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ARIZONA RANCH & METALS CO
818 W. MAIN STREET
SCOTTSDALE, ARIZONA

George M. Colvocoresses
Mining and Metallurgical Engineer
1102 Luhrs Tower
Phoenix, Arizona

January 18, 1943

Swansea Development Company
Bouse, Arizona

Report on Swansea Mine

Gentlemen:

In compliance with the request of your officials I have revisited the Swansea Mine in order to go over the property with Mr. Lane and to refresh my memory concerning former operations and familiarize myself with recent work and present conditions. I beg to submit the following report which is partly based upon information recently obtained but mostly on my personal knowledge of the mine and its operations from December, 1913, when I first visited the property, until the Swansea Lease, Incorporated, whose operations I directed, discontinued its activities in 1924.

PROPERTY AND LOCATION

The present holdings of the Clara-Swansea Company on which you now hold the lease comprise sixty-one (61) unpatented lode mining claims (about 1220 acres) situated at Swansea which lies twenty (20) miles north of the small town of Bouse, Yuma County, Arizona. A very good road 28 miles in length connects the mine with Bouse, which is on the Parker Branch of the Santa Fe Railway.

The elevation is about 1400 feet and the country is rocky and rugged with extremely scant desert vegetation and no large timber. The climate is very hot in summer and very dry at all times of the year, the mean annual rainfall being about 7". Water for both domestic and industrial purposes is obtained from a pumping plant located on the Bill Williams River some four miles distant from the mine with which it is connected by a 6" pipe line in good condition. The company owns both pumping plant and pipe line, as well as all necessary water rights so that an adequate supply of excellent water is at all times assured.

All supplies must be brought to the mine from Bouse to which point the outgoing ore or concentrates must also be trucked, the current rate being $1.25 per ton.

The living accommodations are exceptionally good for a mining camp

and with minor repairs could accommodate some two hundred (200) men. There are also a well constructed office and laboratory (assay Office) with complete equipment. Reference to the power plant and mining and milling machinery will be made elsewhere in this report.

GEOLOGY AND ORE OCCURRENCE

Country rock is coarse-grained, light-colored granitic gneiss of igneous origin with considerable chlorite and epidote. More compact phases of the rock resemble quartzite or quartz porphyry with nearly flat schistosity striking to northeast and dipping 10 to 20 degrees to northwest. In certain sections, particularly west of the outcrops, the gneiss is capped by dark brown limestone, also some light colored siliceous rock which appears to be a quartzite and of sedimentary origin. West of the mine and south of the office there is chloritic-amphibolite schist conformable to the limestone and farther west and north the formation is cut by diorite which probably occurs as intrusive dikes and along the contact of which quartz veins have been formed.

Above the granitic gneiss and diorite,--which are pre-Cambrian age--is found a series of shaley limestone upon which rests a flow of andesite with fragments of other rocks and volcanic ash and tuff, all of which are of comparatively recent origin, probably of tertiary age.

The ore deposits are replacements in the limestone containing much hematite,--partly crystallized as specularite,--also chalcopyrite. Here the limestone overlies the gneiss (footwall of ore body) and is often intimately associated with the amphibolite schist. Large bodies of hematite usually form the hanging wall of the copper ore with schist and/or lime lying directly above them. The strike of the ore bearing zone is north 55 degrees east and the dip is to the northwest, about 45 degrees. Two major north-south faults have been noted and several minor ones, and the ore deposit lies in one or more faulted blocks of country rock thus being essentially irregular replacements of limestone by specularite and chalcopyrite.

The ore body pitches in the zone to the northeast and the lateral

width of pay ore is from 10 to 40' varying in accordance with the amount of replacement in the country rock. Lenses or shoots of ore have so far been developed at intervals throughout a length of over 2,000', the longest single shoot having a length of over 500' on the 600' level of the mine.

The origin of the primary ore, consisting of pyrite and chalcopyrite, has not been fully established. By some geologists it has been attributed to solutions resulting from the gradual alteration of the iron and copper minerals which normally occur in the diabase dikes and associated basic igneous rocks, and after these minerals had been deposited as replacements in the limestone at high temperature and pressure a subsequent alteration liberated sulphuric acid which converted the iron sulphide to oxide, or--when the action affected the limestone,--to soluble sulphate, crystals of which are found scattered throughout the deposit. This condition is similar to that which may be observed at the Planet Mine and elsewhere in the district where in all similar cases the ore is closely associated with the amphibolitic and chloritic rocks in which a certain percentage of copper normally occurs, but since the copper at Swansea is all in the form of sulphide, it must be assumed that oxidation did not affect the copper to a similar extent, or more probably, that the copper represented a different and later deposition than the iron.

HISTORY AND ORE PRODUCTION

According to available information, ores in this district were discovered probably during the 1870's and a little desultory development was done by J. W. Johnson and others prior to 1908, when several holdings companies were combined by the Clara Consolidated Gold and Copper Mining Company, including the Signal, Clara Gold and Copper, Crown Princess and Crown Queen Mining Company thus bringing under one ownership the Signal, Morro and Clara Groups aggregating about 200 unpatented mining claims. Stock and bonds of this Com pany were largely sold in France, Belgium and Holland.

Active mining and development was then started on a substantial scale and a railroad was constructed 22 miles from Swansea to the Santa

Fe Railway at Bouse. Water was piped four miles from a newly constructed pumping plant on the Bill Williams River and a 600 tons smelter (second hand) was purchased and erected with blast furnace and converting plant.

In 1910 there were six shafts all on or near the Copper Prince Claim and extensive development was in progress but regular production does not appear to have begun until after March of 1911.

The management as this time was both extravagant and inefficient and the price of copper was low. The Clara Company failed in May, 1912, and to avoid bankruptcy its assets and stock were then acquired by the Swansea Consolidated Company which continued active operations but an operating loss was consistently sustained and the Swansea Company was put in bankruptcy in November, 1913, with C. M. Souden as Trustee. The smelter was never operated subsequent to that date, prior to which about 40,000 tons of ore had been mined, mostly under the direction of Ernest C. Lane as mine foreman and mine superintendent. Souden leased the mine to Judge Thomas in 1914 and shipments to Humboldt and other smelters were begun around the first of 1915 and were continuous from that time forward for several years. The above mentioned lease to Thomas expired in October, 1916, prior to which date Judge Thomas had died and C. M. Souden operated the property as Trustee and E. C. Lane as manager. These operations were very profitable and served to greatly reduce the indebtedness of the bankrupt company.

From the shipments made from 1914 to 1916 the Humboldt Smelter alone received over 80,000 tons of ore containing about five million (5,000,000) pounds of copper.

On May 12, 1917, the property was again leased, this time for a period of ten (10) years to the Swansea Lease Incorporated, which organization was financed and controlled by Charles M. Clark, who advanced about $ 120,000 to pay off the remaining debts of the Swansea Consolidated Company in order to permit it to be released from bankruptcy. Clark continued to actively operate the mine and put down a new vertical shaft (known as #7) and also, after thoroughly testing the ore, he erected a 300 ton flotation mill and began concentrating the ore in 1918, during which year the Humboldt Smelter received 5,441 tons of ore and 110 tons

of concentrates containing altogether 155,566 pounds of copper. Shipments of ore were also made to the United Verde Smelter at Clarkdale, Sanco Smelter, and other plants.

During the early part of 1920 the low price of copper resulted in somewhat reduced activity and in July of that year Clark sold the Swansea Lease to the Consolidated Arizona Smelting Company of which I was then Manager and which owned and operated the Humboldt Smelter which received during the latter part of 1920, 3,050 tons of ore and 2,756 tons of concentrates containing altogether 1,697,004 pounds of copper.

During all of 1921 and the first few months of 1922 the copper smelters of Arizona were closed and no shipments were made from Swansea but development work was continued in the mine and the mill was revamped.

Active mining was resumed before the middle of 1922 by which time the Southwest Metals Company, of which I was also manager, had succeeded the Consolidated Arizona Smelting Company and from that time forward a large percentage of the ore was sent to the mill which regularly treated 7,000-8,000 tons of ore per month making a recovery of 96 to 98% copper. This procedure continued until the middle of 1923 when the Southwest Metals Company, having failed in its efforts to secure a renewal of the lease (for which it offered to pay a bonus of $100,000) discontinued all exploration and development work and after cleaning out the best of the ore in the main shoot between the 500' and 700' levels relinquished the lease and turned the mine back to the owners in the early part of 1924. At that time, the higher grade ore which was then available for mining had been exhausted and with copper selling at about 12¢ it would not have paid to mine and mill the lower grade material which only averaged from 3.00 to 3.5% copper. Of this last mentioned ore about 90,000 tons was known to exist in the upper workings of the mine and a somewhat smaller tonnage of similar material had also been left between the 4th and 7th levels.

The Swansea Consolidated Company was reoganized in 1926 as the Clara-Swansea Company and work was resumed at that time under the direction of Mr. Lane who made some shipments and later took a new lease in which the American Smelting and Refining Company became interested. This company promptly made a large investment for a new mill, power

plant, camp buildings and equipment, all of which were utilized for a short time in 1930 until the depression and exceedingly low price of copper forced a shut down which continued until 1937 when mining and milling were resumed but soon discontinued when the price of copper again declined. The A.S. & R. then decided to relinquish their interest in the existing lease which was subsequently renewed on a more favorable basis in favor of your company which under the management of Mr. Lane has recently resumed developments and shipments of high grade are mined on a small scale from the upper levels.

A complete record of production is not in my possession but the following is believed to be approximately correct:

Clara and Swansea Company	1911-14	40,000
Thomas Lease and Condon operation	1915-17	100,000
Swansea Lease, Incorporated (Clark)	1917-20	100,000
Swansea Lease, Incorporated (Consolidated Arizona & Southwest)	1920-24	200,000
Clara-Swansea Company	1917-20	10,000
American Smelting & Refining Co.	1930	20,000
American Smelting & Refining Co.	1937	20,000
TOTAL (about)		490,000

The average grade of this ore, excluding some low grade material from the old dumps, was close to 4% copper. The heart of the main ore body between the 500' and 650' levels, as mined by the Swansea Lease Incorporated averaged a little over 3% and ore shipped to Humboldt from 1915 to 1920 averaged about 3.5%,--a somewhat better grade may have gone to other smelters. The ore mined and milled by the A. S. & R. is reported to have averaged just about 3.5%. The gold and silver contents in all of the Swansea ore is negligible.

ESTIMATED ORE RESERVES

At the time when my company took over the Swansea Lease (1920) there were many blocks of ore left in the upper portion of the mine, some of which were no longer accessible but most of which had been seen by me or my engineers on the occasion of numerous visits which we made to the property subsequent to 1913. In 1925 the ore in the open workings above the 400' level was measured and sampled by my engineers and the estimate was 80,000 tons averaging a little below

5.0% copper. Some of this ore was probably mined in 1930 and 1937 by the A. S. & R. The estimate did not include the remaining portions of several ore bodies which branched off into the hanging wall but to which the easements had caved in the heavy ground that lay along the footwall of the ore zone. With all this section of the mine, Mr. Lane who actually did the previous mining, is most familiar and his estimates and statements, which in my opinion are most reliable, indicate that much of this ore could probably be recovered with profit.

When mining the main ore body from the 400' to the 700' levels the management of the Swansea Lease left a large quantity of lower grade material in place and also a substantial quantity of ore was lost since most of it was mined by the top-slicing method of mining which we found to be somewhat cheaper than the square-set-system that had formerly been employed. No accurat estimate of the tonnage or grade of this material was attempted but it was believed that we left behind some 60,000-70,000 tons that would average better than 3% copper. In view of the subsequent caving and present resultant conditions of these workings, I do not think that any future attempt to recover this ore from between the 500' and 700' levels would be justified,--unless an exceptionally high price for copper should exist.

This main ore body pinched out above the 7th level where the hanging wall of iron and lime closed in on the footwall gneiss and I believe that this shoot was bottomed but on the 600' level there was a stringer or narrow vein of high grade ore with quartz which was followed for some distance to the northeast and swinging to the north and we felt that this might well lead to another shoot lying further along the contact or in the hanging wall of the ore-zone. Further exploration in this direction was discontinued when we were unable to make a satisfactory arrangement for a renewal of the lease.

METALLURGY

The great excess of iron in the Swansea ore rates it most unsuitable for direct smelting unless it can be mixed with a similar tonnage of highly siliceous ore to form a self-fluxing mixture. This fact was responsible for the failure of smelting operations at Swansea,

but at Humboldt excellent smelting costs and results were obtained by mixing in the furnace charge a suitable proportion of siliceous Blue Bell ore.

However, the Swansea ore is ideal for flotation concentration and our recovery of copper was consistently in excess of 98%, while the concentrates were almost pure chalcopyrite and carried 26 to 28% copper. The milling cost averaged slightly over $1.00 per ton.

Even better results should be obtainable today with modern flotation practice and reagents.

EXISTING AND REQUIRED EQUIPMENT

In 1929 the A. S. & R. reconditioned the mining and power plant and rebuilt much of the camp. They added new machinery as required and constructed and equipped an entirely new mill, designed for the treatment of 250 tons of ore per day and they replaced the office and assay office, both of which had been destroyed by fire, with exceptionally good structures.

However, the old steam power plant, consisting of four 250 h.p. stirling-type ~~builders~~ boilers can never be made satisfactory or economical and the turbo-generator and condenser are in bad shape. Therefore, in any future program, I strongly recommend that either electric power should be obtained from the Colorado River Power Line which passes about nine miles from the mine, or preferably (in my opinion) the installation of diesel engines and generators. The operation of the mine and river pump will require clost to 500 electric h.p. and another 300 h.p. would be required for the mill, and to accomplish either of the suggested installations a substantial initial investment approaching $40,000 will have to be made.

To properly recondition the mill, it will be necessary to replace all of the belts (which have been sold) and some of the motors, and I believe it will be important to replace the present flotation cells with those of a different type employing mechanical agitation which is more suitable for the heavy gangue of the Swansea ore.

The mine hoist should be altered to operate by electricity and a new electric driven compressor with capacity of 500-600 cu. ft. should

be installed. As to underground work; in order to make accessible the remaining ore above the 500' level it will be advisable to repair, unwater and clean out the #7 shaft to the 500' level and perhaps right down to the bottom below the 700' level. The cost of this work is hard to estimate but from my knowledge of the condition of this shaft in 1934 and statements made to me by Mr. Lane, plus my experience in other localities where conditions were somewhat similar, I should expect that this would involve an outlay of from $12,000 to $15,000. A station pump of about 300 gallons capacity should be installed at the sump.

From this shaft some new crosscuts and drifts would have to be driven to the known ore bodies especially to those which were left on the 400' level southeast of the shaft and some of the old openings would have to be cleaned out. In my opinion, about $20,000 will have to be spent for these purposes. A working capital of $30,000 should also be provided.

While time did not permit me to investigate in detail the availability and cost of the required new equipment and all expenditures for work in the mine must in any case be estimated on the basis of many uncertain features, I submit the following recapitulation of these costs after full consultation with Mr. Lane and careful consideration and I believe the figures to be liberal:

(see next page)

Recapitulation of Expenditures to be made at Swansea Mine to permit further development and operation of known or partially developed ore bodies above the 500' level at the rate of 200-250 tons of ore per day:

Power Plant - Involving installation of either a branch line from Government high tension power line with substation and transformers or Diesel Engines and generators for 500 electric horse-power (second hand)	$ 40,000
Altering Hoist and purchase and installation of new compressor and motors for both	7,000
Repairs to river pump, power and pipe line to camp buildings. Also miscellaneous equipment.	7,000
Mill	
New crusher and flotation cells, motors, belts, reagent feeders, thickener tanks, ore feeders, etc., with installation of above	25,000.
Mine	
Repairs to #7 shaft and mine pump	20,000
About 1200 feet of drifts and crosscuts on 400' and 500' levels @ $15.00 per foot	18,000
Raises, winzes, and general repairs	3,000
	$120,000
Working capital	30,000
TOTAL	$150,000

EXPLORATION

For the future exploration of the mine and the search for new ore bodies in the hanging wall, and also in depth below the 700' level, one might either lay out a comprehensive program of churn drilling with say 40 holes to be drilled to a depth of 1000', located at the corners of 100' coordinates; or a new shaft could be sunk at a point which Mr. Lane and I agree should be almost directly above the end of our 700' drift. From this shaft cross-cuts and drifts could be run out to explore the locations at which it seemed most likely that ore shoots would be found.

Since the drilling, if successful, would in any event call for the new shaft and drifts to the ore shoots, it would probably be more economical to sink the shaft as soon as the drills had proved up pay

ore in sufficient quantity to justify such a procedure but since, at the present time, there is no positive assurance that such ore bodies actually exist and no definite clue to their location, I believe that it would be more prudent to start the exploration campaign by doing a certain amount of drilling which could always be suspended at any time that either the positive or negative results appeared to be conclusive.

The cost of drilling, if carried out by itself, would probably be in the order of $3.00 per foot but if this work should be done in conjunction with regular mining operations the figure might be reduced to perhaps $2.50.

There is, I believe, every reasonable ground for expecting that new ore bodies will be found in the unexplored sections of the property and also that some of these will have a substantially higher value than the average of the ore which is known or believed to remain above the 500' level and thus serve to permit a reduction in the cost of producing copper and to increase the profits beyond present justifiable expectations. The completion of such a program will necessarily involve a further outlay of from $100,000 to $150,000 and the future course of the copper market will very obviously influence the return that will accrue from such an investment.

GENERAL CONSIDERATIONS AND FUTURE OUTLOOK

The present condition of the Swansea Mine is largely a reflection of its past history in which two factors are outstanding,--namely the frequent changes in the operating management and the tremendous variations in the market price of copper during the past 30 years. The second condition has affected all copper mines but more particularly those which, like Swansea, must be classed as comparatively high cost producers.

The character and size of the Swansea ore-shoots, their lenticular shape, dip and rake in the ore zone, long underground haulage and the very heavy character of the ore and porticos of the hanging wall have all combined to make mining costs relatively high, while expensive

transportation, water-supply and operating the steam power plant have disproportionately added to the total cost of producing copper. Treatment of the ore in a local concentrator since 1920 effected a substantial economy as compared to direct shipment to a smelter,--the installation of diesel or hydro-electric power should serve to reduce the power cost from 3¢ to 1¢ per hour.

As far as I have been able to judge from the records of our own operations and from such information as has been given me concerning the work of others, copper from the Swansea Mine has never been produced for less than 12¢ per pound while during the greater part of the operating period the figures were nearer 14¢ or 15¢.

In any future operations, the saving in power cost and improvements in mining and metallurgical equipment and methods will make for further economy but as long as labor and supplies remain at a higher level than at any previous period I do not believe that one could figure on any reduction below the 12¢ minimum except on the chance of finding a higher grade of ore than has been produced in the past over any extended period of time and reasonably profitable operations at Swansea seem likely to require a market price in the order of 15¢ per pound.

Aside from the fluctuation in the market price for copper this mine has suffered to an exceptional degree from frequent changes in operating management and because,--aside from the ill-advised work of the owners from 1908 to 1913,--the mine has been continuously in the hands of lessees who did not have any great incentive to insure the future situation by extensive exploration and development and who quit work in some cases just as soon as a depressed market made current operations unprofitable.

Had one well-financed and efficiently managed concern conducted the affairs of this mine from 1908 to date I am satisfied that both its past record and its present condition would be far different and that in all probability a steady and substantial production would have been made from the date when the 17¢ bonus price for copper was established.

But in facing the actual facts it must be recognized that the present condition of the mine is very unfortunate in that a large amount of money must be spent to reopen and equip it for operation while even after it is reopened, no very large tonnage of ore will be exposed in such a manner that it can be measured and sampled.

The nature of the Swansea ore bodies is such that even when the mine was working to capacity and under the most favorable market conditions no substantial ore reserve has ever been blocked out in advance nor is this likely to happen in the future unless a very thorough campaign of drilling should be carried through to a finish.

However, a large quantity of the 3.5% ore in which the A.S. & R. were working in 1937 will certainly be available and portions of the higher grade stopes on the 400 and 450' levels in which Lane mined prior to 1918 can be made accessible by reopening these old workings and through a comparatively small amount of new development.

A further continuation of the last mentioned ore-shoots into the hanging-wall country seems highly probable but the tonnage and grade which they will produce can only be estimated from past experience.

I think that it may be reasonably assumed that the mining and milling of 4% ore with new and efficient equipment can be conducted with an operating profit of $5.00 per ton while the present bonus copper price of 17¢ prevails and therefore the production and treatment of 50,000 tons of ore of this grade should serve to repay the preliminary outlay of $150,000.

The chances that such a tonnage will be found on or above the 500' level of the mine appear to be excellent and on that basis I recommend the said expenditure and the above outlined program.

The results of the suggested exploration for undiscovered ore bodies is obviously uncertain but as a matter of opinion I think that such ore bodies exist and can be found and that the question of their profitable exploitation will be mainly dependent upon the future course of the copper market after the war.

Yours very truly,

(signed) G. M. Colvocoresses
January 18, 1943

TYPE NO. 1

DEPARTMENT OF MINERAL RESOURCES
STATE OF ARIZONA
FIELD ENGINEER'S REPORT

PRODUCTION POSSIBILITY SURVEY

Mine SWANSEA COPPER MINE Date 9/28/42.

District Swansea M. Dist., Yuma Co. Engineer Elgin B. Holt

Subject:

PRODUCTION POSSIBILITY

LESSEE: Swansea Development Company; E. C. Lane, President, Bouse, Arizona; Dr. E. P. Palmer, Secretary & Treasurer, Phoenix, Arizona.

METALS: Copper.

LOCATION & HISTORY: The old Swansea copper mine, is located 26 miles north of Bouse, Arizona. Various companies operated this property during the last 50 years; the peak of this work being during World War I, during which time the mine was connected with Bouse by means of a railroad, which later on was abandoned and torn up. During 1929-30 a new company was formed and a 250-ton flotation plant was built, which still stands intact at property; but for several years has not been operated. This plant consists of a bulk flotation unit, inasmuch as the ore consists of copper sulphides, with no other metals, of importance, present. The mill is powered by a 600-KW steam turbine engine, all units in the mill being driven by motors. Other equipment: four 250-HP boilers; pumping plant on Williams River, 4.5 miles of 6" pipe line, with 450-foot lift. Pumping plant and mill are in fair shape, and these could be put in first class running order, per Lane, for around $40,000.

PAST PRODUCTION

At the time of my visit to this property, June 10, 1942, Lane advised me that the past production of property, during its history, approximates 1,000,000 tons of ore assaying from 3.5 per cent to 4.0 per cent copper.

1942 PRODUCTION

Lane also stated that the property was taken over by his company during September, 1941, and that one of the working shafts was reconditioned

to the 175-foot and 200-foot levels, from which ore was being mined, from veins around 14 feet wide, at the time of my visit above mentioned; and two car loads of ore had been shipped, assaying 10 per cent copper. Lane also stated his company was planning to increase production, during July, 1942, to around 300 tons daily of ore assaying about 10 per cent copper.

DEVELOPMENT WORK

There are several working shafts at this property and several miles of underground work, concerning which I have no data, as this report is being prepared.

CAPITAL NEEDS

As stated above, Lane estimated that it will require around $40,000 to put the 250-ton flotation mill in first class running order. At this time, I have no data at hand as to what it would cost in the way of reconditioning some of the old mine workings as well as blocking out new ore reserves, of sufficient volume to supply the said mill with continuous ore; but, as a rank guess, I would say at least $150,000 should be provided for that purpose. Hence, total capital needs for mine and mill would approximate $190,000.

REMARKS

It would seem that this old copper mine should be taken over by some financially responsibe company and refinanced with a view to carrying out extensive new exploratory work, with the prime end in view of increasing the ore output to around 1,000 tons per day; and also with a view to increasing the milling capacity to the said 1,000 tons per day. Roughly, such a project would probably require the investment of around $2,000,000 to carry out. According to the past history of the property, probable mill heads for a 1,000-ton plant should approximate at least 2.5 per cent copper.

SURVEY OF OPERATING MINES

By: Elgin B. Holt

June 10, 1942

SWANSEA DEVELOPMENT CO.

SWANSEA DEVELOPMENT CO.

E. C. Lane, President
Dr. E. P. Palmer, Sec. & Treas.

Address: Bouse, Arizona.

SWANSEA MINE

Located 26 miles north of Bouse, Arizona, in Yuma Co.

1941 production: none.

1942 production: Just started to ship ore. Two cars have so far been shipped assaying 10 per cent copper - no gold nor silver.

PAST PRODUCTION:

Lane estimated past production at around 1,000,000 tons assaying from 3.5 to 4 per cent copper.

Mine was closed down for a number of years, but resumed operations in a small way, under Lane, during September, 1941. Chalcopyrite and bornite ore, of above grade, now being mined on the 175-foot and 200-foot levels from veins around 14 feet wide, occuring in schist.

MILL:

Property equipped with a 250-ton flotation plant, built in 1929-30, powered by one 600-KW steam turbine engine, mill units being electrically driven by motors. Other equipment: 4 250-HP boilers, pumping plant on Williams River, 4.5 miles of 6" pipe line, with 450-foot lift. Pumping plant and mill in fair shape and these could be put in first class running order for around $40,000, per Lane.

At time of visit, mine was being examined by T. A. Dodge, Mining Engineer, representing the International Copper Co.

PLAN TO INCREASE PRODUCTION:

Lane stated his company plans to increase production during July to about 300 tons daily of ore assaying about 10 per cent copper.

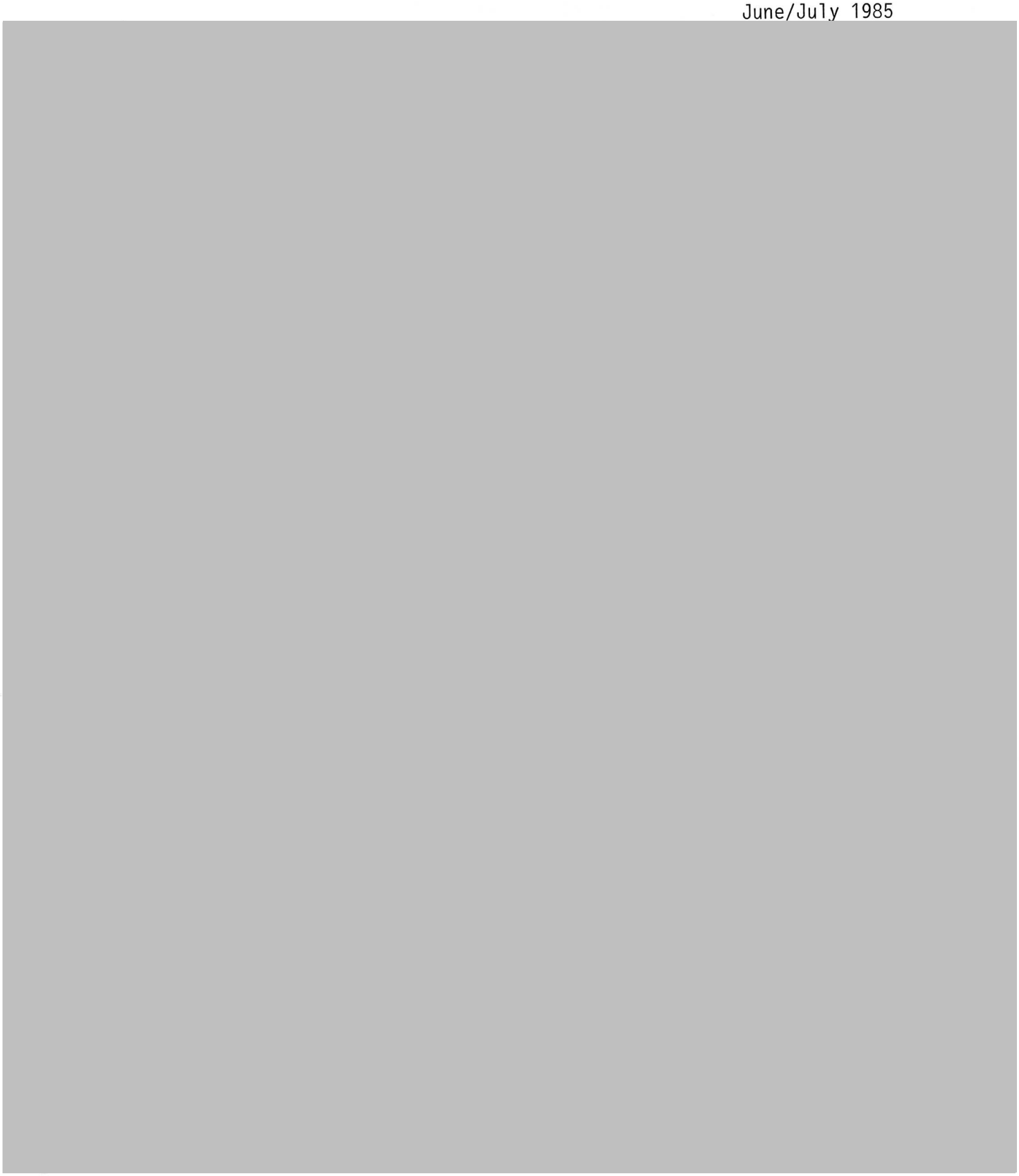
It would seem that this old property should be taken over by some large company, refinanced with a view to carrying out extensive exploratory work and erection of suitable reduction plant or plants at mine. The mineralization is extensive and large ore bodies indicated by past work.

Elgin B. Holt

1912

SWANSEA,

DESERT MAGAZINE
June/July 1985



NVAL

GEOLOGY AND MINERALIZATION AT THE SWANSEA MINE, LA PAZ COUNTY, ARIZONA

For

John Challinor

by

Joe Wilkins
Exploration Consultant
Tucson, Arizona

June, 1990

INTRODUCTION

The Swansea copper-iron deposit is an epithermal, detachment fault-related mineral deposit with a drill-proven ore reserve of about 5,500,000 tons grading 0.81% Copper and 6.0% iron in an open-pittable configuration. In addition to the open pit mine reserve, there are about 5000 tons of tailings which are virtually pure Micaceous Iron Oxide(MIO), and about 250,000 tons of dump material which will average between 20 and 40% iron. Both are readily amenable to extraction. Total copper resource is about 87,804,000 lbs and the total MIO resource is about 889,000,000 lbs.

LOCATION

The Swansea Mine is located in the Buckskin Mountains about 20 air-miles east of Parker, Arizona. The mine is accessible by about 30 miles of paved and all-season gravel roads. The property is situated in sections 20, 21, 27, 28 ,29 ,30 ,31, 32, and 33, in T10N, R15E, La Paz County, Arizona. The mine is at an elevation of 1350 feet.

LAND

The property consists of 52 unpatented mining lode claims in a contiguous block. The claims are staked on land administered by the Bureau of Land Management(BLM) and cover about 2300 acres. The claim names and claim numbers are listed in Appendix I.

LOGISTICS

The mine is accessible from Parker, Arizona which is served by a spur of the Santa Fe Railroad. A small natural gas pipeline crosses the property and the gas may be utilized(if available); additional inquiries are needed regarding the availability of the gas. Water resources are limited but water rights to water from the Bill Williams river may be acquired. In addition, water for limited use is available from the flooded underground mine workings with a water-table at 250 feet. A work force would be available in Parker and from the small community of Bouse, about 30 miles south of the Mine. Major supply centers are Phoenix, Tucson, and Los Angeles.

ENVIRONMENTAL

The mine is located in the Lower Sonoran life zone of the Sonoran Desert. Rainfall averages less than 4 inches per year and vegetation consists of a cacti-palo verde-creosote association. Temperatures range from near freezing in the winter to 120 degrees in the summer. A year-around operation is entirely feasible. The area is classified multiple-use by the BLM. No environmental problems are anticipated.

PREVIOUS WORK

The Buckskin Mountains were initially mapped by Blanchard in 1913 following a geological reconnaissance by Bancroft who visited the Swansea and described the mining operation in 1911. During operations, between 1910 and 1937, a number of private reports were completed by various groups. The report by Colvocoresses in 1943 summarized previous work and outlined a plan for further exploration. Following exploration by a number of companies and individuals, a report by Sharp for Redford Mines Inc in 1975 detailed the results of all the drilling, the sampling and the geophysical work at Swansea. Sharp calculated an ore reserve totalling 5,500,000 tons grading 0.81% copper in an open pittable configuration.

The geologic setting was not adequately known until Shackelford's work in the Rawhide Mountains in 1975. Following Shackelford's work, the metamorphic Core complex setting, the extensional tectonic setting and the role of the detachment faults in the Buckskin and Whipple Mountains was established by Lingrey and others, (1977), Davis and others, (1977, 1980), and Frost, (1981). The relationship between mineralization and detachment faulting was derived from work at Swansea and adjacent properties by Wilkins and Heidrick, (l982), and Wilkins, Heidrick, and Beane, (l986). An update of the geologic setting, edited by Spencer and Reynolds(1989) includes geological maps of the Swansea Mine area.

MINING HISTORY

The Swansea deposit was discovered in 1886 by Johnson, West, and Halpin but not developed until the Arizona copper boom in 1905-1910 when the railroads built spurs to isolated areas of the state(Spude, l976). In 1907, T. J. Carrigan of the Clara Gold & Copper Mining Company enticed George Mitchell of Cananea Copper fame, to become involved with the Swansea. By February, 1910, the town of Swansea with a newspaper and a population of 500 had been established and served by a 22-mile railroad spur from Bouse, Arizona; a mine and a smelter with a 700 t/day capacity had been built. However, the mine capacity was not sufficient to handle smelter demands, plus the copper price was responsive to a worldwide depression and the operation went into bankruptcy in 1911. The company was re-organized as a France-Belgium-Netherlands backed operation and limped along until World War I began in 1916(Spude, l976).

During WW-I, the operation became profitable under the management of E.C. Lane. Lane continued as manager intermittently for the nest 20 years and under lessors, the mine was intermittently profitable. The final lease-operation was by A.S & R (parent company to Asarco) in 1937. During the life of the mine and mill, the Swansea produced **544,911** tons grading **2.43%** copper with by-products of Ag at .061 oz/ton and Au at 0.0009 oz/ton (Spencer and Welty, 1989). Total production was about 26,000,000 lbs **Cu**, 33,100 oz **Ag**, and 507 oz **Au**. In addition, during the A.S. & R. operation the copper was concentrated by flotation which also separated out and concentrated the MIO tailings.

The property was acquired by John Challinor in 1959 and has been held under one ownership since that time.

REGIONAL GEOLOGY

Regionally, the Buckskin Mountains are part of the Buckskin-Whipple Terrain, an area composed of mid-level crust, uplifted and extended during Tertiary time(Wilkins and Heidrick, 1982, Spencer and Reynolds, I989). The Swansea Mine, and all mineralization in the Planet-Swansea-Cienega Districts, is located within ENE-trending synformal troughs consisting of a variety of upper plate lithologies juxtaposed onto a mylonitic gneiss lower plate by a regionally developed detachment fault(Wilkins and Heidrick, 1982, Spencer and Reynolds, 1989). The regional setting is illustrated on figure 2.

The lower plate consists of mid-level crustal rocks which have undergone dynamic and thermal metamorphism which created a distinctive mylonitic fabric. The mylonitic gneiss has a sub-horizontal foliation with a penetrative lineation and consists of augen and compositionally-banded, quartzo-feldspathic gneisses.

The upper plate is a collage of cataclastically deformed units varying in age from Precambrian, to Paleozoic and Mesozoic, to early Tertiary. The Precambrian, Paleozoic and Mesozoic units are metamorphosed but the Tertiary is not. Units present in the Swansea Synform(from Spencer and Reynolds, 1989) include the following:

AGE	LITHOLOGY
Precambrian:	granite, granite breccia
Paleozoic:	limestone marble, dolomite marble, sandstone, shale-phyllite
Mesozoic:	sand- and siltstone, volcanics
Tertiary:	arkose, siltstone, mudstone, lacustrine limestone, conglomerates, volcanic flows and tuffs.

All upper plate units are rotated, complexly faulted, and have been transported laterally from their depositional sites.

STRUCTURE

The dominant structures in the detachment terrains are the ENE-trending antiforms and synforms shown on Figure 2. The antiforms and synforms are mega-grooves associated with extension and control the position of the upper and lower plates, the detachment fault, the upper plate structures, and the mineralization and alteration(Wilkins and Heidrick, I982). Within the synforms, thick packages of upper plate rocks are preserved and host mineralization.

The detachment fault is a low-angle normal fault which has accommodated extensive displacement(up to 40 Km) and is characterized by a thick ledge of flinty microbreccia. Below the fault, the mylonitic gneisses are brecciated and altered by pervasive chlorite alteration. Above the fault, the rocks are a brecciated and gougy package of rocks with enhanced permeability. Upper plate structures include listric normal faults which flatten and merge with the detachment fault, large open folds, and intraplate tear faults which are subparallel to the direction of movement of the upper plate.

ALTERATION-MINERALIZATION

The alteration and mineralization throughout the area is spatially and genetically related to the detachment fault as shown on figure 3. Alteration consists of chlorite veins, vienlets, and replacements in both plates; minor clay development in the upper plate rocks; massive calcite replacing fault gouge, and remobilized calcite in gash veinlets in upper plate rocks.

Mineralization is dominantly specular hematite and earthy hematite with lesser amounts of copper sulfides and their oxidation products, very minor pyrite, rare galena or sphalerite, and manganese oxides. Associated gangue minerals include quartz, fluorite, calcite, and barite. A crude and poorly defined metals zoning is present with copper+iron zones surrounded by a manganese + barite zone and a copper+gold zone associated with but above the copper+iron zone(figure 3).

Mineralization occurs in 7 different sites within the detachment fault complex as illustrated on figure 4. The principle sites at Swansea are (1) along the detachment fault, (2) along subparallel faults and listric normal faults in the upper plate, and (3) as replacements of carbonate host rocks.

SWANSEA GEOLOGY

The geology of the Swansea deposit has been derived from detailed and reconnaissance mapping on the property and on adjacent properties by the author over a 25-year period. Numerous reports by previous workers have been reviewed and the logs (and some of the cuttings) from 50 drill holes have been studied and examined. The geophysical survey data, consisting of VLF-EM lines and an IP-Resistivity survey, have been reviewed and interpreted. The following discussion is a result of these reviews, studies, and field work.

The Swansea Mine is located in iron and copper metallization associated with the Buckskin detachment fault. The detachment fault juxtaposes an upper plate sequence of Paleozoic carbonates and Mesozoic clastics which overly a Precambrian granite onto a mylonitic gneiss lower plate. The fault strikes N 60 E-S 60 W and dips about 45 degrees NW. Micaceous specular hematite with copper-sulfides occurs along the detachment fault, in subparallel fault zones above the detachment, and as replacements in reactive units in the carbonate sequence.

LITHOLOGY

The lower plate sequence is quartzo-feldspathic gneiss with a K-Ar reset age of about 15 to 18 ma(Spencer and Reynolds, 1989). The gneiss varies from augen gneiss to compositionally banded gneiss, is well foliated, has a strong penetrative lineation, and a mylonitic fabric. Foliation trends are orthogonal to the detachment fault trend but lineation trends are strongly unidirectional at N65E. The protolith at Swansea is a Cretaceous to Tertiary-aged granodiorite (Bryant and Wooden).

The upper plate rocks consist of a Precambrian porphyritic granite overlain(?) by late-Paleozoic carbonates and clastics and Mesozoic clastic rocks. To the NE, and to the SW of Swansea, Tertiary-aged clastic rocks with intercalated limestones are present. The Paleozoic sequence has been identified as marbelized Martin formation(Devonian) or Kiabab formation (Permian) and the quartzitic unit as Coconino sandstone by Reynolds and Spencer, (1989). The schistose unit above and interfingering with the carbonates was tentatively identified as Morrison formation or Buckskin formation(Triassic) by Reynolds and Spencer. The units are complexly folded and faulted into a ENE-trending antiform which is cut by the detachment fault.

Tertiary-age units adjoining the Swansea property include playa-type sedimentary rocks of the Artillery Peak formation and coarse-grained clastic rocks of the Chapin Wash formation. The Artillery Peak occurs SW of Swansea and consists of thin-bedded arkoses, shales, felsic tuffs, and conglomerates with interbedded lacustrine limestones and capped by a basalt flow sequence. The Chapin Wash formation is a syn-tectonic redbed sequence of boulder conglomerates with minor algal mat limestones, siltstones, mudstones, and arkoses(Wilkins and Heidrick, I982). Both units are rotated 35 to 45 degrees to the ENE indicating ENE transport.

The lithologies that are host to the Cu-Fe metallization are the Paleozoic carbonates and to a lesser extent the Mesozoic schists.

STRUCTURE

The most prominent structure is the Buckskin detachment fault which strikes ENE and dips to the NW at about 45 degrees, as established by drill holes.In the upper plate, 2 subparallel faults have been mapped by Reynolds and Spencer(1989) and at least 1 more is present in the underground workings. All of the low-angle faults appear to host Fe-Cu mineralization. Although not well-defined, a series of NW-striking, NE-dipping listric normal faults cut and rotate the upper plate; 2 such faults are shown on Figure 5 and many more probably exist in the subsurface. The listric faults terminate at the detachment fault and are loci for mineral deposition especially where they intersect the detachment fault or other low-angle faults. However, because the ore minerals were deposited snytectonically with the detachment and listric faulting, mineralization is often apparently terminated by the listric faults (Wilkins and Heidrick, I982).

Intraplate tear faults are high-angle faults which strike in the direction of plate movement and have a strong lateral offset component. These structures also terminate at the detachment fault, are extensional in nature and commonly host ore

mineralization or act as feeder zones for mineralization. Although none are mapped at Swansea, they are common throughout the district(Wilkins and Heidrick,1982, Spencer and Reynolds, 1989), and probably occur in the subsurface.

A post-detachment fault, the Swansea Fault of Reynolds and Spencer,(1989), cuts the upper and lower plate and offsets the entire sequence about I km to the northwest. The fault occurs about 4000 feet WSW of the Swansea Mine.

ALTERATION

Alteration is chlorite-dominant throughout the Swansea area. In the lower plate, the section below the detachment fault surface is brecciated gneiss with black greasy chlorite as veins, veinlets, microveinlets, replacing clasts and replacing interclast gouge. In the upper plate, chlorite is present with specular hematite and chalcopyrite along low-angle fault zones, and as irregular masses and vein-veinlets in and cutting the marbelized carbonate rocks. Chlorite alteration commonly forms an envelope above and below the detachment fault(Wilkins and Heidrick, 1982).

Other alteration effects noted in the area include minor silicification as weakly developed jasparoids and minor quartz veins; and some clay development which is, in part, supergene clay.

The carbonate sequences are marbelized to recrystallized limestones and dolomites but appear to have been metamorphosed prior to mineralization.

MINERALIZATION

Mineralization at the Swansea consists of specular hematite and chalcopyrite with very minor pyrite, chalcocite, bornite, and native copper. At surface, the chalcopyrite is oxidized to malachite, azurite and minor chrysocolla. In the subsurface, the chalcopyrite varies from massive to veinlet-microveinlet disseminated. The massive ore occurs as replacements of carbonate units. Along the detachment fault and in the subparallel faults, the chalcopyrite is semi-massive, occuring as rounded grains to subrounded masses in a specular hematite matrix and as brecciated clasts in specular hematite. Massive to semimassive chalcopyrite also occurs replacing carbonate units; stopes in 28% Cu were encountered during mining(C.B. Osborne, personal communication). Stockworks of veinlet and microveinlet chalcopyrite are present in the carbonate and clastic units, and probably occur in listric fault zones similar to those at the Copper Penny(Wilkins and Heidrick, 1982).

The presence of native copper was recognized during drilling by John Challinor in 1979. According to Challinor(personal communication), discrete grains of native copper were present in cuttings below the sulfide zone. The lack of other oxidation products with the native copper suggests hypogene deposition as native copper. A similar native copper occurrence was noted at the Planet Mine by Cummings(1946).

The specular hematite was deposited as finely divided, micaceous particles along fault zones, as irregular masses surrounding chalcopyrite which replaced

marbelized limestone, and as veinlet and microveinlet stockworks in carbonates and in the schistose clastic rocks. The specular hematite was syntectonically deposited and later movement along the detachment fault could have contributed to the micaceous nature by brecciating and grinding larger particles. An example of this type of communited iron and copper was shown by Wilkins and Heidrick(l982) at an adjacent property and Bancroft (1911) noted and commented on the presence of extreme faulting in the ore at Swansea.

The finely ground and micaceous specular hematite is an industrial mineral used as a paint pigment and in other applications requiring ultra-violet light protection. This product is known in the pigment industry as "micaceous iron oxide" or MIO.

SWANSEA MINE

The Swansea Mine was developed by 7 shafts and 7 mining levels; the deepest was the 700 level. Total workings, including stopes, exceeds 11,400 linear feet. The deepest level with production stopes was the 700 level. The cut-off grade for copper was 3.0 to 3.5 %. The location of the mine workings, compiled from a map filed with the Arizona Geological Survey and projected to surface, is given on Plate 1.

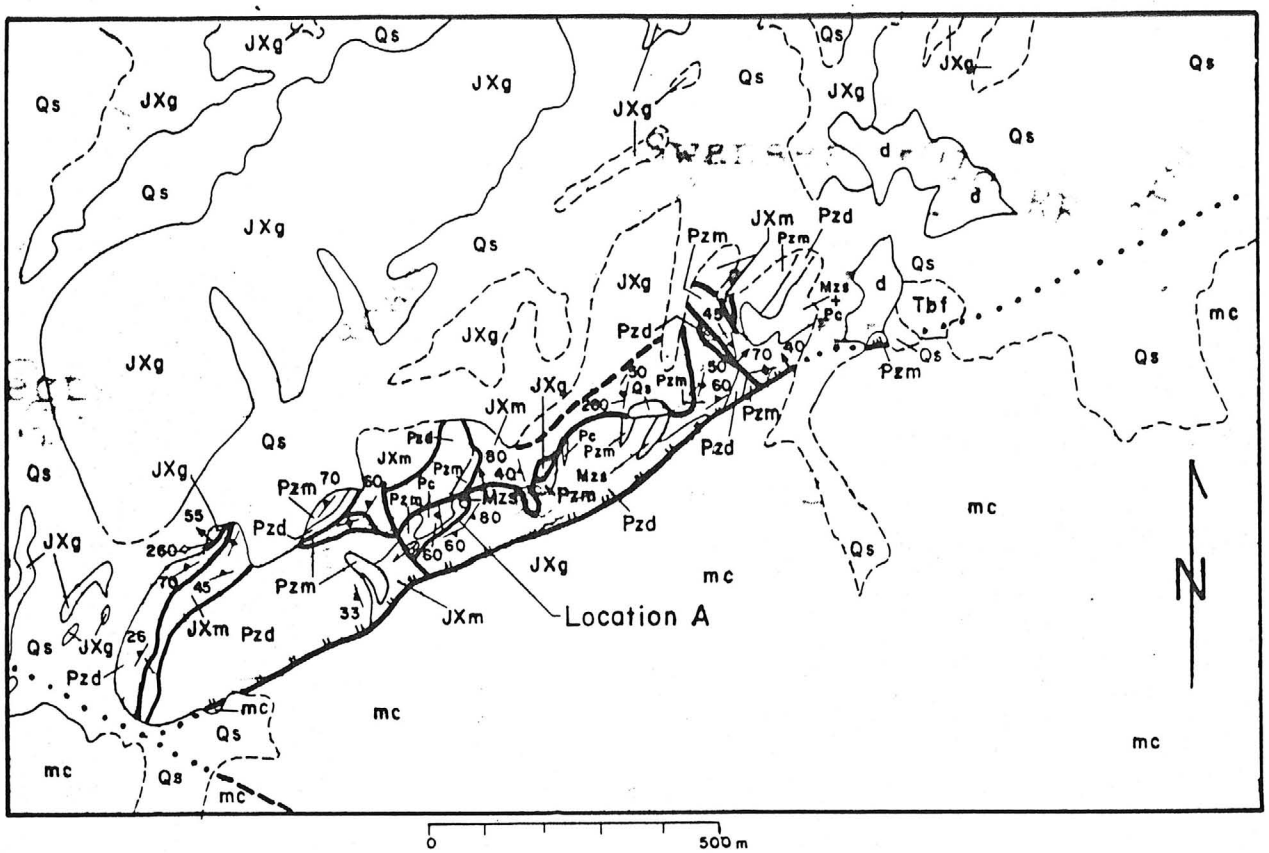
MINERAL DEPOSIT

The copper+MIO deposits at Swansea occur as lenticular masses along the detachment fault and as subparallel to subhorizontal lenses in the upper plate. The lowermost ore zone was referred to by the early miners as the "footwall ore body" (Bancroft, 1911) and occurred along the detachment fault. In plan(figure 5), the Cu+MIO ore zones are elongate ENE-WSW, and appear to be en echelon. In section(figures 6 and 7), a series of 3-4 lenses appear to coalesce and diverge along strike creating the en echelon effect. Total length of the ore zones mined was about 2100 feet with widths up to 300 feet. Ore shoots up to 500 feet long and as much as 40 feet thick were mined. However, the bulk of the mining was from much smaller ore shoots(Colvocoresses, 1943).

The areas between copper-MIO deposits are also mineralized with copper and MIO (probably as stockwork veinlets) as indicated by low-grade Cu and Fe values in drill holes(.05-.15 %Cu).

EXPLORATION TO DATE

Exploration to date includes completion of 62 drill holes by various companies and groups. The drill holes, the time interval for the drilling, the hole depths, and the company responsible for the drilling is as follows:



d MINE DUMP

Qs SURFICIAL DEPOSITS (Quaternary)

Tbf BASIN FILL (Late Tertiary)

Mzs SCHIST; MOSTLY DERIVED FROM SEDIMENTARY ROCKS, BUT INCLUDES SOME MYLONITIC CRYSTALLINE ROCKS (mostly Mesozoic fabric and protolith)

Pc COCONINO SANDSTONE (Permian)

Pzm CALCITE MARBLE (Paleozoic; probably Permian)

Pzd DOLOMITE MARBLE (Paleozoic; probably Permian)

JXm METAMORPHIC ROCKS, INCLUDING MYLONITIC CRYSTALLINE ROCKS AND METASEDIMENTARY SCHIST (Mesozoic fabric; Mesozoic and probably Proterozoic protoliths)

JXg GRANITE (Jurassic or Proterozoic)

mc MYLONITIC CRYSTALLINE ROCKS BELOW DETACHMENT FAULT (middle Tertiary mylonitic fabric; various protoliths)

——— CONTACT; dashed where approximately located

10 FAULT, showing dip of fault and trend of striae; dashed where approximately located

DETACHMENT FAULT; dotted where covered; ticks on upper plate

30 FOLIATION, showing trend of lineation

VERTICAL FOLIATION

Figure 9. Geologic map of the Swansea area, Swansea synform, central Buckskin Mountains. Boundaries of the map area are at 34°9.64', 34°10.37', 113°50.10', and 113°51.54'. Geology by J. Spencer and S. Reynolds.

developed foliation. The granite is locally associated with finer grained, less megacrystic equivalents and with pegmatites. The granite was informally referred to as the *Swansea granite* by Wicklein (1980), who considered it to be Mesozoic based on Rb-Sr whole-rock data on an enclosed pegmatite. Alternatively, the granite could be Proterozoic.

The granite is cut by fine- to medium-grained mafic dikes and irregular intrusions (the Signal diorite of Wicklein, 1980). The intrusions vary from medium-grained diorite to foliated, dark-green aphanitic andesite(?). Several generations of mafic intrusions are probably present because some are strongly affected by fabrics of probable Mesozoic age, whereas others intrude middle Tertiary units.

The crystalline rocks are depositionally overlain to the southwest by the basal sandstone of the Tertiary section. The sandstone dips moderately to the southwest, which indicates that the crystalline rocks have been rotated during Tertiary detachment faulting.

Swansea. The main ridge at Swansea is composed of Paleozoic carbonate rocks with less abundant Mesozoic

Company-Date	No. holes	Feet
Magma-1968	11	6081
Phoenix Ventures-l968	14	5970
Bagdad-1968	4	1260
C.F.& I,-1969	4	1275
Swansea-1943 to 1967	14	3513+
Redford-1974	15	3070+
Totals	**62**	**21,171+**

Of the 62 holes, 47 cut significant intervals of iron- and copper-bearing mineralization. The drill holes and the assays and footages are listed in Appendix II. The drill holes were rotary holes or in the case of the 14 Swansea company holes, churn drill holes. Cuttings and pulps for virtually all the holes have been preserved and maintained by John Challinor.

In addition to drilling, 2 IP-Resistivity surveys totalling 9 and 7 lines at an a-spacing of 400 and 500 feet respectively, have been completed, and an 11-mile VLF-EM survey run over existing lines. The results of these surveys have been interpreted by the contractors(Mining Geophysical Surveys Inc, and Tri-Con). Additional interpretations within the context of the mineral deposits are required.

ORE RESERVES

According to Colvocoresses, proved and probable ore totalling at least 145,000 tons grading about 4% was left in the mine prior to A.S.& R.'s entry. A.S.& R. mined about 40,000 tons which would leave a reserve of about 100,000 tons at 4% Cu (in a matrix of massive specular hematite). This reserve is present between the 400 and 700 levels.

Additional calculations of ore reserves by Sharp(l975) were made using drill hole cross-sections, a cut-off grade of 0.10% Cu, and a tonnage factor of 10 cu.ft./ton. The calculations are as follows:

CATEGORY	TONS	Cu
Proved and Probable	4,358,000	0.81%
Possible	1,062,000	0.81
Total	**5,420,000**	**0.81%**

In an open pit configuration, a strip ratio of 3:1 is indicated. The area covered by this reserve is a 1050 feet by 600 feet block between the no. 5 shaft on the east and the nos. 1 and 2 shafts on the west and represents only 40% of the total drill-indicated and underground mine-indicated mineralization. In addition, the 100,000 tons at 4% indicated by the Colvocoresses' report are not included in this reserve.

The iron content is a bit more problematic because only 14 of the 38 drill holes have iron assays. A review of the data shows that Fe assays corresponding to Cu values range from 3.0 to 10.0% with an average value of about 6%. In addition, iron values form a shell around the copper core with thicknesses up to 100 feet on either side. At an average thickness of 20 feet above and below the Cu zones, the tonnage

increase would be about 1.1 million tons. The resulting iron ore reserve would be as follows:

Proved, Probable and Possible: **6,500,000** tons at **6% Fe.**

If selective mining methods are used during open pit mining, the head grades for the iron could easily be upgraded to the 7 to 8% range without a significant loss in overall tonnage.

DUMPS AND TAILINGS

During the A.S.&R. operating period, about 40,000 tons of copper ore with a substantial iron content was mined and milled using flotation methods. The iron, as finely ground, micaceous specular hematite(or MIO) was separated from the copper and dumped into 2 separate tailing ponds. The tails represent at least 5000 tons of relatively pure MIO, easily extractable and readily upgraded by screening.

The dumps from the 1911 to 1937 mining operations contain about 250,000 tons with an estimated MIO content of at least 20%, with areas as high as 50% Fe. These dumps represent an easily mineable, readily upgradable resource of at least 50,000 tons (and as much as 75,000 tons) of MIO.

The Dumps and the Tailings have been measured and surface sampled but require additional sampling. The thickness of the dumps and tails should be measured with an auger drilling program to provide assay data and the depth of the deposit.

TOTAL ORE RESERVE

The following ore reserve is an estimate based on Sharp's calculation, a review of the iron assays, and the addition of the dumps and tailings.

Category	Tons	Cu	Fe
Proved+Probable	4,358,000	0.81%	6.0%
Possible	1,062,000	0.81	6.0
Iron increment	1,100,000	*	6.0
Tailings	5,000		90.0
Dumps	250,000		20.0
Copper total	**5,420,000**	**0.81%**	**87,804,000 lbs Cu**
MIO total	**6,755,000**	**6.60%**	**889,000,000 lbs Fe**

* Cu in the .05-.10% range is present and may be extractable.

EXPLORATION REQUIRED

Although the Swansea Mine has undergone fairly extensive explor- ation, a number of problem areas need to be addressed. A tentative exploration program designed to address these problems is as follows:

1. The mine area needs to be re-mapped within the context of the regional geological setting.

2. The Tailings and Mine Dumps need to be re-surveyed, sampled, and drilled to fully establish the MIO resource present.

3. The existing drill-hole date, including drill hole logs and cuttings need to be re-examined, re-logged, and sampled for MIO content.

4. A series of cross-sections should be constructed following steps 1 thru 3, to calculate preliminaryore reserves and then, to design a drilling program.

5. Drill additional holes as needed for Cu and MIO ore reserve calculations

6. Recalculate the ore reserve, including the MIO, and design an open pit mine to extract the resource.

gmc

REPORT ON THE DEVELOPMENT ON THE SWANSEA MINE DURING 1927.

Swansea - Yuma Co

Mr. O. M. Souden, President,
Clara Swansea Mining Company

Previous to my first trip to the mine, during April last, your Manager, Mr. Lane, had dewatered the mine workings, opened up some of the old drifts and made new ones on the 300 and 400 Levels of the mine, had rehabilitated both No. 7 and No. 2 shafts and connected them in a manner that gave excellent ventilation to the mine workings. The new work up to this time had been the driving of the 403 crosscut a considerable distance into the hanging wall country, and the 301 crosscut into the footwall territory of the ore zone.

The object of this initial work was to so open the mine that the known orebodies above the 300 and 400 ft. levels could be economically worked thru the No. 7 shaft. The objective of all of the work during the year 1927 was to locate the extensions of the several footwall orebodies that had been previously worked in the vicinity of the Nos. 1 and 2 shafts, and particularly one of these that had been penetrated in several places by raises from underlying orebodies. In each case the ore that had come down at these points was of a slightly different character than the general run of ore, and of a considerably higher grade. The nature of this ore, as of all ore in the footwall hematite orebodies, is such that it cannot be worked from below upward, but must be worked downward by a top slicing method, and for that reason this high grade orebody still exists practically intact.

OREBODIES LOCATED.

The 301 and 303 crosscuts to the footwall and the respective upraises and intermediate levels, and intermediate crosscuts, have positively located two of the footwall orebodies besides the recently located high grade orebody, and have sufficiently opened them to determine their character and grade. A very little more work in 301 raise will probably show an extra body of ore above the ore that is now opened.

There are two more footwall orebodies in virgin condition, that are positively known as to location and relation to these demonstrated orebodies, that were previously developed by an early company's work under supervision of Mr. Lane. These can be entered by further work from the recently made openings. One of these is an orebody lying directly on the footwall between the 200 and 300 foot levels, and extending northeasterly from the 303 Raise. The other lies above the high grade orebody that is desmontrated in 303 Intermediate. It was stoped to a slight extent at one point on the 300 ft. level, and passed thru No. 5 shaft at 375 ft.

The orebodies of this mine have a lenticular cross-section and extend up thru the formation as rather flatly inclined chimneys. Such a character makes them difficult to locate at any certain point and the experience in driving the 303 crosscut, which passed 13' below the high grade ore that was the prime object of search, shows how easily these ore shoots can be missed in a method of development that is restricted to drifts, crosscuts and raises. The extensions of these orebodies vary in dip and rake so that but a rough estimate as to position can be made, and the liability of just missing the object of search is considerable.

This is particularly true in the upper or hanging wall portions of the ore zone in that territory that lies west and northwesterly from the No. 7 shaft.

HANGING WALL ORE BODIES ON THE 400 FOOT LEVEL.

The first exploration was the 403 crosscut. This was driven out northwesterly from the No. 7 shaft for 300'. With the exception of a large body of schist cut near the present end of this crosscut, the rock passed thru was fractured dolomite lime. At numerous places along the drivage, fault planes and fractures were encountered on which small deposits and bunches of very high grade copper occurred that showed considerable secondary enrichment. Three short crosscuts and two short raises on these ore occurrences showed them to be erratic and irregular and of limited extent, and the work at these points was very disappointing.

It is my opinion, however, that the large body of schist encountered in the far end of this work will show ore if explored at some distance above this level; but the method of further development and other at this/points in the hanging wall area of the ore zone will be discussed later in this report.

_404_CROSSCUT. This crosscut was run northwesterly in the hope that it would intersect the downward extension of the 302 orebody, but as that ore did not go below the 350 ft. level no ore was encountered.

With the possibility of picking up another such body of ore in the dolomite, the crosscut was carried out at a distance of 335' from the main haulage drift. Numberous stringers of high grade ore were encountered, and an upraise was made on the most promising showing. This raise was carried up a distance of 58' above the 400' level. At 48 ft. the raise passed thru a contact and entered the sandy silicious schist (locally called porphyry) similar, I believe, to the rock showing in the last 125' of 304 crosscut.

This raise (404 raise) is up to the 350 ft. level and is less than 70' from the end of the 350 crosscut. Between these two workings is the contact with the sandy silicious schist on which the ore of the "Lane" shaft occurs, and altho this "Lane" shaft ore may be much above this horizon there is a good possibility that an ore deposit may occur more or less continuously along this contact. At this time a crosscut is being driven to connect these two workings. The face of this crosscut from the top of 404 raise was in silicious schist on January 31st, but a very considerable amount of water coming from the face showed that the contact was very close, and a showing of ore is looked for.

_FOOTWALL_OREBODIES_ON_THE_400_FOOT_LEVEL.

Another important proposed development on this level was the continuation of the 401 crosscut eastward to the point indicated by No. 11 Drill-hole that shows the continuation of what I have referred to in my previous reports as the No. 4 orebody. This orebody was extensively worked south of No. 5 shaft in 1917. No. 11 Drillhole showed 35' of ore that averaged 4.75% copper and this ore should be encountered on the same horizon as the crosscut.

This work was proposed last June but, due to the fact that the 303 crosscut had failed to encounter the high grade orebody just recently discovered, it was determined not to proceed with it until the various bodies could be more positively located on the 300' level, and we could then proceed with more definite assurance that the North extensions of the orebodies would be found. The work during the past 30 days has now given us the data that was necessary. As the grade of the best of these orebodies cannot be expected to be much better than 5%, it will not be advisable to open them up until a much more favorable smelter and freight rate contract, than you now have, can be made, or unless milling tests on the lower grade ore will show that with the aid of concentration such ore can be made profitable.

HANGING WALL ORE BODIES ON THE 300 FOOT LEVEL.

The 302 crosscut was started northeasterly with the object of encountering the downward extensions of extensive orebodies that were productive of excellent grade ore in the vicinity of No. 1 shaft, and also to locate the extension of an ore body that is designated the "Lane Shaft" orebody that outcrops at what is considered as the top of the ore zone, and lies in a contact of dolomite and a sandy silicious schist.

Before this work had encountered any schist it cut a stringer of rich ore in the dolomite that, on drifting, developed an orebody of considerable extent of a character different from any ore previously encountered in the mine. This ore lay entirely within the dolomite lime and may be considered a replacement in limestone. It showed a horizontal extension of 90 ft. in its longest dimension, and was followed for about 75' down an incline. The ore was a hard spongy ore composed largely of secondary sulphides of copper, besides the chalcopyrite, and some samples carried as high as 20% copper. About 400 tons mixed with lower grade ore was shipped and averaged 10.71% copper. It was more silicious and much less ferruginous than the typical hematite copper-ore of the footwall orebodies of the mine. This ore was extracted and shipped and somewhat more than $10,000.00 was realized. Quite a bit of prospecting

was done on the 350 ft. level to find the extension of this ore without result, but the evidence of the occurrence of orebodies of this character within the dolomite is of considerable importance, and with a less expensive method of prospecting these areas of dolomite, numerous other bodies of similar extent and grade will undoubtedly be discovered.

302 crosscut was not extended further after the discovery of this ore, but 304 crosscut, that more directly connected with the 300 raise, was used to explore the ground further to the northwest. In that drivage, after passing thru the dolomite, a large area of chloritic schist, showing traces of hematite copper, was cut near the contact of the dolomite and the schist but no orebody. Beyond this schist the crosscut passed thru 25' of dolomite and, on encountering a fault, entered what is probably the sandy silicious schist described above as the overlying formation of the ore zone.

THE 350 LEVEL CROSSCUT. This crosscut was run northwesterly at this horizon to cut the same formation as did the 304 crosscut at 100 ft. north of the latter, in the hope that if the 304 crosscut had passed below the extension of the orebodies worked in the vicinity of No. 1 shaft, that the 350 ft. level crosscut would encounter such extensions. At 107 ft. from the 350 level drift the schist was encountered and showed 7 feet of excellent ore, some of it similar to the enriched ore of the 302 orebody. A drift and a raise is now being run to determine the character and extent of this ore. When I last saw it on January 31st a certain amount of black graphitic hematite ore showed in a chloritic schist against a footwall of dolomite lime. The high grade spongy ore, that had occurred below it, was not showing in the raise, and conditions did not lead me to expect that this ore was the extension of the ore that was looked for, but it was probably a deposit that had leached down from the orebodies above. The many careful computations that I have made, lead me to believe that the extensions of the ore bodies worked in the vicinity of No. 1 shaft, and on the 145' level, should be found between 50 and 100 ft. above both of these crosscuts.

PROPOSED METHOD FOR FURTHER EXPLORATION.

Within the past two years a special type of rock drill has been developed and perfected for drilling holes from underground workings to a depth of from 100 to 200 ft. The direction of the hole is at any angle from horizontal to vertical, but the most efficient angles are between 10 degs. and 50 degs. above the horizontal. This drill has been so successful in exploration of irregular ore deposits in roughly parallel lenses and narrow runs of ore that in districts like the Pitcher camp in the Tri-state district of Oklahoma-Missouri-Kansas many mines that were considered worked out are being leased and redrilled.(1) (Underground Deep-hole Prospecting at the Eagle-Pitcher Mines, Trans. A.I.M.E. Vol. 75. p. 35)

This method was originated and perfected by the Chief Consolidated Mines, Eureka, Utah (2) Deep-hole Prospecting at the Chief Consolidated Mines Trans. A.I.M.E. Vol. 72, p. 677) and the signal success of this company in the large and profitable production from very irregular orebodies is attributable to this method of prospecting. Holes as deep as 270' have been drilled in the Chief Consolidated property. The cost per foot of hole in limestone at this property averaged 97¢. In the Swansea ground drilling should not exceed this amount. The cuttings from the drills are caught when a sample is desired, and it is found that these samples check satisfactorily with actual mining. The cuttings as collected clearly show changes in formation, and indicate the position of faults, breaks, mineralized stringers, and an average sample in cross-section of the orebody, and position of both walls. The driving of 100 ft. of crosscut in the Swansea Mine takes 20 days and costs $1,000.00. A drill hole that will show the same formation, and show the value of ore cut thru would take four or five days and cost $100.00.

The necessary requisite for this work is a certain amount of underground workings from which holes can be drilled to explore adjacent ground. Your present openings are now of sufficient extent that a deep-hole drilling campaign should not only definitely delineate the various orebodies, but accurately sample them at the

same time. In drilling the necessary number of holes to sample the orebodies in the mine it is most probable that other bodies of high grade ore, of the character of the 302 orebody, will be located by the drill.

GENERAL CONDITION OF THE MINE.

The main haulage way on the 400 ft. level, connecting the main winzes from the 300 and 350 levels with No. 7 shaft, is in excellent condition, and capable of handling a large tonnage with economy as soon as the station at the shaft is enlarged. Maximum haul on the 400 ft. level is 500 feet.

The 300 and 350 raises are centrally located for handling all the ores to be mined between the 300 and 200 levels, and between the 300 and 350 levels, with a maximum haul from the shutes to top of raises of 400 feet.

Ventilation throughout the mine is good due to connection between Nos. 2 and 7 shafts. Motor driven blowers drive cool, fresh air from the main drifts to the faces, and excellent efficiency is had in all parts of the mine.

MINING COSTS:

As most of the ore taken from the mine since present operations started has been largely from development work, there is no definite figure as to cost of ore under systematic production methods asyet available. Your Manager's previous experience in shipping a number of thousand of tons of ore from this mine, under very unfavorable conditions, should allow a very close estimate of what could be done now/with excellent facilities. And I believe, that with at least 4 stopes opened up in the footwall orebodies, that 300 tons per day could be mined and delivered at $3.00 per ton. On a 100 ton basis production costs would be within a $4.00 per ton limit, and probably about $3.50 per ton.

As a shipping proposition the present contract would give no profit on ore of 5% and less copper content, when copper is 12¢ per pound. A 7% ore should give aprofit of approximately $250.00 per day.

In order to utilize the lower grade ores of the mine it appears necessary that a certain amount of concentration be made on the average run of mine ore, and I would suggest that tests be made at once on a sufficient scale for positive results. From laboratory tests recently made it would appear that an iron copper concentrate can be had from a very simple water washing process, that would run from 10 to 15% copper and should carry about 75% iron. Provided you can be paid for the iron, as well as the copper, a profitable business can be made, but if payment alone for copper is the best that can be had, a higher ratio of concentration would be necessary. This would mean flotation and fine grinding, and very clear proof in a test mill, that profit can be had on a 3% ore, will be necessary before the milling proposition can be seriously considered.

ORE RESERVES:

As has been explained before, in regard to the characteristic orebodies of this mine, it is not possible to block out with crosscuts thru the orebodies, as the ore is too soft and heavy to stand but for a short time.

For this reason one must rely on generally known factors relative to the orebodies that have been located in the recent development work.

As this work has showed the position of orebodies that have been formerly opened up, either in the vicinity of Nos. 1 and 2 shafts above the 200 ft. level, or in the vicinity of No. 5 shaft below the 400 ft. level, or between the 400 and 500 levels, the knowledge of your Manager, Mr. Lane, who was in charge of operations when ore was mined at these points, must be taken in making a rough estimate of ore now available. The recent work in the mine has confirmed your Manager's knowledge of the position of these orebodies, and the extent and approximate grade of the same as well.

My sampling, in places that have been opened have checked closely with Mr. Lane's estimates of copper content, and having discussed the subject thoroughly with him, as to methods of

approximating probable tonnage in the mine that can be made available as soon as it may be wanted, I am confident that his estimate is conservative as to tonnage and very nearly correct as to copper contents.

Without Mr. Lane's personal knowledge of these orebodies, any approximation of reserves would be almost impossible with present mine openings. I believe, with the adoption of the deep-hole drill that is suggested, that ore estimates can be made in the future with a very considerable accuracy, and could we have had such data at this time, a much greater tonnage could be considered as reserves than can be allowed with safety in the approximate estimate that can now be given.

ESTIMATE OF ORE RESERVES.

FOOTWALL OREBODY (#5)

WIDTH50± FEET
Estimate 52,706 tons.
2.5% to 3.5% copper.

Estimate necessary from E. C. Lane's knowledge when ore was previously opened. This ore was at that time delineated by drifts and crosscuts for a distance of 250', but no ore stoped above 300 ft. level.

NO. 4 OREBODY

Width 17 feet to 20 feet.
Estimate 24,471 tons.
2% to 3.5% copper.

This orebody was crosscut in No. 1 Intermediate level, where it showed a width of 17' and sampled 2% as delivered to the surface. A sample of first 10' gave a result of 6% when opened. In crosscut No. 2 it showed a mixed ore of low grade. Crosscuts 3 and 4 were not carried into the ore. I believe that this same orebody was crosscut in the main 303 crosscut, where it showed a width of 12' and sampled 5.26% copper, and at 13' above this point showed a width of 15', 9' of which sampled 3% copper.

INTERMEDIATE OREBODY.

Width 25 feet
Estimate 20,206 tons
3.5% to 4.5% copper

This body of ore has been opened recently in the Intermediate stope above 303 crosscut and this is the highest grade ore of any of the footwall bodies. My last sample from the two lead sets, taken on January 29th, gave 4.99% and 4.40% copper respectively.

NO. 3 OREBODY

Width 30 feet.
Estimate 44,235 tons
2.5 to 3% copper.

It is Mr. Lane's knowledge that this orebody was cut and some ore extracted on the 200 level and the 300 level, and that it passed thru the No. 5 shaft between the 300 and 400 levels. Its further continuation between the 400 and 500 levels is mentioned in the Reber report, made during the Clark lease, as an addition to probable ore existing at that time.

Orebodies Nos. 1 and 2 that Mr. Lane worked in the past inn the vicinity of No. 1 shaft, and the extensions of which were looked for in the recent hangingwall development, cannot yet be counted on for but a moderately small tonnage adjacent to where the old work was done. (Mr. Lane estimates 7,529 tons of 2.5% to 3.5% ore.)

These orebodies are undoubtedly continuous but do not pitch downward at as much of an angle as do the orebodies nearer the footwall and the three long crosscuts that have been recently driven towards the hangingwall are undoubtedly beneath these extensions.

A resume of the approximate ore reserve as indicated is as follows:

OREBODIES	ESTIMATED TONNAGE	ESTIMATED COPPER CONTENT %
Nos. 1 & 2	7,529	2.5 to 3.5
No. 3	44,235	2.5 to 3.
Intermediate	20,206	3.5 to 4.5
No. 4	24,471	2. to 3.5
No. 5	52,706	2.5 to 3.5
TOTAL	149,147 tons @ 3.02%	

PRODUCTION POSSIBILITIES.

It is obvious that, given a certain tonnage of available ore in a mine, the larger the block that can be worked from any one place the less is the cost, and if an entire orebody can be mined as it breaks the best economy results.

However, there are many factors that control what amount of ore of an orebody can be mined, for there is a limit at which the costs will equal the recovered value and beyond such limit the operation will prove a loss. The controlling factors are the grade of the ore, the cost of mining, transportation and smelting in case the ore is shipped,and when the ore is too low grade to ship, there will be cost of mining, cost of milling and concentration of the ore plus cost of transportation and smelting of the concentrates. Besides these costs, the ratio of the concentration is as important a factor as the grade of the ore.

These numerous factors will control the grade of ore that can be worked at a profit. The cost of transportation and smelting are fixed within certain limits and cost of mining can be estimated approximately on recent costs and by past experience in the same mine. The ratio of concentration, however, is the most important factor that must be determined by a mill test and such test should be made as soon as possible for altho the ore reserve estimates show a very large tonnage of ore as approximately available there is no average ore at this time that will return a profit on shipping directly to a smelter.

A concentrating mill can take ore of and above a certain limit of value and by carrying away a large part of the ore for which the smelter does not pay will raise the value of the small tonnage of concentrates that remains, and eliminate the freight and treatment cost for the larger part of the ore.

For estimating what can be done with the ores of this mine we have certain factors at the present time as follows:

Copper quotation is approximately 13¢ per pound.

The average grade of the ore in the min is 3.02% copper.

This ore is assumed to carry 5% moisture.

The concentrates from a mill would be assumed to carry 5% moisture.

The extraction in milling should be 97%.

The production of the mine is assumed at 200 dry tons per day.

The freight rate at present is:

Swansea to Bouse	$1.20
Bouse to smelter	3.10
TOTAL	$4.30 on ore over $20. value.

The freight rate on less than $10.00 ore may be $2.72 from mine to smelter.

The treatment rate at the smelter has been $3.00 per ton, but a $2.50 per ton rate is expected.

The liquidation is on a basis of current copper quotations less 2.5 cents per pound, and a deduction of from 10 to 15 pounds per ton depending on the grade of the ore.

There are three propositions to be considered:

1st. Shipping direct.

2nd. A concentration by washing after coarse crushing and fine grinding.

3rd. Concentration by flotation after fine grinding.

Mining costs on a basis of 200 tons per day allowing for the necessary development of the orebodies is estimated at $3.50 per ton of ore mined.

Milling costs on same tonnage is estimated at 65¢ in a coarse crushing (10 mesh) and table concentration. $1.25 per ton with fine grinding and oil flotation.

PROPOSITION NO. 1.

Shipping ore direct

200 dry tons (215.3wet) Smelter pays 13¢-2.5¢ = 10.5¢

Grade of ore	Pay on	Value per ton.	Treatment	Rec'd per ton	Costs
4%	70 lbs. @ 10.5¢	$7.35	$2.50	$4.85	Mining $700.00 Freight 688.00 $1388.00 970.00 $ 418.00

Value of day output
Loss per day

Grade or ore	Pay on	Value per ton	Treat-ment	Rec'd per ton	Costs.

If freight rate was reduced to 36, 36, 2.00 or $2.72

Loss per day $316.00

5% ave.	90 lbs. @10.5¢	$9.45	$2.50	$6.95	Mining	700.00
					Freight	688.00
						$1388.00
	Value of day output					1390.00
	PROFIT PER DAY					$ 2.00

A reduction in freight rate to $2.72 would show estimated profit per day $ 105.34

6% ore at 13¢ copper gives an estimated profit of $363.00 per day.

The possibilities of the mine as a shipper depend on its ability to produce a better than 5% grade of ore of have a better than 13¢ copper market.

PROPOSITION NO. 2.

Coarse grinding (10 mesh) and table concentration.

For this estimate the ratio of concentration, and percentage of extraction must be assumed until a mill test can be made that will give approximately these factors.

(A.)

200 dry tons per day of 3% ore. Ratio of concentration 4 into 1. 97% extraction or 48.5 dry tons of 12% concentrates.

Freight to be paid on 52.63 tons of concentrates with 5% moisture.

(A.)

Grade of concentrates	Pay on	Value per ton.	Treat-ment	Rec'd per ton	Costs	
12%	225 lbs. @ 10.5¢	$23.63	$2.50	$21.13	Mining	$700.00
					Milling	130.00
					Freight	226.30
						$1056.30
	Value per day output					1024.80
	Loss per day					$ 21.50

If all the copper was saved loss would be .20¢

With copper at 13½¢ per lb. estimated profit is 355.20
With copper at 13½¢ per lb. extration 75% estimated profit is $22.83.
With copper at 14¢ per lb. estimated profit is $65.00

(B.)

200 dry tons per day of 4% ore. Ratio 4 to 1.

16%	315 lbs. @10.5¢	$33.075	$2.50	$30.575	Mining	$700.00

Costs	
Milling	$130.00
Freight	226.30
	1056.30
Value day output	1482.89
Profit per day	$ 426.59

A 3.5% ore would show an estimated profit of $172.00 per day.

The Arizona smelters will not pay for the iron content.

The iron content will run at least 70% which at 7¢ a unit would add $4.90 per ton of concentrates or $237.00 per day.

The rough concentration mill was considered particularly with the idea that the smelter would allow us something for the high content of iron as hematite that these concentrates will carry.

The Arizona smelters, however, do not need high iron content ores or concentrates, but if the Salt Lake smelters would need this iron and could pay you 7¢ per unit for iron it would probably pay the freight rate to Salt Lake, in which case the3% ore would show a profit of $200.00 per day.

PROPOSITION NO. 3.

Fine grinding and flotation. Ratio 7 to 1. Extraction 97%/

The ratio of concentration and percentage of extraction is what was done in operating the Clark mill that treated this ore in 1920. Since that date a great advance has been made in the flotation of most ores, and better results at less cost should be expected with a modern mill at this time. The milling cost exclusive of overhead was at that time $1.25 per ton of ore milled. The General Expense was $1.36, and if distributed one-half to milling would make milling charge of $1.83. This was based on 100 tons per day. On a 200 ton basis it would not have been more than $1.50 per ton and with a modern mill the cost of milling with overhead would not exceed $1.25 and should be brought down to $1.00 per ton.

200 dry tons per day of 3% ore would produce 28.57 tons of concentrates. 97% extraction would be 27.71 tons of 21% concentrates.

Freight on 28.57 tons plus 5% moisture or 30 tons.

21% concentrate or 420 lbs. less 15 lbs. would be 405 lbs. @ 10.5¢ would make a value per ton of	$42.525
Less Treatment charge	2.50
Receive per ton	$40.025

27.71 tons @ $40.025 would be a production per day of $1108.00

Costs:	Mining 200 tons @ $3.50	$700.00
	Milling 200 tons @ $1.25	250.00
	Freight on 30 tons @$4.30	129.00
	Costs per day	1079.00
	Profit per day	$ 29.00

A 3% ore with copper at 13½¢ would be a profit per day of $136.00

A 3% ore with copper at 14¢ would be a profit per day of $190.00

A 3½% ore with copper at 13¢ would be a profit per day of $236.75.

A 3½% ore with copper at 13½¢ would be a profit per day of $294.00.

Should milling costs be reduced to $1.00 per ton it would add $50 per day to the profits. A $3.00 mining cost which your Manager, Mr. Lane, believes is possible, will add $100 per day to estimated profits.

RESUME OF PRODUCTION POSSIBILITIES.

As a shipping proposition under existing freight and smelter rates, a 5% copper ore will just about break even. A reduction of freight rates on low grade ore to $2.72 would allow an estimated profit of $105 per day with copper at 13¢. A 6% ore would allow an estimated profit of $363.00.

Should you be fortunate enough to locate a number of high grade orebodies similar to the 302 orebody, the admixture of such ore should give a profitable grade of ore for shipment, but while other bodies of rich ore undoubtedly exist, their location cannot be determined by any physical conditions as yet noted, and the shipping possibilities of the property must await the accidental discovery of these high grade bodies of ore that will undoubtedly come during the exploration for the extensions of the large lower grade bodies.

The coarse grinding concentration consideration would mean the minimum investment in milling, but the ratio of concentration is not sufficiently high to show the possibility of a profit on a 3% ore due to the necessary charge for freight on the heavy iron content of the concentrate. Should, however, it be possible to raise the grade of ore milled to 4%, the estimate shows a satisfactory profit.

Should it be possible that the Salt Lake smelters would take the concentrate and pay sufficient for the iron content, the problem would undoubtedly be solved in a satisfactory manner.

With no possibility for credit on iron, but with perhaps slight reductions in freight and treatment charges and refinement in milling, which a test may show, an ore running 3½% copper will doubtless show a good profit (with present factors $172.00) and by mining the ore as clean as possible, this grade will undoubtedly be made, altho the possible ore tonnage as estimated would be considerably reduced.

The third consideration. Fine grinding and flotation.

On the average mine grade of 3%, copper estimated at 13¢ and with a tonnage of 200 dry tons per day, the operation shows a profit of but $29 per day.

A reduction in milling costs to $1.00 would add $50 to profits and a reduction in mining to $3. would mean the addition of $100 to daily profits.

By raising the grade to 3½% profit is estimated as $236.00. per day.

The difference between coarse grinding, provided mill tests can give us the 4 to 1 ratio that we have assumed, and the fine grinding plant appears to be about $60 per day, or a little more than 50¢ a ton extra saving in favor of the fine grinding mill.

The results, then, of a test run on a 3% and 3½% ore from the mine should be the determining factor in the milling consideration which it is evident will be necessary for a profitable production.

It is my opinion that the extensions of the hanging wall orebodies can be readily located in the manner that I have suggested by the deep drill hole method from the drifts and crosscuts that have recently been opened, and I anticipate that these orebodies will show a grade of ore that will, when mixed with the lower grade ore of the large footwall bodies, give a resulting grade that will make a satisfactory production with profit.

(signed) Alvin B. Carpenter, E. M.

February 1, 1928

Swansea, Arizona
January 31st, 1928.

Mr. O. M. Souden, Pres.
Clara-Swansea Mining Co.
Los Angeles, California

Dear Mr. Souden:

About the fifteenth of June, 1927, you requested me to make a report on the mine up to that date, this report was completed on June 24th. In this report I spoke of conditions of the property when we first started operations, also giving you full description of all equipment on the property at that time. About the time this report was completed we made our first discovery in the 302 ore body on the 300 ft. level. This lense produced the richest ore that has ever been found on the property, in face, double anything that has ever been shipped. If I had not mixed from about 75 tons to 100 tons of 3½ and 4% ore with this material, the average on smelter returns would have been in the neighborhood of 10%. 57 mine cars of this material, which would represent 57 tons, carefully sampled when we first encountered this lense, assayed 16%. There were three separate samples taken of each car to get this average. The width of this lense varied from 8 inches to six feet, the lense occurred in a lime fracture, there seemed to be no permanent hanging or footwall. We drifted on this lense 75 or 80 ft. north & easterly direction. We run a raise on this lense of ore on the 300 ft. level 20 feet, this seemed to be the top as near as we could determine of the lense. We stoped out from this raise in the neighborhood of 75 tons of ore.

At the end of the drift this lense pitched below us, and we found it necessary then to sink a winze about 45 ft. In sinking this winze we had about the same condition as we had in the drift, ore varying about the same width. We stoped out considerable on the south side of this winze. At the bottom of this winze the ore pitched off to the northeast, we drifted about 27' on the ore. The ore in this drift averaged from 1 to 2 ft. in width. At the end of this drift the ore pitched down and we sunk another winze about 12 ft. In this last winze that was sunk the ore pitched about 45 degrees, about the same as it was all thru the workings.

In this 13 ft. winze we took out one carload of ore that assayed 11.79%. This seemed to be the end of this lense as far as we could determine from the amount of work that we had done.

As you know yourself, Mr. Souden, sinking winzes is a very expensive method of mining. However, I think it was necessary to sink these winzes in order to determine the extent of this ore body.

After checking over the number of cars that we had shipped from this lense and the amount of money, $11,415.05, it was impossible for me to stop prospecting for this lense of ore. While you were in Europe I run a raise from the 400 ft. level to the 350 ft. level, this raise is marked on the map, 350 raise. From the top of this raise we drove a crosscut 84 feet and connected with bottom of the second winze that we sunk on the ore. This connection was made for two reasons. First, for the ventilation and to try to determine the course of this 302 lense. From this point we drove 97 feet of crosscut in northeasterly direction. We found in this work considerable bunches and stringers of high grade ore. The last 47 feet of this work we seemed to be drifting on the formation instead of crosscutting and we found throughout this 47 feet quite a few tons of very rich ore. You will see on the map on this 350 level a crosscut driven northwesterly 127 feet. The last 15' of this piece of work we were in contact between the lime and the schist, the lime making the footwall and the schist making the hanging wall. The pitch of these two walls as near as we can determine was between 12 and 15 degrees. When we first broke thru this contact we had about three or four feet of ore. The first assay taken from this ore went better than 7%. We took quite a number more of assays that averaged between 4 and 5% and up as high as 9%. /This ore continued thru this crosscut about 20 feet. This ore passed below us in the crosscut. We drifted northeast and southwest. In the northeast drift we drifted 42 ft. From all indications we passed over this lense after the first 5 or 6 feet. After this work was completed we drifted 20 feet in a southwesterly direction. At

the end of this drift the ore seemed to lay above us. About 10 feet from the end of this drift we are running a raise at the present time, but it is impossible to state what this raise will develop until we do a little more work.

You will find on the 400 ft. level 404 crosscut. This crosscut is run in southwesterly direction 335 feet. This crosscut was driven on this level to develop the 302 ore body, as well as to drive back to the hanging wall and develop other lenses of ore that should occur in this formation. At 213 feet we have driven a two compartment raise 58 feet. At 38 feet we encountered 5 or 6 feet of ledge matter, the stringers resembling the 302 ore. After passing thru this ledge formation we encountered the hanging wall which is the porphyry. We raised in this 15 feet in the hanging wall. At the 350 level in this raise we are driving a crosscut in a southeasterly direction. This crosscut was driven to make connection with the 350 level, as well as driving out to break into the contact. The course of the hanginwall is north 16 east, and I expect in the next day or two to break thru and find the ore that we encountered in the raise. I am confident we are close to this contact as the water is pouring from the left hand side at the present time. I have always contended, Mr. Souden, ever since I have opened this property, and I have had the advice of a number of very able mining engineers, as well as mining men, that when this porphyry was developed that we would find our rich lenses on the hanging wall side, which is the porphyry.

I think the ore will occur in lenses along the strike of the wall just the same as it does on the footwall side of the vein and I fully believe that drifting along this wall that we will encounter in a very short time the 302 ore body and I also think we will find other lenses of ore in doing this work. The work that has been done on the west side of the property has all been done in a workmanlike manner and I am confident if we develop along the hanging wall that all of this work will be used to a very good advantage in mining operation. I would also suggest we extend the main crosscut in the 404 about 50' further as I am confident

we will get ore on top of the porphyry. I would recommend a raise atthe end of this crosscut as I think it would be only a short distance thru the porphyry.

A short time before the property was taken over by this company, I made you a report of the ore bodies on the footwall side of the property. I also made the statement to you that most of these ore bodies had only been worked by me in my past operations of the property. About the time that my last report was written, I had just completed the intermediate level about 36' above the 300 foot level. I completed this piece of work which is in the footwall. On this intermediate level I drove a crosscut every 25'. The first crosscut I encountered about 12 feet of ore. The No. 2 crosscut was driven but a very short ways, but we did not get to the ore. The No. 3 crosscut was just driven to the ore. No. 4 was driven into the ore about 8'. This ore would assay from 3 to 4% copper. The ore at this point will be about 12' wide. No. 5 crosscut showed about 12' of ore that would average 3 to 4% and there were places in this ore that would go 6%, but it laid in lenses. No. 6 crosscut shows 25' of ore that will assay 2½ to 3½%. This work was done by me in September of last year. My intentions were when I did thispiece of work and started these crosscuts to develop a body of ore that I had worked some 16 years ago when I was foreman of this mine, and from the point that I had this ore body on 300 ft. level it was my intention when I drove this intermediate level to top slice this ore body and work down on it as I mined. In order to locate the ore that I had 16 years ago, the only record that I had in this office was an old map or tracing that had been made about 20years ago, and taking our new surveys from this map I find that after we had checked it out that it threw us out on our calculations in the neighborhood of 50' and I find that the ore I worked on intermediate was not the lense I was after when I first started the development work.

This intermediate level and workings was not money thrown away as it has developed and will develop thousands of tons of milling ore that will run from 2½ to 3½% copper.

After discovering that I had not discovered the ore body that I was after, I drove a crosscut #303, which is indicated on the map as such. This crosscut is 176 feet long. Driving this crosscut I cut thru a lense of ore on the footwall 25 feet wide. Our engineer has sampled this ore over five sets 25 feet and his assay was 4.91%. Mr. Carpenter, our consulting engineer, was on the property a few days ago. His ample across this body of ore was 5.26%, making an averaged assay of the two samples 4.08%. From the end of this crosscut I raised up in the footwall 15' and crosscut and as soon as my crosscut got thru the footwall I encountered a body of ore that has an assay value of 2.98%. This crosscut is marked on our map 303 intermediate.

From this point I crosscut 40 feet at the end of 40 feet I cut the lense of ore that I was after. I drifted on this body of ore 40 ft. At the end of this drift I crosscut thru 25 feet of ore. The first four cars that I shipped of this stope, the average assay was 3.98%. We have shipped altogether from this stope 22 cars.

On the sill floor we have worked this ore 14 sets, which will make 70 ft. inlength, some places five sets wide, and we have three floors open which will give us perpendicular thru the vein 19 feet and the width so for is 25 feet. In this orebody I have encountered a condition that I never encountered in this mine before. The ore that we had mined up to about January 23rd pitched just the opposite way from anything that I had ever encountered in the mine. Thru this large vein we encountered large pieces of ore that would run 500 or 600 pounds that would assay 6 and 7% copper. These pieces of ore were so hard that we would have to take a machine and plug them before we could break them. The only way that I can state the cause of this was from the lower grade ore that other companies mined underneath this, as well as ones that I had mined here in years gone by, which would be between this ore and the footwall, the stopes being left open and allowed to cave and this orebody being

a parallel ore body and only a short distance from the other ore body has been the cause of this ore body breaking and pitching down in just the opposite direction from which we should encounter it. The last 4 or 5 days that we worked this body of ore we found the conditions altogether different, this ore being hard and in place showing no sign of a break and the values were increasing each day as we drove ahead on the sill floor. Theaverage assay on the last day for 25 mine cars, which would be in the neighborhood of 35 tons of ore assay 4.36% copper. Our assayer took two samples fro m the face the day we stopped working, which ran 4.26% and 5.82% which makes an average of 5.04%. Mr. Carpenter's sample on the lead set was 4.97% and his assay back of lead set was 4.40%.

I am confident now that I had just entered the ore body that I stated was in the mine before I came on the property and I believe when we start extracting ore from this point again that we will be more than pleased with results, that we will get from extraction of this ore. 16 years ago I encountered this same ore body on the 200 ft. level. I elocated this ore body in a crosscut about 55 or 60 ft. from the footwall. I sunk a winze on this ore body at that time 30 ft. The ore that was taken from this winze at that time was sacked and put thru the smelter which was in operation at that time. The assay on this ore was from 5 to 7% on this level. This ore body at thislevel was about 25 feet wide.

At that time there was very little ore extracted as it was just a short while before the property was closed down. I would not say that all the ore on this 25 ft. would assay 5 to 7%, but the ore we took out of the winze showed this value. This ore is the same as we have in the intermediate stopes as the character of this ore was just the same as we are mining at the present time. I have never encountered in any lense of ore in this mine the same character of ore as this. The orebody has never been worked from the point where I am working it and intermediate stopes up to the 200 ft. level. The estimated tonnage of this ore body is 20,706 tons. I think this estimate on this ore body is very conservative as I am confident that it can be worked for quite a distance above the 200'

level.

Take this ore body at the present time with a reasonable freight rate and a smelter rate where you would get an iron credit I do not think there is a doubt but what we could make this lense of ore show a reasonable profit. Freight, as you know, is $3.10 from Bouse to smelter at the present time and the freight on our our road is .90¢. We have a smelter rate of $3.00 per ton. When you and I first started this property, I think that we both planned on the same freight rate and treatment charge that we had when we operated the property before, the freight rate from Bouse to Humboldt was at that time $1.50 on this grade of ore. We had a freight rate to Sasco of $1.65 from Bouse. We had an iron credit from $1.75 to $2.00 per ton,. With this kind of a rate there would be not a doubt in my mind but what we could ship the ore and make a profit.

In my last report to you on June 24th, 1927, I recommended to you, which I will copy in this report "that to my personal knowledge, from my past experience in this property I find that we have a very large tonnage of 2½ to 3½ ore, in my judgment it will take a good many years of mining to over exhaust this ore with reasonable tonnage say from 250 to 300 tons per day, this ore under the present price of copper, freight rate and smelting charge will not pay to ship. I have at various times made tests in a small way in wet concentration on this material and I find it works very satisfactory for wet concentration. I would recommend that we have a test of one ton of these ores made for concentration and if tests are satisfactory I would recommend construction of a 200 ton mill here on the property, sometime this fall or winter, as you know we have our own power unit for this plant, that could be operated with about the same overhead expense as we have now. I find in developing the higher grade ore bodies here in the mine that I have to handle a certain amount as well as this develop this low grade ore. This would lessen the cost of the shipping extraction, as well as the mill ore extraction, while all overhead expenses would be the same outside the labor and an additional 25 or 30%

cost on fuel oil for the mill. I think, however, it will pay to investigate and consider this matter."

Years ago when I was operating this property before I had at different times made tests on wet concentration. I have a friend, by the name of Overstrom in Los Angeles, who is the inventor of the Overstrom concentrator table. Mr. Overstron made a test of this ore for me on wet concentration and he claimed at the time it was wonderful concentrating ore as well as washing ore and the losses at 3 to 1 or 4 to 1 would be practically nothing on your tailings. Mr. Overstrom claimed at the time that it would cost per raw ton anywhere from 50 to 75¢ to concentrate this ore with the right kind of plant. Since I have operated the property this last time I made one or two panning tests and Mr. White has also made tests. The head sample was taken from the bin and showed 4.83% the weight of 86 ozs. after washing allowing a stream of water to run in the pan without any agitation beyond occasionally stirring the ore; 38% of this sample was washed over the side, leaving a concentrate which was by eight 62% of the original sample, which assayed 8.24% copper, the assay of the tailings was no per cent. This is the result of several tests, the best test being made from ore ground 10 mesh which was the mesh of the ore in above tests.

It would be impossible for me to state in this report just what the cost of your mill would be and I do not think that anyone can make a cost sheet on this until there is a test made. I am not so sure but what we could use jiggs here in a mill to very good advantage. I think that the main costs in this plant would be your power unit. We have plenty of boiler capacity already installed. We have our main generator. We have one 50 hp motor that could be used probably for crusher or mill. We have another 15 hp motor that will carry up to 20 horsepower. We have a full set of switchboards that we would need in the operation of this plant. We also have 150 hp. Hamilton Corlis steam compound engine that would have to be installed. The cost of installing this engine and generator and getting equipment ready to run would be from $1,000 to $1,5000. We also have, I think, all the tanks we would

need for the mill which is quite an item. We also have a large Blake crusher. We have quite a lot of pulleys and line shafting that could be used to advantage in this mill. There is one or two mill sites that could be used. Of course this could be gone into if we decide to put up plant at later date.

I have had our engineer make a map showing location of ore bodies that I know of here in the mine, showing the gross tonnage of each individual ore body, also showing the assay value. I have been very conservative in estimating the tonnage in these different lenses and as far as the values of these different lenses, I think, that, I am competent to make the statement of their assay value, as I have worked into these ore bodies from a number of places in the mine, both on the 145 ft. level, 200 ft. level, 300 ft. level, as well as the 350 level.

Between the 200 ft. level and the 145 ft. level on my last operation here at the property I encountered what I called a cross fault. This fault or facture is about 30' wide. One end of this fault was worked under my direction and called the glory hole stope here in the mine. This fault will be on the ore map. The ore that I shipped from this place I think you will remember was 4% copper.

All the main tramming drifts from #7 shaft that connects with the raises to 350 ft. level as well as the 300 ft. level have all been done as I stated before in this report and have been passed on by the State Mine Inspector and other mining men as being first class in every respect and this work will stand for a long time without any repair work. Our raises, ore and waste shutes are in excellent repair and all of this that has been done in these main tramming drifts can be used for the extraction of all mill ores.

I have indicated on the ore map assay value and gross tonnage and approximate width. I have also outlined on this map proposed work to develop this ore in order to show a tonnage for mill. I will start with the 200 ft. level from #2 shaft, by opening this drift it will give direct ventilation into the stopes from the 200 ft. level and all mine timbers will be handled from that level for the stopes below. This drift is caved in and will have to be mucked out and

retimbered. When this drift is cleaned out and retimbered 125' we enter your #5 ore body. From that distance on to 301 raise you will parallel this #5 ore body, which is 103 feet. This will give you an opening of 4 stopes into the ore body from that point. From the top of 301 raise we will drive a crosscut 60 feet. This crosscut will pass thru #5 ore body and penetrate intermediate ore body, the one that we are working at the present time. The 301 raise will have to be extended from intermediate level up to 200 ft. level. From the top of 300 foot raise on the 300 foot level you will find on the map proposed work of a drift running for #3 ore body of 145 feet. At the end of this drift we crosscut into the ore probably 25 or 30 feet. We will be able to open up quite a number of stopes later on from this piece of work.

At the top of 350 foot raise you will find proposed work of 100 feet. This will open up one or two ore bodies. This piece of work will not be in my estimate, as we will not need it, until the ore is worked out from above.

I think after reading this report you will find that I have gone into everything in detail. I know that you are acquainted with all of the work that has been done on the property up to the present time. We may be questioned why this ore has not been opened up in the last development work. There is two or three reasons, first, as I stated in my last report, in order to handle these ores we would have to have a mill and at the present price of copper, freight rates and handling charges it would be impossible to handle them with any profit.

In this report to you I have been very conservative in all my estimates, the cost of putting the property in shape and getting the property developed up to a point for a mill will cost about $15,000.00.

The work that has been done on the property under my management since I first entered the property has all been done with the intention of getting a high grade ore to ship and I believe with

Yuma Co gmc

SWANSEA MINE

District: Swansea, Arizona

Owners: Swansea Lease, Inc. Chas. Clark and associates

Date Visited: November 4, 1918, by J. L. White.

Notes: (This should rather be entitled "Impressions of the Swansea Mine" since White was only on the ground a few hours and made a hurried inspection of the open workings with B. F. Grant, Supt.)

Country rock; gneiss capped with limestone. The ore occurs on or near the contact which at this point has a dip of about 45°, the hanging wall being lime, the footwall gneiss. Near the contact in the hanging wall there occurs a certain amount of chloritic schist. Lenses of hematite carrying chalcopyrite occur at the contact or near it in the hanging wall.

The hanging wall itself is very bad as is the iron and neither can be held open even for a drift without great expense in timbering. At about 60' the hanging wall gets good and drifts will stand without timbering. The footwall is good on the whole and requires very little timbering.

The ore bodies are either large, very irregular shaped lenses, or clusters of small irregular shaped lenses. The maximum widths are about 40' and the ore or ore condition has been found for lengths of 500'. Ore has been found continuous for depths of 500'. Different ore bodies have been found for several thousand feet.

Seven shafts in all have been sunk and at present three are open. Only one, No. 7, the newest, is in good condition and all operations are conducted thru it.

At present the 400and 500' levels are being worked and practically everything above the 400 level is in bodies that have already been mined. Apparently it was formerly the practice to crosscut blindly into this ground from the footwall side and where ore was encountered to start a stope, timbering very closely with square sets. This stope was continued as long as possible until timbers failed and the stope was lost. Then it was in order to crosscut again and if ore was found start a stope. Sometimes these crosscuts ran into mined out sections and no ore was found. In other cases the old

caved stopes were entered where the ore had filled them completely. When this occurred they were mined successfully. This was a very extravagant method of mining, as a very large percentage of ore was not recovered. It was cheap however, as a large amount of ore was obtained without timbering after the cave and at times no timbering was attempted.

About 8 months ago a system of mining was installed that has great promise if it is given a fair trial. Raises were driven in the footwall and at 16' vertical intervals crosscuts were to be started for the ore and a sill mined and timbered for the full width of the ore and each side for about 50', which is probably the safe limit. When the sill is cut the ore above is mined, retreating to the crosscut without timbering the sill sets are seven feet high. The sill timbering forms a matt for the slices below. The top cut is mined first, of course. This scheme has been tried on the 400 level in caved ground, where it did not have a fair chance. 10 raises in the footwall on the 500 level E. are projected. The ground below 400 is new and has never been mined. The footwall crosscuts on the level have exposed ore in five places. In two places sills have been started and in one of them ore is being stoped above the level also. This is where the ore is coming from at present and it is going to ruin more or less the ground above, as it is only a question of time when the stope will cave and loosen the hanging wall for the mining of slices above in the future.

The system of mining with footwall raises looks good and when once installed will probably allow a big production. If the ore bodies are more or less continuous I believe it could be modified to do away with most of the timbering in the ore, that is, by putting in the raises at 50' intervals and caving in to staggered crosscuts.

RE: SWANSEA

Note by G. M. C. May '28.

The Swansea Mine is now owned by the Clara Swansea Co., a Nevada Corporation with authorized Capital:- Preferred stock 1,000,000 shares @ $1.00 par--7% cumulative. All this stock has been issued to pay for mining property and A. & S. Railway.

Common Stock, 2,000,000 shares at $1.00 par, of which 1,600,000 has been issued at from 25¢ to 60¢ per share.

In Treasury. 400,000 shares of common stock and cash, $75,000. (NOTE:) It is provided that when and if the earnings permit 7% dividends on both preferred and common stock additional dividends shall be shared equally between them)

Stock is largely held in France, but company is controlled by O. M. Souden, 1003 Great Republic Life Bldg., Los Angeles.

The developed ore reserves in the Swansea Mine are too low in grade to be treated with profit (in my opinion) except thru erection and operation of a flotation mill which will cost $100,000 after which a profit of $1.00 per ton might be made on the developed ore--total $150,000, assuming a copper price of 18¢ per lb. There is also needed a fund of at least $25,000 for additional exploration and probably $25,000 to put mining plant and railway in good condition.

If new company could absorb Clara Swansea, it might issue at rate 1 share of stock (par $1.00) for each share of Preferred and Common Stock outstanding and pay in stock at 50¢ for stock in the Treasury.

gmc

SWANSEA MINE

NOTE BY G. M. COLVOCORESSES, NOVEMBER, 1937

This well known mine has been operated intermittently since 1909. A great many reports have been made of which I no longerhave copies and which would have little value at present, but the general conditions are pretty well covered by those reports of which copies are enclosed.

In 1910 or 1911 a smelter was erected and operated for something over a year when the company was put in bankruptcy but later leased by the Trustee under authority from the Court.

From late 1914 to 1920 I purchased and smelted at Humboldt some 200,000 tons of ore from this mine which averaged around 3% copper. There was almost no gold or silver, but the high iron content made it valuable as a basic flux.

A good profit was realized during the war and in 1917 the company was discharged from bankruptcy and a new ten year lease was given to the late C. W. Clark (son of Senator Clark)

Clark built a 400 ton flotation mill but discouraged by the low price of copper only operated to a small extent and in the summer of 1920 my company (Consolidated Arizona) purchased his lease and equipment.

Consolidated Arizona and its successor, the Southwest Metals Co., developed a substantial quantity of 4% and 5% ore and mined up to 1924 close to 150,000 tons with good profit but by that time we had worked out the high grade shoot, which appeared to bottom above the 700' level and anticipating no further profit from the large reserve of 3% ore which was left in the mine we gave up our lease and removed the mill.

A subsequent attempt was made to operate by the Swansea Co. but proved unsuccessful and in 1927 a new company, the Clara Swansea, took over the mine and leased the mine to E. C. Lane (their former Supt.) who released it to Howard Fields and through him to the A. S. & R. in 1929.

The A. S. & R. erected a new mill and mining plant but only

worked for a short time in 1930 before the falling price of copper forced them to discontinue.

Operations were not resumed until early 1937 when the mine and mill were active until July or August. I understand that their production averaged about 35% copper but costs were high and they lost money and according to Lane they have now given up all of their interest in this property and Lane is again the lessee, and has become the owner of the very excellent mining and milling equipment.

Lane is now seeking to obtain financial assistance which will permit him to start up again and tells me that he has found a new body of high grade ore but the extent of same has not been determined.

There is undoubtedly a large body of 3% copper ore remaining in the Swansea Mine and small shootsof higher grade material are frequently encountered, but in my judgment it will always be, as it has always been, a high cost producer and I greatly doubt if the cost of production will be less than 12-13¢ per lb. of copper over any long period of time.

I have not personally visited the underground workings for several years, but from reliable information obtained from a competent engineer who was entirely familiar with the mine until August of this year I find no reason to change this opinion.

I do not think that the underground conditions have changed since Carpenter and Lane made their reports (of which copies are enclosed) in '27 and since Lane made the "ore map" in '28.

Lane is a competent and experienced miner and he knows the Swansea Mine far better than any one else, but he has always been an optimist and in the past several of the ore bodies which he had sampled proved very disappointing when check-sampled by my engineers or when mined and sent to the mill.

COPY

SWANSEA MINE - Colvocoresses Report Jan. 18, 1943

In compliance with request of your officials I have revisited the Swansea Mine in order to go over the property with Mr. Lane and to refresh my memory concerning former operations and familiarize myself with recent work and present conditions. I beg to submit the following report which is partly based upon information recently obtained but mostly upon my personal knowledge of the mine and its operations from December 1913, when I first visited the property, until the Swansea Lease Inc., whose operations I directed, discontinued its activities in 1924.

PROPERTY AND LOCATION:

The present holdings of the Clara-Swansea Co. on which you now hold the lease comprise 61 unpatented claims (lode) about 1220 acres, situated at Swansea, which lies 20 mi. north of Bouse, Yuma County, Ariz. A very good road 26 mi. connects the mine with Bouse, which is on the Parker branch of the AT&SFRy.

Elev. is about 1400 ft. and this country is rocky and rugged with extremely scant desert vegetation and no large timber. The climate is very hot in summer and very dry at all times of the year, the mean annual rainfall being about 7". Water for both domestic and industrial purposes is obtained from a pumping plant located on the Bill Williams river some four miles distant, with which it is connected by a 6" pipe line, in good condition. The company owns both pumping plant and pipe line, as well as all necessary water rights so that an adequate supply of excellent water is assured.

All supplies must be brought to the mine from Bouse to which point the outgoing ore or concentrates must be trucked, current rate being $1.25 ton.

Living conditions are exceptionally good and with minor repairs could accommodate 200 men. There are also a well constructed office and laboratory with complete equipment. Reference to power plant and mining and milling machinery will be made elsewhere in this report.

GEOLOGY AND ORE OCCURRENCE:

Country rock is coarse-grained, light colored granite gneiss of igneous origin with considerable chlorite and epidote. More compact phases of the rock resemble quartzsite or quartz porphry with nearly flat soldstosity striking to northeast and dipping 10 to 20 deg. to northwest. In certain sections, particularly west of the outcrops, the gneiss is capped by dark brown limestone, also some light colored siliceous rock which appears to be a quartzsite and of sedimentary origin. West of the mine and south of the office there is a chloritic-arphobilite schist conformable to the limestone and further west and north the formation is cut by dierite which probably occurs as intrusive dikes and along the contact of which quartz veins have been formed.

Above the granite gneiss and dierite, which are of pre-Cambrian age, is found a series of shaly limestone upon which rests a flow of andesite with fragments of other rocks and volcanic ash and tuff, all of which are of comparatively recent origin, probably of Tertiary age.

The ore deposits are replacements in the limestone containing much hematite--partly crystallized as specularite--also chalcopyrite. Below the limestone overlies the gneiss (footwall of ore body) and is often intimately associated with the amphibolite schist. Large bodies of hematite usually form the hanging wall of the copper ore with schist and/or lime lying directly above them. The strike of the ore bearing zone is north 55 deg east and the dip is to the northwest, about 45 deg. Two major north-south faults have been noted and several minor ones and the ore deposit lies in one or more faulted blocks of country rock this being essentially irregular replacements of limestone by specularite and chalcopyrite.

The ore body pitches in the zone to the northeast and the lateral width of pay ore is from 10 to 40 ft. varying in accordance with the amount of replacement in the country rock. Lenses or shoots of ore have so far been developed at intervals throughout a length of over 2500 ft., the longest single shoot having a length of over 500 ft. on the 600 ft. level of the mine.

The origin of the primary ore, consisting of pyrite and chalcopyrite, has not been fully established. By some geologists it has been attributed to solutions resulting from the gradual alteration of the iron and copper minerals which normally occur in diabase dikes and associated basic igneous rocks and after these minerals had been deposited as replacements in the limestone at high temperature and pressure a subsequent alteration liberated sulphuric acid which converted the iron sulphide to oxide, or--when the action affected the limestone--to soluble sulphates, crystals of which are found scattered throughout the deposit. This condition is similar to that which may be observed at the Planet Mine and elsewhere in the district where in all similar cases the ore is closely associated with the amphibolitic and chloritic rocks in which a certain percentage of copper normally occurs, but since the copper at Swansea is all in the form of sulphide, it must be assumed that oxidation did not affect the copper to a similar extent, or more probably, that the copper represented a different and later deposition than the iron.

HISTORY AND PRODUCTION:

According to available information ores in this district were discovered probably during the 1870's and a little desultory development was done by J. W. Johnson and others prior to 1908, when several holding companies were combined by the Clara-Consol. Gold & Copper Mng. Co., including the Signal, Clara Gold & Copper, Crown Princess and Crown Queen Mng. Co. thus bringing under one ownership the Signal, Morro and Clara Groups aggregating about 200 unpatented mining claims. Stocks and bonds of this Company were largely sold in France, Belgium and Holland.

Active mining and development was then started on a substantial basis and a railroad was constructed 22 mi. from Swansea to the AT&SFRy at Bouse. Water was pumped 4 mi. from a newly constructed pumping plant on the Bill Williams River and a 600-ton smelter (2nd hand) was purchased and erected with blast furnace and converting plant.

In 1910 there were 6 shafts all on or near the Copper Prince Claim and extensive development was in progress but regular production does not appear to have begun until after March of 1911.

The management at this time was both extravagant and inefficient and the price of copper was low. The Clara Co. failed in May 1912, and to avoid bankruptcy its assets and stock were then acquired by the Swansea Consol. Co. which continued active operations but an operating loss was consistently sustained and the Swansea Co. was put in bankruptcy in November 1913, with O. M. Souden as Trustee. The smelter was never operated subsequent to that date, prior to which about 40,000 tons of ore had been mined, mostly under the direction of Ernest C. Lane as mine foreman and mine superintendent. Souden leased the mine to Judge Thomas in 1914 and shipments to Humboldt and other smelters were begun around the first of 1915 and were continued from that time forward for several years. The above mentioned lease to Thomas expired in Oct. 1916, prior to which date Judge Thomas had died and O. M. Souden operated the property as trustee and E. C. Lane as Manager. These operations were very profitable and served greatly to reduce the indebtedness of the bankrupt co.

From the shipments made from 1914 to 1918 the Humboldt Smelter alone received over 80,000 tons of ore containing about 5,000,000 lbs. of copper.

On May 12, 1917, the property was again leased, this time for a period of 10 years to the Swansea Lease Inc. which organization was financed and controlled by Chas. W. Clark, who advanced about $120,000 to pay off the remaining debts of the Swansea Consol. Co., in order to permit it to be released from bankruptcy. Clark continued to actively operate the mine and put down a new vertical shaft (known as #7) and also, after thoroughly testing the ore, he erected a 300 ton flotation mill and began concentrating the ore in 1919 during which year the Humboldt Smelter received 3341 tons of ore and 118 tons of concentrates containing altogether 155,566 lbs. of copper. Shipments of ore were also made to the United Verde smelter at Clarkdale, Saco, etc. plants.

During the early part of 1920 the low price of copper resulted in somewhat reduced activity and in July of that year Clark sold the Swansea Lease to the Consol. Copper Ariz. Smelting Co., of which I was then Manager and which owned and operated the Humboldt Smelter which received during the latter part of 1920, 3330 tons of ore and 2738 tons of concentrates containing altogether 1,697,004 lbs. of copper.

During all of 1921 and the first few months of 1922 the copper smelters of Arizona were closed and no shipments were made from Swansea but development work was continued in the mine and mill was revamped.

Active mining was resumed before the middle of 1922 by which time the Southwest Metals Co., of which I was also Manager, had succeeded the Consol. Ariz. Smltng Co., and from that time forward a large percentage of the ore was sent to the mill which regularly treated 7000-8000 tons of ore per month making a recovery of 96 to 98%. This procedure continued to the middle of 1923 when the Southwest Metals Co., having failed in its efforts to secure a renewal of the lease (for which it offered to pay a bonus of $100,000) discontinued all exploration and development work and after cleaning out the best of the ore in the main shoot between the 500 and 700 ft. levels relinquished the lease and turned the mine back to the owners in the early part of 1924. At that time the higher grade ore which was then available for mining had been exhausted and with copper selling at about 12¢ a lb. it would not have paid to mine and mill the lower grade material which only averaged about 3.0 to 3.5% copper. Of this last mentioned ore about 30,000 tons was known to exist in the upper workings of the mine and a somewhat smaller tonnage of similar material had also been left between the 4th and 7th levels.

The Swansea Consol. Co. was reorganized in 1926 as the Clara-Swansea Co., and work was resumed at that time under the direction of Mr. Lane who made some shipments and later took a new lease in which the American S. & R. Co. became interested. This Company promptly made a large investment for a new mill, power plant, camp buildings and equipment, all of which were utilized for a short time in 1930, until the depression and exceedingly low price of copper forced a shut-down which continued until 1937 when mining and milling were resumed but soon discontinued when the price of copper again declined. The A. S. & R. then decided to relinquish their interest in the existing lease which was subsequently renewed on a more favorable basis in favor of your company which under the management of Mr. Lane has recently resumed developments and shipments of high grade ore mined on a small scale from the upper levels.

A complete record of production is not in my possession but the following is believed to be approximately correct:

Clara & Swansea Co. - 1911-14	40,000
Thomas Lease and Souden operation 1915-17	160,000
Swansea Lease Inc (Clark) 1917-30	100,000
Swansea Lease Inc (Consol. Ariz. and South.)	200,000
Clara Swansea Co. 1927-28	10,000
Am. S. & R. Co. - 1930	20,000
Am. S. & R. Co. 1937	20,000
TOTAL (about)	550,000

The average grade of this ore, excluding some low grade material from the old dumps, was close to 4% copper. The heart of the main ore body between the 500 and 660 ft. levels, as mined by the Swansea Lease Inc. averaged a little over 5% and ore shipped to Humboldt from 1915 to 1930 averaged about 3.5%--a somewhat better grade may have gone to the other smelters. The ore mined and milled by the A. S. & R. is reported to have averaged just about 3.5%. The gold and silver contents in all of the Swansea ore is negligible.

REMAINING ORE RESERVES:

At the time when my company took over the Swansea Lease (1920) there were many blocks of ore left in the upper portion of the mine, some of which were no longer accessible but most of which had been seen by me or my engineers on the occasion of numerous visits we made to the property subsequent to 1913. In 1923 the ore in the open workings above the 400 ft. level was measured and sampled by my engineers and the estimate was 80,000 tons averaging a little below 3.5% copper. Some of this ore was probably mined in 1930 and 1937 by the A. S. & R. The estimate did not include the remaining portions of several ore bodies which branched off into the hanging wall but to which cross cuts had caved in the heavy ground that lay along the footwall of the ore zone. With all this section of the mine, Mr. Lane who actually did the previous mining, is most familiar and his estimates and statements, which in my opinion are most reliable, indicate that much of this ore could probably be recovered with profit.

When mining the main ore body from the 400 to 700 ft. levels, the management of the Swansea Lease left a large quantity of lower grade material in place and also a substantial quantity of ore was lost since most of it was won by the top slicing method of mining which we found to be somewhat cheaper than the square set system

that had been formerly employed. No accurate estimate of the tonnage or grade of this material was attempted but it was believed that we left behind some 60,000-70,000 tons that would average better than 3% copper. In view of the subsequent caving and present resultant conditions of these workings, I do not think that any future attempt to recover this ore between the 500 and 700 ft. levels would be justified--unless an exceptional high price for copper should exist.

This main ore body pinched out above the 7th level where the hanging wall of iron and lime closed in on the footwall gneiss and I believe that this shoot was bottomed but on the 600 ft. level there was a stringer or narrow vein of high grade ore with quartz which was followed for some distance to the north-east and swinging to the north and we felt that this might well lead to another shoot lying further along the contact or in the hanging wall of the ore zone. Further exploration in this direction was discontinued when we were unable to make satisfactory arrangements for renewal of the lease.

METALLURGY:

The great excess of iron in the Swansea ore makes it most unsuitable for direct smelting unless it can be mixed with a similar tonnage of highly siliceous ore to form a self-fluxing mixture. This fact was responsible for the failure of smelting operations at Swansea but at Humboldt excellent smelting costs and results were obtained by mixing in the furnace charge a suitable proportion of siliceous Blue Bell ore.

However, the Swansea ore is ideal for flotation concentration and our recovery of copper was consistently in excess of 96%, while the concentrates were almost pure chalcopyrite and carried 25 to 28% copper. The milling cost averages slightly over $1.00 a ton. Even better results should be obtained today with modern flotation practice and reagents.

EXPLORATION:

For the future exploration of the mine and the search for new ore bodies in the hanging wall and also in depth below the 700 ft. level one might either lay out a comprehensive program of churn drilling with say 40 holes to be drilled to a depth of 1000 ft. located at the corners of 100 ft. coordinates; or a new shaft could be sunk at a point which Mr. Lane and I agree should be almost directly above the end of our 700 ft. drift. From this shaft cross cuts and drifts could be run out to explore the locations at which it seemed most likely that ore shoots would be found.

Since the drilling, if successful, would in any event call for the new shaft and drifts to the ore shoots it would probably be more economically to sink the shaft as soon as the drills had proved up pay ore in sufficient quantity to justify such a procedure but since, at the present time, there is no positive assurance that such ore bodies actually exist and no definite clue to their location I believe it would be more prudent to start the exploration campaign by doing a certain amount of drilling which could always be suspended at any time that either the positive or negative results appeared to be conclusive.

The cost of drilling, if carried out by itself, would probably be in the order of $3.00 a ft. but if this work should be done in conjunction with regular mining operations the figure might be reduced to perhaps $2.50.

There is, I believe, every reasonable ground for expecting that new ore bodies will be found in the unexplored sections of the property and also that some of these will have a substantially higher value than the average of the ore which is known or believed to remain above the 500 ft. level and thus serve to permit a reduction in the cost of producing copper and to increase the profits beyond present justifiable expectations. The completion of such a program will necessarily involve a further outlay of from $100,000 to $150,000; and the future course of the copper market will very obviously influence the return that will accrue from such an investment.

GENERAL CONSIDERATIONS AND FUTURE OUTLOOK:

The present condition of the Swansea Mine is largely a reflection of its past history in which two factors are outstanding--namely the frequent changes in the operating management and the tremendous variations in the market price of copper during the past 30 years. The second condition has affected all copper mines but more particularly those which like the Swansea, must be classed as comparatively high cost producers.

The character and the size of the Swansea ore shoots, their lenticular shape, dip and rake in the ore zone, long underground haulage and the very heavy character of the ore and portions of the hanging wall have all combined to make mining costs relatively high, while expensive transportation, water supply and operating the steam power plant have disproportionately added to the cost of producing copper. Treatment of the ore in a local concentrator since 1920 effected a substantial economy as compared to a direct shipment to a smelter--the installation of diesel or hydro-electric power should serve to reduce the power cost from 3¢ to 1¢ a kw hour.

The nature of the Swansea ore bodies is such that even when the mine was working to capacity and under most favorable market conditions no substantial ore reserve has ever been blocked out in advance nor is this likely to happen in the future unless a very thorough campaign of drilling should be carried through to a finish.

However, a large quantity of the 3.5% ore in which the A. S. & R. were working in 1937 will certainly be available and portions of the high grade stopes on the 400 and 450 ft. levels in which Lane mined prior to 1918, can be made accessible by reopening these old workings and through a comparatively small amount of new development. A further continuation of the last mentioned ore shoots into the hanging wall country seems likely but the tonnage and grade which they will produce, can only be estimated from past experiences.

I think that it may be reasonably assumed that the mining and milling of 4% ore with new and efficient equipment can be conducted with an operating profit of $3 a ton while the present bonus price of 17¢ prevails; and therefore the production and treatment of 50,000 tons of ore on this grade, should serve to repay the preliminary outlay of $150,000.

The chances that such a tonnage will be found on or above the 500 ft. level of said mine appear to be excellent; and on that basis I recommend the said expenditure and the above outlined program.

(End of Colvocoresses Report)

Data taken from other reports, etc.:

Carpenter: #11 drill hole showed 35 ft. 4.75% copper.
Concentration by washing, 10-15% copper, 75% iron.
In 1938 estimated 149,147 tons 3.02% copper ore, above 400 ft. level.
Extraction - 97%.
Obtaining an iron content of 70%, at 7¢ a unit, would add $4.90 per ton of concentrates.

Chris Thompson: 1933: "Geologists believe ore body extends mile or more, north of present workings." Ore body near railroad track about 100 ft. wide x about 300 ft. deep, 50 deg incline; and ore body about 600 ft. under surface.

E. G. Lane: Recommends new shaft about 2000 ft. north of present #7 shaft.

Colvocoresses: Must believe water in mine (now, 1949) up to 200 ft. level) as recommends 200 gpm sump pump.