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PRINTED: 08/29/2001

ARIZONA DEPARTMENT OF MINES AND MINERAL RESOURCES AZMILS DATA

PRIMARY NAME: HIGHLAND MINE

ALTERNATE NAMES:

COCHISE COUNTY MILS NUMBER: 232

LOCATION: TOWNSHIP 19 S RANGE 25 E SECTION 20 QUARTER SE
LATITUDE: N 31DEG 45MIN 50SEC LONGITUDE: W 109DEG 48MIN 55SEC
TOPO MAP NAME: TURQUOISE MOUNTAIN - 7.5 MIN

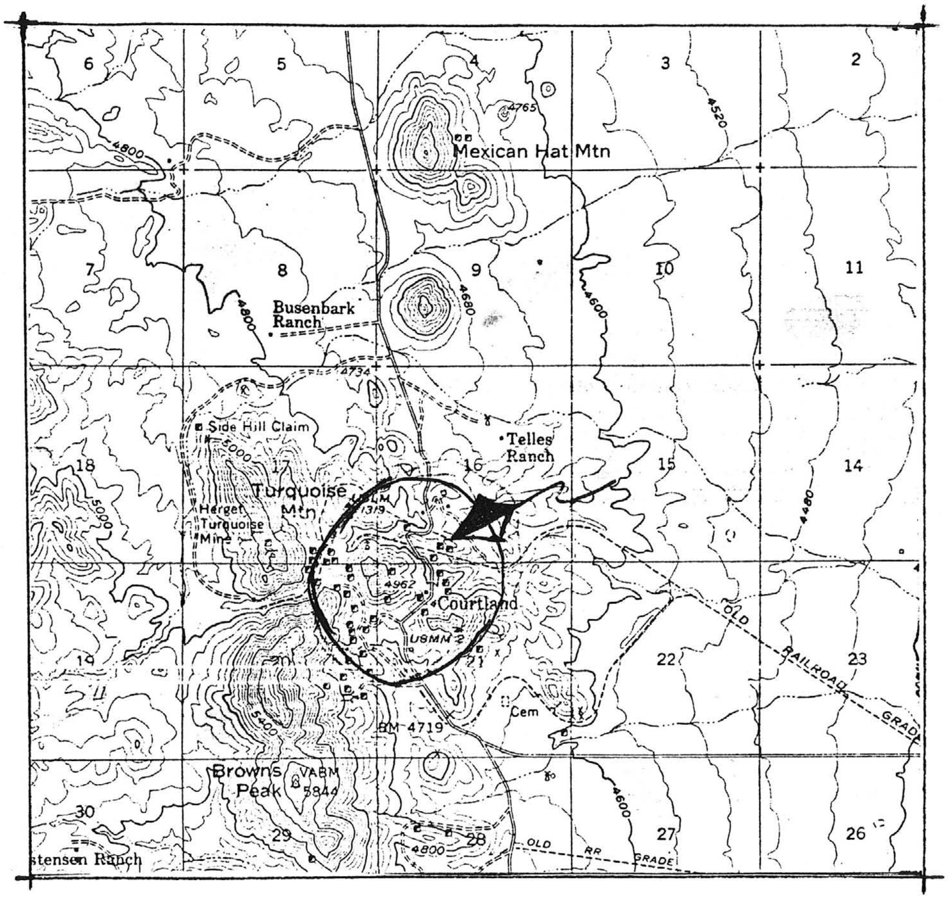
CURRENT STATUS: PAST PRODUCER

COMMODITY:
COPPER SULFIDE
SILVER
GOLD LODE

BIBLIOGRAPHY:

KEITH, S.B., 1973, AZBM BULL. 187, P. 82
AZBM BULL 127, 1927, P 55
SEE ADMMR GREAT WESTERN GROUP - COMPANY FILE
ADMMR HIGHLAND MINE FILE

R 25 E

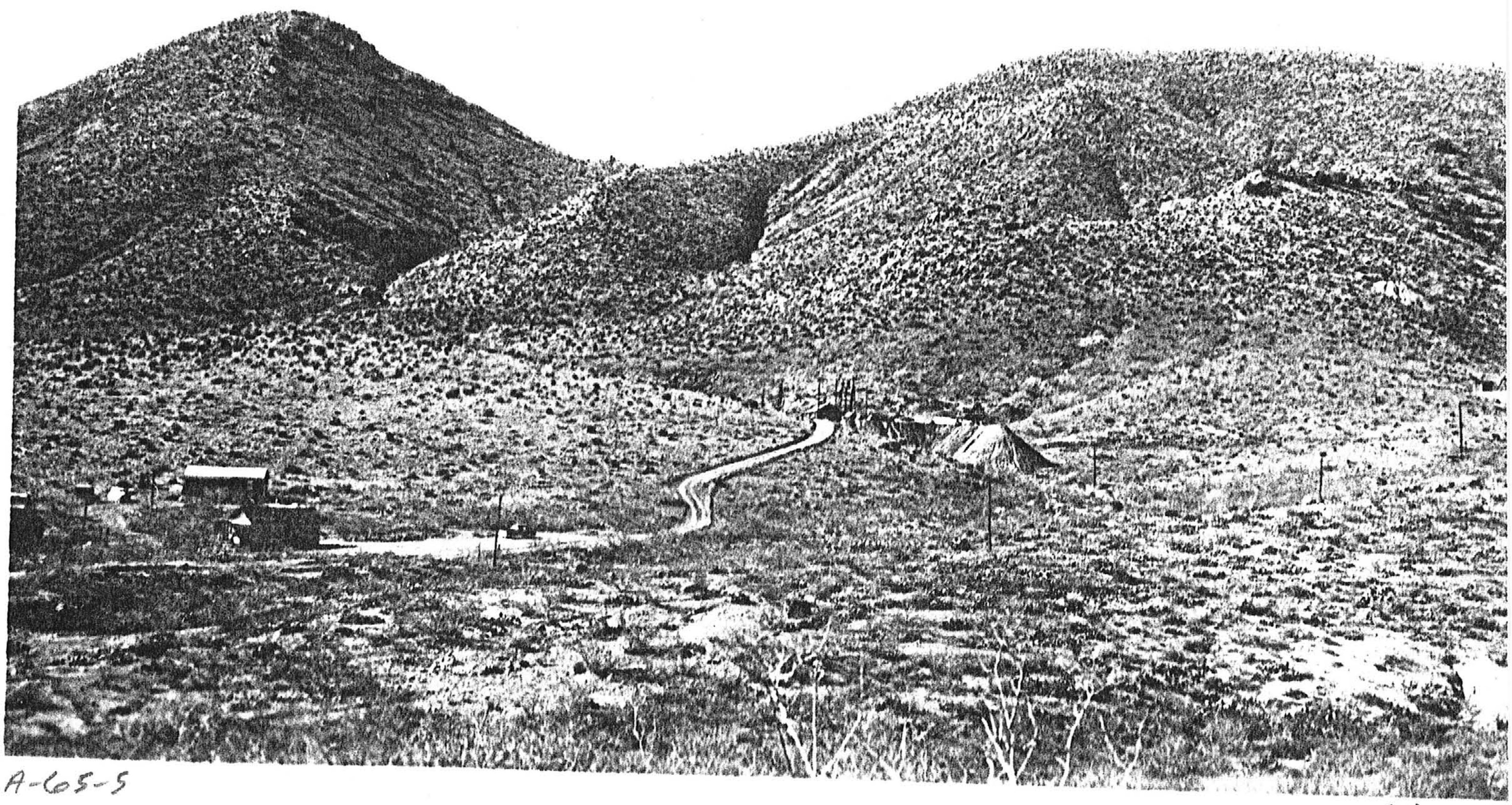


T 19 S

LOCATION OF HOPE MINES ACCUMULATED PROPERTIES

1 : 62,500

A-65-6 SOUTHWESTERN MINES INC 1947



A-65-5 1947

HIGHLAND MINE

COCHISE COUNTY

ABM Bull. 123 p. 52

USGS P.P. 318 p. 96

Mining World March 1958 p. 70

COPPER LEACHING

AN OPERATION WITH LOW CAPITAL REQUIREMENTS AND HIGH PROFIT POTENTIAL

ARIZONA, U.S.A.

Prepared for Calix Mines Ltd. (N.P.L.) by:

Frank K. Fisk
Geological Consultant

THE DEVELOPMENT AND PRACTICAL APPLICATION OF HYDROMETALLURGY

TO THE COPPER ORES OF ARIZONA

The evolution of base-metal leaching techniques from the empirical to the scientific, then to the practical application has followed a familiar pattern. Now with the chemistry and mechanics of leaching well established, the outlook is very favourable for an increasingly wide application of the process, either as a primary or where concentrate mills are in existence, as an auxiliary method of copper production.

It is undoubtedly true that in this locality the enormous instillation expense of a concentrate mill is not feasible where large oxide copper orebodies are concerned.

Production of a high grade copper concentrate by leaching methods, at first thought to be uneconomical and having very limited application, is now firmly established as the prime economical method of producing copper.

Why this sudden surge of interest? It is not entirely due to the increasing shortage of supply and demand, or the increased price of copper, but the unescapable fact that here no mine-mill complex can produce in economic competition.

Utilization of lower grade ores, simple, cheap methods of mining, a plant which is simple, costing a fraction of conventional methods and operating almost without supervision, yet capable of increasing production to any desired level has paved the way to a new era of base-metal production.

This process is not confined to the small producers but is being actively utilized by the major companies producing in Arizona.

HISTORY

Neither reagents suitable for leaching ores, nor the chemical knowledge to use them, nor the economic conditions for successful production of metal by wet processes came into existence until comparatively recent times. That is why hydrometallurgical processes as a source of metals date back only a few centuries. Pyrometallurgical processes, of course, have a history hundreds of years longer.

Men first produced and used the metals they could find free in nature, like gold, native copper, and meteoric iron. In the late Stone Age, such metals were known but had no use beyond ornamentation. Discovery of smelting ushered in the Bronze and Iron Ages, when metals first served as utensils and weapons. Pyrometallurgical methods were used exclusively.

Copper was undoubtedly the first metal to be produced by wet methods. The first, and for many years the only technique was by cementation on iron from mine waters or similar solutions carrying copper. Although this reaction was one of the first known chemical facts, its usefulness was overlooked and its nature misinterpreted. From a practical point of view, no one thought the reaction useful because it was difficult and expensive to get metallic iron itself. Why use it up in obtaining copper?

The alchemists clung to the reaction as a strong argument for transmutation of metals. Anyone could easily see it happen by poking an iron rod into the alchemist's solution. Paracelsus and Basil Valentine mentioned the reaction more soberly as early as 1500 A.D. Not until about 1750 did iron become commonplace enough to be used as a copper precipitant. Its first such use was probably at Rio Tinto in Spain. Up to that time, at Rio Tinto and in the ancient (3000 B.C.) copper mines of Cyprus, the copper-bearing mine waters had been regarded as a nuisance because they corroded the miners' tools.

As chemical knowledge accumulated, and more experience with leaching was built up, a host of methods for copper leaching were gradually tried out. Only a few of these have remained.

The basic principles of the original process at Rio Tinto in Spain were elucidated in recent times, and were subsequently applied in the pioneer commercial treatment of waste ore from Sacramento Hill at Bisbee, Arizona. An earlier small-scale heap-leaching test at Bisbee was a failure, due to lack of knowledge of proper operating methods. Later these methods were determined by laboratory investigation, followed by a 35-ton test at Douglas, Arizona on sand tailings from Tyrone N.M. and by pilot-plant work on a 20,000-ton pile at Tyrone and a 10,000-ton pile at Bisbee.

Results were sufficiently encouraging to recommend the treatment of the Sacramento Hill ore, which resulted in the production of copper from this material at a lower cost than other conventional methods.

The pooled knowledge and experience of many experts in the field of hydrometallurgy has developed the production of copper by this method to its present state. Greater efficiency and refinements in the technique of chemical precipitation of copper will replace conventional methods in the near future.

GEOLOGY

The bedding rocks in a typical porphyry copper district includes carbonates, shales, sandstone and possibly volcanics. One of the striking aspects of porphyry copper deposits is the variety of lithologies and environments in which they occur. Regionally, they may be found in shield, shelf, or geosyncline. Locally, they may be found in the intrusives such as schists, gneisses, granite and salic to intermediate volcanic rocks. Folding and faulting play an important role in localizing mining districts.

The deformed rocks are then invaded by intrusives. Monzonite, quartz monzonite porphyry and grandorite are the most common intrusive rocks associated with copper deposits. The age of most of these intrusives range from Mesozoic to Tertiary. The thermal and chemical effects of the intrusion results in characteristic contact silicate minerals in the carbonate rocks, shales, lithic sandstones and volcanics.

The next stage visualizes the revival of faulting and the formation of breccia pipes and shattered zones in the intrusives and invaded rocks. The likelihood of an associated porphyry copper orebody at depth may be suggested by primary copper mineralization in the pipes. The magnetite deposition usually appears to have occurred during the transitions from the high temperature stage to the low temperature stage of sulfide deposition. Where carbonate rocks are present, substantial magnetite orebodies may form. The close spatial relationship of the magnetite to the intrusive tempts the belief that magnetite orebodies in carbonate rocks are due to fluids emanating directly from the intrusive and attacking the reactive rocks but where it occurs as clots in the breccia pipes or as veins in intrusives is clearly a later sequence.

MINERALOGY

The principle minerals deposited during the hydro thermal sulfide stage include pyrite, molybdenite, chalcopyrite, plus bornite, enargite and other copper sulfides. It may be noted that gold and silver may occur with several of the above.

The primary porphyry copper orebody includes copper, iron and related sulfides and related precious metals as disseminations and fillings or previously opened fissures, stockworks and breccia pipes in and near the intrusives. Then the next stage of evolution involves erosion, usually with an attendant fluctuation of the water table. Oxygenated ground water coming in contact with pyrite becomes rich in ferric sulfate and sulfuric acid. These strong oxidizers dissolve copper from its primary sulfides above the water table and precipitate it at or below the water table where the solution becomes dilute. In arid conditions, as in Arizona, with moderate erosion rates, the water table descends and the process of solution and deposition is repeated until a subhorizontal blanket of secondary copper is laid down. This process also represents a substantial up-grading of primary material, thus the name "Zone of secondary enrichment".

The enriched zone commonly is overlain by an irregular zone in which secondary copper carbonates, salts and silicates with local cuprite and native copper are spectacularly displayed. Over the combined primary and secondary orebodies oxidation products of pyrite, primary and secondary copper sulfides and molybdenite may be recognized.

MINERALOGY (Cont'd)

In summary, porphyry copper bodies may be large, low grade ore-bodies dominated by primary and secondary copper minerals, in disseminated grains, stock works, veinlets and breccia pipes and vein fillings superimposed on an intermediate to salic intrusive rock. The orebody may be steeply dipping pipe of primary mineralization or may be an asymmetrically shaped mushroom with the cap representing the secondary orebody and the stem the primary one.

The size of orebodies may be between 1,000 feet by 1,200 feet and 3,600 feet by 9,000 feet. The oxidized zones average 150 feet with the enriched zone above 300 feet.

TOPOGRAPHY

In general, most of the copper porphyry deposits of Arizona are located in hilly to mountainous areas. The arid conditions of the country makes the drainage pattern of the hills one of wide gullies or ravines with slopes of 100 feet or more above the bottom. This allows the inexpensive building of the leaching heap.

The chief initial cost of the operation is building the launderers and the necessary storage facilities for copper cement, tin cans or as a substitute, sponge iron, and sulfuric acid. It has been found cheaper to pump the return solution to the heaps and where possible gravity feed the pregnant solution to the launderers. Therefore, if possible, the central location should be first selected for the plant and the central ravine prepared for the heap. Normally, the first thing done is to use dozers to smooth out the sides and floor of the ravine, remove all vegetation and make a uniform slope to the bottom, where a retainer dam is built. In some areas where cloud bursts are expected, it is advised to install in the central floor of the ravine, the length of the pad, concrete pipe to drain off this water.

The floor is then covered depending on the area, with mill tailings or other fine material and mixed with cement (soil cement) and rolled. A second method is to put down a 4 inch pad of asphalt, a suggested size 200' x 700'. Three or four feet of fine material is spread over the entire pad, followed by about four feet of fine to small material. This is spread on the floor for protection. On this base the heap is built.

A second heap could then be started as acidified water was added to the first. From time to time a dozer with a rooter would be run across the pile to change the percolation pattern of the oncoming water. In some instances after a heap has been in operation for some time, holes will be drilled 50' or 75' in depth and small charges exploded again to change the percolation pattern. In the case of the Blue Bird Mine near Miami where clay in the base rock was a problem, 2 piles are alternately irrigated with the leaching solution and additions to the pile of 4' to 10' of ore is added when copper recovery in the pregnant solution drops.

TOPOGRAPHY (Cont'd)

The launderer is a concrete series of vats. There is normally 14 passes made through vats before returning the solution to the heap. A common size vat is 24 feet long, 4 feet wide and 4 feet deep. On the bottom is a wooden grid which supports the iron (shredded cans) and allows the copper cement to be washed out a vent in the bottom front of each vat. There is normally 1 foot drop in elevation between each unit. Each unit is also built so that it can be drained and flushed without shutting down other units. The period between the flushing out of the copper cement from the leaching vats varies with the amount and rate of copper precipitation.

The copper cement flows with the solution to another concrete pad, allowed to settle for a few hours and the supernatent solution is returned to the circuit. It then drys here a few hours, is then picked up with a front-end loader and piled on a higher portion of the pad to further drain and dry. When ready for shipment it is packed into drums of 550 pounds or 1,100 pounds, or sold in bulk. Due to the low humidity of the Arizona area no trouble is experienced in drying the cement. When dry it is an orange brown powder.

The solution balance in general is determined by the size of the heap, the pumping rate in gallons per minute and the evaporation rate from both launderers and heap.

The most effective estimated acid requirement will be to maintain a concentration of 10 pounds of acid per ton. This may vary after the plant is in operation to get maximum efficiency. With a 1,000 gal. per minute plant this would require approximately 15 tons of acid per day to maintain this balance. If the acid concentration falls below 0.5 pounds of H_2SO_4 per ton of solution pumped, the pipes, lines, sumps, etc. become clogged with iron salts.

The amount of cans or scrap iron required would be between 1.2 and 1.5 pounds of cans per pound of copper recovered. A new entrant into the iron supply field for leaching is the use of sponge iron made into pellets from magnetite ore sands. This at present is about the same price as the tin cans. It may be anticipated that the cans will become more and more difficult to obtain.

CHEMISTRY OF PROCESS

Although we are primarily concerned with oxide ores, a variable percentage of sulfide forms are present and assuming that ferric iron is the main leaching reagent in this instance, chalcocite among the sulfides is attacked first, bornite next, and chalcopyrite last and probably very incompletely.

CHEMISTRY OF PROCESS (Cont'd)

Regarding chemical reactions, it is believed a number of the following probably take place, but their relative importance is obscure.

(1) $CuO + H_2SO_4 = CuSO_4 + H_2O$

(2) $Cu_2O + Fe(SO_4)_3 + H_2SO_4 = 2FeSO_4 + 2CuSO_4$

(3) $3CuO + Fe_2(SO_4)_3 + 3H_2O = 3CuSO_4 + 2Fe(OH)_3$

(4) $4CuO + 4FeSO_4 + 6H_2O + O_2 = 4CuSO_4 + 4Fe(OH)_3$

Reduction of acidity, as by (3) and (4) above, or by action of soluble basic ore constituents other than copper, results in precipitation of iron compounds. This precipitation may have an adverse effect in tending to plug the porosity but is prevented by maintaining acidity with the addition of H_2SO_4 to the tailing solutions. It is not known where the iron precipitates, but it is probably high in the column.

Maintaining the iron balance is of course important. Theoretically, so far as iron is concerned, reaction (3) is more or less balanced by the precipitation reaction (5)

$$CuSO_4 + Fe + FeSO_4 = Cu + 2FeSO_4$$

As a matter of fact, in the above equations (3) requires only 2Fe for 3Cu while in (5) 1Fe to 1Cu is returned to the circuit.

Both free acid and soluble iron salts may be produced in the heaps from the oxidation of pyrite and maintaining an iron balance is in theory quite complicated. Practically, it is a matter of adjustment of conditions.

Copper sulfides are probably dissolved according to the following equations:

(6) $Cu_2S + 2Fe_2(SO_4)_3 = 2CuSO_4 + FeSO_4 + S$

(7) $Cu_2S + Fe_2(SO_4)_3 = CuSO_4 + 2FeSO_4 + CuS$

Ferrous iron has very little solvent action on copper compounds and therefore its oxidation to the ferric form is necessary.

$$4FeSO_4 + 2H_2SO_4 + O_2 = Fe_2(SO_4)_3 = 2H_2O$$

The production of iron salts and free acid from the oxidation of pyrite has to be accounted for and the direct oxidation of the FeS_2 to produce SO_2 and iron oxide may be written

$$4FeS_2 + 11\ O_2 = 2Fe_2O_3 + 8SO_2$$

This reaction starts at comparatively low temperatures and may have a measurable velocity at ordinary ambient temperatures. At any rate the reaction being strongly exothermic, a heap of pyrite, if not properly ventilated and controlled will eventually burn. With the porphyry ores of Arizona, accumulation of heat and large temperatures rise are not possible, although the same pyrite oxidation may take place slowly.

THEORY

The basic principle involved is that copper carbonates, cupric oxide, cuprous oxide, metallic copper and sulfides are dissolved in the order named. If the ore contains a predominant amount as oxides, then this process is accelerated with the addition of sulfuric acid to the irrigating solution.

This solution is allowed to percolate through the heaps, dissolving the copper with which it comes in contact. The copper-bearing solution is collected and passed through a series of tanks where copper cement is precipitated from this solution. The solution tailings are then pumped back to the surface of the heap to again percolate through the ore and the cycle continues indefinitely.

PROCESSES

There are two basic methods:

(1) In-Place leaching
(2) Heap leaching

The latter "Heap leaching" is the most commonly utilized and has the widest application.

In-Place leaching:-

This method was developed in those special circumstances where a body of ore exists above old workings. The technique utilizes these old workings as a sump to collect the leaching solution which has been distributed over the ore surface by means of 4" drill holes located in the vicinity of the shaft.

A shematic drawing of the plant is shown.

Recovery of copper depends first on the quantity of ore available (2) the acid content of the applied solution (3) rate of application of acid solution which is related directly to the porosity of the orebody.

Size of the operation depends on the availability and distribution of suitable underground workings, which act as a collecting sump.

MECHANISM OF PROCESS

Due to the nature of the host rock, blasting will produce a relatively small size, in addition when moisture is applied a further disintegration of the rock takes place, hence crushing of the ore is not required.

Dissolution and removal of copper from the interior of pieces of rock evidently depend on two main physical factors, namely porosity of the rock and capillary action.

The fracturing and shattering of the porphyry host rock played a vital part in preparing channels for the passage and deposition of the original primary sulphide ore.

This fractured and shattered character of porphyry ores, which makes them both permeable and porous, makes their upper oxidized zones especially amenable to leaching.

Accordingly, material carrying secondary copper is amenable to heap leaching, while rock carrying primary copper may only be amenable if sufficient porosity is present.

It seems certain that the only way leach solutions can contact copper minerals enclosed in any rock is by reason of its porosity. It is also evident that solution cannot be removed after contact by ordinary washing. However, a process called "reversed capillary" action may be counted on to bring the solution to the surface. This gives an idea of the amount of solution theoretically necessary for the continuation of the leaching cycle.

The heap is thoroughly soaked with solution which washes off the soluble salts on the surface. Reversed capillarity then acts to bring further salts to the surface of each piece of rock and the cycle continues until the copper has been removed. (In actual practise it is considered that 80% - 90% of the copper is obtained.)

No greater amount of solution than is needed for this purpose is required. A larger volume simply means more dilute effluent solution; the use of an excessive amount of solution is unnecessary and undesirable.

DESCRIPTION OF PROCESS

The site is first landscaped to promote drainage and control run-off, then some form of waterproofing is laid to prevent effluent from soaking into the ground after percolating through the dump. Water is pumped to the dump surface. This water temperature is seasonally constant and is acidified with H_2SO_4 to increase copper recovery during percolation. It is common to utilize a bulldozer equipped with a ripper on the upper surface of the dump to prevent puddles forming during irrigation and by providing furrows to improve aeration and to direct water saturation of the dump surface. This technique improves percolation rates and contributes to percolation uniformity.

The pregnant solution follows the contour of the waterproof pad and is collected in a basin near the precipitation plant. From here it is directed to launders loaded with shredded or crushed cans. The copper in solution displaces the metal from the cans to form copper cement containing about 80% copper. After the final stages of the precipitation, the solution is then re-acidized and returned to the heap to repeat the cycle.

PRESENT APPLICATION

Within a 100 mile radius of Tucson, Arizona about 12% of the world copper is produced. Here are located huge mills and smelters often in sight of one another. Sam Manuel, one of the largest underground mines in the world, is located in the area. Centres such as Globe, where three mill-smelter complexes are located within sight of each other, Ray, Winkleman, Mammoth, Twin Butes, Safford, Bisbee, Douglas, etc. The list is long and impressive. Here are located the largest copper producers, such as Kenicott, A S & R, Anaconda, Phelps Dodge, etc. At each centre huge leaching piles are in operation or are being prepared for production. The largest U.S. heap is being developed by Anaconda. This heap will eventually be one mile square and 1,100 feet high. Ore at the rate of 150,000 tons per day is being dumped on this pile.

This gives some idea of the magnitude and the importance of the leaching process. A simple, cheap method of producing a tremendous amount of copper, which will undoubtedly affect the world demand.

U.S. produces 23% of world total copper.

B.C. produces 1.05% " " "

SIZE OF OPERATION

One of the most important advantages of the "Heap leaching" process is the possibilities for expansion. This expansion may follow one of two courses.

(a) Expand the original dump to massive proportions, as is practised by the large operators in the area. These dumps may contain several million tons, and will take many years to leach.

(b) Develop a small primary leach pile, taking full advantage of a local gully surrounded with ore to minimize the distance ore must be moved. Then

SIZE OF OPERATION (Cont'd)

expand the operation by utilizing additional local areas in which to develop heaps pumping the pregnant solution to the central plant. Thus, the operation can be expanded to the maximum capacity of the plant for a minimum expenditure.

It is economically feasible in the first instance to limit production to one heap of about 500,000 tons. Leaching can commence when a heap of approximately 150,000 to 200,000 tons has been built. Appreciable recovery can be expected three to four weeks after irrigation has commenced. Copper content of this small heap, considering an average value of 1% ore, would amount to $2,000,000 gross at present day prices. Thus, with a returning cash flow the operation can be expanded to major proportions as funds become available.

A feasible target is to program production to produce 50,000 lbs. of copper cement per day with a gross value of $750,000 per month.

STAFF REQUIRED

Due to the simplicity of the installation and the fact minimal supervision is required for a continuous cycle operation, an adequate staff will consist of a supervisor and two day men. Later, as the operation expands, additional semi-skilled and unskilled labor will be required.

Staff utilized at Miami Copper, where 50,000 lbs. of Cu is produced daily, consists of 18 men. This would be modified in a heap operation to:-

Precipitation Plant

7 day operation

1 Operator or pumpman	3 shifts
1 Equipment operator	day shift
1 Cell washer	day shift
1 Foreman	day shift

Maintenance Crew

5 day operation

1 Pipeman	day shift
1 Mechanic	day shift
1 Electrician	day shift

Administration

1 Man

TOTAL 10

PROFIT

Prepare site and waterproof	10 days
Build heap and plant	60 days
Connecting up	5 days
Lost time	10 days

Total time required - 60 days

Begin irrigation - 2 1/2 months from start

Production begins at end of 3rd month

Production at 4th month - 50,000 lbs.

4th Month	50,000	$25,000
5th Month	75,000	$37,500 gross
6th Month	100,000	$50,000 "

Net recovery without taxes $37,500 monthly

Net return end of 1st year $300,000

Net return end of 2nd year $450,000

Operation can be expanded in increments of this amount as desired.

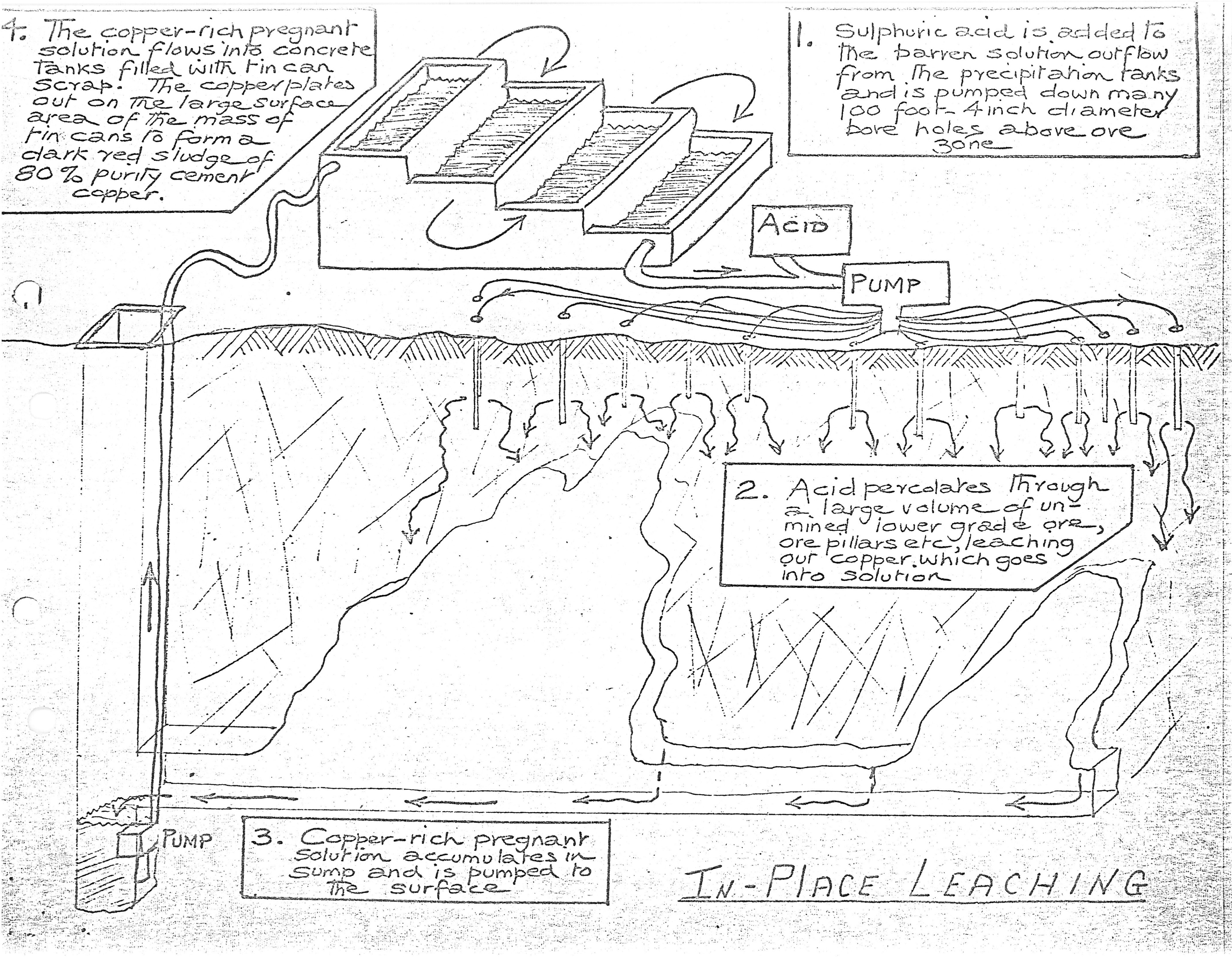
Cost per unit $50,000

Production Expense

Acid	-	1.5¢ to 2¢ per pound of copper produced
Scrap Iron	-	2¢ per pound of copper produced
Variable costs	-	10% of copper recovered
Overall costs	-	20% - 22% of copper recovered

Profit Potential

With copper selling at 50¢ per pound, the cost of producing same would be 11¢ per pound or a profit of 39¢ per pound.


4. The copper-rich pregnant solution flows into concrete tanks filled with tin can scrap. The copper plates out on the large surface area of the mass of tin cans to form a dark red sludge of 80% purity cement copper.
1. Sulphuric acid is added to the barren solution outflow from the precipitation tanks and is pumped down many 100 foot-4 inch diameter bore holes above ore zone
ACID
PUMP
2. Acid percolates through a large volume of unmined lower grade ore, ore pillars etc, leaching out copper which goes into solution
PUMP
3. Copper-rich pregnant solution accumulates in sump and is pumped to the surface
IN-PLACE LEACHING

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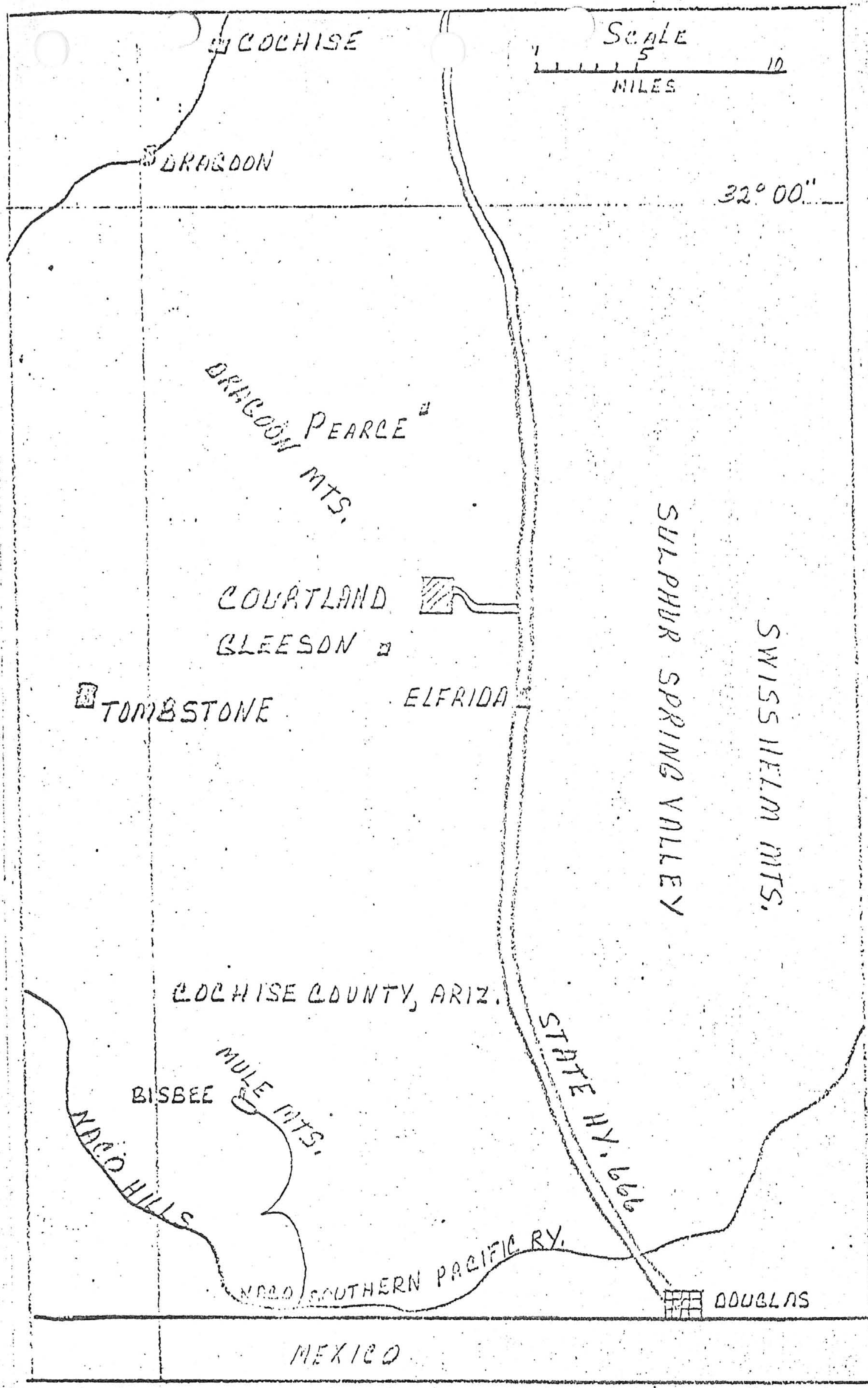


COCHISE
Scale
5
10
MILES
DRAGOON
32° 00"
DRAGOON MTS.
PEARCE
SULPHUR SPRING VALLEY
SWISSHELM MTS.
COURTLAND
GLEESON
TOMBSTONE
ELFRIDA
COCHISE COUNTY, ARIZ.
STATE HY. 666
MULE MTS.
BISBEE
NACO HILLS
SOUTHERN PACIFIC RY.
NACO
DOUGLAS
MEXICO

MEMORANDUM REPORT OF INVESTIGATIONS

Of The

Churn Drilling Program by Sunshine Mining Company on the Big Bear Mining Inc., Great Western and Leadville Groups of claims in the Turquoise Mining District, Cochise County, Arizona.

By Earl F. Elstone, Project Manager, January, 1958.

INTRODUCTION

The Sunshine Mining Company on February 22, 1957, entered into an agreement with Big Bear Mining, Inc., to join in the exploration and development of certain lode mining claims, leased by Big Bear Mining, Inc., from Hope Mining and Milling Company, Inc. Also on February 22, 1957, a Joint Operating Agreement was executed by Sunshine and Big Bear covering the development and operation of the lode mining claims.

The claims, owned by Hope Mining and Milling Company, Inc., are in two groups. The Leadville group consists of seven patented claims, Leadville, Turquoise King, Northern Light, Copper Bug, Western Belle, Grey Mule and Headlight and one unpatented fractional claim, the Winchester, situated in Section 17 and Section 20, Township 19 South, Range 25 East. The Great Western group consists of 23 patented claims, Alice, Billie, Chanco, Chicago, Climax,Clinton, Dorothy, Edith, Esther, Fairview, Fraction, Handy, Hawk Eye, Highland, Homo, Humbot, Iowa, Iron, Mame, Mary Mine, Monarch, Sampson and Starr, situated in Sections 20, 21, 16, 28 and 29, Township 19 South, Range 25 East, G & S R M, Cochise County, Arizona.

per hour. Holes were started with a 13 inch Star bit and eased into the sulfide zone with 10 inch (inside diameter) casing. No casing was lost. The contractor cost per foot of hole drilled, including $500. for mobilization, was $4.92. Assaying $1.00 per foot. Cost of preparing drill sites $0.58 per foot.

ACKNOWLEDGEMENTS

Published works covering the area of this property are: U. S. G. S. Bull 530, 1911, by F.L. Ransome, The Turquoise Copper Mining District, Arizona; University of Arizona Bulletin 123, 1927, by Eldred D. Wilson, Geology and Ore Deposits of the Courtland-Gleeson Region, Arizona; and Geological Survey Professional Paper 281, 1956, by James Gilluly, General Geology of Central Cochise County, Arizona. In addition, short written reports by Forbes Robertson, C. J. Sarie, John W. Cole, J. S. Coapal, and Gloland W. Conwell were available for study.

Grateful acknowledgement is made to Wayne K. Wallace, Geologist of the Kern County Land Company, Norman Eastmore, Geologist for the Minerals Exploration Co., and Eugene Yoakea, an old time resident and the only inhabitant of the old town of Courtland, for their communication of knowledge and history of geology and workings in the area.

LOCATION AND ACCESSIBILITY

The property is accessible from Elfrida, Arizona, about 14 miles of good country road. Elfrida is a hamlet with a 100 plus inhabitants on State Highway 666, 26 miles North of Douglas, where the Phelps Dodge Copper Smelter is located. The nearest railway station for shipment to smelters at El Paso or Miami is at Cochise, 28 miles to the North.

PHYSICAL FEATURES, CLIMATE AND WATER SUPPLY

Elfrida is centrally situated in the Sulphur Spring Valley, a broad plain bounded on the West by the Dragoon and on the East by the Swisshelm Mountains. The Turquoise District is in the Dragoon Mountains. Water is available from wells for agriculture in the Valley. Typical desert shrubs and cacti cover the uncultivated part of the valley and uplands. Torrential rains during July and August account for most of the estimated annual precipitation of 8 to 11 inches.

Wells in the vicinity of Courtland have produced from 20 to 50 gallons per minute of fresh water. It is likely that the Leadville No. 2 shaft would produce about 120 gallons per minute, and the Highland shaft about 60 gallons per minute, suitable for milling purposes. Approximately 750 gallons would be needed for milling 1000 tons per day so that additional sources of water would have to be developed in Sulphur Spring, Valley.

HISTORY AND PRODUCTION

According to Ransome, - Ransome, F.L. The Turquoise Copper Mining District, Arizona, U. S. G. S. Bull. 530, 1911, "Copper mining on an important scale began near Courtland on the Humbot claim about the year 1901, and is reported that this mine yielded about $100,000 from a body of oxidized ore stoped near the surface. In 1907 and 1908 there was much activity in the vacinity of Courtland and extensive prospecting was carried on at several places by Phelps Dodge and Company, the Calumet and Arizona Company; and the Great Western Copper Company. The work as a whole was rather disappointing but the Calumet and Arizona Company shipped 15,000 to 20,000 tons of 7% oxidized copper ore from the Germania Mine, and the Great Western Copper Company had produced at the time of visit about 30,000 tons of ore from the Mary Mine, which is on the same orebody as the Germania. About $250,000 was expended by the Calumet and Arizona Company on the Leadville claims, and some low grade sulfide ore was found, but the work was finally abandoned.....the only mines in operation in 1911 were the Mary and Mame, both owned by the Great Western Copper Company. At the time of visit this company was shipping from all workings, but mainly from the Mary Mine, at the rate of 9-50 cars a week."

Subsequent history is given by Wilson-Wilson, Eldred D., Geology and Ore Deposits of the Courtland-Gleeson Region, Arizona U. of Arizona, Bull. #123, 1927, - as follows:

Two railroad companies, the Arizona Eastern, and the El Paso and Southwestern build railroads into the district in 1909, the former from Cochise and the latter from Douglas, Copper production reached a peak in 1912. The larger mines have been idle since 1920. As quoted by Wilson, "According to Mr. W. J. Young, Jr., President of the (Great Western) Company, production in 1901 acounted to about $100,000 worth of oxidized ore from the Numbot Claim; and for 1909-1920 inclusive, it totalled 176,458 tons, principally ore from the Mary and sulfides from the Mame. Since 1920, lessees have been making small, fairly steady shipments, mainly from shallow workings. The production for 1923 amounted to 1442 tons of oxidized ore, and 740 tons of sulfide ore."

The Leadville group was consolidated by the Leadville Mining Company in 1903. Options were let to various concerns, among which were the Calumet and Arizona Mining Company, about 1907, Fuller and Neary, about 1912, the Needles Mining and Smelting Company about 1916, and the U.S. Smelting and Refining Company in 1916-17. None of these operations resulted in production but after 1917, intermittent production by lessees continued until 1926. In the latter year the owning company was re-organized under the name of Andes Copper Company.

Wilson, the monzonite porphyry was intruded in Carboniferous time, followed by the intrusion of what he calls quartz monzonite porphyry dikes. Primary mineralization is considered to be related to the porphyry.

The ore mined from the Mary, Germania, Maid of Sunshine and April Fool in the early days of mining was believed to be oxidized ore caught in a thrust fault plane between Carboniferous limestone and Bolsa quartzite.

The other type of orebody on the property consists of replacement deposits of pyrite and chalcopyrite in Abrigo limestone and the oxidized outcrops of these deposits.

There is an extreme complexity of the structure in the subject area and its solution is rendered more difficult by rock alteration, owing to hydrothermal metamorphism and the weathering of the highly pyritic material that is so widespread in these rocks. The sulfuric acid formed during weathering has altered the rocks so drastically as to render dubious the distinction between such formations as Abrigo limestone, Copper Belle monzonite porphyry, sugar loaf quartz latite, Turquoise granite and apparently later quartz porphyry instrustions. Ransome, Wilson and Gilluly have recognized inconsistencies in their discrimination and the writer has found many rock type variations that are impossible to identify positively.

As seen from the geology map Plate 5, the Abrigo limestone forms a belt of steeply eastward dipping strata, intruded by quartz monzonite porphyry, Some dikes of felsitic material resembling quartz latite, and probably a sill-like body of quartz latite, along the eastern foot of Turquoise Ridge. The Mame, Leadville No. 2, Musso, Humbot, Leadville No. 1, Armstrong and McLendon Mines are contained in this comparatively narrow belt of Abrigo limesone. Plate 6.

Underlying the Abrigo limestone and forming the crest of Turquoise Ridge is the hard, medium to fine grained, slightly cross bedded quartzite.

The maximum thickness of Bolsa, estimated 800 feet, is believed to have been thrust faulted upon a surface of intrusions of post Carboniferous granite and monzonite porphyry.

The Mame orebody where seen on the 100' shaft level is a low grade pyritic replacement of favorable lime beds and is confined into a tent-like structure approximately 250 ft. wide. See Plate 6. On the west side the bounding structure is a hard, dense, fine grained felsitic dyke dipping west at 40°. Having been identified in S C D no. 14, its strike seems regular at North 15 West.

In the center, or peak of the tent-like structure, are a number of nearly vertical shear planes, with little movement, but around which there are envelopes of alteration minerals. On the east side of the center vertical shear planes are some minor faults which dip steeply to the east, as does the bedding. The Mame fault seems to cut through and displace the ore zone.

To the west of the tent-like structure on the Mame 100 level is seen a flat lying fault plane, with considerable displacement, dipping west-southwest at 10 degrees. Where caved up to the fault in both west crosscuts, slivers of latite and quartz monzonite porphyry dikes were found in the fault breccia. On the surface it is seen that at least one thrust fault has pushed Bolsa quartzite up over Abrigo limestone. Gilluly has mapped a number of thrust faults east of the mining area so there may be several more flat dipping thrust faults between the surface, and the underground workings. The thickness across the outcrop of Abrigo lime is approximately 400 ft. greater than its measured thickness elsewhere in the area, and this is probably due to the repetition by faulting.

On the surface South and West of the Mame shaft is an outcrop of a sill-like mass of quartz-latite and what may be the continuation of the same mass outcrops on both sides of the arroyo some 1800 ft. North where the stream bed crosses the Turquoise King and Leadville claims. This body of latite may lie beneath the surface and above the 100 ft. Mame level in a saucer-like body throughout the

SCD holes drilled so far indicate an area along the east edge where a small enriched zone may be found. See Plate 7. Holes with numbers only indicate probable placement of further proposed holes to test the Proposed Pit Area.

			Total	Non-S.
SCD #1	Interval	130 to 155 ft. - Average	0.78% Cu.	
" 2		none		
" 3		none		
" 4		none		
" 5		105 to 145 ft.	1.14% Cu.	
" 6		90 " 140 ft.	0.18% Cu.	
" 7		50 " 90 ft.	1.86% "	0.06
" 8		120 " 135 ft.	0.80% "	
" 9		140 " 160 ft.	0.64% "	
" 10		95 " 135 ft.	1.11% "	0.17
" 11		150 " 170 ft.	2.42% "	0.11
" 12		140 " 200 ft.	0.41% "	0.04
" 13		135 " 155 ft.	1.02% "	0.46
" 14		75 " 135 ft.	1.25% "	0.07

Using simple averages only it is seen that the total copper assay is 1.11%; thickness of ore bed is 35.4 ft; thickness of waste above the ore bed 111.9 feet; then there would be a waste to ore ratio of 4.1 to 1, assuming a 45 degree pit slope, which is certainly not presently known, but is a reasonable assumption.

If all of the area as shown in the Proposed Pit Plan was underlain with 35.4 ft. of ore, which is an assumed figure, there would be available 1,845,520 tons, and there would have to be mined 7,566,632 tons of waste to recover it, or a total of 9,412,152 tons @ 33 1/3 ¢ per ton - $3,137,384 or $1.75 per ton of ore recovered.

For drilling, exploration and testing	$ 250,000.
A mill of 1000 t.p.d. capacity	2,250,000.
Drills, shovels, trucks and other plant equipment	750,000.
Operating capital	500,000.
Minimum estimated capital	$3,750,000.

Then for 1,845,520 tons, there would have to be amortized $2.03 per ton to recover the original investment.

On 1.1% for concentration with 85% recovery in 20% concentrates, the economics are as follows:

Ratio of conc. $\frac{20}{1.1 \times 84} = 21.4$

20% conc. = 400# - 10# x 25¢ - 3 = 85.50			85.50
plus average gold val. 23¢ per ton for 21.4 ton			4.92
plus average silver val. 7 ½ ¢ per ton for 21.4 ton			1.60
			$92.02
Less hauling and freight	5.00		
Treatment charge	8.00		
	13.00		-13.00
			$79.02

Recoverable value per ton of crude ore	- $3.69	
Mining cost	1.75	
Milling cost 1000tpd	1.00	
Amortization	2.03	
Royalty @ 10%	.37	
Cost of prod.	$5.15	less $1.46 per ton

SUMMARY AND CONCLUSION

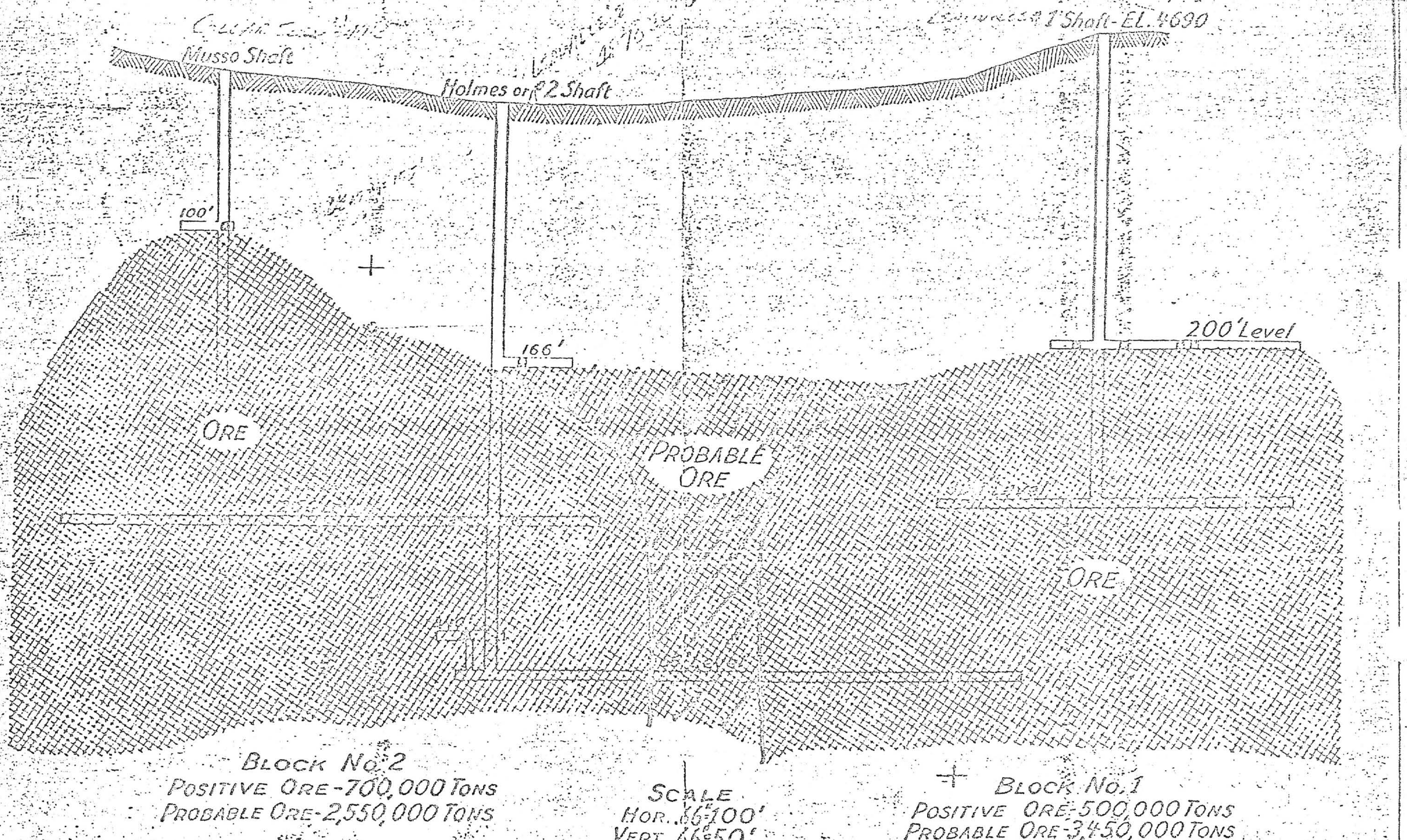
A small body of ore of an average grade of 1.11% Copper is indicated by the drilling so far, but it cannot be said to be blocked or completely drilled inasmuch as it has not been delineated in horizontal projection sufficient to be a continuous body. This is due to the fact that several dikes are seen on the surface within the proposed pit area that may or may not divide the ore bodies.

Geologically, there seems to be a fair chance that a body of enriched ore may be found within structural traps in the area as shown on Plate 7, westerly from the holes drilled along the eat edge.

From an engineering and economic standpoint, it can be seen from the illustration used, which is only hypothetical, that there must be a lot more ore found of the indicated grade, or a good sized body of much higher grade ore. In this case the area where ore might be found is considered to be limited to the area enclosed in the proposed Pit Plan, Plate 7. More ore would most likely have to occur from a thicker zone of enrichment. A third necessary requirement, or at least a welcome help would be a large boost in the price of copper from the present figure of 25¢ per lb.

Respectfully submitted,
Earl F. Elstone

Highland Mine



General Vertical Section thru Musso #1 and #2 Shafts
Holmes-Western Consolidated Mines, Inc.

File

Intra-Company Correspondence

SHATTUCK DENN MINING CORPORATION

and

SUBSIDIARIES

Humboldt Office

Date September 15, 1966

TO: C. R. Sundeen

FROM: J. Olaf Sund

SUBJECT: HOPE MINES LIMITED Highland Mine
Courtland Area, Arizona

TYPE: Copper by leaching in place.

PROPERTY & LOCATION:
The property consists of a total of 32 claims, 31 of which are patented. They are located in the Turquoise mining district immediately adjacent to the old townsite of Courtland. As would be expected, they actually straddle Turquoise Mountain. Courtland is some 14 miles west of State Highway 666, at a point some 26 miles north of Douglas in Cochise County. Specifically they are situated in Sections 16, 17, 20 and 21 of Township 19 South and Range 25 East.

PROPERTY STATUS:
The property consists of a grouping of assorted claims on which separate mining operations were conducted from 1900 through to at least the 1920's.

A Mr. Sam Makalla assembled the ground and leased it all to Hope Mines some time ago for a maximum $500,000.00 to be paid from a 2½ percent royalty of the NSR's. In the late 1950's various exploration efforts were attempted on leases from Hope Mines. Efforts to leach the copper in place have apparently been continuous since 1961.

In early 1966 Hope Mines made a lease-purchase agreement with Calix Mines and Cascade Molybdenum Corporation, both companies with Canadian charters and with offices in Vancouver, B.C. This latter option involves an ultimate $600,000 to be paid from a 7½ percent royalty of the NSR's.

Therefore, there is apparently a total lease-purchase agreement of ~~$110,000.00~~ $1,100,000.00 outstanding on the property to be paid from a total 10 percent royalty of the NSR's.

TERMS REQUESTED:
Cascade and Calix presently are leasing the property on a 60-40 basis. They claim a current production of 1500 pounds of copper cement per day. The above partners wish to increase production to 45,000 pounds of copper cement per day, but require financial assistance. The anticipated cost to do this is suggested to be $200,000.00. Shattuck Denn is invited to form a partnership with a 1/3 split between Cascade, Calix and themselves and a similar distribution of the costs.

REFERENCES:
The property is represented by a Mr. Frank Fisk from Dallas, Texas; phone area 214 and 824-3926. The local Arizona office is at the Grande Vista Motel, Room 10 in Coolidge.

"Geology and Ore Deposits of the Courtland-Gleeson Region, Arizona"; University of Arizona, Bulletin No. 123, 1927.

"The Turquoise Copper Mining District, Arizona"; U.S.G.S. Bulletin 530, by F.L. Ransome, 1911.

"General Geology of Central Cochise County, Arizona" U.S.G.S. Prof. Paper 281, by J. Gilluly, 1956.

GEOLOGY OF MINERAL AREAS:

The general area of the Turquoise Mining District is underlain by a Cambrian limestone, called the Abrigo formation, which hosts the copper deposits. This is an irregular belt approximately $1\frac{1}{4}$ miles long and up to 1/8 mile wide. This unit strikes approximately north 10 degrees west and dips some 70 degrees eastwards.

The Abrigo limestone is bounded on the west by the underlying Bolsa quartzite and on the east by a Mississippian limestone with a fault contact. Quartz-monzonite porphyry masses and dikes have intruded both east and west contact zones and to a lesser extent throughout the Abrigo unit itself. Considerable metamorphism is associated with these intrusives.

Faulting and fracturing is considerable throughout the area including some significant thrusts.

The ore bodies are replacement types mainly in the Abrigo limestone. They are generally lenticular in shape and are elongated parallel to the stratification. Only occasionally are they associated with faults and fractures.

The ore mined was of a low grade type made up mainly of pyrite and chalcopyrite as disseminations, stringers and the lenticular masses. Other associated copper minerals were of only slight importance. Similarly, they were only slightly enriched with secondary copper except at one mine only. It too is a limestone replacement but is devoid of any sulphides and in fact is characterized by earthy limonite, clay and secondary copper. It occurs directly along and within a major thrust fault.

CURRENT PRODUCTION:

The present operators have been producing copper by an in-place leaching process. In this case it has involved pumping sulphuric acid into the ground above the old mine workings and thereafter pumping the copper-rich liquor out from two separate mine shafts and thence to precipitation tanks. The acid is pumped in through 90 separate drill holes down to the water table at 70 to 80 feet. These acid holes are spaced on 15 foot centers and are positioned over the old mine work areas.

The sulphuric acid concentration is apparently 1 to 2 grams per litre. It is pumped in at the rate of $2\frac{1}{2}$ gallons per minute per hole. This involves a total of 200 gallons per minute for 24 hours per day.

The pumps in the old shaft are presently at 160 feet. Therefore, the acid percolates through some 70 to 90 feet of old mine pillars and low grade parts. The copper-rich liquor is collected in a 7-cell precipitation tank with scrap iron. The operators claim to be able to collect some 1500 pounds of copper cement per day that averages 70 to 80 percent copper.

ANTICIPATED PRODUCTION:

Fisk claims that the production can conceivably be increased to 45,000 pounds of copper cement per day. To do this will require a three stage effort.

1. Increase the in-place leach capacity several-fold by utilizing several hundred acid holes overall of the ground they now control. This includes the old Great Western Mines, part of which they are now leaching, as well as the old Leadville properties. At each of a half dozen shafts larger pumps would be installed in order to lower the water table to 300 feet and thus increase the potential leach zone to an excess of 200 feet.

2. Leach the old mine dumps. Fisk proposes to move a suggested one million tons onto a central leach pile on a natural slope that will be prepared for leaching.

3. Increase the capacity of the precipitation tanks, presumably by a factor of 30.

The total anticipated cost suggested by Fisk to complete the above and begin making copper is some $200,000.00.

SUMMARIZING CONCLUSIONS:

A. Current Costs

The present operators could not produce any reliable flow sheet from the present operations, nor could they, or would they, show any regular accounting background. Without any of these facts there is no way to determine if the figures quoted by Fisk are in fact reliable. Furthermore, the copper-cement is supposedly shipped to eastern United States for sale. Therefore, we cannot know if the present operation is in fact making any money.

However, accepting the figures as they were quoted, the following is indicated:

Income: 1500 pounds of 70% copper--$378.00 per day

Costs: 2 grams of acid per litre used at rate of 200 gallons per minute--4798.08 pounds H_2SO_4 per day.
Acid cost is approximately $72.00 per day plus 10% royalty payments, taxes and operating expenses etc. may cost upwards of approx. $200.00 per day. Therefore, a small profit may

Profit: actually be realized and it may be in the order of just under $100.00 per day.

B. Geological

The proposed leach piles from the old mine dumps is of course a reasonable idea. In this case, however, no bulk tests have yet been made to determine if the dump rock is amenable to leach operations in terms of porosity, relative pyrite content and actual composition of the rock.

Similarly, it is not established if the old mine areas will stand up to a vastly increased production by acid leaching. That is to say, has adequate consideration been given to rock porosity, pyrite content, structural conditions with regards to faults, and the actual rock composition etc.

Regarding rock composition, it is important to realize that these sulphide deposits are almost entirely enclosed in limestone sedimentary beds. Therefore, the mine dumps too will be mainly limestone. There is a strong possibility that much of the acid used will be neutralized by the carbonate, unless, of course, the extensive pyritiferous deposits will continue to generate enough acid to overcome this neutralization.

CONCLUSIONS:

A detailed flow sheet or cost tabulation is required to determine if any significant copper is actually being recovered. A feasability study and actual experiments on the property would then be required to establish if such an operation as proposed could be a profitable venture.

Without the above data, one can only have doubts regarding the $200,000.00 expansion proposal. Unless more solid information is forthcoming, this writer can only recommend that Shattuck Denn decline the property.

JOS/db

DEPARTMENT OF MINERAL RESOURCES

STATE OF ARIZONA

FIELD ENGINEERS REPORT

Mine HIGHLAND MINE

Date Mar. 17, 1958 & April 10, 1958.

District Turquoise District, Cochise Co.

Engineer Axel L. Johnson

Subject: Present Status. Information from Stanley Secrist - 3/17/58 and Gene Yoakum, Courtland - 4/10/58

References Report of December 5, 1957.

New Information Sunshine Mining Co. has suspended exploration activities on the property, and moved out. Reason for same not definitely established.

References: ABM Bull. 123, p. 52
USGS P.P. 318, p. 96
Mining World, 3/58, p. 70

DEPARTMENT OF MINERAL RESOURCES
STATE OF ARIZONA
FIELD ENGINEERS REPORT

Mine Highland Mine Date Jan. 10, 1957

District Turquoise District --- Cochise Co. Engineer Axel L. Johnson

Subject: Present Status. Personal Visit & information from W. E. Hawley, Douglas, Ariz.

References Reports of May 4, 1956, and Septl 7, 1956.

Present Mining Activity Mine is, at present, closed down , and there was no one at the mine at the time of my visit on Jan. 10. Mr. W. E. Hawley, assayer, at Douglas, Ariz stated that the mine was closed down because there is a law suit pending against the Hope Mining and Milling Co. of Phoenix, Ariz., regarding the ownership of the mine. The party instigating the law suit is reported as being a Mr. John Betts, supposedly a partner of Mr. Ricardo.

Proposed Plans The Big Bear Mining Co., Inc., 521-22 Commonwealth Bldg., Denver, Colo., who has a Lease with Option to Buy from the Hope Mining and Milling Co., closed down the mine pending the settlement of the legal xxxxxxxxxxxxxxxx ownership. The Big Bear Mining Co. is reported as negotiating for a sale of the property to Sunshine Mining Co. of Idaho, pending the outcome of the legal settlement.

DEPARTMENT OF MINERAL RESOURCES
STATE OF ARIZONA
FIELD ENGINEERS REPORT

Not for publication

Mine Highland Mine Date Dec. 5, 1957

District Turquoise District, Cochise Co. Engineer Axel L. Johnson

Subject: Field Engineers Report. Information from Mr. Bradley and Personal Visit;

References Reports of Jan. 10, 1957, Sept. 7, 1956, and May 4, 1956.

Location Near Courtland, Arizona.

Number of Claims 31 patented claims and 1 unpatented claim.

Owners Hope Mining and Milling Co., Phoenix, Ariz.
L. C. Mead, President, 1606 E. Camelback Road, Phoenix, Ariz.
Margaret Fournier, Secretary, 1619 Palmcroft Drive SW., Phoenix, Ariz.

Lease with option to buy Sunshine Mining Co., 738 Peyton Bldg., Spokane 1, Wash.
Earl Ellstone, Resident Manager, Swissholm Lodge, Elfrida.
Harry Boyer, Mining Engineer, " " "
The above company bought out the lease with option to buy, formerly held by the Big Bear Mining Co., Inc., 521-522 Commonwealth Bldg., Denver, Colo. (see Report of 9/7/56

Principal Minerals Copper ores

Present Mining Activity Exploration work by means of churn drilling.

Milling & Marketing Facilities No mill on the property. Operators will need a mill for treating the ore, if exploration proves to be favorable.

Present Mining Operations Present operations are confined entirely to exploration work. Churn drilling is now being done on contract by the Lyons Drilling Co. of Phoenix, Ariz., with one churn drill operating. Churn drilling was started about 2 month ago. 12 holes have been drilled, and the 13th hole is now being put down. The drill holes are reported as being from 150 ft. to 330 ft. in depth. Access roads to the various drill hole locations are being made under contract to a Mr. Trapman.

Proposed Plans Not stated.

Remarks Information may be incomplete, as the officials of the company, Earl Ellstone, Res. Mgr., and Harry Boyer, Mining Engineer could not be contacted for comments.

DEPARTMENT OF MINERAL RESOURCES
STATE OF ARIZONA
FIELD ENGINEERS REPORT

Mine ✓ Highland Mine Date Sept. 7, 1956

District Turquoise District --- Cochise Co. Engineer Axel L. Johnson

Subject: Present Status. Personal Visit & information ffom C. N. Conwell, Eng. in Charge.

<u>Location</u> Near Courtland, Ariz.

<u>Number of Claims</u> 31 patented claims & 1 unpatented claim.

<u>Owners</u> ✓ Hope Mining and Milling Co., Phoenix, Ariz.
✓ L. C. Mead, Pres., 1606 E. Camelback Road, Phoenix, Ariz.
✓ Margaret Fournier, Secretary, 1619 Palmcroft Drive SW., Phoenix, Ariz.

<u>Lessees and Operators</u> Big Bear Mining Co., Inc., 521-22 Commonwealth Bldg, Denver, Colo.

<u>Officers</u> ✓ Otis E. Sholes, President, c/o Swisshelm Lodge, Box 205, Elfrida, Ariz.
✓ C.N. Conwell, Engineer " " " " " "
Wendell W. Sholes, Denver office..

<u>Principal Minerals</u> ✓ 6opper

<u>Number of Men Employed</u> 4 men ---- day shift only.

<u>Production Rate</u> Very little production to date. Company is engaged in exploration. 3 cars of ore shipped last week to International smelter. No returns as yet.

<u>Milling and Marketing Facilities</u> Ore is expected to be marketed by direct shipment to smelter. Some leaching is being done to supplement income from direct shipping. Leaching vats have been installed for leaching with tin cans.

<u>Present Operations</u> Exploration work being conducted, consisting of raising, drifting and long hole drilling. Pumping about 50 gallons per min. of water from the Highland shaft. This water is run out into a dam on top of the old mine dump and allowed to trickle over and through this dump and then draining into the leaching vats. No acid has been added to the water yet, but Mr. Conwell stated that this will be tried next. The Highland shaft is 350 ft. deep, with two main levels at 250 ft. and 350 ft. The exploration work is being done on the 350 ft. level at present.

DEPARTMENT OF MINERAL RESOURCES
STATE OF ARIZONA
FIELD ENGINEERS REPORT

Mine ✓ Highland Mine Date May 4, 1956

District Turquoise District -- Cochise Co. Engineer Axel L. Johnson

Subject: Present Status. Personal Visit & information from one of the employees.

Location Near Courtland, Ariz.

Number of Claims 31 patented claims, and 1 unpatented claim.

Owners Hope Mining and Milling Co., Phoenix, Ariz.
✓ L. C. Mead, President, 1606 E. Camelback Road, Phoenix, Ariz.
✓ Margaret Fournier, Secretary, 1619 Palmcroft Drive SW., Phoenix, Ariz.

Lessees and Operators Big Bear Mining Inc., a Colorado Corporation. Home address id reported to be Denver, Colo. Lease effective March 1, 1956 for a term of 40 years.

Officers ✓ Otis Sholes, President, Gen. Del., Elfrida, Ariz.
✓ Odell Still, Mine Supt., Gen. Del., Elfrida, Ariz.

Neither of the above named persons were at the mine and could be reached for an interview. Information was obtained from one of the employees at the mine.

Principal Minerals and Metals Copper ores.

Number of men employed 2 to 5. Variable as the work requires.

Production Rate No production as yet. The company is engage d in dewatering the shaft and getting ready for leaching operations.

Milling and Marketing Facilities The company is making preparations for leaching the ore, which they expect to mine from the Highland shaft.

Present Operations The old shaft, where the former lessees, Odell Still and John Still have worked for some time, has been abandoned, and activities have been moved back to the Highland shaft. Work was started there about April 2 according to reports. The Highland shaft is now being dewatered, it being reported that it is now dewatered down to the 250 ft. level, with another 100 ft. to be dewatered (shaft 350 ft. deep). A hoist house has been built and a hoist has been installed. A site has been prepared for leaching operations, a number of leaching vats have been built and several tons of cans have been stocked to be used for the leaching operations. Electricity is being furnished by the REA. No ore has been mined as yet, the mining operations evidently awaiting the completion of the dewatering of the shaft.

Remarks The writer hopes to contact the officials of the compnay on his next visit to the mine and obtain information in regard to the company's plans for operation.

DEPARTMENT OF MINERAL RESOURCES
STATE OF ARIZONA
FIELD ENGINEERS REPORT

Mine Highland Mine | Date Feb. 15, 1956.

District Turquoise District, Cochise Co. | Engineer Axel L. Johnson

Subject: Present Status.

Location Near Courtland, Arizona.

Number of Claims 34 patented claims.

Owners Hope Mining and Milling Co, Phoenix, Arizona.
L. C. Mead, President, 1606 E. Camelback Road, Phoenix, Ariz.
Margaret Fournier, Secretary, 1619 Palmcroft Drive SW, Phoenix, Ariz.

Lessees and Operators Odell Still, Tombstone, Ariz.
John Still, Tombstone, Ariz.

Principal Minerals Copper.

Number of Men Employed 5

Production Rate Has been variable. Operators are reluctant to supply information.

Ore Values Copper ore, mostly in the form of chalcopyrite, mixed with a large amount of pyrite, is reported to contain from 3 to 4 % of copper, with about 1 Oz. of silver and a small amount of gold.

Milling and Marketing Facilities Have been shipping the ore t o the International Smelter at Miami, Ariz.

General Remarks Will make a more complete examination on my next visit to Courtland in order to make a more complete report on the operations.

DEPARTMENT OF MINERAL RESOURCES
STATE OF ARIZONA
FIELD ENGINEERS REPORT

Mine ✓ Highland Mine — Date May 27, 1955

District Turquoise Dist., Cochise County — Engineer Axel L. Johnson

Subject: Personal Visit, and information from Odell Still.

Location. Near Courtland, Ariz.

Owners. ✓ Hope Mining & Milling Co. (see previous report for address).

Lessees and Operators. ✓ Odell and John Still, Tombstone, Ariz.

Principal Minerals. ✓ Copper.

No. of Men Employed. 5

Production Rate. No production at present; operators are cleaning out the old drifts on the 140 ft. level. Intermittent shipments have been made to the International Smelter at Miami, Ariz.

Ore Values. Copper ore, mostly in the form of chalcopyrite, mixed with a large amount of pyrite, is reported to contain 3 to 4% of copper, with about 1 oz. of silver and a small amount of gold.

Ore in Sight, Probable. None.

Present Operations. Operators have been working from 150 ft. level of the old Mossoo shaft, which is a vertical shaft 190 ft. deep. They have had to also repair the shaft to some extent, and are now cleaning out the old drifts on the 140 ft. level.

Proposed Plans. To continue developing ore and shipping same to International Smelter at Miami, Ariz.

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DEPARTMENT OF MINERAL RESOURCES
STATE OF ARIZONA
FIELD ENGINEERS REPORT

Mine ~~Great Western Mine~~ (Highland Mine) Date Feb.11, 1954

District Turquoise (Courtland) District, Cochise Co. Engineer Axel L. Johnson

Subject: Mine Report ---Personal Visit & Information from Odell Still, operator.

Location At Courtland, Arizona.

Number of Claims 5 1/2 -----Mame, Highland, Humboldt, Handy, Chance, and 1/2 of Leadvile.

Owners Hope Mining and Milling Co.
L. C. Mead, President
Margaret Fournier, Secretary, Palmcroft Drive, Phoenix, Arizona.

Lessees and Operators Odell Still, Tombstone, Arizona.
Martin Marcoote, Lordsburg, N. Mex.
Lease wa s executed on Sept. 21, 1953. (Lease in name of Still & Stil
Work started at the mine in first part of November, 1953.
Lease is for 5 years with 10 % royalty payments.

Principal Minerals Ores of Copper.

Number of Men Employed 6

Production Rate No ore production yet.

Present Operations

(1) 3 men are working at the Mame shaft. The shaft has now been sunk to a depth of 150 ft. The 3 men are now cleaning out the old drifts, found standing from the old Mame Mine workings, and removing the blue vitreol ($CuSO_4$) which has been precipitated on the bottom and the sides of the drifts. This product will be either leached or sold direct.

(2) Pumping out the water in the Highland shaft. This shaft is 350 ft. deep. The water in this shaft is now practically all pumped out. (was within 100 ft. of the collar when pumping operations were started). A new headframe has been built at this shaft also. Water from this shaft will be used to conduct leaching operations of the carbonate copper ores

(3) Leaching operations of the carbonate ores were started about 10 days ago. The carbonate ores in the mine dump is being leached with the aid of water from the pumping operations, sulphuric acid ~~acid~~ and old iron cans and iron shavings. No water tight vats or containers are being used to hold the solutions. The solutions are run down an open ditch, the flow of the solutions being regulated by means of rock dams built across the open ditch at various intervals.

DEPARTMENT OF MINERAL RESOURCES

STATE OF ARIZONA

FIELD ENGINEERS REPORT

Mine: Leadville or Andes Copper Group (Courtland Mines)

Date: Feb. 15, 1956

District: Turquoise District - Cochise County

Engineer: Axel L. Johnson

Subject: Present Status

Please file this under "Highland Mine".

Please see my reports on the Highland Mine under dates of Feb. 11, 1954, May 27, 1955, and Feb. 15, 1956.

Hope Mining and Milling Co. now owns this property and it is under lease to Odell Still and John Still.