



CONTACT INFORMATION
Mining Records Curator
Arizona Geological Survey
3550 N. Central Ave, 2nd floor
Phoenix, AZ, 85012
602-771-1601
<http://www.azgs.az.gov>
inquiries@azgs.az.gov

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Jim -

over-



GAYLOR ENTERPRISES

6742-D Calle La Paz
Tucson, Arizona 85715

James E. Gaylor, Pres.
June E. Thiele, V-Pres.

Phone: (602) 886-9663

GEOLOGY DEPARTMENT

December 14, 1987

Gentlemen: Re: Offer of Copper Mining Claims

I am offering my 45 copper mining claims for sale. There is a good showing of silver and traces of gold on these 900 acres. They are in the prime copper mining area of Arizona that produced *in 1925* 74% of United States copper for \$1,300,000,000.00. Gold and silver are by-products of such mining; 3,900,000 ounces of silver and 52,000 ounces of gold.

These claims are ideally situated for mining; just two miles from the Gila River with the highway and railroad on my side of the river. Also, just two miles to the Kennecott open pit at Ray (now owned by ASARCO). See "Kennecott" sheet attached. My claims include the old Alice Mine workings and the half-mile long Pratt Tunnel (1902 to 1907). High grade carbonate ore was mined from the Alice mine running from 8% to 16% copper and some gold. Work was discontinued because of a 31% drop in the price of copper at that time. They could not process sulfide ore at the turn of the century so the 200 feet of 2% sulfide ore in the Pratt tunnel was too "low grade" for them to consider at that time. Today it is considered "high grade" ore by anybody's standards.

The only two drill holes on the 900 acres went through 200 feet of trace copper and silver. The holes did not hit the targeted ore body; however, the good mineralization in the holes indicated that we were close to the ore body.

Enclosed is a report by F. L. Croteau, Ltd. In addition to this report I have a safe full of reports, maps, charts, and other such data at my home that can be examined at our mutual convenience.

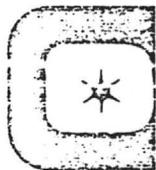
The *depletion of the* U.S. National Defense stockpile of copper, the new scientific requirements for copper, to say nothing of the population explosion, has doubled the price of copper in the last few months. The demand and price of copper can only go up from now on.

If interested in this property you and your geologist will be shown every courtesy. However, no lengthy free option for drilling will be given. These claims are firmed up legally and filed with the Bureau of Land Management. I am the sole owner of these unpatented claims. I am asking \$2,250,000, with \$50,000 at the time of signing of the contract, with the balance negotiable.

Very sincerely yours,

James E. Gaylor
James E. Gaylor, President

JEG/jet



PRELIMINARY GEOLOGICAL REPORT
on
"TROY" CLAIM GROUP
PINAL COUNTY, ARIZONA

F.L. Croteau

February 15, 1971

F. L. CROTEAU LTD.

PRELIMINARY GEOLOGICAL REPORT

on

"TROY" CLAIM GROUP

PINAL COUNTY, ARIZONA

by

F.L. Croteau, B.Sc.
P.Eng. P.Geol.

Vancouver, B.C.
February 15, 1971

INTRODUCTION

Acting under instruction from Mr. J. Abrams of Shawnex Mines Ltd. (N.P.L.) of Calgary, Alberta, I have carried out a reconnaissance geological survey of certain mining claims, commonly known as the "Troy" group, located approximately 60 miles northerly from Tuscon, Arizona. The prime purpose of the examination was to ascertain geological conditions, check location of the older workings, examine the area from an accessibility standpoint and to recommend, if advisable, a future program of operations. The area was visited on February 4 and 5, 1971. Messrs. Abrams and J. Gaylor were present during examination of the property. Weather conditions were satisfactory for field examination.

LOCATION

The claim group is located in the Riverside Mining District in Pinal County in the State of Arizona. Paved roads extend to within 10 miles of the property (Highways 80 and 77) after which a winding, variable elevation trail continues to the claim group. A four-wheel drive vehicle is advisable over the latter portion of the trail. The nearest town where nominal supplies can be obtained is Winkelman. Mining and major supplies would be secured from Tuscon or Phoenix. Good airline services are available at Tucson.

There are no power lines in the immediate vicinity of the property but adequate power is available in the general area and

would necessitate connections less than 10 miles in length.

There are indications of minor springs and some water seepage from former mine workings but any substantial demand for water would have to be met from the Gila River, a distance of approximately 3 miles from the claims.

CLAIMS

original

*Now approx
56 claims
45*

The "Troy" group consists of 14 unpatented lode mining claims, the location notices of which are recorded in the office of the County Recorder of Pinal County, Arizona, in the Book and at the Pages of "Record of Mines" set opposite their respective names as follows:

<u>Name of Claim</u>	<u>Book Number</u>	<u>Page</u>
Alice #1	52	331
Alice #2	52	322
Alice #3	52	322
Alice #4	52	327
Alice #5	52	327
Alice #6	52	327
Alice Annex	52	328
Alto	52	328
Burro	52	329
Johnny Boy	52	329
Pratt Spring	52	329
Skyline	52	330
White Tail Deer	52	330
Gaylor		

31 additional claims have been added to this group

All claims are contiguous and are staked in accordance with the laws and regulations governing Mineral Rights in the State of Arizona.

ACREAGE

There are 280 acres, more or less, included in the 14 claim block.

TITLE

The claims are currently held by Shawnex Mines Ltd. and associates under an option agreement with Mr. James E. Gaylor. Mr. Gaylor is the owner of, subject only to the paramount title of the United States of America, those certain fourteen (14) unpatented lode mining claims ^{Now A TOTAL OF 45 CLAIMS} described in the above section under title of "Claims". The claims are held under the laws and regulations governing Mineral Rights in the State of Arizona.

HISTORY

Historical records indicate that mining activity in the "Troy" area commenced sometime prior to 1900 but the first recorded information shows in the "Copper Handbook", Volume 2, dated 1902. Between this latter period and 1925 considerable mining was carried out in the area. There were numerous company changes and various mining engineers and mining personnel reported on activities that took place on the "Troy" and adjoining claim groups.

A number of shafts, adits, winzes and underground workings were developed on the various properties, none of which are fully accessible today. However records show that a considerable amount of copper oxide ore was removed from the area.

It would appear that finances and widely varying demand and pricing for copper created an unstable media for mining in the area. Transportation and lack of nearby smelting facilities ^{in 1902} were also adverse factors.

Comments made through various mining reports indicate that various engineers were conscious of the possibility of copper sulphide ore at depth in the area. This assumption has been proven to be a correct one in various nearby mining operations in southern Arizona.

TOPOGRAPHY

The general claim area can be described as rugged but is not mountainous. The general elevation of the country increases when one proceeds westward from Highway 77 and leads into an area known locally as the Dripping Spring Mountains. Elevations in the area reach a maximum of 4800 feet but on the claim group are closer to a maximum of 3600 feet above mean sea level.

The area is quite arid and there is little or no tree growth on the claims. Fault action has created a number of sharply

incised valleys and canyons. There are a few springs in existence in the claim area but a main water source would have to be obtained from the Gila River, a distance of three miles westward from the subject property.

Present access to the property is from an easterly direction over a winding road with variable but not severe grades. It would appear that a much shorter route with more equitable grades would be possible.

There is a limited soil cover in the claim area and a general strip mining operation would not necessitate a high stripping ratio to reach rock surfaces.

AREAL GEOLOGY

The general area under consideration has been one where most developments of ore have originated as carbonate replacement bodies in the limestone and ultimately these have given way to potential sulphide ore bodies in the deeper seated intrusive bodies.

The general geology is represented by a predominantly sedimentary series of rocks which are underlain by rocks of an intrusive nature. Locally there may be some reversal or juxtaposition of the above sequence due to faulting and other structural causes.

Sedimentary rocks in evidence were quartzite, limestone, phyllitic schist and conglomerate. Intrusives present were diabase, dacite porphyry and granite which ranged to altered granodiorite in composition. The porphyry and diabase occur from reasonable sized dykes to more broad intrusions (diabase) in form. Brecciation is not an uncommon characteristic of the rock formations.

There is considerable evidence of alteration both in the sediments and in the intrusives and can be attributed to the metamorphic and hydrothermal action associated with the intrusive rock formations. The most important alteration effect, associated with the development of ore bodies, is the lime-silicate alteration sequence.

STRUCTURAL GEOLOGY

The main copper bearing areas of Arizona have been subjected to considerable faulting and fissuring which originated from broad tectonic movements and from the more local intrusions of igneous rock. The faults and fissures thus created have proven to be excellent sources for ore deposition within the sedimentary rock sequence. The intrusive diabase and porphyry bodies were the likely carriers of primary sulphide material from the main igneous mass and should act as focal points for copper ore concentration.

The "Troy" area shows pronounced faulting to occur in a northeast-southwest trending direction and this together with the

resultant fissuring has proved to be the locus for the ore bodies, that occurred in the "Alice" mine. A pronounced north-southerly fault occurs in the more westerly portion of the claim block and creates a sharp demarkation line between the limestone and quartzite bodies and gives definite indication that the quartzite body to the west formed the up-thrown side of the fault.

CLAIM GEOLOGY

A reasonable portion of the claim block is exposed as rock outcrop and a fair idea can be secured of rock sequence and some of the structural controls. The main area of previous exploration and mining was centred around the "Alice" shaft which is located in the north-easterly corner of the Alice No. 2 claim. Later, in an effort to reach the "Alice" orebody at greater depth, an adit known as the "Pratt" tunnel was driven from a point in the east central portion of Alice No. 1. (These locations can be more readily seen on the accompanying maps.)

The presently known ore body lies along and may well have been associated with the NE-SW trending "Climax" fault.

Previous geological work reported from the "Alice" mine workings and the "Pratt" tunnel indicate a descending series comprised as follows:

Martin Limestone (Devonian)
Troy Quartzite (Cambrian)
Diabase Sill (Mesozoic)
Troy Quartzite (Cambrian)

with the entire above series intruded intermittently and irregularly by Quartz Monzonite Porphyry (possibly of Tertiary age) occurring both fairly massively and as definite dykes.

Ore in the "Alice" shaft occurred along and adjoining a contact zone between the Martin Limestone and a prominent Quartz Monzonite Porphyry dyke. A fault zone was the apparent locus for the Quartz Monzonite Porphyry intrusion.

The sedimentary formations are well developed and readily distinguishable. The limestone is a dark grey, fossiliferous formation, massive in nature and thus readily subject to fracture. The quartzite is a dense, clean silica type and shows a well developed conglomerate base. Specimens of intrusive material seen on the "Pratt" tunnel dump were relatively fresh in appearance while surface outcrop specimens showed marked weathering effects.

A local zone approximating a phyllitic schist occurs on surface at the approximate position where the vertically upward extension of the "Pratt" tunnel would intersect the main N-S fault separating the limestone and quartzite bodies. This may be an occurrence of Pinal Schist (Pre Cambrian).

ECONOMIC GEOLOGY

There is no record of the mining activity or production that may have taken place in the Troy area previous to 1900. Records show that mining was actively in progress in 1900 and that a vein 3.0 to 11.0 feet wide was being mined from a 400 foot shaft with a number of supporting levels. Grade of copper was 12 per cent and 3000 tons of ore were reported stockpiled at the "Alice" mine. In 1901 production was reported at 120,000 pounds of copper secured from a 500 ton shipment of ore. Similar production averaging in the 8.0 to 16.0 per cent copper range carried on intermittently until about 1922.

It was apparent in the early 1920's that unstable copper prices and the likelihood that the oxide ore in the "Alice" workings may have been decreasing in volume and grade. The latter assumption is made on the basis of a 1917 newspaper report which stated "The Alice shaft is down 400 feet and passed through 50 feet of 4.0 per cent sulphide ore, too low grade to be handled profitably at the time it was opened. This ore will be developed through what is known as the Pratt tunnel".

Other mines in the area known as the Buckeye, Manhattan, and Rattler were productive but to what extent is unknown to the writer.

Ore mined from the area was essentially copper oxide and little or no effort was made to mine or to advance exploration of sulphide bodies. Conversation with technical personnel has indicated that oxide bodies vary widely in size and that when any accumulation occurs the general area should be closely examined for deeper seated or repeat bodies that may be quite extensive in nature. It has also been proven in Arizona that oxide bodies commonly give way to primary sulphide bodies which form the majority of the "porphyry copper" bodies of that state.

The subject claim block occurs near the boundary between Pinal and Gila counties and some generalized descriptions of ore occurrences in those areas is as follows:

1. Vein deposit with some replacement ore in limestone.
Underground.
2. Chalcocite blanket in schist and chalcopyrite in diabase.
Open Pit.
3. Disseminated in granite and monzonite porphyry.
Underground.
4. Disseminated in quartz monzonite. Open cut.
5. Vein deposit with some supergene enrichment. Under-
ground.

6. Limestone replacement deposits. Underground.

Understandingly grades vary over a considerable range and in general enrichment is associated with the main fault and fissure areas of the formation.

CONCLUSIONS

1. The subject area has a record of production from oxide ore bodies and old reports indicate that primary sulphides were encountered during extraction of the oxide ores.
2. Structural conditions on the property are favourable for the accumulation of ore bodies.
3. The broad sedimentary cover on the property has been subject to fault activity and to substantial igneous intrusion.
4. The igneous intrusives are essentially diabase, which appears to occur as a sill or flatly bedded deposit, and Quartz Monzonite Porphyry which occurs as small masses and more particularly as dykes ranging from a few feet thickness to around 200 feet.
5. Ore occurrences appear to be a function of fault action. The fault areas having opened the channels along which igneous intrusion took place carrying the copper sulphide.

into areas where ultimate near surface oxidation took place.

6. As a consequence of Item 5 the main areas of exploratory concentration should be those embracing faults and intrusive rock formation.
7. Recorded information shows that minor copper oxide occurrences will commonly lead to major bodies both in the horizontal and vertical planes, and that oxidation is not merely a near surface phenomenon.
8. The substantiation of primary sulphide bodies on the claim group is a feature that requires deep seated geophysical techniques.
9. No useful purpose would be served through conducting a geochemical survey.
10. Sufficient water for diamond drill purposes should be available due to a limited seepage from the Pratt tunnel.
11. No useful purpose would presently be served by any attempt to rehabilitate the "Alice" shaft or the "Pratt" tunnel.
12. Old maps indicate that there may be linkage between the former "Alice" mine workings and the "Pratt" tunnel.

This would appear from maps and conversation with local individuals to be a rambling type of decline as opposed to a standard winze. This must be classed as conjecture since no formal record exists.

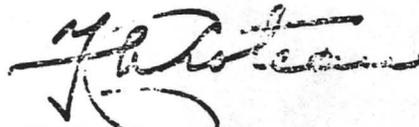
RECOMMENDATIONS

1. A program embracing 10 line miles of Induced Potential geophysical surveying which would explore to a 1000 foot vertical depth should be carried out to establish the primary sulphide potential of the property.
2. Regardless of any negative results that may be obtained from the above geophysical survey it will be necessary to carry out a diamond drilling program that would approximate 2000 feet and cover 4 holes of 500 foot depth. This must be done to adequately test for possible copper oxide bodies since they will not respond to geophysical methods.
3. Check the current status of all corner and location monuments.
4. Some road improvements are necessary and will become more so when moving in a diamond drill.
5. Should geophysical survey indications be favourable an immediate investigation should be made in regard to further land acquisition.

The approximate cost to carry out the above recom-
tations would be as follows:

Geophysical survey 10 miles @ \$400 per mile	\$ 4,000
Diamond Drilling 2000 feet @ \$10 per foot	\$20,000
Road improvement	\$ 2,000
Assay, sampling, etc.	\$ 500
Transportation and camp maintenance	\$ 3,000
Engineering and supervision	\$ 2,500
	<hr/>
	\$32,000

Respectfully submitted,



F.L. Croteau, B.Sc.
P.Eng. P.Geol.

Vancouver, B.C.
February 15, 1971

CERTIFICATE

I, F.L. Croteau, of 1055 West Hastings Street, Vancouver, in the Province of British Columbia, certify that:

1. I am a graduate of the University of Saskatchewan and hold the degree of B.Sc. in Mining Geology. Year of graduation was 1936.
2. I am a Registered Professional Engineer in the Province of British Columbia and in the Yukon Territory, a Registered Professional Geologist in the Province of Alberta and hold a licence to practise Professional Engineering in the Province of Saskatchewan.
3. I have practised my profession in Canada, the United States, Mexico and the West Indies since 1936.
4. That the claims are properly staked under the Mining Regulations of the State of Arizona.
5. I have no interest direct or indirect in the lands or securities of Shawnex Mines Ltd. (N.P.L.)
6. That the material in this report is based on personal inspection of the claims, perusal of numerous reports and maps and personal discussion with technical personnel at the University of Arizona.

Respectfully submitted,



F.L. Croteau, B.Sc.
P.Eng. P.Geol.

Vancouver, B.C.
February 15, 1971

ESM
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Kennedy

30 So. Main St.
P. O. Box 1389

JACOBS ASSAY OFFICE

Phone 2-0813

REGISTERED ASSAYERS

DUPLICATE

Certificate No. 53452 Tucson, Arizona, April 4th, 1958

Sample Submitted by Mr. Universal Paper Corp

SERIAL	SAMPLE MARKED	GOLD Ozs. per ton ore	GOLD Value per ton ore	SILVER Ozs. per ton ore	COPPER Per cent Wet Assay	LEAD Per cent Wet Assay	Percent Wet Assay
156231	0		\$		304		
32	1				212		
33	2				201		
34	3				242		
35	4				046		
36	5				147		
37	6				500		
38	7				514		
39	8				570		
40	9				473		
41	11				018		
42	2				020		
43	3				044		
44	4				21.25		
45	5				754		
46	6				745		
47	7				341		

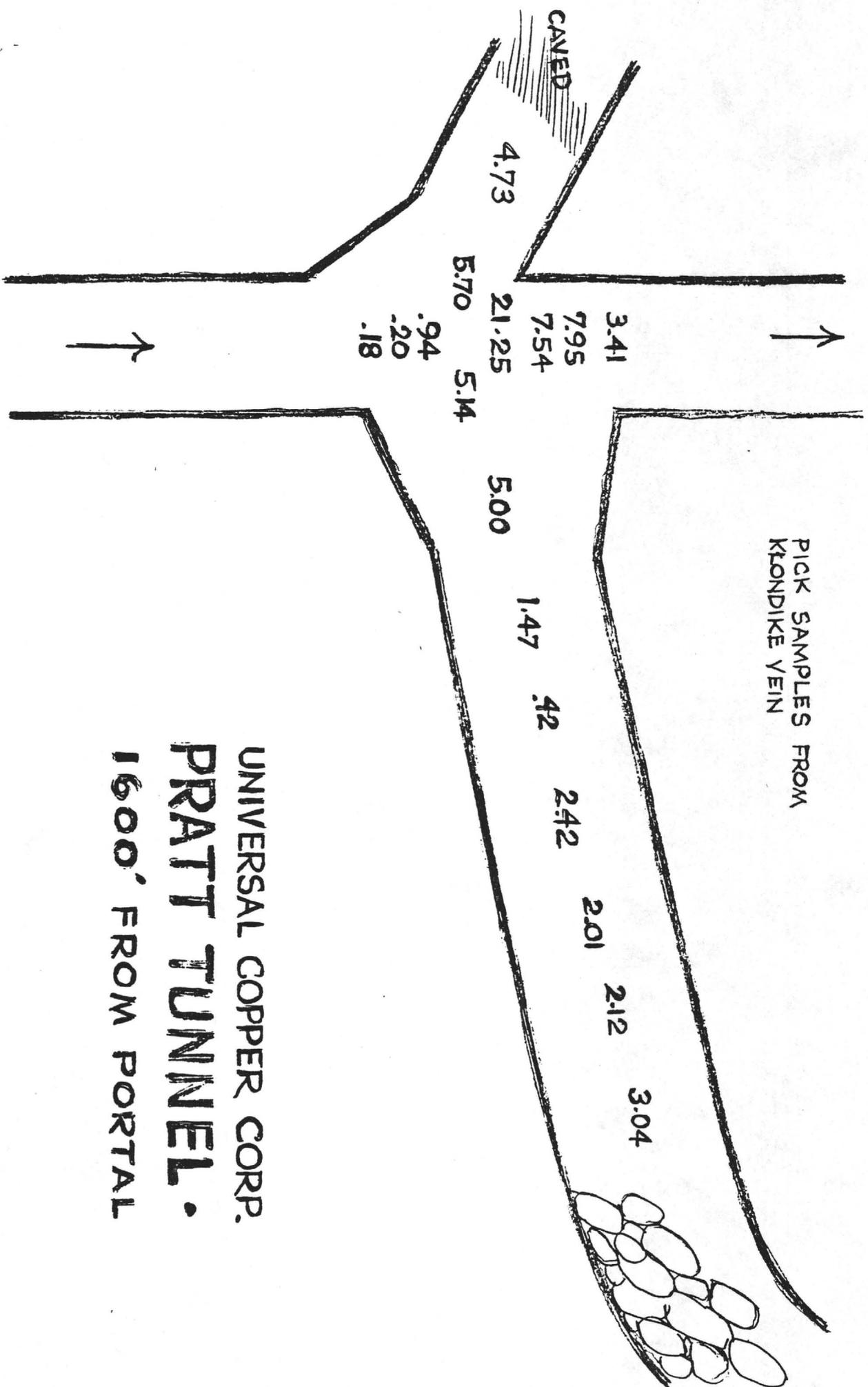
* Gold Figured \$35.00 per oz. Troy

Charges \$ 25.50

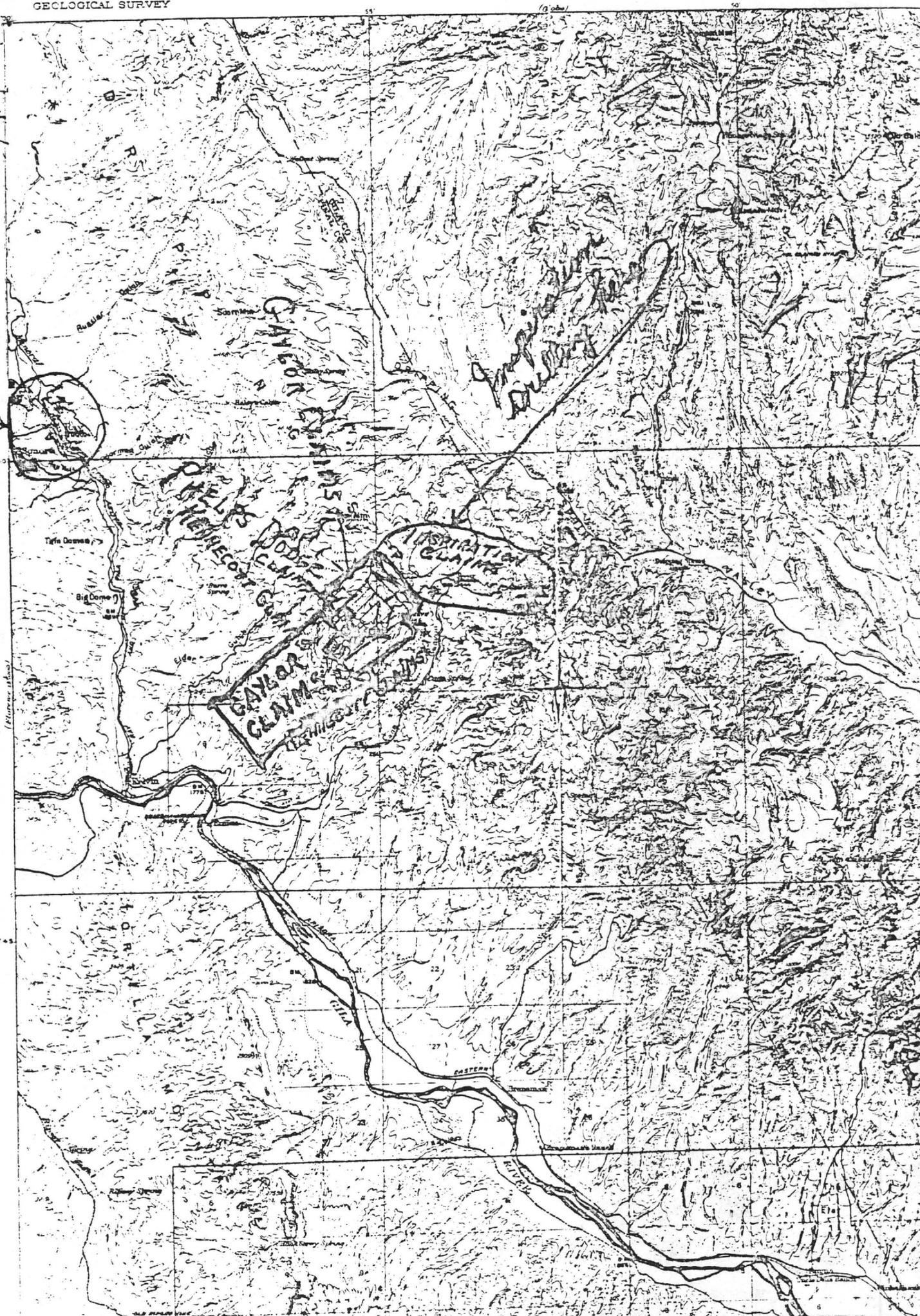
Very respectfully,

Ben P. Jacobs

This would be # ⁵⁰⁰ ~~420~~ ore in 1989



UNIVERSAL COPPER CORP.
PRATT TUNNEL.
 1600' FROM PORTAL



Kommatt open Pit

Dear Mr. Ryan, here is data re Wall St Journal ad on copper property you called about.

UNIVERSAL COPPER COMPANY

5613 E. MABEL
TUCSON, ARIZONA

James E. Gaylor
PHONE: 792-0877
298-5516

JAMES E. GAYLOR, PRESIDENT

Geology Department

Gentlemen: RE: Sale of Copper Property

Enclosed are a geology map (compiled by Dr. Willard C. Lacy of the University of Arizona at Tucson), assays, and a report on 85 claims which include my 14 claims that I am offering for sale or royalty.

The Troy Copper Co. (an eastern stock company), between 1900 and approx. 1912 had grouped 85 copper claims forming a 4-mile long oval extending NE and SW. My 14 claims are on the extreme SW end; referred to in the report as the "West Group". Inspiration Copper Co. recently spent a number of months doing geophysical work and drilling on their property north of and contiguous to my 14 claims and around the old townsite of Troy. No drilling has been done on my claims. My claims consist of the old Alice Mine workings and the 2,200-foot long Pratt Tunnel which shows on Dr. Lacy's map.

At the turn of the century this was perhaps the largest copper mining operation in Arizona. According to the old reports the richest copper ore was taken from the Alice Mine. In those early days the miners only worked the carbonate ores because they were unable to process sulphide ores. Therefore, all of the sulphide ores remain untouched. Ore that was under 7% copper was too low to mine profitably in those days. The old reports indicate that 50,000 tons of high grade carbonate ore was mined from the Alice Mine in 1902 running from 8% to 16% copper for an average of 12%. Since the Alice Mine workings (4 levels) and the Pratt Tunnel are caved-in, this property is offered simply as a raw prospect. The surface area is extremely broken and difficult to geologize. I believe that a modest amount of drilling will prove enough copper ore to justify expansion. Because the property is unproven at the moment as to whether it will or will not support a sizeable mining operation--underground or open pit--I believe it would be better for both parties to agree to an equitable royalty. The property is free and unencumbered and I will give a reasonable exploration and drilling option to any substantial company who will contract to perform the various phases of development within reasonable time limitations.

Dr. Lacy stated to me that there might be between 1,000,000 and 2,000,000 tons of "high-grade copper ore" in and near the Alice Mine. If this averaged 5% copper at current prices it would approximate \$100,000,000 worth of copper. I doubt whether any other mine in Arizona--large or small--started with a better looking base. Yet, invariably, nearly all of the big mines in Arizona have continued to expand their reserves from year to year.

In addition to such potential high-grade copper ore, the Pratt Tunnel cuts through over 200 feet of low grade copper ore. Also, for your easier evaluation, here are some quotes from the enclosed report and from the "Copper Handbooks" at the U. of A. Library pertaining to my property:

"A map compiled by the writer (Mead circa 1904) several years ago when the ore body was exposed, is a geological section of the ore exposure of the shaft of the third and fourth levels (Alice workings). The ore exposed at that time was high grade and assayed from 6 to 12% copper. The Alice Shaft went down on the Alice Vein. It was 3 feet wide at the top and had widened out to 11 feet at the bottom of the shaft at 350-foot depth."

Vol. III of Copper Handbook, 1903 states, "Vein is 3' to 11' in width and gaining in width at bottom of Alice Shaft. Smelter returns for 1902 gave an average of 10% copper. 200 feet of drifting east from the Pratt Tunnel should hit the Alice Vein about 150 feet lower than the bottom of the Alice Shaft."

John C. Devine said in the old report, "The work done on the east side of the Alice Shaft on the lowest level cut a porphyry fault running somewhat across the general trend of formations and it is this fault that produced some very high grade ore and appeared to be making downward with increasing strength. It would require driving the Pratt Tunnel five or six hundred feet east in order to cut this ore, and considering the pitch of the ore body, a stoping backing of about 400 feet would result from this development." This fault was probably the south end of the Climax Fault mentioned in next paragraph.

Devine further reports with reference to the Climax Fault: "The prominent features of this fault are its strength and regularity, traceable on its surface as it is for a distance of more than 2,000 feet. Copper values are to be seen along the fault at several points where surface work has been done." I walked the length of this fault with a geologist and picked up a lump of chrysocolla copper ore from the surface that assayed 36% copper.

The 1905 Copper Handbook (Vol. V) states, "The Buckeye winze is said to show a 25-foot vein of malachite, giving smelter returns of 6 to 10% copper." My claims run right up to the edge of the Buckeye dump. The Pratt Tunnel could be extended to reach this copper ore.

These old reports and maps have proven fairly accurate as far as I have been able to tell. Any minor discrepancies appear to be personal differences by the 4 men reporting rather than any intention to deceive. John Devine (now deceased) had an outstanding reputation among mining men in his time according to my investigations. If you consider the enormous fluctuations in copper prices in those years (a drop of 31% in 1902, for example) you can understand why copper mining operations might have stopped in this relatively remote area and in later years new mines were opened in easy-to-get-to places. Today, however, the economics of mining this property are excellent. It is only 2-1/2 miles at a raise of approx. 1,000 feet from the railroad, excellent highway, and the Gila River to the adit of the Pratt Tunnel. This road could easily be built today, whereas, in the old days such road building was not even considered. This property lends itself well to block-caving, or it could be open pitted if enough copper ore were blocked out to justify it. This is the best copper ore in the world to process as it is very high in silica. The silica in places runs as high as 95%. There is a trace of gold and silver in the ore. In some places the gold should be a worthwhile by-product. Another extremely valuable factor is the fact that this copper property is within spitting distance of 7 copper smelters and only a half hour by rail to the new copper refinery that Newmont is planning to build at San Manuel (Magma Copper). This property is in the very heart of Arizona's "Copper Porkchop".

The way the faults and beds are making nearly straight down into the earth they could very well go down for a mile as the ore did at the Magma mine at Superior, nearby. After nearly 50 years, Magma at Superior is still taking out extremely high-grade copper ore from a depth of 5,000 feet. When they started down on a vein they didn't look as good as the Alice Mine looks today. Yet they have sold over a billion dollars' worth of copper.

Several firms attempted to reach the Alice bodies during World Wars I and II but gave up when they ran out of money and the copper price took a sharp drop. The Government engineers thought enough of this property to give an R.F.C. loan during World War II, but the first ore body was never reached.

This mine can be put into operation quickly and profitably. Some of the ore blocking could be done by drifting on high grade ore. There would be no need to block all the ore before starting to mine. Millions of dollars' worth of ore could go right out the Pratt Tunnel while the over-all blocking program was being carried out. Another tunnel could be driven later to the bottom of the ore simply by starting further down the mountainside, which will be closer to the Gila River, the railroad, and the highway. Ore can be removed from the side of the mountain by a stripping operation. Large tonnage may be blocked out by relatively inexpensive tunnel drilling and drifting.

Because President Johnson virtually depleted nearly all of our copper stockpile, any military emergency could put this country into an extremely critical short position on copper, despite expected production increases in the immediate future. As our population explodes, the demand for copper increases.

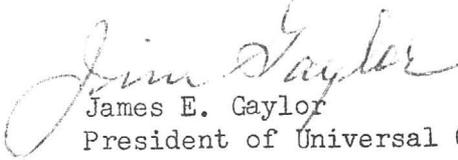
Copper ore bodies are almost impossible to find in Arizona any more. Numerous companies have had top-notch geologists and engineers working for years and spending hundreds of thousands of dollars on drilling (mostly in the most unlikely places) only to finally pack up their tents and silently steal away. They would have been miles ahead if they hadn't been so independent and had put their time and effort on a property that had such a proven copper history as the Alice Mine and surrounding claims and the Climax Fault.

Furthermore Russia is working overtime to place Communist regimes in copper-producing countries in Africa and South America, as well as building the world's largest submarine fleet to cut off American imports. In future years the United States won't be able to produce one-half as much copper as she consumes, because our mines will be petering out rapidly because of the huge tonnages of ore being milled daily. Here in Arizona some of our open pit copper mines are hauling out over 50,000 tons of ore per day, to get from 10 to 15 pounds of copper per ton of ore. As Unions force mining, milling, and smelting costs up, much of the "reserve" ore here that is marginal now will become unworkable and will remain waste rock forever. So when certain mining companies claim they have reserves for a certain number of years, they are not reckoning with over-population, inflation, and the "Unthinkable War".

This property is perhaps the only one in Arizona where a relatively small investment might result in a billion-dollar bonanza, and where you could start producing quickly enough to cash in on the current shortage of copper and record high price.

If interested in making a copper mine or pit out of this property, please have a geologist evaluate it for you as soon as possible. I will show him the property and assist him in every way I can. I can also show him additional maps, data, etc. This proposition will remain open until all parties have made preliminary examinations and made their respective proposals. I am seeking a fair and equitable proposition from a good company. No promoters will be included.

Very sincerely yours,


James E. Gaylor

President of Universal Copper Co.

30 So. Main St.
P. O. Box 1889

JACOBS ASSAY OFFICE

Phone 2-0813

REGISTERED ASSAYERS

DUPLICATE

Certificate No. 53432 Tucson, Arizona, April 4th, 1958

Sample Submitted by Mr. Universal Paper Corp

SERIAL	SAMPLE MARKED	GOLD Ozs. per ton ore	GOLD Value per ton ore	SILVER Ozs. per ton ore	COPPER Per cent Wet Assay	LEAD Per cent Wet Assay	Percent Wet Assay
156231	0		\$		304		
32	1				212		
33	2				201		
34	3				242		
35	4				046		
36	5				147		
37	6				500		
38	7				514		
39	8				570		
40	9				473		
41	11				018		
42	2				020		
43	3				044		
44	4				2125		
45	5				734		
46	6				745		
47	7				341		

* Gold Figured \$35.00 per oz. Troy

Charges \$ 25.50

Very respectfully,
Ben P. Jacobs



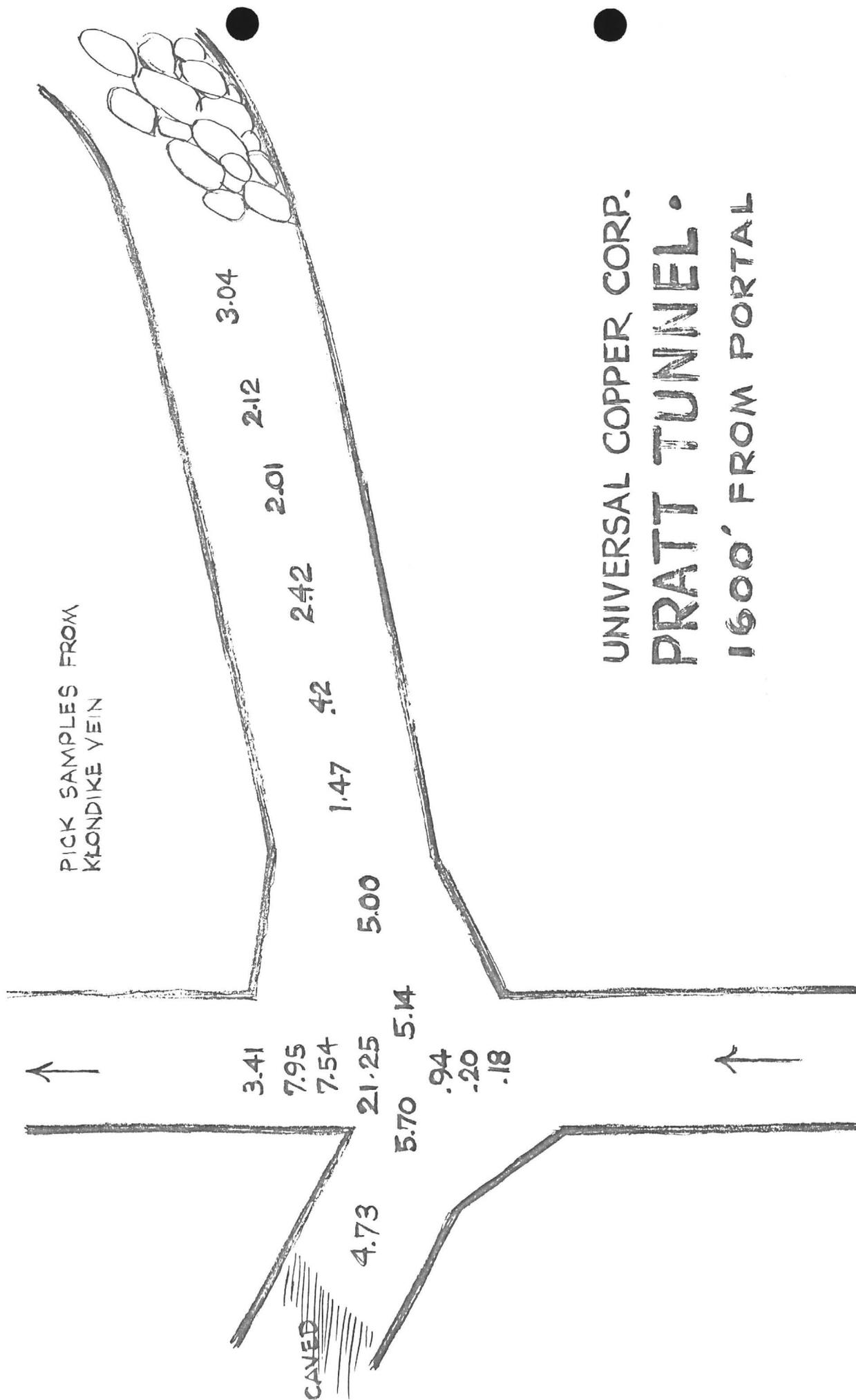
SECTION THROUGH ALICE MINE

SECTION ALONG PRATT TUNNEL

GEOLOGY OF ALICE MINE AREA

COMPILED BY: V.C. LACY 9-7-66

SCALE: 1" = 200'



PICK SAMPLES FROM
KLONDIKE VEIN

CAVED

UNIVERSAL COPPER CORP.
PRATT TUNNEL.
1600' FROM PORTAL

3.41
7.95
7.54
21.25
5.14
5.70

3.04

2.12

2.01

2.42

.42

1.47

5.00

4.73

.94
.20
.18

TROY-ARIZONA COPPER COMPANY

ENGINEERS

The following well known engineers have been employed to examine the property:

LEO VON ROSENBERG

Mr. Von Rosenberg was on the property at various times from 1912 to 1916, studying its geology, securing and adding desirable claims and sinking test shafts.

ROY G. MEAD

Mr. Mead was employed from 1912 to 1916 by the Department of the Interior as Mineral Examiner of the General Land Office. This work took him all over California and Arizona and enabled him to study the geology and various classes of mining and development work in these states. He has passed upon the holdings of many of the important companies operating in Arizona and has done much work in the mineral belt in which Troy is located.

G. G. WALD

At the time Mr. Wald made his examination of the property he was in the employ, as engineer, of the Ray Consolidated Copper Company located about five and one half miles from Troy, and consequently thoroughly understood this territory.

JOHN C. DEVINE

Mr. Devine was employed by the Ray Consolidated Copper Company for a period of ten years. About 1916, at which time he was Assistant Superintendent at the Ray Mines, he voluntarily resigned and has given his personal attention to our property. He has done a large amount of shaft and tunnel work at the mine and consequently is the best informed man about the underground conditions there.

EXTRACTS FROM ENGINEERS' REPORTS

GEOLOGY

LEO VON ROSENBERG:

"The geology of the area in which the property of the Troy-Arizona Copper Company is situated, is more or less complex. Briefly stated, the rocks of the locality are granite, granodiorite, diabase, porphyry, limestone, quartzite, schist and conglomerates. The diabase, granite, granodiorite and the porphyry, occur as intrusions. The porphyry occurs mainly in the form of a very strong and persistent dikes, cutting through the granite, diabase, etc. Very probably the diabase was the first intrusion into the sedimentary rocks (sandstone, limestone, etc.,) when they were still in the horizontal position. The intrusion of the diabase was followed by the intrusion of the granite rocks, which caused the displacement of the diabase and further tilting of the sedimentary rocks. Then occurred the intrusion of the porphyry, followed by the ore deposition. It might be stated that the intrusions of the porphyry are closely related to the ore deposition although the diabase may also have been a mineralizing agency. At various times the whole area was subject to much faulting and shattering.

The porphyry dykes are from a few to fifty feet in thickness, and in some cases are much thicker. They have a general northeasterly and southwesterly strike; in the eastern portion of the property, they assume a more easterly and westerly course. The dip of most of the dykes is rather steep. The ore occurs along the fault fissures in the granite and diabase (usually along or near the porphyry dykes) and also in the fractures of the sedimentary rocks, and along the bedding planes of the same. The mineralogical character of the ore is virtually the same as that of the ores produced in the various mines at Globe, Cananea, Clifton, etc.

The ores consist of carbonates of copper and of the various copper and iron oxides and sulphides. The predominating gangue is quartz. Generally stated, the ore bodies carrying oxides occur mainly on the contact of the different sedimentary rocks, also on the contact of the sedimentary rocks and porphyry and diabase.

The sulphide ores will be found mainly in veins occurring in granite rocks, and in the porphyry and diabase. However, secondary copper ores may also be found in the veins associated with the intrusive rocks, especially in the upper portions of these veins."

GEOLOGY: East Group of Claims

ROY G. MEAD:

"Briefly stated, the geological formation underlying the group in question, consists of a basal granite exposed over the northern and eastern part, which is overlain in the south by sedimentary series consisting of quartzite and limestone which is traversed in an easterly direction by diabase and porphyry dikes. There has been considerable faulting and displacement of the sedimentary beds, which renders the geological structure more or less complex. However, the pronounced faulting offers a very favorable condition for ore deposition.

Two mineralizing dikes traverse the area in an easterly direction; one a diabase dike averaging one hundred feet in width, lying between the granite and limestone; the other a porphyry dyke averaging two hundred feet in width, lying between the quartzite on the south and the limestone on the north, along which is exposed the Rattler vein. The porphyry dyke caused a faulting of the sedimentary beds, resulting in a drop or displacement of several hundred feet on the north side, and the present position of the limestone which is apparently below and underlying the quartzite.

The porphyry dyke, in my opinion, the source of the mineralization in the limestone designated as the Queen vein, as well as the source of the mineralization in the Rattler vein. Owing to the fact that the limestone is a soluble rock, it offered a favorable condition for the deposition of copper and iron from the mineralized solutions coming from the porphyry dyke, and there resulted there from the Queen vein. As the mineralization extended upward from the dyke, it follows that it became weaker the farther it got from the porphyry dyke, consequently, the richer ore bodies are to be expected near the dyke, which fact is being proven by the work now being carried on in the Rattler workings; the deeper work now showing an ore with a higher copper content and less magnetite than the ores found nearer the surface. While large bodies of secondary sulphide ore are to be expected in the limestone beds, the future of the property as a steady producer of copper, depends upon the development of the primary sulphide ores which will no doubt be found below the limestone in the Rattler vein and in the porphyry dyke. In view of the extensive body of secondary ores in the limestone, the source of which is from the porphyry dyke, there is every reason to believe that the primary ores will be very extensive and of a commercial grade.

The diabase dyke lying between the limestone and the granite is of later origin than the porphyry dyke, and no doubt was intruded after the faulting of the sedimentary rocks. This dyke has had very little mineralizing effect upon the adjacent limestone. The dyke is, however, very much altered near the surface, showing indications of being mineralized below the surface, and it is quite probable that if explored with depth that it will be found to contain primary ores. The old Sisson shaft was sunk on the contact of the diabase and limestone, and it is reported that low grade sulphide ores were encountered in the bottom of the shaft."

GEOLOGY: West Group of Claims.

ROY G. MEAD:

"The geologic formation underlying the area embraced by the west end group is more or less complex owing to extensive faulting and displacement, caused by the numerous

eruptive dykes which traverse the area. Briefly stated, the formation consists of a basal granite and diabase overlain by a sedimentary series consisting of quartzite, limestone, schist and conglomerate. The diabase occurred in the form in intrusions, and displaced the sedimentary beds. After the intrusion of the diabase the formation was subjected to movement and displacement by faults followed by later intrusions of porphyry in the form of strong persistent dykes cutting the granite, diabase and sedimentary beds. The ore disposition followed the intrusion of the porphyry dykes and its source is traceable to the primary mineralization which came up with the porphyry dykes.

There are no less than twelve porphyry dikes traversing the group, all of which have had an important bearing on the mineralization of the area and with exploration at depth will be found to contain primary copper sulphides in sufficient quantity to be commercial ore under the present modern methods of mining and ore reduction.

The dikes vary from fifty to one hundred feet in width, and in many cases are considerably wider. They are, with few exceptions, nearly vertical and traverse the property in a general northeasterly and southwesterly direction. The secondary surface ore bodies occur along the contact of the porphyry and limestone, and are known as contact ore bodies when occurring near the porphyry dikes, and replacements ore bodies when occurring in the limestone.

The surface showings and conditions on the property are quite similar to those on some of the principal copper mines of Arizona, such as Magma Mine, Old Dominion and Copper Queen, where rich surface carbonate ores were found in limestone and other sedimentary rocks, the source of which was traceable to primary sulphide ores occurring at depth in porphyry and diabase dikes."

GEOLOGY:

G. G. WALD:

"The country rocks are quartzite, limestone, diabase, porphyry and granite. The overlying sedimentary formations have been shattered, faulted and tilted by the intrusion of the porphyry and later of the diabase. These eruptive rocks were intruded, in places, into the bedding places of the sedimentaries, and also followed up planes of weakness developed at angles to the bedding planes. These fissures and dikes strike generally in the northeast to southwest direction. There is one marked exception to this general rule, the Climax fault, N 10 degrees E, and dips 60-65 degrees to the NW, cutting the numerous NE-SW faults at angles varying from 45 to 60 degrees. The Climax fault is a strong fissure; on the Climax No. 3 a width of 30 feet between well defined walls was measured. Just north of here the fault swings around into the northwest and widens out. The space between the walls is filled with crushed drag from the quartzite and lime beds it cuts, and both porphyry and diabase have been intruded into the fault. On the surface it is strongly iron stained, and at many places it shows stains and stringers of copper carbonate. At the point at which the shaft is located, the fault material is especially leached and koalinized; further to the north the outcrop is more siliceous.

The fissures and faulting of the sedimentary formations by the intrusion of the igneous rocks has created an ideal condition for the deposition of minerals from mineral bearing solutions. The values consist of carbonates and silicates of copper, and chalcopryrite and chalcocite, the sulphides of copper. As far as developed, this mineralization has been found to consist of replacement ore bodies in the sedimentary beds adjacent to faults of intrusive dikes and of contact ore bodies between igneous rocks or between an igneous rock and the sedimentary deposits. The ores were deposited from vapors and mineral bearing water accompanying and emanating from the igneous intrusions. In this section the porphyry and diabase are both mineral carriers and mineralizing agents. Note the Magma mine, where the ore body is associated with porphyry dike intruded into a fault fissure cutting the sedimentary beds. The diabase is not as favorable for ore deposition, but at Globe and Ray, sulphide and oxide ores have been found in the diabase, usually as a contact.

Development to date, has disclosed several mineralized areas almost exclusively on the NE-SW veins and faults. The Buckeye, Alice and Rattler-Sisson workings are examples of this ore occurrence. Although considerable ore was shipped and smelted, the ore bodies were of low grade and of limited extent.

Pratt Tunnel; On the Pratt tunnel dump, a pure crystalline quartzite, with disseminated values in chalcocite, was found. The tunnel is now inaccessible, and no assay maps are available, at the mine. The map shows that two beds of the brecciated quartzite were cross-cut near the end of the tunnel; the first, 30 feet wide, was drifted on for 120 feet, and the second, 260 feet wide, was drifted on for 80 feet. It is reported that this quartzite ran 2% copper; and the fact that the drifts were driven on the quartzite, and at no other part of the tunnel, indicates that encouraging values were encountered. However, at that time ore of 2% copper content had no commercial value. This quartzite ore could be cheaply milled, and as it will have a high ratio of concentration, would be pay ore today, if a sufficient tonnage was developed. A sample taken of this quartzite on the surface of the dump ran trace copper; a second, taken below the surface, where values had been concentrated by surface waters since the rock was mined, ran 5.1% copper. These samples merely show that there is copper in the quartzite. If the old assay maps or data are extant and show the copper values reported, it would pay to open up the Pratt tunnel, as there is a possibility here of developing a considerable tonnage of low grade ore."

GEOLOGY:

JOHN C. DEVINE:

"The formation consists of limestone, quartzite, granite, diabase, and porphyry. The latter eruptives occur in the form of intrusions, having caused minor displacements in some instances of the overlying sedimentaries. These displacements are usually marked by distinct brecciation, and ore deposits of varying degree of importance are in evidence along these lines of faulting.

Massive outcrops of iron gossan mark the proximity of the mineralized portions on the western half of the property, and on the eastern half, large bodies of magnetic iron are found closely defining the mineral zone."

DEVELOPMENT:

LEO VON ROSENBERG:

"The development done by the former company, consisting of several shafts, a number of levels, tunnels, etc., was largely ill-advised. It is of no particular importance, and probably will be of little use in future operations.

A new plan of development has been inaugurated. Recently a new shaft was started in Climax 2 claim, situated on the south slope of Climax Hill. This shaft has reached a depth of 80 feet. It is in the meta-diabase. The territory embraced in the south slope of Climax Hill shows prominent croppings of hematite. Judging from these surface showings, and from the openings already made, it is reasonable to expect that by further development, large bodies of valuable copper ore will be opened up, in this part of Climax Hill. It is reported that a considerable amount of very rich ore was taken from the shallow workings of Climax 3 claim, and also from the Copper Glance claim. Assays of a number of samples taken from the various openings on Climax Hill showed good copper values.

A new shaft was started on the California claim, situated on the east slope of Climax Hill. This shaft is now 100 feet deep. It is a meta-diabase. In the bottom, the material is heavily mineralized, showing iron pyrite. The shaft should be sunk about 200 feet deeper, cross cuts should then be run about 500 feet northwesterly and about 200 feet southerly. Judging from the surface indications, consisting of heavy gossan (hematite and limonite) about six veins should be intersected by these cross cuts. It is reasonable to assume that some of these veins will be found to carry workable copper ore in quantities.

When the veins have been opened up, levels should then be run on them in a southwesterly direction; ultimately these levels should be connected by cross cuts with the new Climax 2 shaft.

It is reasonable to expect that with the development recommended, a large copper mine will be opened up in Climax Hill."

THE RATTLER MINE:

"The vein of the Rattler is reached by a short tunnel driven in a southerly direction, mainly through diabase and lime. The vein is intersected at a point 150 feet from the mouth. The workings consist of various drifts and a number of large, irregular chambers from which ore has been extracted. The vein is exposed in most of the workings. It lies at an angle of about 20 degrees, dipping to the south. The thickness of the vein varies from 2 to 8 feet. The ore is magnetite. There are a number of faults or slips. Apparently several veins course through the Rattler claim.

According to the assays of a number of samples taken from the ore exposures, the ore carries from 2 to 9% copper; 30% silica; 4% sulphur; 32% iron oxide; 10% magnesia; some alumina and a small amount of lime. The returns of ore shipped in quantity several years ago to the Humboldt Smelter, near Prescott, Arizona, show the average as follows:

Copper 3.55%; Silica 30%; Iron 24%; Lime 0.5%; Sulphur 3.8%

Thirty-two tons of sorted ore shipped as a test, in January 1914, to the smelter of the American Smelting and Refining Company at Hayden, Arizona, contained:

Copper 5.22%; Iron 30.8%; insolubles 19.2%.

The gold and silver contents of the ore amount to about \$1.50 a ton.

The indications are that even with a comparatively moderate amount of development work, a considerable tonnage of this class of ore could be made available. The workings of the old Sisson mine, the shaft of which is about 400 feet west of the Rattler mine, are now inaccessible below the first level. On this level at the shaft, a very strong vein of red hematite is exposed. The surface showing in the eastern part of the Copper Reef claim adjoining the Rattler claim on its west end line, is exceedingly favorable. The cropping of rich ore should be followed by an incline. With a moderate amount of prospect work, very likely quite a tonnage of rich ore could be extracted. The vein exposed by the croppings is no doubt a continuation of one of the Rattler veins.

It is reported that very good sulphide ore was encountered in the lower Sisson mine workings. This class of ore, mixed with copper bearing magnetite would make a good smelting product.

The development proposed might be supplemented by diamond core drilling."

DEVELOPMENT: (West group of claims)

ROY G. MEAD:

"The Alice vein traverses the Dime, Alice and Maggie claims, and is a contact vein having a limestone hanging wall and a granite porphyry dike for a footwall. The general strike of the vein is about north 60 degrees east, and the dip about 45% to the northwest. The vein filling is iron oxide accompanied with copper carbonate ores and altered porphyry. This vein has been explored to a depth of about 350 feet by means of the Alice incline shaft and the Pratt tunnel, and a large tonnage of carbonate ores extracted, which had a copper content in excess of 10%. The development work on this vein, while quite extensive work, was done for the purpose of extracting the carbonate ores, and not with the view of developing the primary ore bodies; therefore, sufficient depth has not been attained to reach the primary ores.

In the Pratt tunnel, which reached a distance of 2300 feet, sulphide ore in shattered quartzite was encountered at a distance of about 1600 feet from the portal and at a vertical depth of about 500 feet. The mineralization consists of fine particles of copper sulphide and native copper extending over 50 feet in width near the granite porphyry dike, the average copper content being 2.5%. This mineralization is undoubtedly the Alice vein exposed at a depth below the limestone, and the mineralization in the quartzite is traceable to the granite porphyry dike. The fact that the values are in the quartzite is conclusive evidence that further depth is required in order to reach the primary sulphide ores. The ore developed in the tunnel, is, however, at the present time, commercial ore, although when the tunnel was driven several years ago, it was considered too low grade, as at that time, the possibility of mining low grade ores was not an established fact.

The Alice shaft follows the vein filling between the limestone and porphyry and the ore deposits encountered are typical of the secondary ores worked in the early days by the principal copper mines which are today getting their output from primary sulphides in porphyry. There is no record of the tonnage of carbonate ores obtained from the workings, and the shaft is now inaccessible. A map compiled by the writer several years ago when the ore body was exposed is a geological section of the ore exposure of the shaft of the third and fourth levels. The ore exposed at that time was high grade and assayed from 6 to 12%.

The fact that the mineralization near the surface in the limestone is so pronounced, together with the fact that there is a large area of mineralization in the quartzite, now commercial ore, exposed in the deeper workings, is conclusive evidence that the porphyry will be found to contain workable deposits of primary sulphide ores when developed below the leached zone. The surface showing, together with past developmental work, warrants systematic exploration, which in my opinion will lead to the development of a large copper producing mine."

DEVELOPMENT:

JOHN C. DEVINE:

"For convenience in the discussion of the development I shall divide the property into two groups, viz; the East and West end.

Taking up the east end of the group, the Rattler vein is found traversing the group and prominently outcropping for a distance of several thousand feet. Deposits of low grade ore are in evidence at several points along the outcrop, and on the Rattler claim, whereat most of the development has centered, a large body of magnetite has been opened that carries copper values ranging from 2% to as high as 5%.

Considerable ore has been shipped from this deposit and more is available for shipment at this time.

The vein of magnetite lies on a diabase footwall and beneath an altered limestone hanging wall, the values below the oxidized zone consisting of finely divided particles chalcopryrite and bornite very evenly disseminated throughout the entire mass.

The development as it stands today has exposed considerable ore of milling grade and some more that could be shipped at a profit.

Continued development to the west closely following the ore strata would undoubtedly open an extensive body of commercial ore.

The ore now developed in this end of the property and probable ore that can be readily added to the reserves by following the ore on the second level of the vertical shaft, places this property in the position wherein immediate shipments can be started.

Thousands of tons of low grade milling ore in the mine and stockpiled on the surface offer immediate opportunity for the first unit of a reduction plant, and it can therefore be stated that this end of the property has passed beyond the prospective stage of development, and with little expense it could be placed in the producing class. Proper experiments should be made in order to determine the best and most efficient process of recovering the copper values from these low grade ores. In view of the high percentage of iron or magnetite contained in the ore, the writer believes that separation by magnetic attraction, will give satisfactory results. If flotation seems necessary, this unit could easily be added afterward.

Taking up the west end of the property which embraces all of the area west of the camp, we find the development well advanced, and with comparatively little further development this end of the property could also be made to produce ore, the volume of which would depend entirely on the magnitude of operations.

Traveling west from the camp we come first to the Climax shaft which is equipped with a hoist and compressor and has reached a total depth of 500 feet vertically. This shaft was designed to explore what is known as the Climax fault, an intrusion of porphyry 40 to 50 feet in width, carrying copper values in the oxidized zone in the form of carbonates, and evidencing a very much leached condition and indicating that when the primary zone is reached, high grade copper should be found in quantity.

The prominent features of this fault are its strength and regularity, traceable on its surface as it is for a distance of more than 2000 feet. Copper values are to be seen along the fault at several points where surface work has been done.

The shaft was started in the porphyry but left it within the first 100 feet, the porphyry having pitched sharply to the west. At the 500 foot level a cross cut was started to cut the porphyry, but this work never reached the contact due to the suspension of operations. It is estimated that 150 feet of drifting will cut the vein. This work should be completed and the shaft should be sunk 225 feet deeper and a drift started to the west with the ultimate purpose of exploring the very favorable ground lying between the Climax shaft and the Alice mine.

The approximate cost of finishing the development at this point as indicated would be about \$20,000.00 and the work could be accomplished in three to four months after the shaft was unwatered.

The next development of importance on the west end of the property is centered on the Alice and adjoining ground, and is very extensive. However, due to a long period of idleness considerable of this work is inaccessible at this time. Much ore has been mined from this part of the property, mostly high grade copper, and in the writer's opinion, will be the inevitable result of intelligent development through the Pratt tunnel on the west end.

The Pratt tunnel which was driven a distance of about 2000 feet some years ago, has opened up some ore in two different places. The elevation of this tunnel is about 250 feet deeper than the Climax or Alice shaft, and just brings the development to the primary zone where both primary and secondary sulphides are in evidence quite abundantly. The tunnel cut two distinct ore veins, one known as the Klondike vein measuring four feet in width and averaging about 2% copper. Very little work was done on this vein due to the low tenor of the ore which was not considered at that time commercial. The evolution of metallurgical processes however has demonstrated that low grade ores can be made profitable by applying the modern methods of concentration and flotation.

A second area of low grade sulphides was encountered at 400 feet east of the Klondike vein and this was cross cut a total width of 150 feet. The ore here was not developed to any extent either, due to the above reasons. In both instances the ore occurs in a much shattered and brecciated quartz formation, and a fine separation of the values could be obtained by concentration with a very high ratio of recovery.

This part of the property offers a better opportunity than any other for the opening up of a mine of large proportions, and there is no doubt in my mind that any development extended to the east from this tunnel following the present low grade ore, will from time to time encounter deposits of high grade ore, the existence of which was fairly well determined by the work done from the Alice shaft.

The work done on the east side of the Alice shaft on the lowest level cut a porphyry fault running somewhat across the general trend of formations, and it is this fault that produced some very high grade ore and appeared to be making downward with increasing strength. It would require driving the Pratt tunnel five or six hundred feet east in order to cut this ore, and considering the pitch of the orebody, a stopping backing of about 400 feet would result from this development. An approximate estimate of the cost of reopening the Pratt tunnel and driving east to the ore above mentioned would be about seven months."

ECONOMIC CONDITIONS:

JOHN C. DEVINE:

"The property is so situated with relation to the railroad that transportation facilities should be ideal. The embarking point could be located at Erman Siding, one and one-half miles east of Ray Junction and thus reduce the distance from the railroad to the mines, to five miles. Cheap transportation could be obtained by the use of motor trucks and trailers.

It has been suggested in this connection than an aerial tramway might be considered to deliver supplies to the portal of the Pratt tunnel and transport ore from this end of the property to the railroad. The project is entirely feasible and the distance would be reduced to three and one half miles all down grade to the railroad.

The proximity of the Hayden Smelting plant, a unit of the American Smelting and Refining Company's string of smelters, which lies about fifteen miles east of the property is an economic factor of more than ordinary value. The short railroad haul together with the efficient method of transporting ores and concentrates that could be developed, would contribute largely to the profitable marketing of the low grade ores now available on the property, which have been heretofore not considered commercial, due to inadequate transportation facilities."

CONCLUSIONS:

LEO VON ROSENBERG:

"It is reasonable to expect that with development recommended, the existence of large quantities of workable ore will be demonstrated.

Altogether, the future of the property is very bright. It must be borne in mind that the condition of a number of copper properties, which are now large producers, was at one time not at all as encouraging as is the present showing at the Troy mines.

The Troy-Arizona copper property forms a very attractive mining proposition, which with proper development, has every promise of becoming one of the great copper producers of Arizona.

A few weeks ago I visited the property for the third time. After another examination of the property, I am still more convinced of its great possibilities. There can be developed at least three if not more, great copper mines. One or two great mines will be opened up by the development proposed on Climax Hill. The Copper Glance itself will become a great mine. The showing on Climax Hill is most promising, and it is surprising that this part of the property has been so long neglected. The claims southwest of the Tiger can also be expected to contain workable ore bodies.

I am convinced that by the development proposed to be done on the Manhattan group, large and profitable ore bodies will be opened.

I will not go into details, but I will state that I am much impressed with the great possibilities which the property possesses and I urge that drilling and other development recommended in my report of last year, be begun as soon as possible. With an expenditure of from 100,000 to 150,000 dollars several great copper mines will be opened up on the property."

CONCLUSIONS: East group of claims

ROY G. MEAD:

"In my opinion, the future of the property is very bright, and with well directed development work, large bodies of secondary sulphide ores will be developed in the limestone, which in itself will make the property a very large producer of copper. In addition extensive bodies of primary sulphide ores will be developed by exploring the porphyry dike and the Rattler vein at a sufficient depth below the surface."

CONCLUSIONS: West group of claims

ROY G. MEAD:

"All of the previous development work on the property was done with the end in view of obtaining carbonate ores. This was a time when ore carrying less than 7% copper was considered unprofitable to extract, and before the time of working low grade primary sulphide ores. The history of the property is quite similar to numerous other properties in Arizona, all of which are on a steady producing basis, drawing their output from the primary sulphides encountered in the deep-seated eruptive dikes. With the favorable surface showing on this property and its similarity to the other prominent copper properties in Arizona, I feel justified in my opinion that proper development work will result in a large producing copper mine."

CONCLUSIONS:

G. G. WALD:

"The property lies in the mineral belt of the South West, and surface indications and geological conditions are favorable for the mineralization of the Climax vein, especially at its intersection with the various NE to SW cross faults. The fact that the faults intersect at acute angles is a favorable condition as the zone of shattering is larger than if they cut at right angles. These shattering zones, and also the limestone beds, are most likely to contain ore bodies.

The leached zone will be found to be comparatively shallow and the highest grade ore will be found at the water level at the point of transition from oxidized to sulphide ores.

Revenue could doubtless be derived, and cheap development obtained, by letting leases on the carbonate ores exposed on surface and old workings."

CONCLUSIONS:

JOHN C. DEVINE:

"In conclusion it is to be noted that with the expenditure of an amount somewhat less than \$100,000.00 on the east and west end of the property combined, the proposition will be converted into a steady producer and in consequence ample justification for a more elaborate plan of operations will inevitably follow.

The limit or volume of ore that could be mined here once the property is properly opened up, should be very extensive, and judging from a comparison of the formations here with those of other large producers in the district, mining costs could be maintained as low or lower than those of any other property now producing on a large scale. Due to the possibility of considerable high grade ore running 10% or better being encountered on cross faults throughout the area, it can be stated beyond the adventure of a doubt, that commercially the property will average better than 5% on a very large scale of operation."

953.4

COPIES TO: D. H. Freas



TO B. L. White
FROM J. B. Imswiler
DATE January 26, 1970

SUBJECT Comment on Shannon Mine, Cochise County, Arizona and Alice Mine, Pinal County, Arizona.

SHANNON MINE

The Shannon Mine is located in the Turquoise Mining District, Cochise County, Arizona. The Turquoise District includes the towns of Courtland and Gleeson. The Charleston Group, which is situated northeast and east of Gleeson, contains nine patented claims and is owned by the Shannon Mining Company.

At the time of shutdown, September 1957, the Shannon mine was the third largest producer of copper in Cochise County, being preceded only by the Phelps Dodge Bisbee operations and the Johnson Camp operation of Cyprus Mines. The total production from 1896 through 1957 was 494,256 tons of ore with an average value of 1.8% copper.

The Shannon Mine has been worked as a high grade copper mine throughout its history. The fact that it has not reopened, in spite of a doubling of the price of copper since 1957, indicates that it is probably finished as a high grade mine.

Ore in the Shannon Mine occurs as pyritic copper deposits in Carboniferous limestone. The limestone has been intruded by sills of quartz monzonite porphyry, and the copper mineralization is considered to be contact metamorphic in nature. The quartz monzonite porphyry has strong quartz-sericite alteration and contains disseminated pyrite and chalcopyrite.

This mine is located in an area which I have always considered to be favorable for copper prospecting. It is an area of proven production, complex structure, strong alteration, and mineralized intrusive. I think it represents an area of "good hunting" for a porphyry copper deposit. In prospecting this district, however, an area much larger than that represented by the Shannon Mine must be considered. The feasibility of an exploration project in this area would largely depend on the property status of the district and what, if anything, has been done by other companies in the way of drilling in the district. I suspect that this area has been carefully scrutinized by other companies, but it has enough merit to warrant looking at and checking the land status and previous work.

Page 2.

To: B. L. White
From: J. B. Imswiler
Subject: Shannon and Alice Mines - Arizona

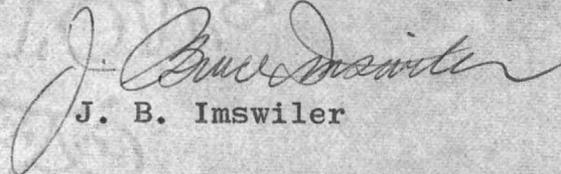
ALICE MINE

The information submitted by Universal Copper Company does not specifically locate the Alice Mine, but the general description would place it in Eastern Pinal County between the towns of Ray and Hayden. No literature references could be found pertaining to the Alice Mine.

The geological setting is certainly a familiar one in Arizona copper deposits, i.e., contact metamorphic and replacement deposits with mineralization associated with late porphyry intrusion. This area has been and is being heavily prospected. Mr. Gaylor's letter states, "Inspiration Copper Company recently spent a number of months doing geophysical work and drilling on their property north of and contiguous to my 14 claims....".

The Alice Mine obviously is not economical to operate today, but would have value only as part of a larger package if a porphyry copper should exist at depth. Since the surrounding ground is apparently taken up, and since the area has been heavily prospected, I can see nothing desirable about acquiring the Alice Mine.

Respectfully submitted,



J. B. Imswiler

JB I: jh
Cc D. H. Freas
Inc.

①

TO: ~~D. H. PHOAS~~ B. C. WHITE, DISTRICT MANAGER

FROM: J. B. INSULLER

DATE 1-23-67

SUBJECT: COMMENT ON SHANNON MINE, COCHISE
Co., ARIZONA AND ALICK MINE,
PINAL Co. ARIZONA.

SHANNON MINE

① THE SHANNON MINE ~~IS~~ IS LOCATED IN THE
TURQUOISE MINING DISTRICT, COCHISE COUNTY, ARIZONA.
THE ~~COCHISE DISTRICT~~ TURQUOISE DISTRICT INCLUDES
THE TOWNS OF COURTLAND AND GLEESON. THE
CHARLESTON GROUP, WHICH IS SITUATED NORTHEAST
AND EAST OF GLEESON, CONTAINS NINE PATENTED
CLAIMS AND IS OWNED BY THE SHANNON MINING
COMPANY.

② AT THE TIME OF SHUT DOWN, SEPTEMBER 1957,
THE SHANNON MINE WAS THE THIRD LARGEST PRODUCER
OF COPPER IN COCHISE COUNTY, BEING ^{PRECEDED} ~~PRECEDED~~ ONLY
BY ~~BY~~ THE PHOENIX DODGE BUSBY OPERATIONS AND
THE JOHNSON CAMP OPERATOR OF CYPRUS MINES.
~~THE MINE HAD PRODUCED SPORADICALLY ~~FOR~~ SINCE~~
THE TOTAL PRODUCTION FROM 1896 THROUGH 1957 WAS
494,256 TONS OF ~~ORE~~ ORE WITH AN AVERAGE VALUE
OF 1.8 % COPPER

(2)

~~THE MINE IS LOCATED IN AN AREA WHICH I HAVE ALWAYS CONSIDERED TO BE FAVORABLE FOR COPPER PROSPECTING. THE ONE~~
~~OF IN THE SHANNON MINE OCCURS AS PYRITIC COPPER DEPOSITS IN CARBONIFEROUS LIMESTONE.~~
~~THE~~ OR OCCURS THE LIMESTONE HAS BEEN INTRUDED BY SILLS OF QUARTZ MONZONITE PORPHYRY, AND THE COPPER MINERALIZATION IS CONSIDERED TO BE CONTACT METAMORPHIC IN NATURE. THE QUARTZ MONZONITE PORPHYRY HAS STRONG QUARTZ-SERICITE ALTERATION AND CONTAINS DISSEMINATED ~~AND~~ PYRITE AND CHALCOPYRITE.

(4)

THIS MINE IS LOCATED IN AN AREA WHICH I HAVE ALWAYS CONSIDERED TO BE FAVORABLE FOR COPPER PROSPECTING. IT IS AN AREA OF PROVEN PRODUCTION, COMPLEX STRUCTURE, ~~AND~~ STRONG ALTERATION, AND MINERALIZED INTRUSIVE. I THINK IT REPRESENTS AN ~~AREA~~ AREA OF "GOOD HUNTING" FOR A PORPHYRY COPPER DEPOSIT. IN PROSPECTING THIS ~~AREA~~ ^{DISTRICT}, HOWEVER, AN AREA MUCH LARGER

(5)

~~THE SHANNON MINE, CONSISTING OF ONLY ONE UNPATENTED~~
 THAN THAT REPRESENTED BY THE SHANNON MINE, MUST BE CONSIDERED. THE FEASIBILITY OF AN EXPLORATION PROJECT IN THIS AREA

3

WOULD DEPEND LARGELY ON THE PROPERTY STATUS OF THE DISTRICT AND ^{IF ANYTHING} WHAT HAS BEEN DONE BY OTHER COMPANIES IN THE WAY OF DRILLING IN THE DISTRICT. I SUSPECT THAT THIS AREA HAS BEEN CAREFULLY SCRUTINIZED BY OTHER COMPANIES,

5 contd

THE SHANNON MINE HAS BEEN WORKED AS A HIGH GRADE COPPER MINE THROUGHOUT ITS HISTORY. THE FACT THAT IT HAS NOT REOPENED, ~~SINCE IT LAST CLOSED~~ IN SPITE OF A DOUBLING ~~OF~~ OF THE PRICE OF COPPER SINCE 1957, INDICATES THAT IT IS PROBABLY FINISHED AS A HIGH GRADE MINE.

3

BUT ~~THE~~ ^{IT} AREA HAS ENOUGH MERIT TO WARRANT LOOKING AT AND ~~SEE~~ CHECKING THE LAND STATUS AND PREVIOUS WORK.

5 contd 2

(9)

ALICE MINE

THE INFORMATION SUBMITTED BY UNIVERSAL COPPER COMPANY DOES NOT SPECIFICALLY LOCATE THE ALICE MINE, BUT ~~THE~~ THE GENERAL OBSERVATION WOULD PLACE IT IN EASTERN PINAL COUNTY BETWEEN THE TOWNS OF RAY AND HAYDEN. NO LITERATURE REFERENCES COULD BE FOUND PERTAINING TO THE ALICE MINE.

THE GEOLOGICAL SETTING IS CERTAINLY A TYPICAL ONE IN ARIZONA COPPER DEPOSITS, i.e., CONTACT METAMORPHIC AND REPLACEMENT DEPOSITS WITH MINERALIZATION ASSOCIATED WITH LATE PORPHYRY INTRUSION. THIS AREA HAS BEEN AND IS BEING ^{HEAVILY} PROSPECTED. TO ~~DATA~~, ~~MR. GAYLOR'S LETTER INDICATES THAT INSPIRATION COPPER COMPANY, "RECENTLY SPENT~~ MR. GAYLOR'S LETTER STATES, "INSPIRATION COPPER COMPANY RECENTLY SPENT A NUMBER OF MONTHS DOING GEOPHYSICAL WORK AND DRILLING ON THEIR PROPERTY NORTH OR AND CONTIGUOUS TO MY 14 CLAIMS..."

THE ALICE MINE OBVIOUSLY IS NOT ECONOMICAL TO OPERATE TODAY, BUT ~~WOULD~~ ^{IT} WOULD HAVE VALUE ^{ONLY} ~~CERTAINLY BE~~ VALUABLE AS PART OF A

(5)

LARGER PACKAGE IS A PORPHYRY COPPER
SHOULD EXIST AT DEPTH. SINCE THE
~~LAND~~ SURROUNDING GROUND IS APPARENTLY
TAKEN UP, AND SINCE THE AREA HAS
BEEN HEAVILY PROSPECTED, I CAN SEE
~~NO~~ NOTHING DESIRABLE ABOUT ACQUIRING
THE RUCHE MINE.

RESPECTFULLY SUBMITTED

JB1

C.C.: D.H. PERAS

INCLUSIONS

a water table, but neither the top nor the bottom of the secondary enriched zone is now determined by a water table.

The Phelps Dodge Corporation prospectus covering the issue of convertible 3½ per cent debenture bonds, in regard to the Morenci open-pit ore reserve, estimates 284,000,000 tons of ore assaying 1.036 per cent copper. The ore carries small and relatively unimportant amounts of gold and silver. The ore available for extraction on the basis of the pit lay-out now contemplated for this program is estimated at 270,000,000 tons carrying 1.06 per cent copper.

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- Lindgren, Waldemar, The Copper Deposits of the Clifton-Morenci District, Arizona, U.S. Geol. Survey Prof. Paper 43, 1905.
 U.S. Geol. Survey Geol. Atlas, Clifton Folio (No. 129), 1905.
 Reber, L. E., Jr., The Mineralization at Clifton-Morenci, Arizona, Econ. Geology, Vol. 11, pp. 528-73, 1916.
 Tenney, J. B., Copper Deposits of Morenci District, XVI Int. Geol. Congress, Copper Resources of the World, Vol. I, pp. 213-21, 1935.

RAY DISTRICT⁴⁸

INTRODUCTION

Ray is about 17 miles south of Miami on Mineral Creek, between the Dripping Spring Range on the east and the Tortilla Mountains on the west.

The latest and most complete report on the Ray district is by Dr. F. L. Ransome.⁴⁹ Since the time of Dr. Ransome's report, underground development has further revealed the extent of faulting and the structural relationships.

The present paper gives a general description of the geology largely summarized from Ransome's reports, together with new data regarding the structural features of the ore body. These new data, together with Figure 7, are taken from an unpublished manuscript by C. Leroy Hoyt.⁴⁶

HISTORY AND PRODUCTION

1873. Mineral Creek district organized prior to this time by silver prospectors.

⁴⁴ Paper compiled for the regional meeting of the A.I.M.&M.E. held at Tucson, Arizona, November 1-5, 1938.

⁴⁵ F. L. Ransome, *Copper Deposits of Ray and Miami, Arizona* (U.S. Geol. Survey Prof. Paper 115, 1919); *Description of the Ray Quadrangle* (U.S. Geol. Survey Folio 217, 1923).

⁴⁶ Engineer, Nevada Consolidated Copper Company.

1880. Location and prospecting of claims. Mineral Creek Mining Company builds a five-stamp mill.
 1883. Ray Copper Company organized with a capital of \$5,000,000. Small-scale operations at Ray Mine.
 1890. Ray Mine acquired by Ray Copper Mines, Ltd., capitalized at \$260,000. Building of 250-ton mill at Kelvin and blocking out of ore at mine. This company failed because of inadequate sampling.
 1907. Ray Consolidated Copper Company organized by D. C. Jacking and others to acquire and work the ground formerly held by the Ray Copper Mines, Ltd. Arizona Hercules Copper Mining Company and Kelvin-Calumet Mining Company begin operations.
 1909. The existence of about 50,000,000 tons of ore is ascertained. Ray Central Copper Mining Company succeeds Kelvin-Calumet Mining Company.
 1910. Louis S. Cates becomes Superintendent of Mines and develops mining system whereby Ray later became the first copper mine in the world to produce 8,000 tons or more of ore per day by caving methods.⁴⁷
 1911. Production starts from mines of Ray Consolidated Copper Company after construction of mill at Hayden.
 1924. Ray Consolidated and Chino companies merge.
 1926. Nevada Consolidated absorbs Ray and Chino.
 Production of the Ray mines to the end of 1931 has been recorded⁴⁸ as follows:

TABLE 4.

	Copper (pounds)	Gold (value)	Silver (value)	Total value
Ray, 1911-31.....	1,156,000,000	\$280,000	\$150,000	\$198,500,000
Ray Hercules, 1918-23.....	8,000,000	1,500,000
Total.....	1,164,000,000	\$280,000	\$150,000	\$200,000,000

Rocks⁴⁶

The oldest rocks in the region are the Pinal schist, which consists mainly of metamorphosed siliceous sediments and various granitic intrusive rocks. All these rocks are of older pre-Cambrian age. Resting on the eroded surface of the old crystalline rocks are Apache group beds (Pl. III) aggregating from 1,200 to 1,300 feet in thickness, apparently in conformable sequence and supposed to be younger pre-Cambrian. More than two thirds of this thickness is represented by two quartzite formations; the remaining beds include shale, dolomitic limestone, and conglomerate. Great masses of diabase of uncertain age (p. 15) intrude the

⁴⁷ A. B. Parsons, *The Porphyry Coppers* (A.I.M. and M.E., 1923).

⁴⁸ M. J. Elsing and R. E. S. Heheman, *Arizona Metal Production* (Univ. of Ariz., Ariz. Bureau of Mines Bull. 140, 1936), p. 99.

⁴⁹ Description largely from Ransome, *op. cit.*

Apache and older rocks. Overlying the Apache group, without any recognizable unconformity to explain the apparent absence of the Ordovician and Silurian, is 325 feet of limestone, supposed to be Devonian. Conformably above the Devonian limestone is the light gray Carboniferous limestone, at least 1,000 feet thick. After the deposition of the Carboniferous limestone the region was uplifted and eroded.

Cretaceous sediments were probably deposited, although no remnant of these is present in the region here particularly described. Their nearest known representatives are in the Deer Creek coal field, south of Gila River. The deposition of the supposedly Cretaceous beds was succeeded by andesitic eruptions, of which some of the products remain in the southern part of the Ray quadrangle.

The andesitic eruptions were followed by the successive intrusion of (1) quartz diorite, in small irregular masses and a few fairly large dikes; (2) granite, quartz monzonite porphyry, and granodiorite in masses, some of which, as the Schultz granite, are several miles in diameter; and (3) quartz diorite porphyry in dikes, sills, and small rounded bodies. The intrusion of the rocks of the second group was the cause of the original or hypogene metallization that, followed some time later by downward or supergene enrichment, gave rise to the disseminated copper ores of Ray and Miami. The time of the intrusion of the rocks in these three groups is not known but is thought to have been Laramide.

A period of active erosion, during which the coarse clastic material of the Whitetail conglomerate was washed by streams into local basins, followed the granitic intrusions, and this formation in turn was buried under a flow of dacite, probably in late Tertiary time. After this outburst the region was much faulted, vigorous erosion set in, and the generally coarse fluvialite deposit known as the Gila conglomerate was deposited, probably in late Tertiary time. This deposit has since been deformed by faulting and has been much dissected by the intermittent streams of the present drainage system.

STRUCTURE

The rocks of the area are cut by innumerable faults running in all directions. There is scarcely any flexing or folding of the beds. The structure is characterized by the dominance of deformation by faulting, mostly of the normal type.

The region east of Mineral Creek is marked by a network of block faults which have lowered the sedimentary rocks against pre-Cambrian schist. Roughly paralleling Mineral Creek and adjacent thereto is the Ray fault, striking northwest and forming the eastern boundary of ore enrichment. Branching from this North End fault, which, as its name implies, has limited enrichment on the north side of the ore body. Deposition on the west has been limited by the West End fault which strikes north-south.

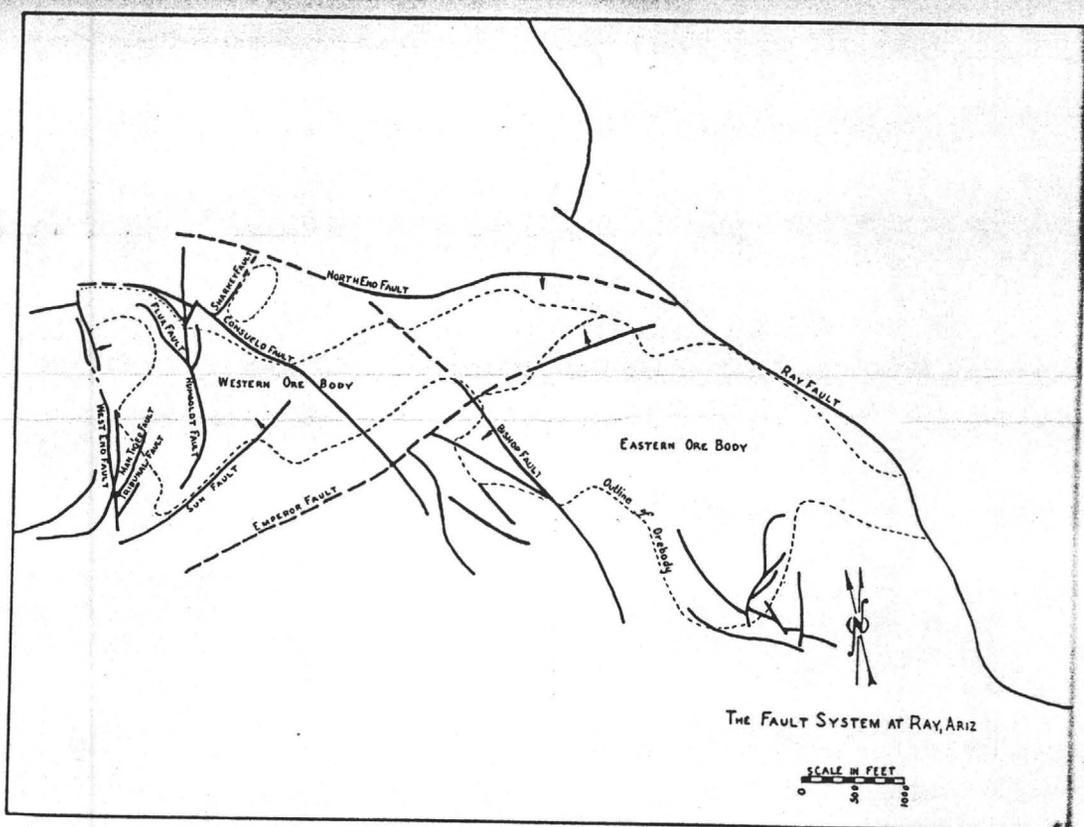


Figure 7.—Fault system at Ray. (By C. Leroy Hoyt.)

On the south the ore enrichment has been controlled by a series of diagonal faults (Fig. 7).

The fissuring that accompanied the early intrusion of the diabase into the schist established lines of weakness which were followed in a general way by the later porphyry intrusions and still later by the major faults, such as the Sun, Consuelo, and Emperor. The Ray, Bishop, Consuelo, and other faults strike approximately parallel to the general trend of the Dripping Spring Mountain Range. South of the Consuelo fault is a series of somewhat concentric circular faults generally dipping to the center and flattening out as they progressed downward, as shown by the Man Tiger, Tribunal, Sun, Flux, and the southern end of the Humboldt faults.

ORE DEPOSITS

The ore deposit is a secondary enrichment of disseminated chalcocite, associated with and partially replacing primary pyrite in the pre-Cambrian Pinal schist and, to a slight extent, in Laramide porphyries. It is generally referred to as being a low-grade porphyry deposit. The ore body proper is a flat-lying mass, irregular in outline, and of variable thickness. The long axis extends roughly east and west for about 7,000 feet. It ranges in width from about 200 feet at the center to over 2,000 feet near the eastern and western extremities. The central constriction divides the ore into two sections which are called the "Eastern ore body" and the "Western ore body." The thickness of the ore as determined from drilling and development averages about 120 feet and ranges from 15 to more than 400 feet.

The area of oxidized capping is somewhat more extensive than that of the ore, but has the same general shape. Around the margin of the ore many of the drill holes pass directly from the oxidized capping into the unaltered primary protore. The thickness of the capping varies greatly, but its average is about 225 feet.

Doubtless as a result of the intrusion and solidification of the porphyries, the rocks were intricately broken by numerous small, irregular fissures which were permeable to the ore solutions.

Under the greater portion of the Eastern ore body a diabase sill that slopes gently to the east and north was more highly mineralized than was the surrounding schist. Chalcopyrite associated with the pyrite makes this diabase considerably higher in copper than the corresponding primary schist protore but is not of economic importance at the present time. This diabase sill is covered by a layer or blanket of gouge about 15 feet in average thickness, and it has acted as a dam to descending solutions from the oxide zone, causing them to deposit a large portion of their metallic burden in the gouge blanket. This enriched layer has been sufficiently high in copper to warrant some square-set mining in the past.

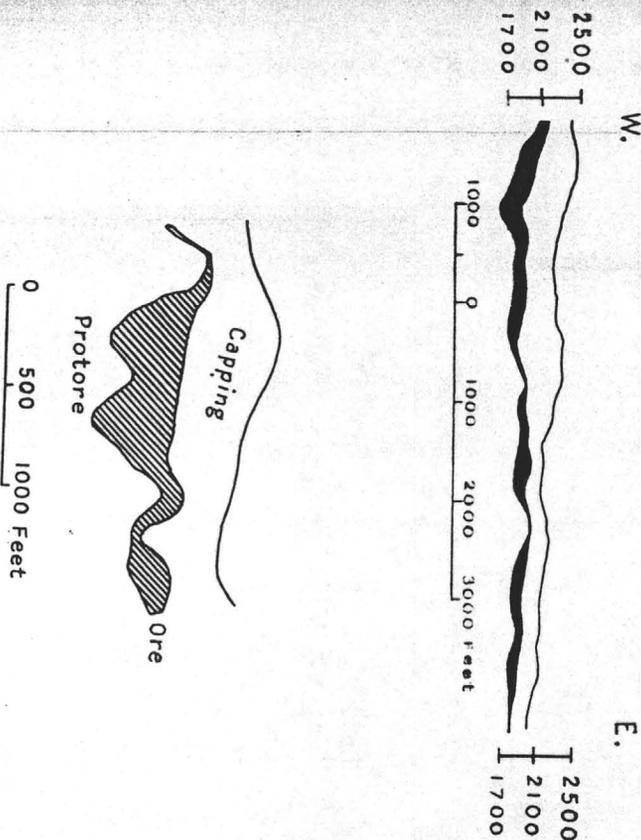


Figure 8.—Generalized sections through Ray ore bodies. (After Ransome, U.S.G.S. Prof. Paper 115.)

The concentration of the copper was greatly influenced by barriers that confined the descending solutions to well-defined areas. One of the most important of these areas is in the triangular trough formed by the Consuelo, Sun, and West End faults. Near the center of this area in the vicinity of the Humboldt fault the greatest vertical thickness of the ore is attained. Along the West End fault, however, some sections have not received the enrichment found in the rest of this trough due to the fact that in these places erosion progressed more rapidly than oxidation.

North of the Consuelo and lying in the trough between the North End and Sharkey faults is a small, isolated ore body known as the Sharkey area.

A third important ore zone lies north of the Emperor fault in successive troughs formed by the intersections of the Emperor with the Consuelo, Bishop, North End, Ray, and other faults.

These three areas comprise the Western ore body. The Emperor fault controlled enrichment on the south side of the Western ore body for about 3,000 feet and formed a definite boundary between the Eastern and the Western ore bodies.

The Eastern ore body lies south of the Emperor in the section between the Bishop and the Ray faults and terminates in a series of unnamed faults at the southern end. Under a large part of this area the ore bottoms on the diabase previously mentioned.

From the preceding discussion the conclusion is drawn that the structural relationship of the fault system at the Kay property has been the controlling factor in the enrichment of the ore. During the process of enrichment the copper-bearing solutions which permeated the district were prevented from migrating laterally by fault barriers. The downward progress of the solutions was checked either by a flattening of the faults at depth, by troughs formed at their intersections, or, as in the Eastern ore body, by a diabase sill.

ACKNOWLEDGMENTS

Acknowledgments are due Dean LaGrange, Assistant Superintendent of Mines, and P. T. Whitehead, Geologist, Ray Mines Division, Kennecott Copper Corporation, for their assistance in the preparation of Hoyt's manuscript.

AJO DISTRICT⁵⁰

By JAMES GILLULY⁵¹

GEOGRAPHY

The Ajo copper district is in southern Arizona, in Pima County, about 43 miles south of Gila Bend, on the Southern Pacific Railroad, and 125 miles west of Tucson. It is in the extremely arid section of the state, with rainfall averaging less than 10 inches a year.

The district lies in the low desert plains, at altitudes ranging between 1,700 and 2,500 feet above the sea. The topography is hilly but not extremely rugged, with rather steep-sided hills rising abruptly above wide sloping pediments that merge into the alluvial intermontane plains.

HISTORY

Although the occurrence of copper at Ajo was established at least as early as 1750, it first came to the attention of English-speaking Americans in the days of the California gold rush of 1849. The first locations were made just after the Gadsden Purchase, but the early attempts at exploitation were unsuccessful owing to the low grade of the ore, the difficulty of water supply, and the extremely costly transportation. A renewed attempt to develop the deposits was made in 1894, but it too was ephemeral.

⁵⁰ Published by permission of the Director, U.S. Geological Survey. For a more detailed description of the district, see James Gilluly, *Geology and Ore Deposits of the Ajo Quadrangle, Arizona* (Univ. of Ariz., Ariz. Bureau of Mines Bull. 141, 1937). Paper prepared for the regional meeting of the A.I.M.&M.E. held at Tucson, Arizona, November 1-5, 1938.

⁵¹ Geologist, U.S. Geological Survey.

At the beginning of the present century the brilliant success of the Utah Copper Company at Bingham inspired greater interest in the diamondated copper ores. Considerable promotion but little real development work was done at Ajo.

The active and successful development of the great deposit began in the fall of 1911 when the Calumet & Arizona Mining Co., of Bisbee, under the leadership of John C. Greenway, general manager, formed a reorganized New Cornelia Copper Company and began to test the property.

The successful exploitation of the deposit hinged upon development of a leaching process for the carbonate ores. The railroad from Gila Bend to Ajo was completed in 1915, and shipments of high-grade ores were made throughout 1916. An ample water supply was developed at the "water mine," about 600 feet deep, 7 miles north of Ajo. A 5,000-ton crushing, leaching, and electrolytic precipitation plant was completed by May, 1917. The oxidized ores were the sole source of copper until 1924 when, a 5,000-ton concentrator having been built, production began from the sulphides. In 1930 most of the oxidized ore having been exhausted, the leaching plant was closed. In the meantime, in 1928 and 1929, the sulphide concentrator was enlarged to a present capacity of 16,000 tons a day. Relatively minor changes would increase the capacity to 20,000 tons.

In 1929 the New Cornelia Copper Company was absorbed by the Calumet & Arizona Mining Co., and in 1931 this company was in turn consolidated with the Phelps Dodge Corporation.

Geology

The oldest rocks in the immediate vicinity of the Ajo ore body (Pl. XXI) are a series of lavas and associated tuffs, chiefly keratophyres and quartz keratophyres (locally called "rhyolites"), with subordinate andesite. It is possible that the keratophyric rocks were originally less sodic and owe their present chemical composition to later albitization.

The attitude of these volcanic rocks is uncertain, for although structures resembling flow phenomena are widespread they are of such diverse orientations, even on the same outcrop, as to preclude any confident deductions as to the original surfaces of the flows.

Into this volcanic series was intruded an elongated stock of porphyritic quartz monzonite with an external discontinuous shell of quartz diorite as much as 1,000 feet wide. The present outcrop of this intrusive mass is roughly wedge shaped, with the point in which practically all the known ore is concentrated projecting toward the southeast. The northern and northeastern limits are obscured by alluvium. As now exposed it is about 2 miles long and a mile wide at the north end. At the south end the monzonite has been found by diamond drilling to extend at least half a mile south of its surface limit in that direction. The southeastern tip of the quartz monzonite (as exposed on