTION COSTS
TREATMENT PLANT

<u>Class of Construction</u>	<u>Estimated Cost</u>	<u>Per cent of Total Cost</u>
Coarse Crushing plant	\$9,905.00	4.1
Coarse Ore Bin, etc.	5,153.00	2.1
Fine Crushing Plant	34,512.00	14.1
Fine Ore Bin, etc.	9,331.00	3.8
Classification and Slimes Plant	59,908.00	24.5
Leaching Plant proper	101,020.00	41.3
Precipitation Plant	11,580.00	4.8
Tailings Disposal	6,350.00	2.6
General Items	<u>6,700.00</u>	<u>2.7</u>
Total Estimates cost - - - - -	244,459.00	100%

OPERATION COST ESTIMATES

No mention has been made in this report of other possible methods of producing copper save that of cement copper. However, it should be here pointed out that full consideration has been given to all other possible methods. The chief reason that it is recommended that cement copper be produced at this plant is the matter of cost of plant as well as cost of operation. The 600 ton plant size is such that electrolytic refining of the copper would not be the most economic method of copper production, especially at the cost of power for such a size of plant. To get cheaper power for the refining would mean a large sized power plant, and this, in turn, would mean more production of ore than 600 tons daily. With a plant of larger daily capacity at this location, it may well be feasible to then install such a power plant and produce electrolytic copper. Another reason for the adoption of cement copper precipitation is of course the fact that about one-third of the copper would have to be thus produced in any event in order to prevent fouling of the leaching solutions.

The operation cost estimates given below are based on definite data now available as to unit costs of all needed supply items. The base costs for such items as acid, iron, power, etc., are from actual quotations of late date. In some cases they can be improved upon later, I feel certain.

The assumption of 1.75% oxide copper heads is based on the ore reserves now blocked out and which grade is shown in reports on the ore reserves by the engineers who have examined the property. The assumptions as to percentage of extractions, grade of precipitates and moisture of precipitates are based on the test plant results as shown in the data sheets attached. The 15 cent copper price used is felt to be fair over a term of years.

Unit costs for supplies are as follows:

ACID: Estimated consumption 2.4 pounds of 60 degree acid per pound of copper extracted, or 2.00 pounds of 100% acid. This acid to cost \$14.40 per ton F.O.B. plant.

IRON: Estimated consumption, 1.20 pounds per pound of copper precipitated. Iron cost, \$20.30 per ton F.O.B. plant.

SMELTING: These figures are from actual smelter contract now offered the Hammon Copper Company, Ltd. Treatment rate, \$4.00 per dry ton of precipitates; 20 pounds of copper to be deducted per dry ton to cover slag losses; 85% copper in precipitates; 15% moisture in precipitates; two and one-quarter cents per pound to be deducted from the copper price for selling expense, freight on blister copper to refinery, refining and converting.

FREIGHT: Estimated at \$8.50 per wet ton of precipitates; this figure also includes trucking to the railroad, etc.

TONNAGE: 600 tons of ore to be leached daily.

PRICE OF COPPER Fifteen cents per pound at New York.

GRADE OF ORE: 1.75% oxide copper leaching plant heads.

EXTRACTION: 93% of the oxide copper content of the heads.

The detailed costs as shown on the following page are based also on a careful study of the operating conditions as they actually will be found at this plant. As will be noted, the chief items of cost are iron and acid and costs of marketing the cement copper. These three items are fixed, in that I feel that the iron and acid consumptions have been most definitely proven by the test work. The marketing costs are also certain, as they are based on actual quotations now available to the Hammon Copper Company, Ltd. The other local operating costs form but 18% of the total cost so that it is felt that the accuracy of the cost as shown can be depended upon.

LEACHING AND MARKETING COST ESTIMATE

<u>Cost Items</u>	<u>Daily Cost</u>	<u>Cost per ton Ore</u>	<u>Cost per lb. Copper</u>
CRUSHING:			
Repairs and renewals	\$ 18.00	\$ 0.030	¢ 0.092
Labor - - - - -	18.80	0.031	0.096
Power - - - - -	22.40	0.037	0.115
LEACHING:			
Labor in plant	31.20	0.052	0.160
Repairs and Renewals	30.00	0.050	0.154
Iron @ 1.2# # cu.	237.60	0.396	1.218
Acid @ 2.4# # cu.	337.20	0.562	1.728
Charge and Discharge	18.00	0.030	0.092
Tails Disposal	15.00	0.025	0.077
Assaying & Supt.	30.00	0.050	0.154
Precipitation	40.00	0.067	0.205
Power	51.20	0.085	0.262
FREIGHT AND TRUCKING OF PPTS.	114.92	0.192	0.589
COPPER DEDUCTION @ 20#/ton or 230 lbs @ 15¢	34.50	0.058	0.176
SMELTING @ \$4.00 dry ton	45.96	0.077	0.235
CONVERTING, REFINING, FREIGHT ON BLISTER COPPER & SELLING EXPENSE @ 2¼¢ /lb copper	<u>432.97</u>	<u>0.722</u>	<u>2.217</u>
TOTAL COST OF ABOVE - - -	\$1,477.75	\$2.464	¢ 7.570
<hr/>			
VALUE OF COPPER IN PPTS. DAILY @ 15¢ /Lb	2,929.50	4.882	¢ 15.00
TOTAL COSTS AS ABOVE	<u>1,477.75</u>	<u>2.464</u>	<u>7.570</u>
BALANCE AVAILABLE FOR MINING COSTS AND PROFIT - - - - -	\$1,451.75	\$2.418	¢ 7.430

21,000 pounds oxide copper in heads daily
19,530 pounds of copper in precipitates daily.

13.52 wet tons of precipitates daily
11.40 Dry tons of precipitates daily.

S U M M A R Y

The results obtained in the French Gulch Test Plant have been carefully checked by me during the last part of the first series of test charged and all of the work done since that time, so that I feel personally assured that all the data obtained therefrom is as reliable as possible to get in such work. The extent of this test work was such that it seems safe to plan on being able to obtain in commercial work the results used in the cost calculations of this report. In every case the figures used are the average results of the testing as done. All important points of commercial practice were checked many times at the test plant; also all the machines of any importance, especially those that would come into contact with the acid bearing solutions, were subjected to actual plant conditions in the test work. Assuming a mining cost of \$0.586 per ton of ore, then the plant as here outlined of 600 tons daily capacity should be paid for from the treatment of about 140,000 tons of 1.75% oxide copper ore, or at 600 tons daily, in about 233 days time.

Two factors greatly favor acid leaching at this location, namely, the extremely low acid consumption by the gangue, and the very low cost that should be had in "breaking" the ore, both in the mine as well as in the crushing plant.

It should be kept in mind that the grade of ore at this property, namely 1.75% copper content puts it in a different class from most plants treating ores by leaching methods; the other plants in most cases are treating ores of from 1.00% to 1.25% copper content. The cost of mining, of overhead, of crushing, leaching, labor, etc. in fact every cost save acid, iron and smelting, etc., are the same, regardless of the grade of the ore; so that with the higher grade ores at this property, the cost per pound of copper produced will be lowered in direct proportion to the increase of grade here, as over other plants.

The type of plant outlined in this report is one that fits the work to be done in each case and at the same time is one that can be built at a minimum cost, for such a plant.

Complete plans for the proposed 600 ton plant as outlined in this report are now ready, together with specifications of all the machinery needed for the plant. Also the necessary roads for plant construction are finished, in addition to a telephone line, power line, etc. A complete camp for the construction and mining crews is finished and the ground on which the plant is to be built has been broken and the ground is ready for the power shovel.

(Signed) E. L. Sweeney,
Mining Engineer.

COMPARISON OF OPERATING RESULTS OF THE VARIOUS
SERIES OF TEST CHARGES RUN

	1 TON TANK CHARGES			15 TON TANK CHARGES			AVERAGE OF SIX AGITATOR CHARGES
	<u>#30-39 Average</u>	<u>#30-49 Average</u>	<u>#50-73 Average</u>	<u>Chg.#1</u>	<u>Chg.#2</u>	<u>Chg.#3</u>	
Heads-% Total Copper	2.37	2.40	1.95	2.19	1.98	1.82	1.90
Heads-% Oxide Copper	2.16	2.15	1.80	2.03	1.79	1.65	1.72
Tails-Total Copper	0.46	0.37	0.30	0.26	0.275	0.25	0.26
Tails-% Oxide Copper	0.29	0.20	0.17	0.12	0.125	0.11	0.107
% Extraction-Total cu.	80.3	84.6	85.01	88.1	86.1	86.3	86.03
% Extraction Total Cu.	86.4	90.5	90.8	94.1	93.0	93.3	93.9
Heads-Plus 6 Mesh	44.2	43.0	42.4	44.4	48.9	42.6	All ore
Heads-Plus 40 Mesh	40.0	38.9	41.5	50.0	47.9	48.5	From-14 60 65 Mesh
Heads-Minus 40 Mesh	15.8	13.1	16.1	5.6	3.2	8.9	
Pounds acid used per lb.extracted	1.92	1.92	2.08	1.92	1.84	1.83	1.89
Average Acid Content of Leach solutions	1.91	2.09	2.20	2.57	1.90	1.82	1.79
Average Copper content of leach solutions	2.04	1.76	1.28	2.06	2.51	1.10	0.90
Average time of leach days	8	6	7.3	6.0	4.4	3.2	4.3

DATA ON AGITATION CHARGES

<u>CHARGE NUMBER</u>	<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>	<u>E</u>	<u>F</u>	<u>AVERAGE</u>
Heads-% Got. CU.	1.80	1.78	1.69	2.17	2.02	1.94	1.90
Heads-% OX CU	1.60	1.64	1.48	2.00	1.85	1.76	1.72
Tails-% TOT. CU	0.25	0.22	0.27	0.275	0.27	0.27	0.26
Tails-% OX CU.	86.2	87.7	84.0	87.3	86.6	85.8	86.3
EXTRACT % OX CU	93.2	94.5	94.9	93.5	94.05	92.9	93.9
# Acid # Copper	2.12	1.82	1.75	1.69	1.69	1.69	1.79
HOURS TOTAL LEACH	6	12	4	5	5	5	6.2
HOURS LEACH THAT GAVE MAX. EXTRACT	6	6	1	4	5	4	4.3
Aver. % Acid in Leaching Sol.	1.28	2.25	1.95	1.57	1.80	1.57	1.79
Aver. % Copper in Leaching Sol.	1.05	1.07	0.10	0.79	0.85	1.54	0.90
Mesh All Feed Passed Through	30	30	65	30	30	14	- -

The above table shows that sands even as coarse as 14 mesh made by the crushing of this ore to the 3/8 in. size could be treated in a short time by the agitation equipment. Tests were also run for longer periods of time and on slimes alone - as per charge No. "C" above, and in each case quick extractions were had. Small tests made so that quick and accurate samples might be taken showed that with real slimes the extraction was made in a few minutes at most. These tests also showed the possible limit of extraction on this ore by the sulphuric acid process, as when the ore was finely ground and the acid solutions and this pulp were agitated together it gave the maximum of opportunity for copper solution.

TABLES BELOW GIVE THE SOLUTION ASSAYS OF THE THREE LARGE TANK CHARGES AT THE START AND AT THE END OF EACH LEACHING DAY. THEY SHOW THAT MOST OF THE EXTRACTION WAS MADE IN A SHORT PERIOD OF TIME.

Time Leached	% Acid	% Copper	% Ferrous Iron	Ferric Iron	Specific Gravity
<u>Charge No. 1</u>					
Start of Leach	1.10	0.30	1.42	0.90	1.02
After 1 day	1.43	1.53	1.42	0.45	1.055
After 2 days	2.38	2.25	1.42	0.37	1.08
After 3 days	3.00	2.52	1.69	0.40	1.10
After 4 days	<u>3.46</u>	<u>2.62</u>	<u>1.79</u>	<u>0.43</u>	<u>1.05</u>
AVERAGE	2.57	2.06	1.55	0.51	1.08
<u>Charge No. 2</u>					
Start of Leach	1.22	0.93	0.03	0.00	1.04
After 1 day	0.33	2.31	0.00	0.03	1.075
After 2 days	1.69	3.06	0.00	0.04	1.10
After 3 days	2.51	3.14	0.00	0.05	1.115
After 4 days	<u>2.60</u>	<u>3.14</u>	<u>0.01</u>	<u>0.11</u>	<u>1.115</u>
AVERAGE	1.90	2.51	0.00	0.05	1.093
<u>Charge No. 3</u>					
Start of Leach	1.64	0.00	0.00	0.00	1.015
After 1 day	1.10	1.67	0.07	0.01	1.055
After 2 days	2.56	2.01	0.01	0.03	1.075
After 3 days	2.81	2.16	0.01	0.03	1.080
After 3 days & 4 hrs.	<u>2.80</u>	<u>2.18</u>	<u>0.01</u>	<u>0.03</u>	<u>1.085</u>
AVERAGE	1.82	1.10	0.01	0.02	1.062

RESULTS OF SLIMES DISPOSAL TEST MADE BY PUMPING SLIMES TAILINGS AFTER AGITATION ONTO A 15 TON TANK CHARGE THAT WAS READY TO BE DISCHARGED

93.2 per cent of the slimes were held in the charge in the large tank.

89.5 per cent of the water pumped in with slimes was retained as this portion of the water was saved in a clear state for re-use for the same purpose.

SCREEN TEST SERIES TWO

Charges 50 to 73

<u>M E S H</u>	<u>LEACHING HEADS</u>		<u>T A I L S</u>		
	<u>% Tot. Cu</u>	<u>% Weight</u>	<u>% Tot. Cu</u>	<u>% Weight</u>	<u>% Ext.</u>
Plus 6	2.075	42.4	0.374	42.0	92.0
Plus 40	1.85	41.5	0.266	43.0	85.6
Minus 40	<u>1.96</u>	<u>16.1</u>	<u>0.287</u>	<u>15.0</u>	<u>85.4</u>
AVERAGE	1.985		0.308		84.33

The above table shows that the oxide copper values are quite evenly distributed through the various sizes, as proved to be the case with all ore tested.

POUNDS IRON USED PER POUND OF
COPPER PRECIPITATED

Charges Nos. 30 to 49, inclusive - 1.23 lbs. iron per lb. CU.

Charges Nos. 50 to 73, inclusive - 1.07 " " " " "

TYPICAL WASHING DATA - LARGE TANK
CHARGE # 2.

Four washes used and each circulated for four hours through tank. Open drainage of rich solution before first wash applied, and one hour's drainage before each of the other washes applied.

WASH SOLUTIONS ASSAYS - AT END OF THE WASH

	<u>% Acid</u>	<u>% Copper</u>	<u>Spec. Gravity</u>	<u>Gals. per ton Ore</u>
Wash # 1	0.88	1.22	1.04	108
Wash # 2	0.45	0.67	1.02	108
Wash # 3	0.226	0.34	1.015	108
Wash # 4	0.045	0.07	1.005	113

R E P O R T

on

HAMMON COPPER CO. LTD.

YAVAPAI COUNTY

ARIZONA

by

W. J. LORING

October 1st, 1930.

Hammon Copper Co, Ltd.,
Balfour Building,
351 California St.,
San Francisco, California.

Dear Sirs:

The following is my report upon your property, to
Oct. 1, 1930.

LOCATION

Walnut Grove Mining District, Yavapai County, Arizona.
Nearest railway (Santa Fe) at Kirkland, twelve miles distant.
Good motor road from mine to railway, of which eight and one half
miles is County road and three and one half is mine road. The
mine road is as good as the County road. The County seat is
Prescott, (Population 7000) 32 miles distant, is reached by
motor in one hour; while Phoenix the Capital of the State is
97 miles distant, reached in three hours by motor. The State
highway connects both Phoenix and Prescott, seven and one half
miles from your mine.

ELEVATION

The elevation at your Cuprite shaft is 4780 feet, at your
Loring shaft 4820 feet. At the Hammon Camp (New camp) 4750 feet,
and at the old camp in use for the past four and one half years
4225 feet.

*Yp 11. N. W. (Copper Camp)
R. 4.*

CLIMATE

The climate is favorable for outside work the year round. Winter begins in November and ends the middle of April. Some snow falls during these months but causes no interruption to outside work and usually remains only a few days. Between April 15th and July 1st, the weather is usually warm in the day time and cool at night, with a breeze blowing during the day. Highest temperature April 15th and the end of August sometimes is 105 degrees in the shade. Summer rains usually begin to fall early in July and are in the form of thunder storms as a rule, but sometimes rain will fall for hours and end with no wind and no thunder or lightning. Rain usually brings a fall in temperature. These rains are of material benefit to agriculture, fruit and stock raising, as well as the miner, as the water level is raised in wells and springs, for all purposes, grass usually springs up and provides feed for the various stock enterprises in this section. From the end of August to the first of November the climate is pleasant and the temperature gradually falls to cold at night.

TIMBER

There is no mining timber on the property, although the whole country is covered with scrub oak; while in all the gulches and water ways are to be found walnuts and the usual variety of Arizona bush.

WATER SUPPLY

There is practically no running water on the property, but an ample supply for domestic needs of the finest water in the Country has been developed in shallow wells. For ore treatment purposes an ample supply has been developed in the Cuprite shaft. Sufficient to treat more than the contemplated 1800 tons of ore daily.

HISTORY

The history of this district dates back to the early eighties. Around thirty or more years ago a company was formed for the purpose of building a small smelter upon the property. The results of this operation were evidently not satisfactory; as the old slag dump shows that the tonnage smelted was of little consequence. No evidence of smelting ore of sufficient tonnage to justify a smelter has thus far been found in the aggressive development campaign carried on by your company; however the future may develop a sulphide ore that would justify a change in the conditions that are to be seen at this date.

Some of the mining claims have been held continuously by one family since 1887. In 1919 a strong group examined the district and decided that there was a chance to develop a large sulphide copper ore tonnage. The formation shows a possible width of 800 feet at the point where 872 foot vertical shaft was sunk. This is a two compartment shaft, timbered with Oregon pine.

Several cross cuts were extended East and West off this shaft at points below the water level, none of any important length above the 700 or 800 levels.

At the 700 foot level a west cross cut was driven 123 feet, and at the 850 foot level 320 feet west was driven, at which later point water was encountered at the rate of 200 gallons per minute. The shaft was equipped with oil engines of the second hand order, and were found to be inadequate to handle the water encountered in this shaft. Property payments were due, amounting to a large sum; more powerful and dependable plant was necessary and the money market was tight in 1920 - 1921; and rather than face all these problems it was decided to close down, before the original plan was fully carried into effect.

It would appear that the cross cut at 850 foot level, having encountered a heavy flow of water should have induced the Company to drift south with a view of at least exposing the ground in this direction, which shows a large body of oxidized ore, that has since been not only exposed by your efforts in deep cross trenches at the surface, but also at your 210 & 335 foot levels.

This shaft passed through the oxidized ore body, but the then operators were looking for a sulphide ore body as already mentioned. No drifting was done. As an indication of the importance placed upon this section of country by the company who sunk the shaft, 140 claims in a compact block were secured either by purchase, option or location, all of which were surveyed for patent.

At the date when this program of shaft sinking was commenced no leaching of oxidized copper ore was being done except at the New Cornelia Copper Co, at Ajo, Arizona. So little was known of up to date leaching at that time, that no attention was given to the possibilities of applying this method to the oxidized ore at this property.

Eventually the claims under option, those located, and those purchased, either reverted back to the original owners, or due to lack of annual assessment work, became open for relocation. The 872 foot shaft did not prove or disprove the value of the property.

This work did the following:

- 1.- Provided a vertical shaft 872 feet deep with several stations and levels started, all of which may be valued at no less than \$87,500.00.
- 2.- A means for exploring the ground at a depth of 850 feet vertical when it was desired for primary ore which must lie under the oxidized ore to the south.
- 3.- An ample water supply available in this shaft to furnish all the needed water for over the contemplated 1800 tons of leaching ore per day.
- 4.- A ready means for the development of the oxidized ore body, showing at the surface.

by G. L. ...

*prob
correct*

Your operations commenced in April 1926; first by a careful examination of the surface of the sections now under control of your company. Hundreds of samples were taken of the surface exposures over several thousand feet in length and several hundred feet in width. These samples gave a remarkable insight into the possibilities of development of a large tonnage of carbonate copper ore. It was then decided to trench the outcrop for a reasonable distance along its strike and for a width as far across the outcrop as the sampling results gave encouragement.

Careful sampling was carried out, and the results were recorded upon an assay plan built upon the coordinate system, following an accurate survey of the claims being sampled. By this method it was easy to outline the ore limits at the surface.

An investigation of the Cuprite shaft was made and ore was found in the shaft similar to that exposed in the surface trenches. Water was standing at 365 foot vertical in the Cuprite shaft. It was decided to open a level and cross cut east off the shaft at 210 feet and 335 feet below the surface. This cross cut encountered ore almost from the start at 210 foot level, but at 56 feet east it encountered the real ore body and drifting was commenced both north and south, upon ore that corresponded with the ore exposed in the trenches.

All the ore so far developed in this mine is oxidized, & easily leached.

A great amount of information was obtained from the New Cornelia Copper Co, at Ajo, Arizona, on the leaching of oxidized copper ores, as the result of treating 5000 tons daily by the cold solution of weak sulphuric acid.

It was obvious that if a tonnage of oxidized ore could be developed that would justify the installation of a plant of commercial size, that there would be a mine here of great value, as all the indications pointed to that fact. It appeared that the possible copper content of the ore was at least one half per-cent higher than New Cornelia. There were points to be determined however,

They were:

- A.- Did the ore contain anything that would destroy sulphuric acid?
- B.- Was there sufficient ore to justify a treatment plant?
- C.- What average value of ore would be developed?
- D.- What size plant and what type?

With the above four major points in view, the problem was attacked. A - was determined at first by selecting a 250 pound sample of average ore which was analyzed at the Hayden smelter at Hayden, Arizona. This proved to be most satisfactory and the report came back that there was nothing in the ore to prevent an extraction of over 90% with a minimum consumption of sulphuric acid. With this lead the work commenced.

A treatment plant was put up to treat one ton daily. The testing of the ore in this plant was carried on as the mine was being developed. This plant did many things of value.

It proved the following:

- 1.- Size to which the ore must be crushed to give the best extraction.
- 2.- The acid consumption per pound of copper recovered.
- 3.- Time necessary to obtain the necessary extraction.
- 4.- Check on the value of ore being developed.

After running seventy three charges of ore through the test plant of one ton each, a fifteen ton tank was installed and used as a check against the one ton charges. This proved a complete check of a most satisfactory character, Improvements were made as this series of tests were made. These improvements followed the principals of cyanide treatment.

It was finally decided to build a plant of 600 tons daily capacity, separation of the fines from the coarse ore, leaching the coarse in 600 ton Douglas fir tanks, obtaining over 93% extraction in three days and four hours.

Agitating the fines and recovering the maximum copper content in four hours. This meant a shortening of the days of treatment by half those at New Cornelia, and a positive recovery of 93% of the oxidized copper.

In all of this work Douglas fir tanks were used, and after three years these tanks show little deterioration, although they have been subjected to more severe usage than will be the case in a commercial plant.

The foregoing is a short history of these properties and their operation, covering a period of forty-three years, ie;- from 1887 to 1st October 1930. During that period, many changes have taken place. At the beginning of the forty three year period, there was no railroads, roads, or anything else to make these properties attractive. The district was prospected for gold, as that was a gold period in Yavapai County. There are some gold values in this district, but those seen to date are not within your property.

At this date the following facilities are available:

- 1.- State highway within seven and one half miles of the mine, connecting the Capital of the State and the County seat of Yavapai County, which is joined by a very fine road from the mine, just completed.
- 2.- Santa Fe railroad at Kirkland, 12 miles from the mine.
- 3.- Telegraph, Post Office, Store, Hotel, Garage, and repair station at Kirkland.
- 4.- Copper smelter at Jerome 50 miles distant, also at Hayden, Arizona 202 miles distant.

by R.R. dated 9/22/30

The following may be added to the above which have been the result of efforts in developing this property.

- A.- Known tonnage of ore reserves , containing nearly 70,000,000 pounds of copper, with every assurance that the mine will develop six times the above copper.
- B.- Good roads constructed by the company.
- C.- Equipped with electric power, fine electric hoist and compressor equal to all development work demanded of it.
- D.- Fine new boarding house with modern equipment, capable of taking care of 200 men; together with new sleeping houses, bath and septic tank. All protected with fire system under 150 foot head. Telephone connects five local stations.
- E.- Long distant private line to central station, Prescott Arizona.
- F.- Water service to all parts of the two camps, water of the finest in Arizona.
- G.- Old camp in fine condition to accommodate 60 men, with office, residences, boarding house, assay office, Experimental plant, trucks and cars, all in fine condition.
- H.- Excavation for treatment plant blasted and ready for power shovel to move the 7000 cubic yards of broken rock.
- I.- New assay office and store room erected at point convenient to mine and treatment plant. All timber for treatment plant ordered and 70% delivered.
- J.- Plans and specifications for treatment plant 100 % completed.

K.- Spur track and lease on 1.41 acres of yard space at Kirkland.

L.- Total footage of development 14,834 feet. This entire footage has been carefully sampled and recorded, the total assays and determinations number 20,000.

DISTANCE TO IMPORTANT COPPER MINES

Your property is located in a highly mineralized section of Arizona. The United Verde Copper Co. and the United Verde Extension Copper Co. are located at Jerome 52 miles distant. Magma Copper Mining Co., 87 miles. Miami and Globe 113 miles; and Bisbee, 262 miles distant, with many small mines within these distances.

Copper is the basic resource of Arizona. The State normally produces 42% of the copper of the United States and approximately 25% of the entire world's output.

The principal producing copper companies of the State of Arizona are:

United Verde Copper Co.,
United Verde Extension Copper Co.,
Magma Copper Mining Co.,
Miami Copper Mining Co.,
Inspiration Copper Mining Co.,
Old Dominion Copper Mining Co.,
Copper Queen (Phelps Dodge)
Calumet and Arizona Copper Co.,
New Cornelia Copper Co.,

To say the least your mine is in a copper State, and its ore bodies are in a geological formation similar to the big mines of the State.

TITLES

There are 735.1 acres in the ground owned by your Company. Some of the claims are patented and some held by location rights and the titles are sound, with no flaws or anything to cause trouble.

The ore bodies are well protected, with ample protective areas on all sides. Great care has been observed in securing all ground necessary for protection and for plant location.

OBJECT OF DEVELOPMENT WORK

The object of the development work underground was to carry this on for a sufficient distance under the surface trenches to prove the width and copper content of the ore showings on the surface, and to check one with the other. It was not intended to prove the entire showing at surface by underground work, but to prove sufficient of this length along the strike of the ore to warrant an ore treatment plant of sufficient size to return a reasonable profit. Build the plant in units of 600 tons per day. Start one unit as soon as possible, and let the mine develop itself thereafter. The above program was carried into effect and was marked with unqualified success.

There being developed a tonnage sufficient to warrant the building of a 600 ton unit of treatment plant to start with, so planned as to be added to with no difficulty and with a minimum of further cost and expense. Considerably over \$1,000,000 has been expended upon the property. The property contains

The property contains an area in one solid block, 11,000 feet long by 2400 to 3600 feet wide.

EXPLORATION

There are 1214 feet of substantial two compartment working shafts; the main shaft being 872 feet deep, well timbered another shaft 340 feet deep also well timbered, as well as other shafts of a prospecting nature.

The surface trenching covers a greater length along the strike of the ore than the underground work has been carried on, and the results obtained by trenching has disclosed as good results at one place as another; therefore it may be assumed that there will be developed by underground work, additional tonnage when the underground exploration work is carried on under the surface sections and beyond the ends of the underground drifts.

It may be further stated that the section of ground that has been developed for proven ores, is not fully developed, but this will be left for further extentions by stoping operations; this being a cheap and effective method of completing this work.

With an ore deposit having possibilities of width ranging from 60 feet to several hundred feet, and about 5000 feet in length, it would be a big task to develop this immense area, and every consideration should be observed in solving the problem with a minimum of expense, hence the suggestion that stoping operations be allowed to take its share of the burden, not only for the sake of economy but for the more certain and effective control of ore values.

By the method of stoping to be adopted at your mine full control of ore values will be easily effected; at the same time no ore will be overlooked, and ground prospected by the simple and effective method of stoping, thus exposing greater areas than any development campaign, could possibly disclose. At the same time to a certain extent making mining develop the area being stoped.

Under this heading, I wish to call your attention to one point of importance that has not yet been referred to in any report. In addition to the partial development of the mine in the process of ore extraction, the existence and location of the sulphides, which are covered no doubt by the large oxidized areas so far developed by your company, will be located, and if this works out as it should, this point will be reached with little expense.

No effort has been made to locate the sulphide ore bodies, as it was felt that there was every chance to produce a large tonnage of oxidized ore above the water level; this being fully demonstrated, it clarifies the treatment problem, making one process treatment upon a highly profitable basis and leaving the sulphides treatment to be taken care of at a later date, when the location, value, and magnitude of the same have been proven at the expense of the oxidized ore.

ESTIMATED COSTS

The calculations given below are based on a 600 ton daily capacity treatment plant, and with 1.75% copper content of ore leached, and 93% extraction of the copper in the ore.

	DAILY COST	COST PER TON ORE	COST PER LB COPPER
COST: Mining, Development, & Camp expense.	\$351.36	\$0.5856	¢1.799
COST: Crushing, Leaching, & Marketing.	1459.02	2.4310	7.472
COST: Taxes, Fire Insurance, and Compensation Insurance.	59.70	0.0995	0.306
Total daily cost:	\$1870.08	\$3.1161	¢ 9.577

The costs are calculated upon the basis of maximum costs at the mine, which includes not only ore production and treatment, but the cost of development and every cost that may be charged to this operation. It will be seen that upon this basis, the cost to produce copper will be 9.577 ¢ per pound; therefore, any market above that figure leaves a profit.

At various selling prices for copper the balance, will be as follows:

<u>COPPER PRICE</u>	<u>DAILY PROFIT</u>	<u>PROFIT PER TON</u>	<u>PROFIT PER POUND OF COPPER</u>
12 cents.	\$ 473.52	\$0.7892	¢ 2.424
13 " .	668.82	1.1159	3.423
14 " .	845.12	1.4085	4.327
<hr/>			
15 cents.	1,040.42	1.7340	5.327
16 " .	1,235.72	2.0595	6.327
17 " .	1,431.02	2.3850	7.327

The profit balances per month and per year at various selling prices for copper, based upon treating 600 tons of ore per day, and allowing for 1.75% copper, with 93% extraction, and a total cost of \$3.1161 per ton, will be, as follows:

<u>COPPER PRICE CENTS PER LB.</u>	<u>PROFIT PER MONTH</u>	<u>PROFIT PER YEAR</u>
12 cents.	\$ 14,205.60	\$ 170,467.20
13 " .	20,064.60	240,775.20
14 " .	25,353.60	304,243.20
<hr/>		
15 cents.	31,212.60	374,551.20
16 " .	37,071.60	444,859.20
17 " .	42,930.60	515,167.20

ORE RESERVES

The developed ore consists of 1,424,770 tons, averaging 1.75% oxide copper, to which is added 653,809 tons partly developed ore, which is not fully opened up to allow the usual engineering methods to be applied as in the case of the fully developed ore, but sufficient openings have been made to give this ore an average content of 1.5 % oxide copper. Using the foregoing data we have the following results.

POSITIVELY DEVELOPED ORE:	1,424,770 tons	@1.75%	is	49,866,950 lbs.
PARTLY DEVELOPED ORE:	653,809 tons	@1.5 %	is	19,614,270 lbs.
<hr/>				
Totals and averages:	2,078,579	@1.67	is	69,481,220 lbs.

The extraction as per extensive tests on a large scale in the test plant of the company, gave an extraction in excess of 93% of the oxide copper contents of the ore. The following are the results, applying the foregoing;

POSITIVELY DEVELOPED ORE:	Extractable copper	46,376,083 lbs.
PARTLY DEVELOPED ORE:	Extractable copper	18,241,271 lbs.
		<hr/>
Total extractable		64,617,354 lbs.

The ore reserves dealt with are only those that have been exposed in the development of the mine to date, and do not exhaust the great possibilities of developing many times more than the over two million tons developed and partly developed. The surface indications are even more favorable for the development of a great tonnage beyond the section that contains the blocked ore, and from the surface trenching that has been done to date, at random points beyond the developed area, the tonnage of possible ore at this date is very strong.

LEACHING PLANT

It is proposed to build the leaching plant in units of 600 tons daily capacity each. As soon as the first unit is completed and in operation the second unit is to be added, making a total daily capacity of 1200 tons. The ore now available for the treatment plant based upon treating 600 tons, & 1200 tons daily, followed by another unit of 600 tons, at a date when the available ore is sufficient to supply 1800 tons daily, is as follows:

<u>ONE & TWO UNITS TONS DAILY</u>	<u>MONTHLY TONS</u>	<u>YEARLY TONS</u>	<u>YEARS LIFE</u>
600	18,000	216,000	9.6
1200	36,000	432,000	4.8

In conclusion it is pointed out that the mine is developed to the point of justifying the immediate erection of the first unit of 600 tons leaching Plant, to be followed by the second and third units of similar size and capacity as soon as conditions are favorable for this addition. The plans for the whole plant are completed in detail for erection purposes, The roads have been completed, and the telephone line both long distance and local, is in operation. Electric power line has been in use for three years. Boarding house and sleeping quarters all completed for the accomodation of 200 men, all modern equipment ready for use, with water service under 150 feet head. Assay office and store room completed, excavation for treatment plant all blasted ready for removal of the muck with power shovel. Lumber and timber 80% delivered either at mine lumber yard at the railway or at the mine. Old camp in first class order for accomodation of 60 men. Ample water of the best in the country for domestic purposes and ore treatment. The work of completion of the plant and putting it in operation can be commenced in one week and completed in four to five months.

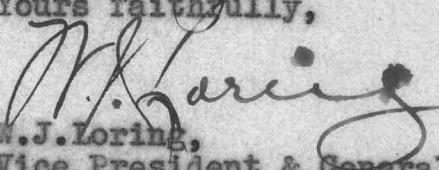
The costs are based upon contracts already made for these items that can be contracted, and those costs that come under the heading of mining and local supervision, have been checked with similar operations in Arizona, so that the cost of \$3.1161 per ton can be considered reliable. In fact these costs are above the cost that the actual figures show, and it is anticipated that this set up will be reduced.

Hammon Copper Co, Ltd., - 20.

Considerable work has been done at the 335 foot level during the past five months and most encouraging results have been attained. Although the work done at this level was for the purpose of making a haulage level and not in search of ore, very good ore was encountered in the drift, which indicates that the further south the development work extends the more does it appear that the large body of ore developed at the 210 foot level comes down to the 335 foot level.

This opens up the question as to the depth of the oxidized ore, and the position of the primary ore that should form the base upon which the oxidized ore may rest. No attempt has been made to locate the primary ore, there being sufficient oxidized ore already developed and evidence of additional large tonnage to be cheaply developed by simply extending the drifts southerly under the great showing at the surface to warrant the immediate construction of the first unit of the treatment plant.

Yours faithfully,


W.J. Loring,
Vice President & General Manager,
Hammon Copper Co, Ltd.,

C. D. BLAKE
1301 NORTH SIXTH STREET
ST. LOUIS, MO.

A. 2/26/41

February 25, 1941.

Mr. Geo. M. Colvocoresses,
1102 Luhrs Tower,
Phoenix, Ariz.

Dear Mr. Colvovoreses:

You are doubtless wondering why you have not had a call from me; but we were in Phoenix only three days and we had a telegram calling us East owing to the serious illness of a relative, so that I did not have time to call at your office.

We were charmed with Phoenix and hope to be able to go there again some day. If we do, you may be sure it will give me great pleasure to call and make your personal acquaintance.

With best wishes,

Sincerely yours,

C. D. Blake

CDB:T

2/24 47

F. H. Stephens, C. S. & R. Carter

you can have some data in ~~the~~

the property & also cleaning property

state with map.

Stephens says that they are now

making a thorough survey of all

properties that have fronted on the

development a large amount of ground

is a lot for the purpose of ^{the} them

improvement made I think will make

the headquarters at present for

some time a mile back on the

Hammer & Berg, as well as any

other property shown in the present

also of Kenneth Wilson

Hammon
Cuprite
File

To file with
Hammon

See Hammon's Journal

Report on the "McMahan Group of Mines"
Situating in the Walnut Grove Mining District
Kirkland, Yavapai County, Arizona.

copied

Names of Claims and Area of Group.-

The property consists of the following named lode claims,-
Iron Hat, Oro, Oro No. 2, Rising Sun, Union, Black Prince,
Shamrock, Umpire and Cuprite, aggregating an area of approx-
imately 177 acres.

Titles.-

The titles to the whole of the property are held by lo-
cation, possession and compliance with the laws of the United
States. The owners are R.B. McMahan and the heirs of Constan-
tine McMahan.

Enclosures.-

- 1.- Topographical Map showing location of camp and property.
- 2.- Claim Map.
- 3.- Plan of Workings.
- 4.- Geological Sketch Map.

Geography and Accessibility.-

This group of mining claims is located in the Walnut
Grove Mining District, Yavapai County, Arizona, and is distant
by wagon road from Kirkland (Kirkland is on the Santa Fe, Pres-
cott & Phoenix Ry) about 12 miles in a south-easterly direction.

The cost of hauling ore will vary from \$2.75 to \$5.00 per
ton. Freight rates from Kirkland on ores not exceeding \$20
valuation, minimum carload of 60,000 lbs, are \$1.50 to Clarke-
dale, \$1.30 to Humboldt, \$2.50 to Hayden, and \$4 to Douglas.

The elevation of the Cuprite Shaft is 700 ft. higher than
Kirkland station and 4700 ft. above sea level.

Geology.-

The formation of territory surrounding the immediate vi-
cinity of the mining claims is reflected on the "Geological
Sketch Map", and is the following, - commencing about one mile
east of the mining claims and going in a westerly direction is
granite on which lies schists tilted at angles of about 56 de-
grees from the horizontal and dipping toward the west. The
schists are cut with siliceous porphyry dikes and finally on

the McMahan Group come in contact with diorite and quartz porphyry. The schists near the contact are highly silicified, faulted and intruded with porphyry dikes (especially on the Cuprite claim) and this section constitutes the main ore bearing zone. There is a zone of approximately 2000 ft extending from the N.E. corner of Cuprite claim to the center of the Black Prince claim. This zone is heavily impregnated with secondary minerals formed in the surface zone of weathering, the most important being cuprite, malachite, azurite and chrysocolla. From this zone on the Cuprite claim 267 tons of copper ore have been extracted and shipped to the Smelters. The ore occurs as replacements in schists, in the form of shoots, the surface dimensions being outlined on the map "Plan of Workings." Oxidized copper outcrops assaying from 1 to 4% copper extend in a south-easterly direction, at right angles to the strike of the schists, for a distance of 100 ft. from the hanging wall side of the main deposits, and surface trenches cut in this direction show alternate leached and oxidized copper bearing stretches of siliceous schists, indicating that when water level is reached and primitive ores encountered, the possibility of immense lateral dimensions in the ore shoots. While the surface ores so far extracted have averaged about 6% copper, workings in the lowest depths so far obtained indicate that values will be leached from 100 ft. depth to water level (450 ft. beneath the surface) with only occasional bunches of 6% ore. When water level is reached, secondary sulphides will probably be encountered of a good grade of copper, and at a lower depth primitive sulphides of a grade of from 2 to 5% copper. The ore occurrence resembles those of the main copper ore deposits in Yavapai County, such as, - the United Verde and United Verde Extension at Jerome, and the Consolidated Arizona and Arizona-Binghamton located near Humboldt. The property is located approximately 20 miles from Humboldt, measured on an air line.

Prospecting Work Done,-

The principal work has been done on the Cuprite claim, the plan of said work being shown on the map "Plan of Workings."

The vertical shaft reaches a depth of 100 ft. and is bottomed in 1-1/2% copper material. The crosscut on the 60 ft. level passes through 9 feet of 4% of copper ore from the shaft and then enters leached siliceous schists in which are occasional blotches of copper ore. The lower tunnel is driven on a fault plane for about 1/2 its length from which nodules of high grade cuprite ore was extracted. The high grade ore shipped (5 tons of 17.88% copper) came from here. The Upper tunnel passed through the ore body for a width of about 25 feet. The hanging wall side of this ore body was stoped out to the surface for a width of 8 ft. averaging 6 to 9% copper. The upper portion of the Incline Shaft was in 6 to 9% ore and gradually entered leached material of 1-1/2% copper.

Ore Produced and Shipped to the Smelters,-

<u>Tons</u> <u>Net</u>	<u>Gold</u> <u>ozs.</u>	<u>Silver</u> <u>ozs.</u>	<u>Copper</u> <u>%</u>	<u>Ins.</u> <u>%</u>	<u>Silica</u> <u>%</u>	<u>Iron</u> <u>%</u>	<u>Lime</u> <u>%</u>	<u>Alumina</u> <u>%</u>
13.000	tr	0.04	12.9	70.0		2.0		
37.3760	tr	0.26	6.8	74.8		5.7	0.9	
46.7465	(no assay)		6.57		(no analyses)			
36.2570	"		9.0		"			
23.7520	tr	tr	6.11		55.8	7.4	1.3	13.0
18.4175	0.01	0.10	7.27	73.6		5.8		
24.7715	tr	tr	5.59	78.0		6.6		
5.2825	0.06	0.60	17.88	50.4		9.7		
28.0745	tr	tr	4.46		(no analyses)			
33.373			4.35					
<u>267.0505</u>								

Cost of Opening up the Property,-

Permanent water level lies at approximately 450 ft. beneath the collar of Cuprite Shaft, as determined by several churn drill holes drilled in this locality. It is the intention to sink to water level and drift on the ore shoots opened up on.

The enlarging of the Cuprite Shaft (vertical) from the surface to its present depth, 100 ft, and sinking same to water level, crosscutting to the ore shoots and drifting for a distance of 700 ft. on same, is what should be done to determine the

true worth of the property. That a large property of great value will be opened up, there can be no doubt. The cost of this work, present price of material and cost of labor considered, would be approximately,-

450 ft. of sinking (enlarging shaft 100 ft of present depth) at \$40 per ft.-----	\$18000.00
100 ft. of crosscutting at \$9 per ft.-----	900.00
700 ft. of drifting at \$8 per ft. -----	5600.00
Total development ---	<u>24500.00</u>
Equipment,-	
Gasoline hoist, cable, buckets, cars etc-	3000.00
Buildings-	
Head frame and engine house -----	300.00
	<u>\$27800.00</u>

The dwellings of the Zonia Copper Mining Co., 1 mile from Cuprite shaft, are capable of housing 20 men. These dwellings can be rented very reasonable. No work has been done on the Zonia property for 18 years.

Remarks,-

As already stated, the ore occurrence resembles that of the properties of the Arizona Consolidated and the Arizona-Binghamton near Humboldt. The two properties mentioned had high grade oxidized ore near the surface, followed by a leached zone, before encountering the sulphide zone. The sulphide ores are mainly treated by flotation, averaging about 3% copper for the crude ore concentrated. The better grade ores are treated direct in the smelters without concentration.

There is still exposed on the surface of the Cuprite claim of the McMahan Group, a large tonnage of oxidized copper ore ranging in grade from 1 to 4% copper, which might be handled profitably by leaching with dilute sulphuric acid, or by sulphide filming and subsequent flotation.

Denver, Colo, 1217 Adams St.,

(signed) C.H. McMahan

Mining Engineer

Feb. 22, 1918.

Parrott

Name - Zonia & McMahon
Date - Feb. 15, 1920
Report - Additions to report of L.F.S.
Holland, of August 1917.

Geology -

A series of schistose intrusives among which quartz monzonite; quartz porphyry and quartz diorite were recognized. A few isolated areas of schist presumably sedimentary.

The intrusives have been greatly fractured and sheared the resulting schistosity is more pronounced in the softer rocks. Fracturing was followed by mineralizing solutions and chalcopryite deposited largely in the fracture planes in the various rocks. The area over which this mineralization occurs is great tho the principle mineralization is confined to five distinct zones more or less lenticular in shape and showing on the Zonia ground considerable copper carbonate in cleavage planes as a replacement of the sericite developed from alterations of feldspar during matamorphism. The solutions from which the carbonate was deposited probably originated from leaching of narrow bands of primary chalcopryite high in iron which now appear within the areas mentioned as stringers of iron oxide and quartz. One of these areas near the 100' shaft mentioned in Holland's report shows five feet of material that has possibilities of developing in depth into a body of commercial ore of fair grade. It is doubtful, however, if deep work will develop any larger bodies of ore and from the grade of ore encountered at the surface on the various outcrop it is more than likely that depth will show small lenticular bodies of ore ranging from 2 to 3% copper and larger areas of 1 to 1.5% ore.

The possibilities for development of disseminated ores over areas large enough to permit of cheap mining is poor.

Properties previous to examinations had been optioned by Dr. Richel^{ts} and associates and preparations were under way for the sinking of a shaft on the McMahon group.

Humboldt, Arizona.
April 6, 1920.

W. V. De *Camp*

DISTRICT	PROPERTIES	LOCATION	OWNERS & OPERATORS	DATE VISITED
Kirkland, Yavapai Co., Arizona	MacMahan	11½ m. S. E. Kirkland, ad- joining Zonia property. Elevation 4250 to 4650. 9 claims unpatented.	C MacMahan Idle	October 5, 1917

To. Hamm file

NOTES

The geological conditions are similar to those on the adjoining Zonia property and two out of the six holes, put down by the Mines Development Company (Shannon Copper Company) were on the MacMahan claims. For a distance of 700' N. E. and S. W., along which are several surface cuts, is a belt of siliceous schist, with intrusive "porphyry", probably diorite. The diorite appears to have given the schist a reverse dip at the S. W. end, instead of the dip to the West. Siliceous schist shows malachite, more particularly on the cleavage planes, and spots of cuprite. Nodules of quartz in the porphyritic belt show copper carbonates and cuprite. The belt is 150' across on one place. From a tunnel on this belt are a winze and raise, exposing 100' in depth. Copper carbonates are concentrated on fault planes. Another incline shaft of same depth shows a little ore on fault planes. The ore is usually hard and siliceous. A carload shipped to Hayden in 1916, assayed 4.36% Cu; 82.6% insol. No charge was made for the latter. The treatment charge was \$3.93 per ton. The width of the ore appears to be about 9', due to concentrations on fault planes.

The silicified schist belt appears to have possibilities for the development of a commercial ore body of the replacement type in depth, as is the case with the adjoining Zonia property, but there would seem to be little chance of developing a disseminated copper deposit, as was apparently hoped when the drilling was done.

L.F.H.

DISTRICT	PROPERTIES	LOCATION	OWNERS & OPERATORS	DATE VISITED	NOTES
Kirkland, Yavapai Co., Arizona	MacMahan	11½ m. S. E. Kirkland, ad- joining Zonia property. Elevation 4250 to 4650. 9 claims unpatented.	C MacMahan Idle	October 5, 1917	<p>The geological conditions are similar to those on the adjoining Zonia property and two out of the six holes, put down by the Mines Development Company (Shannon Copper Company) were on the MacMahan claims. For a distance of 700' N. E. and S. W., along which are several surface cuts, is a belt of siliceous schist, with intrusive "porphyry", probably diorite. The diorite appears to have given the schist a reverse dip at the S. W. end, instead of the dip to the West. Siliceous schist shows malachite, more particularly on the cleavage planes, and spots of cuprite. Nodules of quartz in the porphyritic belt show copper carbonates and cuprite. The belt is 150' across on one place. From a tunnel on this belt are a winze and raise, exposing 100' in depth. Copper carbonates are concentrated on fault planes. Another incline shaft of same depth shows a little ore on fault planes. The ore is usually hard and siliceous. A carload shipped to Hayden in 1916, assayed 4.36% Cu; 82.6% insol. No charge was made for the latter. The treatment charge was \$3.93 per ton. The width of the ore appears to be about 9', due to concentrations on fault planes.</p> <p>The silicified schist belt appears to have possibilities for the development of a commercial ore body of the replacement type in depth, as is the case with the adjoining Zonia property, but there would seem to be little chance of developing a disseminated copper deposit, as was apparently hoped when the drilling was done.</p>

L. F. Holland
[Signature]

Hammmon

February 19, 1947

Mr. F. M. Stephens
American Smelting & Refining Co.
Valley Bank Building
Tucson, Arizona

Dear Mr. Stephens:

The next time you are in or near Phoenix and have a few minutes to spare, I wish you would drop into my office as I would like to tell you briefly of a deposit of copper ore in the central part of the state concerning which I recently dug up some information in my files.

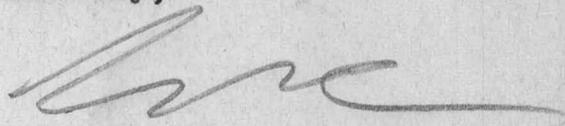
While the previous investigations of this property were not altogether satisfactory, the conditions as reported by others, and as I recall them myself, were such that it appears to me quite possible that a large body of oxidized copper ore could be developed at or near the surface with an average grade in excess of 1%, and that portions of this orebody might be underlain by sulphides of a somewhat similar grade.

I am writing you this letter on the assumption that your company would be disposed to consider a deposit which is in some respects similar to the showing at San Manuel, and in so far as I know, the property mentioned could probably be secured on favorable terms, but I will not attempt to go into details in this letter.

If the matter is of no interest to you, please, let me know as I think that there are other companies who might be disposed to investigate. One large copper company did so some 25 years ago, but at that time conditions were very different from what they are today.

Personal regards.

Sincerely,



GMC: IM

HAMMON COPPER COMPANY

Notes by J. H. Hazen - May 31st, 1926

The Loring property has been greatly overestimated by Mr. Loring. (See report). I do not think that he could ship more than a car per day, and would probably lose money on it. The Zonia has an area of stained material that would probably average 2.5% to 3% and has no precious metal value. The possibilities of a mine in depth on the McMahon group are, in my opinion, good.

The navy group, Mathy and Leferino, has possibilities. They have about a car of ore ready to ship, but told me they wished to let it lie, as an aid to disposing of their property. Mr. Reed has written them concerning their siliceous gold ores.

Office

HAMMON COPPER COMPANY

Note by G. M. Colvocoresses, October, 1937.

The claims owned by this Company were at one time known as the MacMahon Group and at another time as the Zonia, -hence the reports on these two properties are included in this file.

During the war small shipments of high grade oxidized ore were made to Humboldt.

Around 1922²⁰ the claims were optioned to the Inspiration Copper Co. which sank a shaft and did considerable drilling in the hope of proving up a large body of disseminated secondary sulphide ore which might be worked in a similar manner to the porphyry coppers.

In this expectation they were disappointed and according to statements made to me by their Engineer, Mr. P. G. Spilsbury, they concluded that there had been practically no secondary enrichment in the sulphide zone and the primary sulphides carried less than 0.5% copper per ton.

Reno Sales, Geologist for the Anaconda Company, definitely condemned the project and work was abandoned.

The subsequent development and operations of the Hammon Co. under direction of Loring were very ill advised, his shipments of ore were very low grade and his plan of erecting a large mill never materialized. Mr. Hammon told me that he lost some \$300,000 on this venture. The plant and equipment has been removed.

My personal investigation of the property, which did not include any extensive sampling, has led me to conclude that no large scale operations could be profitably conducted here unless the price of copper were in excess of 20¢ per pound.

There are some small veins and pockets near the surface which might be worked by lessees but otherwise the property is wholly unattractive.

McGUIRE, HORNER & SMITH

ATTORNEYS AND COUNSELLORS AT LAW

150 NASSAU STREET

NEW YORK

TELEPHONE BEEKMAN 3-8436

ELISHA W. McGUIRE
HERBERT RAYMOND SMITH

CABLE ADDRESS "GUIDONIAN"

December 23rd, 1935.

A 3/11/36

Mr. George M. Colvocoresses,
1108 Luhrs Tower,
Phoenix, Arizona.

Dear Cal:

I was glad to have your letter of December 12th and had had in mind to write you. I have been a very poor correspondent of late. All through the seven or eight weeks prior to election I was in the midst of the campaign and since election there has seemed to have been one thing or another to keep me busy.

I hope your litigation in Delaware will go satisfactorily. It is not easy to handle it at such long range. I am glad that you have a representative there that you like.

The news in regard to Katrine's engagement was very interesting. You must be a pretty busy man to have two daughters in college at the same time. I still have one in high school.

I was at the Yale Club having dinner one night quite recently and Roland Palmer came in. I have not seen him for years. He has had an office in Paris but has returned to live on his farm in Dutchess County. He asked to be remembered to you when I wrote.

In looking over our wills file sometime ago I found that we had an envelope bearing the endorsement ~~an~~ a will dated June 25, 1907. I have not opened the envelope but would suppose it to contain a will of that date. I expect you have made wills since then and thought I would mention this when I wrote.

This is a very poor letter but I am writing very hastily at the end of the day but want to get it off to you to tell you how glad I was to hear from you and to wish you and Marion and all your family a happy New Year, as this letter will not reach you in time for Christmas greetings although I am writing it two days before Christmas. Shall hope to do better as a correspondent in the future.

Sincerely,

But

HRS:arc

11/11/30

4/25

Keyes called with Stanton & Benz

Who might be interested in purchase of
report for which asked 1.00.

Probably no deal

been one thing of interest to keep me busy.
the committee and since election there was assumed to have
of some more bills to election I was in the midst of
and the collection of the same. At present the seven
and the bill in mind to write for. I have been a
and the bill to make some report of research

DEAR SIR:
I have the honor to acknowledge the receipt of your letter of the 11th inst. in relation to the purchase of the report for which you offered \$1.00. I regret to inform you that I have no report for sale at this time.

11/11/30

December 22nd, 1930

CHANGE ADDRESS: SMITHSONIAN INSTITUTION
WASHINGTON, D. C.

SMITHSONIAN INSTITUTION
WASHINGTON, D. C.

TELEPHONE: 3-4436

Young claims that the length of
the possible ore zone is 5000' & width
800' = say 300,000 tons per foot
of depth or 30,000,000 if depth
is 100'

Assume grade of oxidized
ore for depth of $\frac{1}{2}$ ft is 1.75%

cu. (Actually developed 1,500,000 + 650,000
partly devel. all near surface)
? - Secondary enriched zone, if any

& primary ore below which was
reported to contain only 0.5% cu.

330 EAST 22 STREET



CHICAGO 16, ILLINOIS

Dear Subscriber:

If this letter crosses your instructions to me in the mail, please forgive me.

But if you have just overlooked renewing your gift subscription order for TIME, I would appreciate your doing so now -- by return mail.

For although I have not yet sent an expiration notice to your TIME reading friend, I will have to send one very soon now -- unless you authorize me to send in its place a handsome engraved card with word that you have renewed your gift for another year.

The enclosed slip records the subscription which is now going in your name as a gift.

And I hope you will initial this renewal memorandum and mail it right back to me today.

Cordially,

A handwritten signature in dark ink, appearing to read "F. D. Pratt". The signature is written in a cursive style with a long horizontal stroke extending to the right.

CIRCULATION DIRECTOR

P. S. I am pretty sure your friend hopes so too. For with the news pouring in 20,000 words an hour and every word of it more personally important to your friend than ever before, this is no year to be left without TIME.

R. I. 4023

Hammon Copper Mine, file

MARCH 1947

UNITED STATES
DEPARTMENT OF THE INTERIOR
J. A. KRUG, SECRETARY

BUREAU OF MINES
R. R. SAYERS, DIRECTOR

REPORT OF INVESTIGATIONS

at Hammon

ZONIA COPPER MINE, YAVAPAI COUNTY, ARIZ.



BY

CHARLES A. KUMKE

R. I. 4023,
March 1947.

REPORT OF INVESTIGATIONS

UNITED STATES DEPARTMENT OF THE INTERIOR - BUREAU OF MINES

ZONIA COPPER MINE, YAVAPAI COUNTY, ARIZONA^{1/}

By Charles A. Kumke^{2/}

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INTRODUCTION

In June 1942, the Bureau of Mines selected the Zonia copper mine, near Kirkland, Yavapai County, Arizona, as a property meriting investigation in connection with its search for supplies of strategic minerals for use in the war. The following month, representatives of the War Production Board conferred with Bureau officials and requested that the property be explored with the object of determining the tonnage and grade of ore that could be brought into production quickly and mined cheaply by open-pit methods. The work was designed to verify information submitted by the owners in support of an application for a Government loan.

It was essential that the investigations be completed promptly, so that operations might be planned and copper produced for war needs. The investigations called for surface trenching, diamond drilling, and check sampling of underground workings. Unable to purchase equipment for trenching without considerable delay, the Bureau saved time by borrowing most of the necessary items from the Golden Queen mine of the Gold Fields Development Co. at Mohave, Calif. This company, whose engineers had sampled some of the old trenches, had a tentative agreement with the owners to operate and manage the Zonia mine

^{1/} The Bureau of Mines will welcome reprinting of this paper provided the following footnote acknowledgment is used: "Reprinted from Bureau of Mines Report of Investigations 4023."

^{2/} Mining engineer, Bureau of Mines.

in event the loan was granted. Additional equipment was borrowed from two Governmental agencies. The exploratory work, completed in 16 weeks, was carried on 7 days a week.

ACKNOWLEDGMENTS

In its program of exploration of mineral deposits, the Bureau of Mines has as its primary objective the more effective utilization of our mineral resources to the end that they make the greatest possible contribution to national security and economy. It is the policy of the Bureau to publish the facts developed by each exploration project as soon as practical after its completion. The Mining Branch, Lowell B. Moon, chief, conducts preliminary examinations, performs the actual exploratory work, and prepares the final report. The Metallurgical Branch, R. G. Knickerbocker, chief, analyzes samples and performs beneficiation tests.

The investigations of the Mining Branch, as reported in this paper, were under the direction of J. H. Hedges, district engineer for the State of Arizona. Samples were analyzed at the Reno, Nev., and Salt Lake City, Utah, laboratories under the supervision of E. S. Leaver and S. R. Zimmerley, respectively. Ore-dressing tests were made at the Salt Lake City laboratories under the direction of G. H. Schack and H. G. Poole.

Special acknowledgment is made to the Grazing Service, the Geological Survey, and the Gold Fields American Development Co. for making equipment and supplies available to the Bureau. Engineers of the Gold Fields Co. cooperated splendidly with the Bureau throughout the project.

LOCATION AND ACCESSIBILITY

The Zonia mine is in sec. 12; T. 11 N., R. 4 W., in the Walnut Grove mining district in Yavapai County, Arizona. (fig. 1.) It lies about 11 miles southeast of Kirkland, Ariz., a station on the Ash Fork-Phoenix branch of the Santa Fe Railroad, and 7 miles from Kirkland Junction, which is 22 miles south of Prescott, Ariz., on U. S. Highway 89. The road from Kirkland through Kirkland Junction and thence to Zonia mine is a good dirt road with no difficult grades and is graded occasionally by the county.

PHYSICAL FEATURES AND CLIMATE

The property is near the northwestern edge of the Weaver Mountains. The topography is rugged and in the vicinity of the mine has a maximum relief of about 700 feet. It is characterized by a series of steep-sided canyons, which trend northwesterly to French Gulch. Zonia camp, situated in the gulch at an altitude of about 4,150, is about 0.5 mile northwest and 500 feet lower than the mine. French Gulch drains southeasterly to the Hassayampa River.

The climate is pleasant from October through May. During the remainder of the year, the days are hot but the nights are comparatively cool. Average annual precipitation is about 18.5 inches.

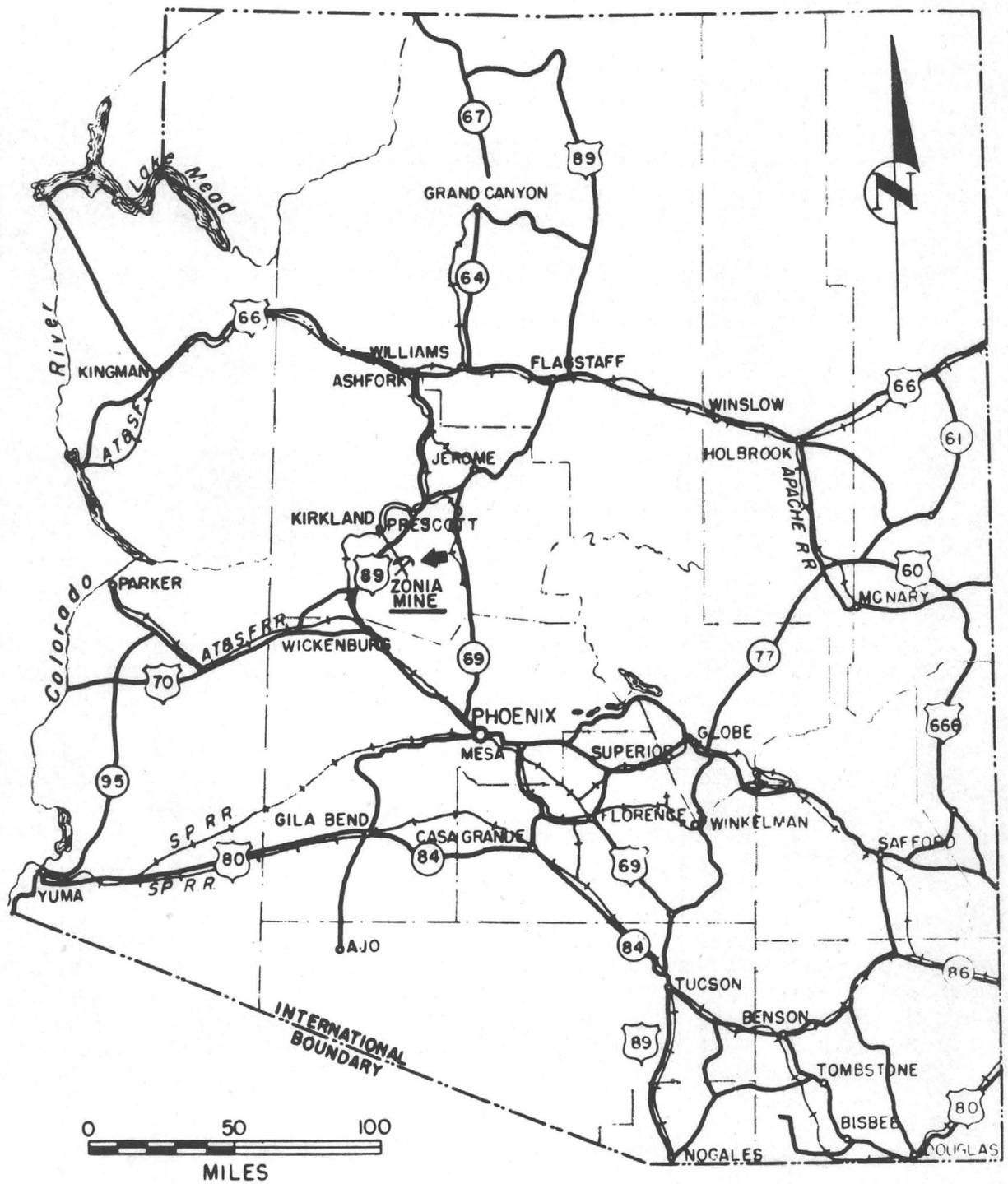


FIG. I-LOCATION MAP, ZONIA MINE, PROJ. 1417, YAVAPAI CO., ARIZ.

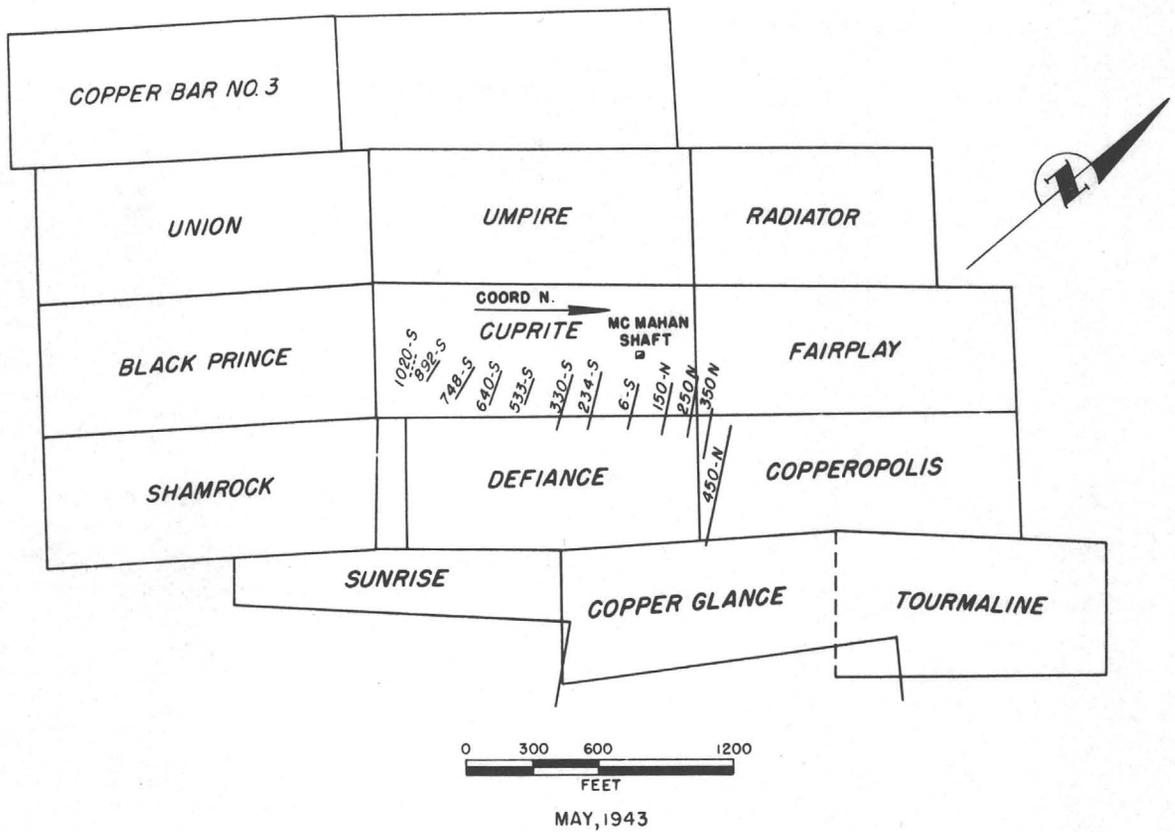


FIG.2-CLAIM MAP, ZONIA MINE, PROJ. 1417, YAVAPAI CO., ARIZONA

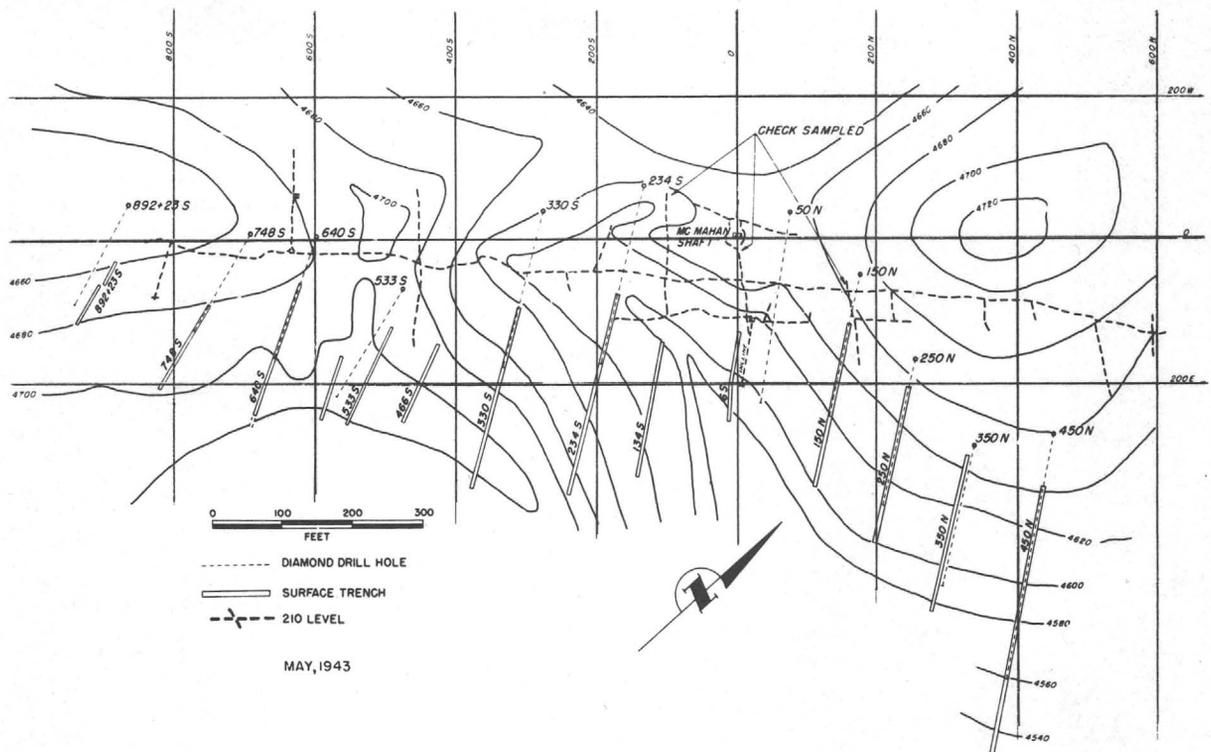


FIG.3-ZONIA MINE, PROJECT 1417, YAVAPAI COUNTY, ARIZONA

Vegetation, typical of the semi-arid regions of Arizona, consists mainly of greasewood and the common varieties of cactus.

PROPERTY AND OWNERSHIP

The property is composed of the Zonia and McMahan groups of claims. Figure 2 shows the location of the project area with reference to some of the claims. The Zonia group consists of 255.5 acres in 14 claims, all patented. The McMahan group originally consisted of approximately 175 acres of unpatented ground. In later years the assessment work was kept up on only five claims - the Union, Black Prince, Shamrock, Umpire, and Cuprite. The ore body indicated by trenching and drilling is almost entirely in the Cuprite claim. The Zonia group of claims is owned by James L. Gillingham, 1265 Webber Street, Alameda, Calif., who also holds an option on the McMahan group, owned by the Charles N. McMahan estate. W. C. Hannon, former president of the defunct Hannon Copper Co., the last operators of these properties, represented the owners in the present negotiations.

HISTORY AND PRODUCTION

The earliest recorded activity on this property occurred during the latter part of the 1880 to 1890 decade, when an attempt was made to smelt the higher-grade copper ore. The remnant of an old smelter furnace can be seen in Zonia camp.

In 1910, the Shannon Copper Co. of Clifton, Ariz., drilled six churn-drill holes on the property in search of a copper sulfide ore body. Three of the holes were on the Cuprite claim and one each on the Zonia, Defiance, and Black Prince claims. Results were disappointing and work stopped in October 1911.

A syndicate operated the property from 1916 to 1920. It sank the Cuprite or McMahan shaft (referred to in this report as the McMahan shaft) to a depth of 874 feet and from it did development work on five levels. It is reported that 150 gallons of water per minute was entering the shaft when the syndicate ceased operations after failing to find ore that could be mined at a profit.

About 1927, the Hammon Copper Co. of San Francisco acquired the property. They planned to mine the ore and recover its copper by the recently developed process of leaching. They did considerable development work on the 210- and 335-foot levels and extensive surface trenching. A leaching plant was built, and underground development was planned for production of 600 or more tons of ore per day. The property never entered into production, and the venture was abandoned in 1930.

Nearly a million dollars has been expended on the property.

Statistics on past production are not available, but it is possible that a few hundred tons of hand-sorted ore may have been produced. At present the property is inactive.

GEOLOGY AND ORE OCCURRENCE

The ore occurs in a belt of pre-Cambrian sericite-schist that has been intruded by monzonite porphyry. The belt, about 2,000 feet long and 100 to over 300 feet wide, strikes northeast-southwest and dips to the northwest at about 55 degrees. About 1,000 feet south of the shaft it narrows to a few feet in width.

Copper minerals are sparsely disseminated throughout the schist and in similar manner occur locally in the intrusive rock. The most abundant copper mineral is the carbonate malachite. An undetermined but minor amount of copper occurs as the silicate chrysocolla and as an unidentified green stain on gangue rock. Of more importance is the occurrence of cuprite and melanconite, red and black oxides of copper, respectively. These oxides are occasionally found in malachite veinlets, which occur in zones of pronounced schistosity. At a few points the veinlets, knife blade to an inch or more thick, coalesce to form shoots, from which 10 to 15 percent copper ore can be cobbled. These higher-grade bands, from which some ore has been produced, are 5 to 20 feet wide but do not appear to be continuous for any great length. They appear to rake sharply northward from trench 748-S to the vicinity of the most southerly of the Bureau-sampled crosscuts on the 210-foot level. (fig. 3.)

DEVELOPMENT

The principal surface workings consist of a series of trenches cut across the mineralized zone south of the shaft.

The mine has been developed underground from the McMahan shaft which, according to company records, is 874 feet deep. The collar and other timbers of the shaft have collapsed and the shaft opening is closed above the 210-foot level. On this level, accessible through a timbered inclined raise near the shaft, north-south drifts total 1,700 feet in length. Raises have been started from some of the numerous crosscuts, and all of the workings are standing in virtually their original shape. Workings below the 210-foot level are inaccessible. Over 7,000 feet of development work is recorded.

The three churn-drill holes drilled on the Cuprite claim are recorded as having been located a short distance north of the shaft.

WORK DONE BY THE BUREAU OF MINES

The project engineer and a few laborers arrived at French Gulch on October 8, 1942; buildings in the old Zonia camp were repaired, a crew was assembled, and the repairing and construction of roads and trails was started. Two portable compressors borrowed from the Grazing Service were delivered October 18, and other trenching equipment borrowed from the Gold Fields Development Co. arrived on October 20. The equipment was assembled at the project site, pipe lines were laid, and excavation of trenches started a few days later.

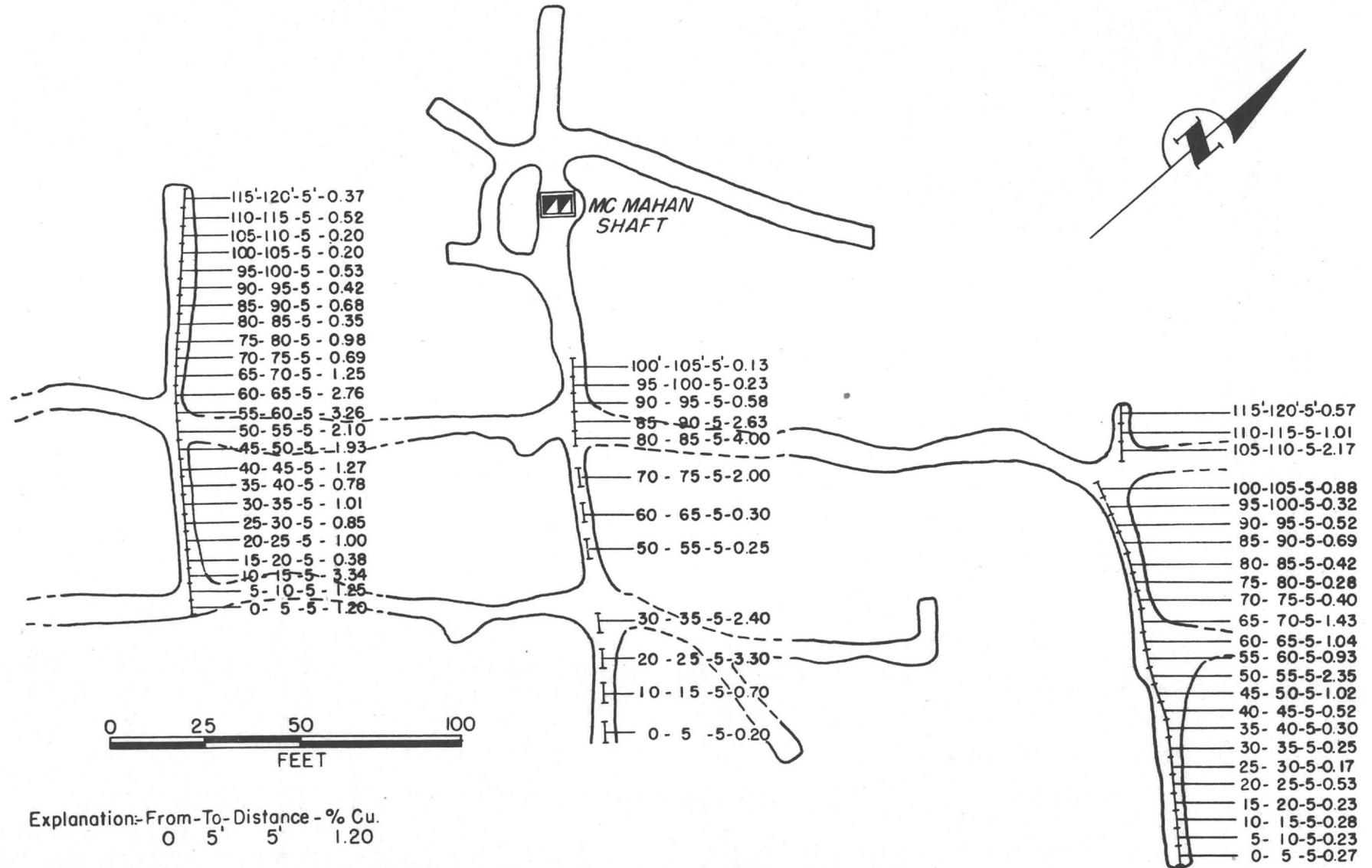


FIG. 4- UNDERGROUND CHECK-SAMPLES, ZONIA MINE, PROJ. 1417, YAVAPAI CO., ARIZONA

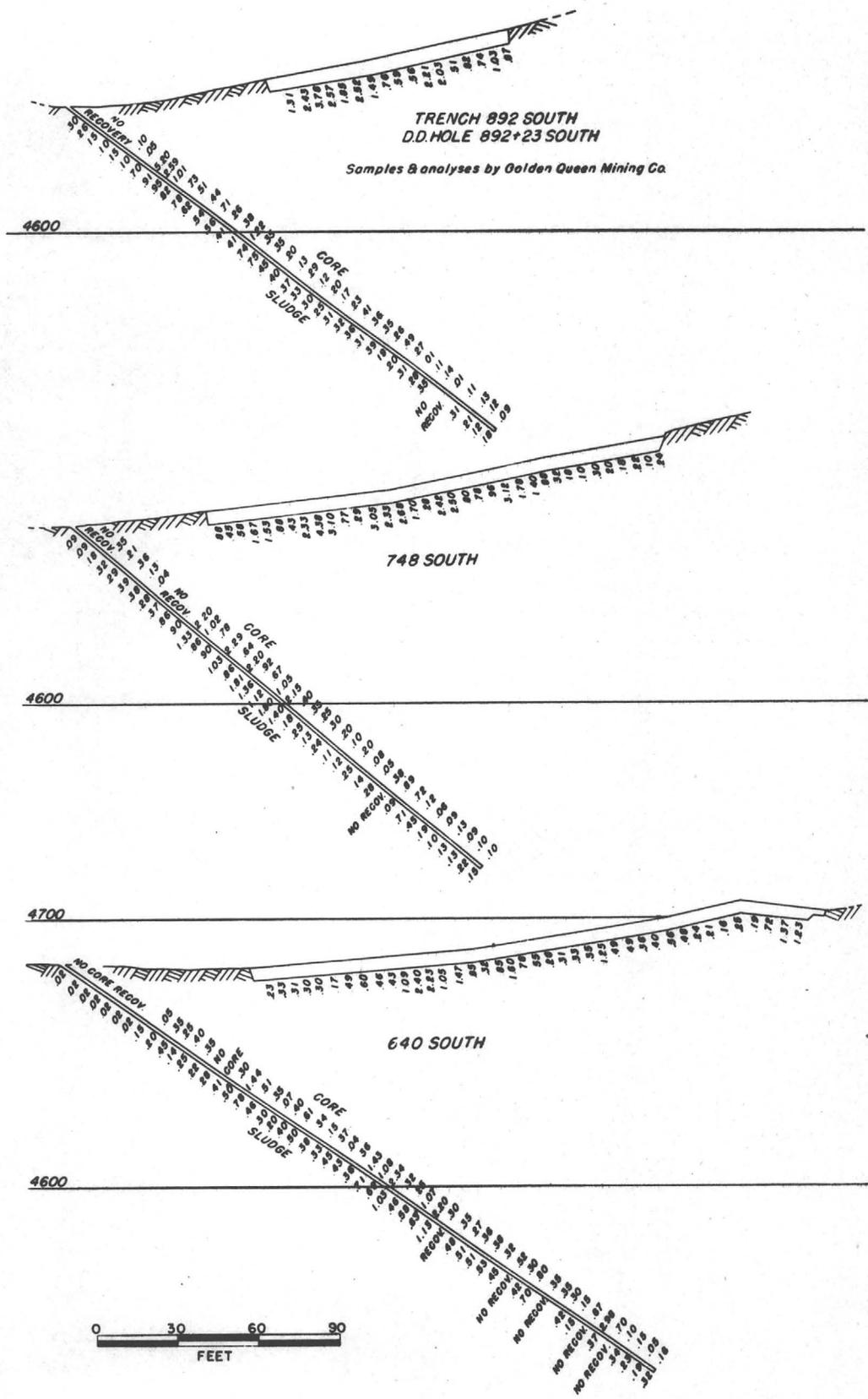


FIG. 5- TRENCH AND DIAMOND DRILL HOLE CROSS SECTIONS, ZONIA MINE, PROJ. 1417, YAVAPAI CO., ARIZ.

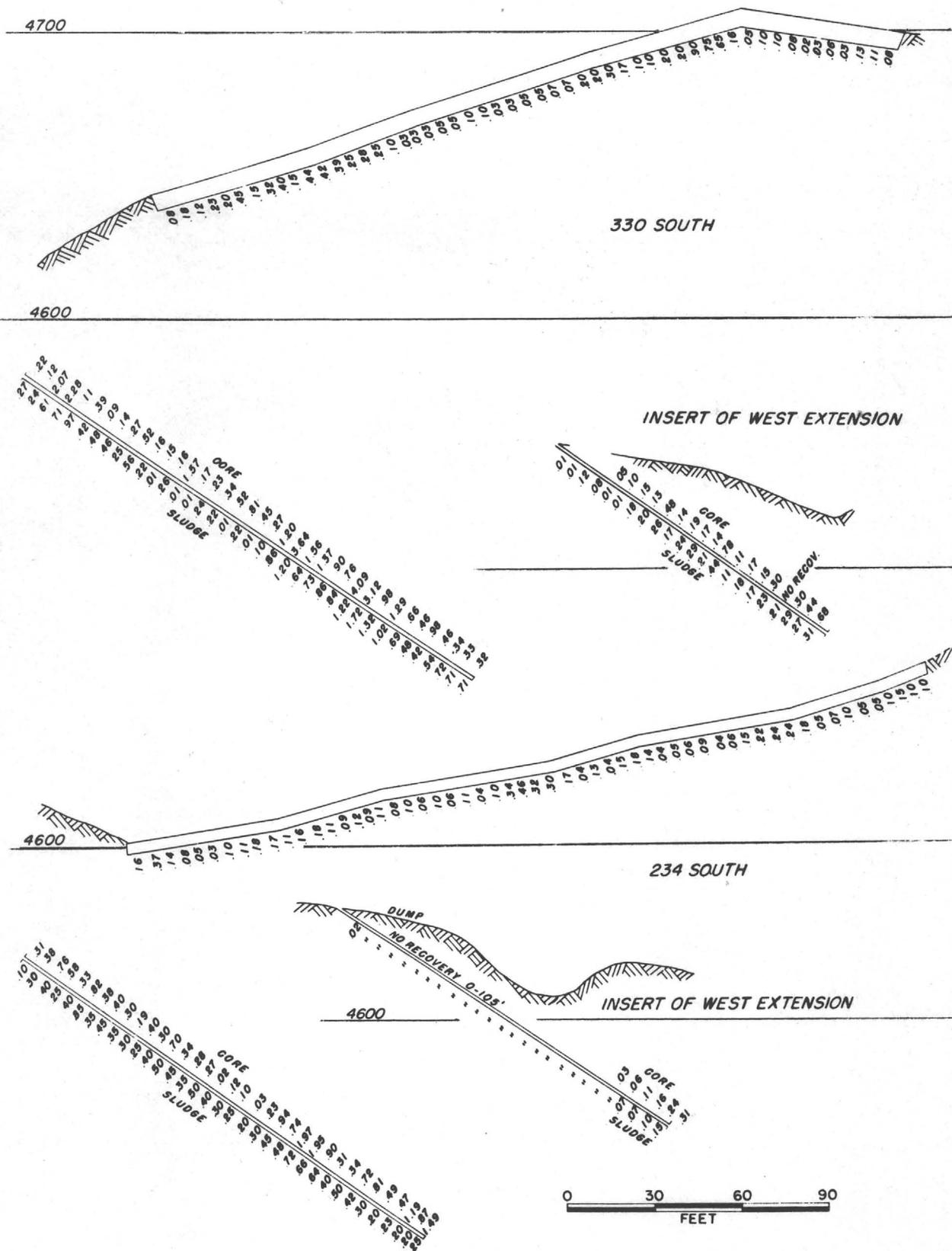


FIG. 6-TRENCH AND DIAMOND DRILL HOLE CROSS SECTIONS, ZONIA MINE, PROJ. 1417, YAVAPAI CO., ARIZ.

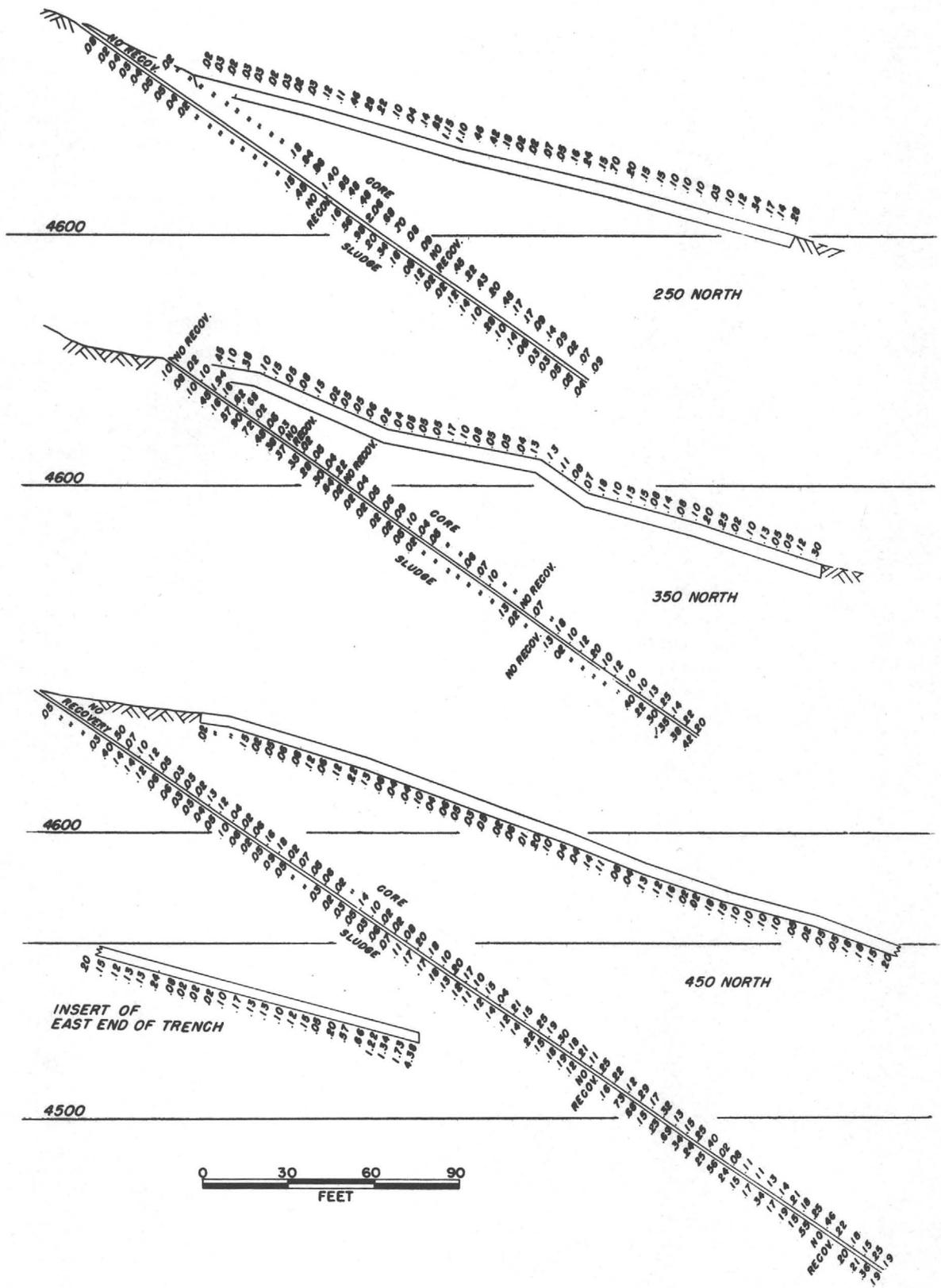


FIG.8-TRENCH AND DIAMOND DRILL HOLE CROSS SECTIONS, ZONIA MINE, PROJ.1417, YAVAPAI CO., ARIZ.

A diamond-drilling contract was negotiated, and the drill crew and equipment arrived at Zonia camp on November 4. Drilling started November 7 and was completed January 29, 1943. Eleven holes totaling 2,960 feet were drilled at approximately 100-foot intervals along the strike of the ore body. Each hole was drilled in or parallel and close to a vertical plane projected downward from one of the more important trenches. They were collared and pointed to cut the ore formation normal to its dip at approximately 100 feet below the center of the corresponding trench.

Seven new trenches were excavated at 100-foot intervals to an average depth of about 5 feet for a total length of 1,795 feet. Of the old trenches, two were lengthened a total of 140 feet and two were deepened for a total of 270 linear feet.

Underground work was confined to the check sampling of three crosscuts.

All new trenches and the old ones that were deepened were channel-sampled in 5-foot lengths at the rate of about 5 pounds of material per foot of sample length. The samples were dried and cut down at the project, and duplicate pulps were shipped to the Bureau laboratory at Reno, Nev., and the Golden Queen laboratory at Mojave, Calif. A sample made from rejects of all channel samples in trenches 748-S and 640-S was shipped to the Bureau's laboratory at Salt Lake City, Utah, for metallurgical tests. Drill-hole sludge samples and underground samples were handled similarly. Cores were split, half going to Reno for analysis and the other half to Mojave. The number and distribution of samples were as follows:

Trench.....	488
Underground....	60
Sludge.....	573
Core.....	505
	<u>1,626</u>

Sampling was completed February 17, and the final sample shipment was made February 22. All equipment was shipped or stored, and the camp was abandoned February 27.

The locations of trenches and collars of drill holes are shown on figure 3. Figure 4 shows the locations and analyses of underground check samples. The copper content, in percentage, of the trench and drill hole samples is shown in figures 5, 6, 7, and 8. The analyses, except as noted for hole 150-N, are for sample lengths of 5 feet. Table 1 gives pertinent diamond-drill data.

METALLURGICAL TESTING

Preliminary leach tests in the Salt Lake laboratories indicated that 71 percent of the copper can be recovered. By employing the leach-float method, about 74 percent of the copper, 58 percent of the gold, and 32 percent of the silver were recovered in a concentrate assaying 33.9 percent copper, 1.38 ounces silver, and 0.13 ounce gold per ton of concentrate. This was attained

by leaching for 4 hours ore crushed through 48 mesh. The equivalent of 60 pounds of sulfuric acid per ton of ore was used in a 2.5 percent solution, and 32 pounds of metallic iron per ton of ore was required for precipitation of cement copper. Tests of finer sizes, stronger acid, and longer leach cycles gave no better results. Preliminary tests in the Bureau's laboratories also revealed that stronger acid not only failed to extract additional copper but dissolved alumina and iron, thereby increasing the consumption of acid. Cleaning raised the concentrate grade to 67.6 percent copper, 1.8 ounces silver, and 0.32 ounce gold, with recoveries of 70.6 percent of the copper, 18.9 percent of the silver, and 48.7 percent of the gold.

The sample used in the leach tests assayed 1.15 percent copper, of which 1.05 percent was present as oxides, 0.4 percent lime, 3.9 percent iron, less than 0.05 percent sulfur, 16.5 percent alumina, 0.35 percent magnesia, 86.6 percent insoluble, 0.20 ounce silver, and 0.015 ounce gold per ton. The analysis of the leach-float sample was 1.02 percent copper of which 1.00 percent was present as oxides, 0.5 percent lime, 3.7 percent iron, less than 0.05 percent sulfur, 15.9 percent alumina, 0.2 percent magnesia, 87.8 percent insoluble, 0.005 ounce gold, and 0.10 ounce silver per ton.

TABLE 1. - Diamond drill-hole data

Hole no.	Collar		Bearing, degrees-minutes	Dip, degree	Depth, feet
	Elevation, ft.	Coordinates			
892 / 23-S	4646.46	S 863.0, W 42.5	S 58 13 E	-37	200
748 - S	4665.18	S 716.0, W 16.0	S 58 13 E	-40	200
640 - S	4684.40	S 597.0, W 2.5	S 81 30 E	-35	270
533 - S	4684.43	S 573.5, E 69.5	S 58 13 E	-37	230
330 - S	4653.47	S 279.0, W 37.0	S 74 30 E	-35	300
234 - S	4639.30	S 136.5, W 69.8	S 77 0 E	-35	305
50 - N	4653.50	N 68.5, W 34.0	S 80 30 E	-40	300
150 - N	4674.19	N 173.4, E 53.6	S 76 30 E	-35	350
250 - N	4672.00	N 253.0, E 172.5	S 76 30 E	-35	215
350 - N	4645.00	N 340.0, E 277.0	S 76 30 E	-38	230
450 - N	4649.00	N 452.0, E 270.5	S 76 30 E	-35	360

copied R.W.
See also Drawer File

W. J. ...

Report on the "McMahan Group of Mines"
Situating in the Walnut Grove Mining District
Kirkland, Yavapai County, Arizona.

Names of Claims and Area of Group.-

The property consists of the following named lode claims,-
Iron Hat, Ore, Ore No. 2, Rising Sun, Union, Black Prince,
Shamrock, Umpire and Cuprite, aggregating an area of approx-
imately 177 acres.

Titles.-

The titles to the whole of the property are held by lo-
cation, possession and compliance with the laws of the United
States. The owners are R.B. McMahan and the heirs of Constan-
tine McMahan.

Enclosures.-

- 1.- Topographical Map showing location of camp and property.
- 2.- Claim Map.
- 3.- Plan of Workings.
- 4.- Geological Sketch Map.

Geography and Accessibility.-

This group of mining claims is located in the Walnut
Grove Mining District, Yavapai County, Arizona, and is distant
by wagon road from Kirkland (Kirkland is on the Santa Fe, Pres-
cott & Phoenix Ry) about 12 miles in a south-easterly direction.

The cost of hauling ore will vary from \$2.75 to \$5.00 per
ton. Freight rates from Kirkland on ores not exceeding \$20
valuation, minimum carload of 60,000 lbs, are \$1.50 to Clarke-
dale, \$1.30 to Humboldt, \$2.50 to Hayden, and \$4 to Douglas.

The elevation of the Cuprite Shaft is 700 ft. higher than
Kirkland station and 4700 ft. above sea level.

Geology.-

The formation of territory surrounding the immediate vi-
cinity of the mining claims is reflected on the "Geological
Sketch Map", and is the following, - commencing about one mile
east of the mining claims and going in a westerly direction is
granite on which lies schists tilted at angles of about 56 de-
grees from the horizontal and dipping toward the west. The
schists are cut with siliceous porphyry dikes and finally on

the McMathan Group come in contact with diorite and quartz porphyry. The schists near the contact are highly silicified, faulted and intruded with porphyry dikes (especially on the Cuprite claim) and this section constitutes the main ore bearing zone. There is a zone of approximately 2000 ft extending from the N.E. corner of Cuprite claim to the center of the Black Prince claim. This zone is heavily impregnated with secondary minerals formed in the surface zone of weathering, the most important being cuprite, malachite, azurite and chrysocolla. From this zone on the Cuprite claim 267 tons of copper ore have been extracted and shipped to the Smelters. The ore occurs as replacements in schists, in the form of shoots, the surface dimensions being outlined on the map "Plan of Workings." Oxidized copper outcrops assaying from 1 to 4% copper extend in a south-easterly direction, at right angles to the strike of the schists, for a distance of 100 ft. from the hanging wall side of the main deposits, and surface trenches cut in this direction show alternate leached and oxidized copper bearing stretches of siliceous schists, indicating that when water level is reached and primitive ores encountered, the possibility of immense lateral dimensions in the ore shoots. While the surface ores so far extracted have averaged about 6% copper, workings in the lowest depths so far obtained indicate that values will be leached from 100 ft. depth to water level (450 ft. beneath the surface) with only occasional bunches of 6% ore. When water level is reached, secondary sulphides will probably be encountered of a good grade of copper, and at a lower depth primitive sulphides of a grade of from 2 to 5% copper. The ore occurrence resembles those of the main copper ore deposits in Yavapai County, such as, - the United Verde and United Verde Extension at Jerome, and the Consolidated Arizona and Arizona-Binghamton located near Humboldt. The property is located approximately 20 miles from Humboldt, measured on an air line.

Prospecting Work Done.-

The principal work has been done on the Cuprite claim, the plan of said work being shown on the map "Plan of Workings."

The vertical shaft reaches a depth of 100 ft. and is bottomed in 1-1/2% copper material. The crosscut on the 60 ft. level passes through 9 feet of 4% of copper ore from the shaft and then enters leached siliceous schists in which are occasional blotches of copper ore. The lower tunnel is driven on a fault plane for about 1/2 its length from which nodules of high grade cuprite ore was extracted. The high grade ore shipped (5 tons of 17.88% copper) came from here. The Upper tunnel passed through the ore body for a width of about 25 feet. The hanging wall side of this ore body was stoped out to the surface for a width of 8 ft. averaging 6 to 9% copper. The upper portion of the Incline Shaft was in 6 to 9% ore and gradually entered leached material of 1-1/2% copper.

Ore Produced and Shipped to the Smelters.-

<u>Tons</u> <u>Net</u>	<u>Gold</u> <u>ozs.</u>	<u>Silver</u> <u>ozs.</u>	<u>Copper</u> <u>%</u>	<u>Ins.</u> <u>%</u>	<u>Silica</u> <u>%</u>	<u>Iron</u> <u>%</u>	<u>Lime</u> <u>%</u>	<u>Alumina</u> <u>%</u>
13.000	tr	0.04	12.9	70.0		2.0		
37.3760	tr	0.26	6.8	74.8		5.7	0.9	
46.7465	(no assay)		6.57	(no analyses)				
36.2570	"		9.0	"				
23.7520	tr	tr	6.11		55.8	7.4	1.3	13.0
18.4175	0.01	0.10	7.27	73.6		5.8		
24.7715	tr	tr	5.59	78.0		6.6		
5.2825	0.06	0.60	17.88	50.4		9.7		
28.0745	tr	tr	4.46	(no analyses)				
33.373			4.35					
<u>257.0505</u>								

Cost of Opening up the Property.-

Permanent water level lies at approximately 450 ft. beneath the collar of Cuprite Shaft, as determined by several churn drill holes drilled in this locality. It is the intention to sink to water level and drift on the ore shoots opened up on.

The enlarging of the Cuprite Shaft (vertical) from the surface to its present depth, 100 ft, and sinking same to water level, crosscutting to the ore shoots and drifting for a distance of 700 ft. on same, is what should be done to determine the

true worth of the property. That a large property of great value will be opened up, there can be no doubt. The cost of this work, present price of material and cost of labor considered, would be approximately,-

450 ft. of sinking (enlarging shaft 100 ft of present depth) at \$40 per ft.-----	\$18000.00
100 ft. of crosscutting at \$9 per ft.-----	900.00
700 ft. of drifting at \$8 per ft. -----	5600.00
Total development ---	<u>24500.00</u>
Equipment,-	
Gasoline hoist, cable, buckets, cars etc-	3000.00
Buildings-	
Head frame and engine house -----	300.00
	<u>\$27800.00</u>

The dwellings of the Zonia Copper Mining Co., 1 mile from Cuprite shaft, are capable of housing 20 men. These dwellings can be rented very reasonable. No work has been done on the Zonia property for 18 years.

Remarks,-

As already stated, the ore occurrence resembles that of the properties of the Arizona Consolidated and the Arizona-Binghamton near Humboldt. The two properties mentioned had high grade oxidized ore near the surface, followed by a leached zone, before encountering the sulphide zone. The sulphide ores are mainly treated by flotation, averaging about 3% copper for the crude ore concentrated. The better grade ores are treated direct in the smelters without concentration.

There is still exposed on the surface of the Cuprite claim of the McMahan Group, a large tonnage of oxidized copper ore ranging in grade from 1 to 4% copper, which might be handled profitably by leaching with dilute sulphuric acid, or by sulphide filming and subsequent flotation.

Denver, Colo, 1217 Adams St.,

(signed) C.H. McMahan

Mining Engineer

Feb. 22, 1918.

Read in Shannon file

DISTRICT	PROPERTIES	LOCATION	OWNERS & OPERATORS	DATE VISITED	NOTES
Kirkland, Yavapai Co., Arizona.	Zonia	11 m. S. E. Kirkland. Elevation of camp 4325. 13 patented claims.	Zonia copper Mining Company Judge Gilling- ham, New Bed- ford, Mass. controls. Idle for many years except for drill- ing by Shannon Co. in 1910 and 1911.	October 4th and 5th, 1917	Yavapai schists and belts of diorite. On the Copperopolis claim is an old incline 60 degrees S.W., at least 200' deep. At the collar is a fault plane running N. 70 W. For a width of 50' the porphyritic schist shows chrysocolla and malachite. 20' East is another 10' belt of porphyritic schist with copper stains. On the Sunflower claim a steam hoist and upright boiler stand at the mouth of a tunnel in schist, iron and manganese stained, dipping N W about 45 degrees. Just inside the tunnel is a caved incline. A few stains of copper show on the cleavage planes of the schist here. To South is another little opening, nearly caved, running behind the incline. Still farther South is a caved tunnel or diorite dipping N. W. in contact with schist standing much straighter. At the Junction of the Copperopolis and Defiance claims, is a drill hole (4A) put down by the Shannon Copper Company on the lower edge of a mahogany colored iron stained schist belt having a flat dip and striking S 70 W. East and Northeast across the gulch are two cuts with dumps showing copper carbonates. Down hill to the East, over good looking iron stained schist, is a shaft with no timbers and unknown depth. No copper shows on the dump. Going East from the old smelter along French Gulch are intercalated belts of green and brown (iron stained) schist, generally 10'-20' wide, with some diorite. Copper stained float shows along the Creek. On the north side of the gulch is a tunnel in iron stained schist, strike N E, dip vertical, with considerable mahogany colored iron oxides. 20' in the tunnel is a shallow winze, beyond which the tunnel was inaccessible. On the south side is a tunnel running west in diorite, somewhat iron stained.

Kater called

Hammer

*by
G. F. S. Holland*

Copperopolis

Shannon

✓
P. Smith

Name - Zonia & McMahan
Date - Feb. 15, 1920
Report - Additions to report of L.F.S.
Holland, of August 1917.

Geology -

A series of schistose intrusives among which quartz monzonite; quartz porphyry and quartz diorite were recognized. A few isolated areas of schist presumably sedimentary.

The intrusives have been greatly fractured and sheared the resulting schistosity is more pronounced in the softer rocks. Fracturing was followed by mineralizing solutions and chalcopryite deposited largely in the fracture planes in the various rocks. The area over which this mineralization occurs is great tho the principle mineralization is confined to five distinct zones more or less lenticular in shape and showing on the Zonia ground considerable copper carbonate in cleavage planes as a replacement of the sericite developed from alterations of feldspar during matamorphism. The solutions from which the carbonate was deposited probably originated from leaching of narrow bands of primary chalcopryite high in iron which now appear within the areas mentioned as stringers of iron oxide and quartz. One of these areas near the 100' shaft mentioned in Holland's report shows five feet of material that has possibilities of developing in depth into a body of commercial ore of fair grade. It is doubtful, however, if deep work will develop any larger bodies of ore and from the grade of ore encountered at the surface on the various outcrop it is more than likely that depth will show small lenticular bodies of ore ranging from 2 to 3% copper and larger areas of 1 to 1.5% ore.

The possibilities for development of disseminated ores over areas large enough to permit ~~of~~ cheap mining is ~~is~~ poor.

Properties previous to examinations had been optioned by Dr. Richelts and associates and preparations were under way for the sinking of a shaft on the McMahan group.

Humboldt, Arizona.
April 6, 1920.

W. V. D.