UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF MINES

Mining Division
Region IV

NATIONAL DIRECTOR'S
OFFICE
REGION IV
JUL 3 1951
BUREAU OF MINES
DENVER, COLORADO

224 NEW CUSTOMHOUSE
DENVER 2, COLORADO

July 3, 1951

Memorandum

To: J. H. East, Jr., U. S. Bureau of Mines
A. H. Koschmann, U. S. G. S.

From: P. T. Allsman, Chief, Mining Division, Region IV

Subject: Final Report, DMA Docket 112, Oro Mining Corp., Yuma County, Ariz.

The above report has been received. It is noted that the grade of the ore is submarginal and would be uneconomical to mine under the present metal prices. Any additional ore found probably would be too low a grade. I concur with the conclusions and recommendations of the examiners that the loan should be denied.

P. T. Allsman

FOR GOVERNMENT USE ONLY

UNITED STATES
DEPARTMENT OF THE INTERIOR
DEFENSE MINERALS ADMINISTRATION
WASHINGTON 25, D. C.

200 New Customhouse
Denver 2, Colorado

June 18, 1951

Memorandum

To: DMA Field Team, Region IV

From: A. H. Koschmann

Subject: Oro Mining Company, Yuma Copper Mine, Yuma County, Arizona, DMA Docket 112

Enclosed are original and 7 copies of the above report by C. A. Anderson.

A. H. Koschmann

A. H. Koschmann
Supervising Geologist
Colorado-Wyoming

Enclosures

Arizona-New Mexico Branch
[redacted]
Box 4097
UNIVERSITY STATION

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF MINES
MINING DIVISION
REGION IV

Mining Division
Date Rec'd.
JUL 2 1951
BUREAU OF MINES
Denver, Tucson, ARIZONA

June 26,1951

Register

Memorandum

To : Paul T. Allsman, Denver, Colorado.

From : Chief, Arizona-New Mexico Br., Mining Div., Region Iv

Subject : Final Report, DMA Docket 112, Oro Mining Corp., Yuma County, Ariz.

Enclosed are original and 7 copies of the Summary, Conclusions and Recommendations by C. A. Anderson of the Geological Survey and L. L. Farnham for the above report.

This report has my approval.

The brochure also is enclosed.

Walter R. Storms

Walter R. Storms

CC P. T. Allsman (7)
C. A. Anderson
DMA 112
DF

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
P.O.Box 4126, University Station
Tucson, Arizona

June 11, 1951
Registered Mail
Return Receipt Requested

Memorandum

To: Mr. A. H. Koschmann, Denver, Colorado

From: Mr. A. F. Shride, Tucson, Arizona

Subject: Oro Mining Company, Yuma Copper Mine, Yuma County, Arizona, DMA Docket #112

Enclosed are original and 7 copies of the above report by C. A. Anderson. Please return one copy to us and one to W. R. Storms.

The report and the recommendations that both development and exploration loans be denied have our approval.

A. F. Shride

A. F. Shride
Acting District Supervisor
Arizona-New Mexico

Enclosures 8

UNITED STATES
DEPARTMENT OF THE INTERIOR
OSCAR L. CHAPMAN, SECRETARY

DEFENSE MINERALS ADMINISTRATION

REPORT OF EXAMINATION BY FIELD TEAM
REGION IV

DMA-112, Dry Mining Corporation, Yuma Copper Mine

Yuma County, Arizona

Charles A. Anderson, Geologist
U. S. Geological Survey

L. L. Farnham, Mining Engineer
U. S. Bureau of Mines

June 1951

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

By Charles A. Anderson[1/] and L. L. Farnham[2/]

In March 1951, the Ore Mining Corp., Yuma County, Ariz. applied to the Defense Minerals Administration for a development loan of $649,875 under the Defense Production Act of 1950 to further develop the company's Yuma mine and to erect a 200-ton concentration plant. Therefore, in May 1951 the writers visited the property in connection with this application.

The Yuma Copper mine is located in metamorphosed limestone intercalated between quartzite and quartz-mica schist. Oxide copper ore is present on the upper levels but is largely mined out. Sulfide ore on the lower levels consists of disseminated and streaked granules of pyrite and chalcopyrite in a friable gangue of calcite, garnet, and actinolite. The ore zone is possibly 60 feet thick in the main sulfide stope and less than 20 feet thick a short distance further east. Horses of hard, barren, metamorphosed limestone are present in the ore zone.

The limits of the sulfide zone have not been determined, but the present underground workings suggest about 100,000 tons of measured, indicated, and inferred reserves, containing 0.03 ounces gold, 0.3 ounces of silver a ton and 1.32 percent copper. The erratic form of

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1/ Geologist, Geological Survey

2/ Mining Engineer, Bureau of Mines

replacement deposits in limestone makes it difficult to forecast ore reserves, but an optimistic estimate of the potential tonnage of the Yuma mine is from 300,000 to 500,000 tons.

Additional exploration is needed underground to limit the boundaries of the sulfide ore. The applicant was informed of the procedure for obtaining an exploration loan on a matching basis. To date, the applicant has shown no interest in participating in an exploration loan. The grade of the sulfide mineralization is too low in relation to the potential tonnage of the deposit to encourage such exploration, unless he can be assured of a higher price for copper than now prevails.

Laboratory test work indicates that the ore responds well to flotation. The average recoverable value of the ore is estimated to be $6.17 a ton at current metal prices. The indicated operating costs will exceed $10.00 a ton. Thus, the operation of the property at this time, would result in a loss of about $4.00 a ton.

It is recommended that no consideration be given for an exploration loan on the Yuma Copper property and that the request for a $649,879 development loan be denied.

OHIO MINING CORPORATION
YUMA COPPER MINE
YUMA COUNTY, ARIZONA
BMA-1127

Engineering Report

By L. L. Farnham
Mining Engineer
U. S. Bureau of Mines

GRO MINING CORPORATION
YUMA COPPER MINE
YUMA COUNTY, ARIZONA

CONTENTS

Page

Engineering report

Introduction---------- 1
Acknowledgments---------- 1
Location and physical features-- 1
History and production ---------- 2
Ownership---------- 3
Description of the deposit------ 4
Mineable ore reserves---------- 5
Present status---------- 9
Project proposals---------- 13
Production plan---------- 15
Summary---------- 23
Conclusions and recommendations- 23
Appendix---------- 25

ILLUSTRATIONS

Figure — To follow page

1 Location map---------- 1
2 Composite level map, Yuma Copper Mine---------- 6
3 Sketch cross-section---------- 9

INTRODUCTION

This report covers the results of the investigation of the Yuma Copper mine, Yuma County, Ariz., made in connection with the loan application of the Ore Mining Corp., to the Defense Minerals Administration, DMA Docket No. 112. The examining team visited the property on May 21 and 22, 1951.

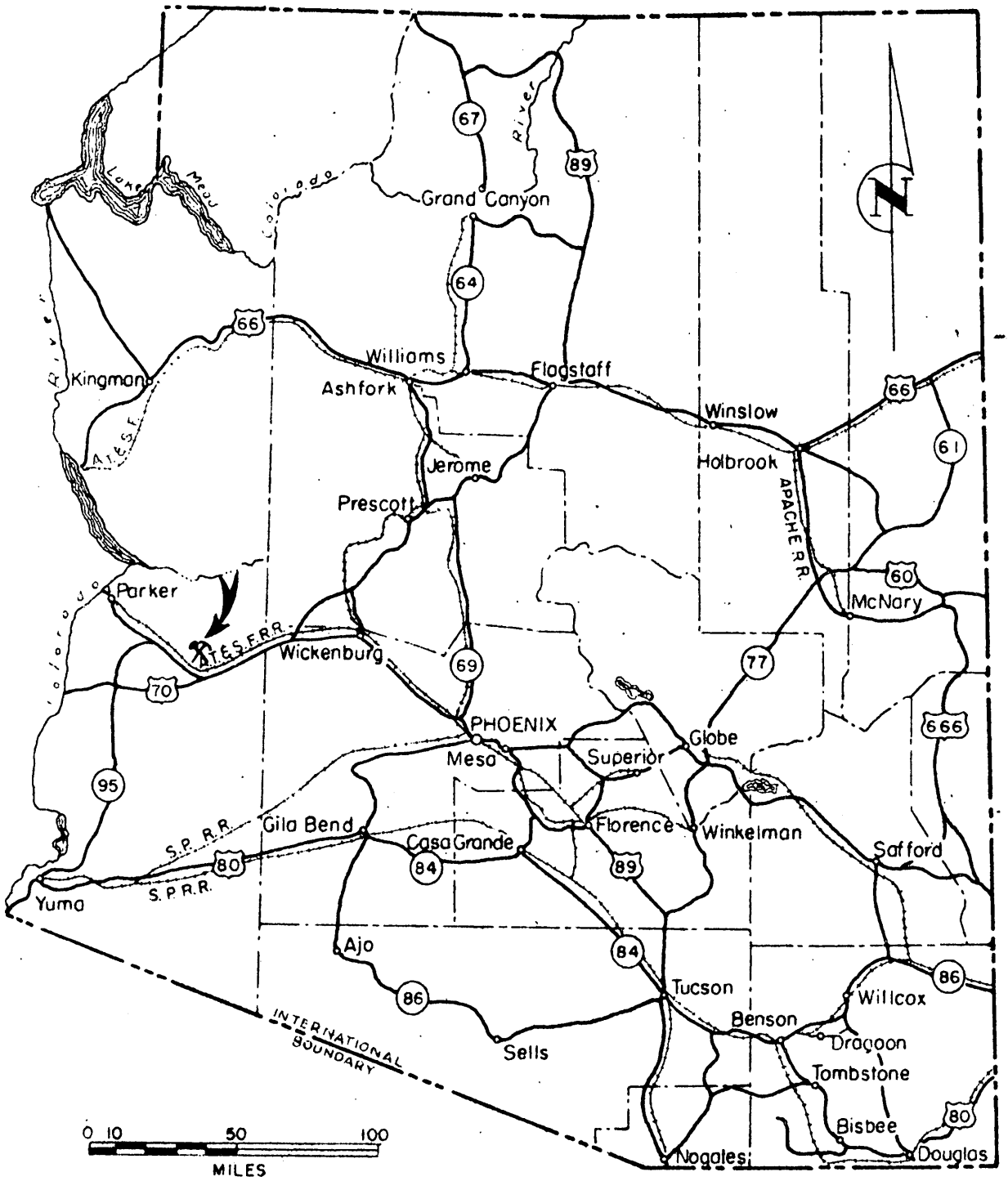
The requested loan in the amount of $649,879 is for the purposes of rehabilitation of the property, construction of 5 miles of power line, and the equipment and further development of the mine to the point of producing sufficient ore to supply a 300-ton flotation mill to be erected on the property.

ACKNOWLEDGMENTS

Thanks are due Mark Gemmill, a director of the Ore Mining Corp., for the many courtesies extended the examining team during the visit to the property.

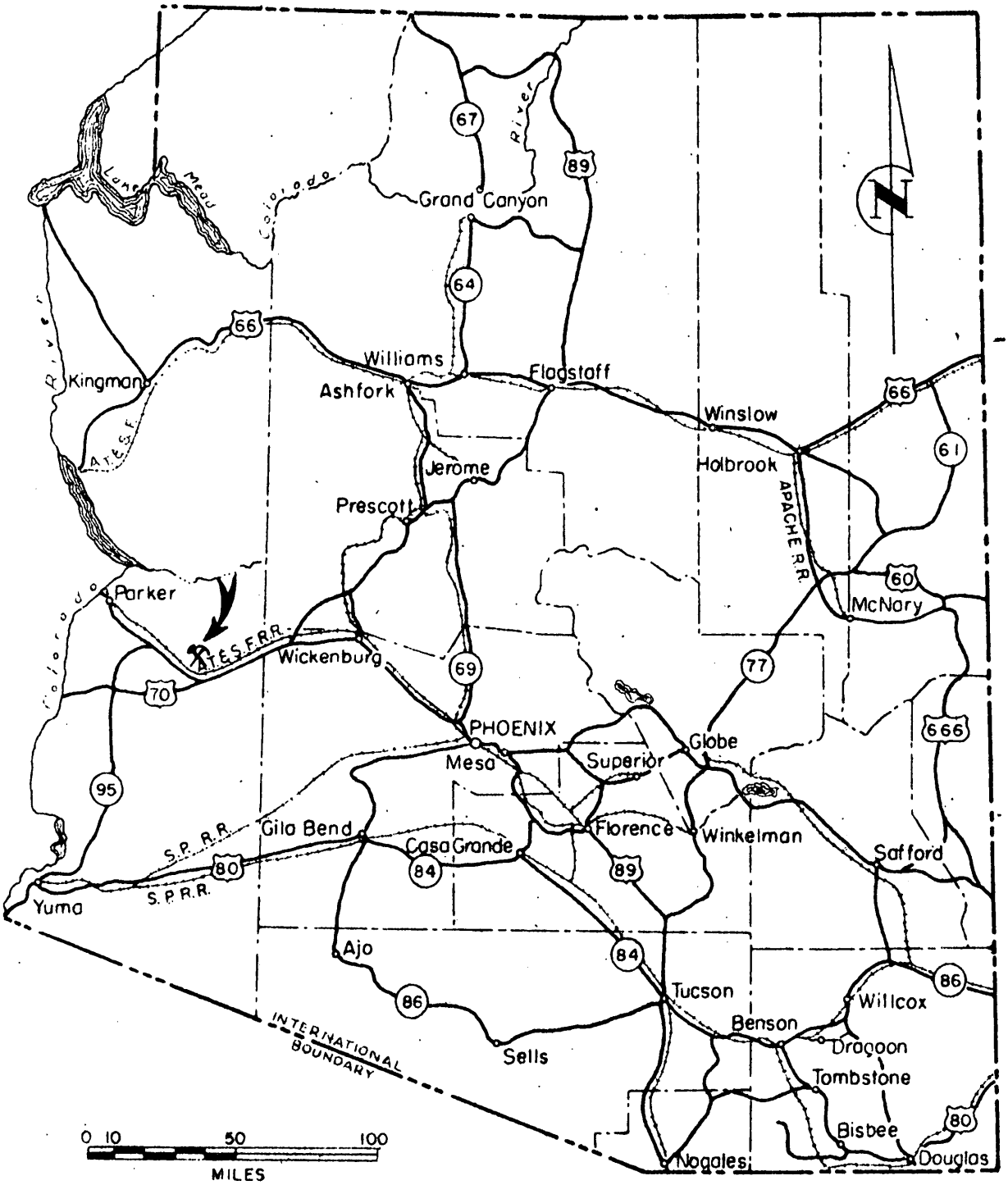
LOCATION AND PHYSICAL FEATURES

The Yuma Copper mine is located in Section 24, T. 6 N., R. 15 W., Yuma County, Ariz. It is 21 miles by road northwest of Salome, Ariz. The nearest rail shipping point is a siding known as McVay on the Parker cut-off branch of the Santa Fe railroad. McVay is about 17 miles northwest of Salome. A good, almost level, desert valley road of 5.5 miles connects the mine with a loading ramp at McVay.



D.M.A. 112

Figure 1.- Location map, Yuma Copper Mine, Yuma County, Arizona.



D.M.A. 112

Figure 1.- Location map, Yuma Copper Mine, Yuma County, Arizona.

The property lies in the foothills at the southwesterly end of the Harquahala Mountains at an altitude of about 1,600 feet above sea level. The topography is moderately rugged in the immediate vicinity of the mine.

Vegetation and climate are typical of the arid desert regions of the Southwest.

HISTORY AND PRODUCTION

The claims were located in the early 90's. In 1943, the Reconstruction Finance Corporation made a loan of $3,000 to the lessee for the unwatering and examination of the mine. There was little or no production until 1944.

The Liberator Mines Co. in 1944 took over the lease and option, and operated the property until 1947. During this operation a total of 7,838 tons of ore was mined and shipped to custom smelters. Some 3,177 tons was oxide copper ore containing some 2.0 percent copper with 0.04 ounces of gold and 0.3 ounces of silver a ton. The remaining 4,661 tons shipped was sulphide ore having an average content of 1.47 percent copper, 0.03 ounces of gold, and 0.3 ounces of silver a ton.

During the time of the Liberator Mines Co.'s operation the Premium Price Plan was in effect. They were given a premium of 15 cents a pound for all copper produced. Then the smelter settlements were based on a copper price of 37 cents a pound. During the greater

part of this period the marketing cost of the ores shipped from the Tuna mine to the Clarkdale smelter was about $4.50 a ton. This included trucking, rail freight, and treatment. This cost would compare favorably with present day milling and concentrate marketing costs. The Liberator Mines Co.'s operation was not profitable and work was terminated in 1947. The property has been idle since that time.

OWNERSHIP

The Tuna Copper property consists of 11 unpatented mining claims owned by the estates of C. H. Waters and Kate E. Waters. The Liberator Mines Co. leased the property from the owners in 1943. The Ore Mining Corp., the assignee of this lease, now has acquired all the interest of the Liberator Mines Co. in the property.

The original lease and option from the owners to the Liberator Mines shows a purchase price of $[illegible],000 payable at 5 percent royalty on net smelter returns, with a minimum of $100 a month. Ore Mining Corp. has assumed this lease and option from Liberator Mines Co. for a consideration of $150,000, payable by 2½ percent royalty with a minimum of $50 a month. The total purchase price to Ore Mining Corp. is thus $150,000 payable at 7½ percent royalty with a minimum payment of $150 monthly.

DESCRIPTION OF THE DEPOSIT

The ore bodies of the Puma Copper mine occur in a bed of metamorphosed limestone trending N. 80° W. and dipping 30° to the north. The limestone is of variable thickness, ranging from less than 30 to over 100 feet. Its outcrop is visible for several thousand feet and its maximum thickness and alteration appears in the immediate vicinity of the mine. The irregular copper mineralization visible in the outcrop is apparent only in the neighborhood of the underground workings. The deposit is of the contact metamorphic type with scattered irregular bodies of pyrite and chalcopyrite locally replacing the limestone.

The oxidized zone extends down to the 350 level. Several thousand tons of oxide copper ore coming from the upper levels have been shipped. This ore had a higher copper content than the underlying sulphide, and has been largely mined out.

The future value of the deposit is dependent upon the primary sulphide ores. The sulphide minerals are pyrite and chalcopyrite with local coatings of covellite. In the better mineralized areas these sulphide minerals are in a friable gangue of calcite, lime silicates, and quartz. The ore breaks down readily to almost a sand. Masses of waste, consisting of hard, metamorphosed limestone, are distributed irregularly through this friable sulphide ore. They range in size from that of a football to masses weighing several tons.

In the present stage of exploration the footwall of the ore-bearing horizon is quite definitely exposed by the level drifts. A very limited amount of crosscutting was done on the lower levels so that the top or hanging wall of the sulphide mineralization is very indefinite. Thus the average thickness of the ore-bearing horizon is unknown. In the so-called sulphide stope above the 415 level the maximum distance between the hanging and footwalls of the mineralization was estimated to be about 60 feet. Some 70 feet east of this area the thickness of copper mineralization appeared to be limited to less than 20 feet. Stopes in the upper levels of the mine show the thickness to be less than 5 feet. Considering these facts, together with the nature of this type of ore occurrence, it is difficult and/or hazardous to estimate the average thickness for the zone as a whole.

MINEABLE ORE RESERVES

The western limits of the sulphide copper mineralization appear to be well defined on all the mine levels. The eastern margin of the sulphides has not been reached by the present underground workings. On one level (415) the maximum length of the copper mineralization is about 400 feet as shown by a long drift. The easterly face of this drift is still in sulphides yet the copper content of three samples from this area is somewhat lower than the average for the rest of the level. The surface outcrops in this easterly section of the property do not appear as

favorable as do those nearer the westerly margin of the mineralization. The 350 level has exposed a length of copper-bearing material for about 200 feet with the easterly face still mineralized. The accessible portion of the bottom level shows the same type of copper mineralization and the eastern face is reported to be in ore.

Unfortunately only one crosscut was driven in the entire sulphide area (Fig. 2). Less than one-half of this was accessible at the time of the examination. Due to this lack of crosscutting, together with the notable erratic size and form of limestone replacement bodies, the average thickness of the copper mineralization is indeterminate.

The individual stopes throughout the mine show a great diversity in the thickness of the ore removed, varying from 4 to possibly 60 feet. Judging from all the observations that the mine workings permit, a reasonable estimate of the average thickness of the sulphide mineralization for the entire length is presumed to be 20 feet.

Using a length of 400 feet and an average thickness of 20 feet, the mineralized zone would yield some 665 tons per foot of depth. The indicated depth down the dip from the 350 level, which is the approximate top of the sulphide zone, to the bottom level is 130 feet. Thus the sulphide tonnage estimate would be 100,000 tons, including measured, indicated, and inferred ore. Owing to the

limited underground workings a breakdown into these three classes only could be done upon an arbitrary basis and would seem to have little significance. Some 10 percent of the total tonnage perhaps could represent an estimate of the measured ore.

The exposures of sulphide ore on the three lower levels were sampled, for the most part, at 20-foot intervals by the writer in July 1948. Channels about 5 inches wide and 1 inch deep were cut from the sides of the drifts. The weighted average of these samples was 0.038 ounces gold, 0.24 ounces silver a ton, and 1.14 percent copper. The weighted average of all lots of sulphide ore shipped according to the operator's records, coming from the same portions of the drifts as were sampled, was 0.027 ounces gold, 0.24 ounces silver a ton, and 1.30 percent copper. The samples were thus 0.16 percent lower in copper than the drift shipments. As it was impossible to sample the better ore that had been removed from the sulphide stope on the 415 level, the tonnage represented by this stope was weighted with the tonnage represented by the drifts. This gave an average representing all the exposed ore of 0.03 ounces gold, 0.3 ounces silver, and 1.32 percent copper.

The company records show that a total of 4,573 tons of sulphide ores, coming from both the drifts and stope, were shipped, the average of which was 0.028 ounces gold, 0.26 ounces silver, and 1.47 percent copper. This grade represents the shipments but

does not necessarily represent the average value of the exposed ore for there is evidence on the dump that all the sulphide ore removed from the mine was not shipped. In view of this fact, the writer is of the opinion that perhaps the results of the sampling weighted with the respective tonnage is as fairly representative of the grade of the ore as present mine exposures will permit. The estimated value of the reserves thus are taken to be 0.03 ounces gold, 0.3 ounces silver a ton, and 1.32 percent copper, with no allowance made for dilution. This average may or may not represent the grade of the deposit as a whole. Both the ore shipments and the channel samples came, for the most part, from the footwall section of the mineralization. The top of the sample channel was in most cases limited by the height of the drift, rather than by the termination of ore. In other words, the ore continued for some unknown distance above the back of the drift. If the average thickness of the mineralization is 20 feet as estimated, the samples and shipments represent only about 7 feet of this thickness. Where higher strands of unexposed mineralization occur above the back of the present drifts their value is unknown and probably would not have the same copper content as the material exposed in the footwall portion.

PRESENT STATUS

Exploration and Development

The major exploration and development openings on the Yuma Copper property consist of the following (Fig. 2):

A vertical shaft, 140 feet deep, connected at the bottom with an incline shaft (30°) having a length of about 310 feet (Fig. 3). An adit 680 feet long, driven in a southeasterly direction, connects with the top of an incline winze (26°). The elevation of the adit level is about 125 feet vertically below the collar of the vertical shaft. Below the adit level the mineralized limestone has been explored by four levels, i.e., the 140, 350, 415, and the bottom level, which is about 60 feet below the 415. All of these levels, with the exception of the deepest, are connected with the incline winze, the bottom of which is about 30 feet below the 415 level.

The 140 level has about 265 feet of drift, and one 30-foot crosscut.

The second level below the adit, known as the 350, extends for about 220 feet east and 45 feet west from the incline winze. At a point some 50 feet east of winze the drift forks with a northeasterly branch which extends some 85 feet. 795 tons of selectively mined oxide ore was stoped from the westerly end of

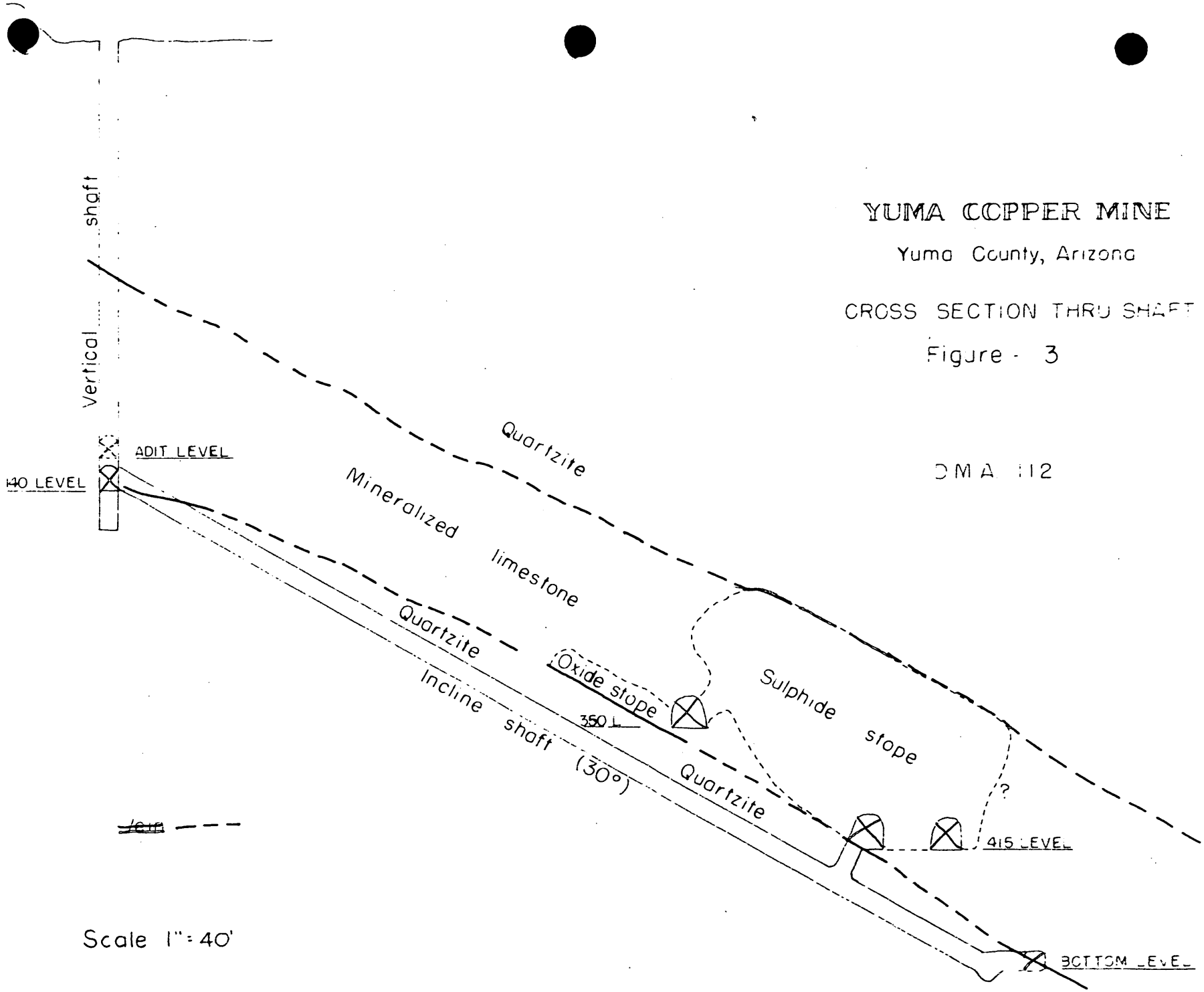
YUMA COPPER MINE

Yuma County, Arizona

CROSS SECTION THRU SHAFT

Figure - 3

DMA 112



this level. The stope dimensions, as shown, were a 45-foot strike length, and 45 feet up the dip, with an average thickness stoped of about 4.5 feet. The company records show this ore averaged 2.53 percent copper with 0.02 ounces gold, and 0.3 ounces of silver a ton. Immediately east of the easterly side of this stope, the first sulphide mineralization makes its appearance and continues to the eastern face of the drift. The assay results of 10 samples taken in the sulphide ore are given in the appendix. The location of the samples with corresponding numbers are shown on the composite level map (fig. 2). The weighted average of these 10 samples was 0.06 ounces gold, 0.20 ounces silver a ton, and 1.12 percent copper.

The face of the 415 level is some 520 feet east of the incline winze. The first 120 feet of this level from the winze is in hard, unaltered lime silicates showing no copper. From this point the sulphide mineralization, with variable copper content, continues along the footwall to the western-most face of the drift. From the point where sulphides first appear, a drift about 35 feet north and parallel to the main footwall level extends 260 feet east of the winze. This northerly drift for the most part was either caved or tightly timbered so that only the eastern-most 25 feet could be examined. The limestone was very poorly mineralized in this area, so that it would appear to limit the thickness of the copper mineralization in this vicinity to not more than 20 feet. Some

70 feet west of this area the stope discloses a well mineralized thickness of possibly 60 feet. Between the easterly side of the above stope and the face of the north drift, the company map shows two crosscuts. One was open through which the northerly drift was reached. The other, as shown, extends some 45 feet further north but was caved and inaccessible.

The so-called sulphide stope above the 415 level lies adjacent to the westerly limits of the mineralization. It represents the only stoping attempted in the sulphide area, and was carried through to the level above. The stope was inaccessible at the time of this examination but the upper portion could be observed from an opening on the 350 level. It has a strike length of about 60 feet on the lower level (415) and tapers up the dip to a length of some 20 feet at the 350 level. The average thickness of the ore that was mined from this area is unknown. The company's records show that 1,823 tons was shipped from this stope, having an average grade of 0.03 ounces gold, 0.29 ounces silver a ton, and 1.66 percent copper.

The results of the channel samples taken in 1948 by the writer, covering the 415 level eastward from the stoped area, are given in the appendix with their locations shown on the level map (Fig. 2). The weighted average of these 15 samples was 0.03 ounces gold, 0.22 ounces silver a ton, and 1.10 percent copper. The average length of the sample channel was 6.4 feet. This length was

limited for the most part by the height of the drift, as it was evident that the true thickness of the mineralization was greater in most places than that exposed by the back of the drift.

The bottom level is shown on the map as extending about 120 feet east from the bottom of the incline shaft. Owing to a caved area, it was only possible to examine the first 50 feet adjoining the shaft. For the first 30 feet east of the shaft the drift was driven in unmineralized lime silicates. At that point a band of sulphides made its appearance and widened rapidly eastward to the full height of the drift.

A sample was cut some 45 feet east of the shaft from the back of the drift to the floor (8.2 feet). This sample, No. 31, assayed 0.01 ounces gold, 0.30 ounces silver a ton, and 1.47 percent copper. The company records show that some 36 tons, coming from the area of the eastern face of this level, was shipped. The lot is reported to have contained 0.028 ounces gold, 0.39 ounces silver a ton, and 2.08 percent copper.

Some diamond drilling evidently was done in an effort to determine the thickness of the copper mineralization. No logs or other data concerning the results of this work are available. It is said that the friable nature of the material prevented core recovery. This was no doubt true.

Mining and Milling Equipment

Most of the former mining equipment has been removed from the property. The mine has never had a mill. The present buildings on the property consist of a change room, blacksmith shop, and three small frame cabins. Water is being pumped from the mine one day each week. A 40-h.p. 2-stage centrifugal pump, located just above the bottom level, is used for this purpose. A 50-k.w. International Diesel unit supplies electric power for the operation of the pump and for a 20-h.p. single-drum electric hoist which is situated at the collar of the incline winze. Several one-ton ore cars, together with most of the track, still remain in the mine.

PROJECT PROPOSALS

Exploration and Development

The proposed exploration and development program for the Yuma mine as set forth in the lease application is as follows:

Shaft extension (300 feet @ $60)	$18,000
Crosscutting and drifting (1,000 feet @ $30)	30,000
Diamond drilling (5,000 feet @ $5)	25,000
Total	$73,000

This proposal by the applicant is so general that the following comments appear in order. The shaft extension should not be undertaken until further drifting, crosscutting, and raising has fully delineated the size, shape and value of the mineralized horizon on the present levels. Diamond drilling has proven

unsuitable for exploration at this property because the ore is so friable it will not core. Crosscuts and raises therefore are recommended in the place of diamond drilling.

The estimated cost of an initial exploration program would probably be about $50,000, exclusive of overhead and the cost of the necessary equipment.

This general procedure could possibly outline 100,000 tons of copper-bearing material which, at current metal prices, would probably prove to be of submarginal grade.

New Equipment and Facilities

The applicant's estimated cost for new mining equipment is listed below:

Compressor, 800 cfm. displacement	$12,500
Hoist, 70 H.P. electric, with 5-ton skip	8,000
Battery tramser and side dump cars	9,000
Electrical installation	8,000
Mucking machine	4,000
Air drills and other equipment	6,000
Total	$48,500

This expenditure probably would be in order if and when the mine were called upon to produce 200 tons of ore daily. To carry out the initial exploration as recommended above, new mine equipment could be limited to a cost of about $25,000, estimated as follows:

Compressor - 420 cfm., Diesel motor	$10,000
Hoist, 23 H.P. electric, with 1-ton skip	4,000
Mucking machine	3,000
Air drills and hose	4,000
Miscellaneous pipe, track, etc.	4,000
Total	$25,000

The nature of the other expenditures as shown in the application are given below:

<u>Buildings and Camp Facilities</u>:

Land and land improvements - new camp roads and general site grading	$7,000
Repair to existing domestic water well, installation of pump and 3,000 gallon tank	$4,000
Road improvement and yards	1,000
Power substation and low voltage distributer lines (exterior)	8,000
Camp sewer system	2,000
Oil storage	1,500
Cleaning up after construction	500
Total	$17,000
Five miles of power line to property	10,000
Engineering and design costs	20,000
Construction general expense: (accounting, legal, purchasing, clerical, telegrams, telephone, general supervision, travel and subsistence)	25,000
Total	$45,000

Buildings - Frame with corrugated iron siding and roof. All to be lined with composition board except shops, warehouse and garage:

10 bunkhouses (10 ft. by 12 ft. with partition-one man to a room)	$8,640
1 Superintendent's cottage	3,000
1 Foreman's cottage	4,000
1 Office building	2,500
4 cottages, one bedroom	8,000
1 Laboratory building	2,000
1 Warehouse and tool room	2,500
1 Oil house	750
1 Shed for 4 trucks and 10 cars	1,250
1 Boarding house, 20 ft. by 60 ft.	2,500
Shop building, 20 ft. by 40 ft.	2,000
Change house, 30 ft. by 30 ft.	4,000
Total buildings	$41,000

Furniture, furnishing and fixtures	$5,000
Portable tools, welder, electric hand tools	3,000
<u>Automotive equipment:</u> 1 1½-ton dump truck 1 2-ton flatbed truck 1 ½-ton pickup truck 1 Station wagon 1 - 40 Tractor with front end loader and dozer Total automotive equipment	$11,300
<u>Operating capital for first three months operation:</u> During the period of mine development and pending the completion of mill, ore will be stockpiled	40,000
<u>Material and supplies:</u> This allowance is made for such supplies as explosives, gasoline, fuel oil, lubricating oils, grease, reagents, pipe, fittings, hardware, etc.	30,000
Heavy Machinery spare parts and replacements	10,000
Machinery cost list for 200-ton flotation plant	87,640
Total	$428,580

Applicant in the summary estimate of expenditures lists the total completed cost of the proposed 200-ton flotation plant at	240,000
Machinery cost for mill (given above)	87,640
	$152,360

It is presumed this difference of $152,360 must represent the cost of grading the mill site, freight on equipment, construction of mill buildings and installation of machinery.

Some errors in addition were made in the application:

Total loan (corrected)	$580,940.00
Contingencies 10%	58,094.00
Corrected total of loan requested	$639,034.00

The expenditure of this sum on the Yuma Copper property most certainly is not justified at this time. In fact it does not seem, under present economic conditions, advisable to even recommend further exploration. The applicant, up to this time, has shown no desire to participate in an exploration loan. The aspect of the whole matter perhaps would be changed if a substantial copper premium were established.

Transportation

Transportation to and from the Yuma Copper mine presents no problems. A good dirt road branching off of State Highway 72 at McVay siding leads to the mine. This distance is about 6 miles.

Manpower

The manpower problem in isolated desert mining camps is becoming more difficult each year. There is a general shortage of miners and it is difficult to get men to live in camps removed from larger towns. Other than a few of the "old timers" residing in the district, all employees would have to be imported from other areas. In order to get and keep good workmen some form of higher compensation than they could earn elsewhere no doubt would be necessary. The applicant estimates that about 55 men will be necessary to operate the property at 200 tons a day.

Power

No electrical power line comes into Yuma Copper property. The nearest trunk line, belonging to the Central Arizona Light and Power Co., is about 5 miles from the mine. The applicant proposes in the loan application to construct a transmission line to the property at a cost of $10,000, exclusive of the substation.

The mine now has a 30-k.w. Diesel-powered generating unit which is used to furnish electricity for the mine pump and a small electric hoist located at the collar of the incline winze.

Water

The inflow of water into the bottom level of the mine is reported to be about 60 gallons a minute. This amount would be ample for a 200-ton mill.

A well sunk in the wash about one mile southwest of the mine is said to serve as a source of domestic water.

PRODUCTION PLAN

Time Schedule for Completion of Project

The applicant states that 60 days after funds are available the engineering design, surface improvements, and mine preparation work would be completed and development started. The mill would be ready to operate in 6 months, and operation of both mine and mill would be up to rated capacity 9 months after starting the work.

Rate of Production

The maximum capacity of the proposed plant as given in the application is 200 tons of ore daily, yielding 155,125 pounds of copper per month.

Mining Methods and Costs

The low dip (30°) of the Yuma ore bodies limits the choice of a mining system to those of the relatively high-cost underground methods. The cheaper open-pit and block-caving system are not suited to this deposit. Too little is know of the size, shape and strength of the hanging wall to be precise as to the best methods and cost of mining. It is apparent from the few old stopes in the mine that widths or thicknesses of the mineralization vary greatly as does the condition of the walls. The presence of numerous transverse post mineral dikes no doubt will offer problems in the course of mining.

The mining method that seems best suited to the deposit would be a room and pillar system, advancing up the dip and using slusher hoists to pull the broken ore down into cars on the haulage level. The size of the rooms, and the pillars left to support the back of the stope would depend upon the local strength of the hanging wall. By retreating from the margin of the deposit some pillar recovery would be possible after the room was completed and before the back was allowed to cave. Complete recovery of the ore, however, would not be possible.

In the thicker portions of the ore body the room would be advanced in benches, keeping the top bench ahead so the back could be reached and properly scaled. Column-mounted light drifters could be used for drilling the upper bench while employing jackhammers for the lower. In narrow portions of ore where timber stulls or props were practical, no ore need be left for pillar support. No records of former mining costs on this property are available.

The cost of a room-and-pillar method of mining in 1940 at another Arizona mine, under somewhat comparable conditions, was about $1.50 a ton. Using this as a basis, the present-day cost estimate for the Yuma mine would be at least $4.00 a ton for mining. The cost of exploration and development would probably amount to about $1.00 a ton. Thus the total mining costs are estimated at $5.00 a ton.

Milling Methods and Costs

In June 1945, the Salt Lake Intermountain Experiment Station of the Bureau of Mines made some laboratory flotation tests on ore from the Yuma mine. The sample contained 1.65 percent copper, 0.035 ounces gold and 0.30 ounces of silver a ton. The results of the test work showed that a 98 percent recovery of copper was possible in a concentrate assaying 28.4 percent copper, 0.52 ounces gold and 5.7 ounces of silver a ton. The indicated

gold and silver recovery was 74 and 67 percent, respectively. Judging from this test work the ore should respond well to concentration by simple flotation.

In the Southwest, at this time, the operating costs of relatively small flotation mills generally range around $3.30 a ton of ore treated. This would appear to be a reasonable estimate of the milling cost for the proposed 200-ton plant to be erected at the Tuma Copper property. The estimate of $3.30 a ton does not include the marketing cost of the copper concentrates.

Marketing Costs

From a recent smelter schedule furnished by the American Smelting & Refining Co., the cost of marketing a ton of copper concentrate, of the grade shown by the test work, is estimated as follows:

Trucking (6.5 miles) per wet ton	$1.00
Rail freight to El Paso (with 10% moisture)	10.50
Smelting charges	8.69
Total marketing cost per ton of concentrate	$20.19

With a ratio of concentration of 21.6 to 1, the cost of marketing would be $0.93 a ton of ore.

Taxes and Insurance

In a private report on the Tuma mine attached to the loan application, J. S. Coupal estimated the taxes and insurance at $0.40 a ton of ore milled. In view of the ever increasing tax burden this is probably an optimistic estimate, but will be used in the tabulation of the total costs.

Royalty

Under the terms of the present leases and options that the applicant has made with the owners of the Yuma property, he is obligated to pay as royalty 7.5 percent of the net smelter value of the ore.

On the basis of the average grade of exposed ore, as estimated in this report, and using the metal recoveries as indicated from the test work, the net smelter value is computed as follows.

Gold -- 0.03 ounces x 74% = 0.022 ounces recovered
Silver - 0.30 ounces x 67.4% = 0.202 " "
Copper - 1.32 percent= 26.4 lbs. x 98% = 25.87 lbs. recovered
With a ratio of 21.6 to 1, the concentrate will assay:
Gold -- 0.48 ounces per ton
Silver -- 4.37 " " "
Copper -- 38.0 percent= 760 lbs. per ton.

Outcome at El Paso Smelting works:		Per Ton
Payments:	Gold- 0.48 ozs. @ $32.3185	$15.51
	Silver-4.37 ozs. @ $0.885	3.87
	Copper-760 lbs. less 20 lbs. @ 0.21075	113.81
	Total	$133.19

With a ratio of concentration of 21.6 to 1 the net smelter value of ore at the mine before marketing is $6.17 a ton.

Deductions:	Base charge	8.00	
	Converting charge	0.31	
	Bullion frt.& tax	0.18	8.49
F.O.B. El Paso Plant			$124.50
Less freight & tax (10% moisture)			10.50
Net per ton concentrates at McVay			$114.00
Cost of trucking to McVay (10% moisture)			1.00
Net per ton concentrate at mine			$113.00

With ratio of concentration of 21.6 to 1 the net smelter value a ton of ore after marketing is $5.23. At 7.5 percent the royalty would be $0.39 a ton of ore milled.

SUMMARY

The estimated operating costs of the Yuma Copper mine are tabulated below.

	per ton milled
Mining	$4.00
Exploration and development	1.00
Milling	3.50
Marketing concentrates	0.83
Taxes and insurance	0.40
Royalty	0.39
Overhead 1/	
Total	$10.22

Based on the average grade as estimated in this report the receverable value of the Yuma mine ore is $6.17 a ton at current metal prices. The estimated operating costs, not including depreciation, depletion, or amortization, amount to $10.22 a ton. Thus the operation of the property at this time would result in a loss of at least $4.00 a ton of ore treated. The copper produced, with the gold and silver credit, would cost about 35 cents per pound.

CONCLUSIONS AND RECOMMENDATIONS 2/

Additional exploration in the Yuma copper mine is needed to determine the limits of the know sulfide ore. No reliable tonnage estimate of ore can be made until this exploration is done. Exploration should consist of underground drifting eastward on the three levels containing sulfide ore, and a series of crosscuts or

1/ A reasonable local operating overhead is included in the estimated mining and milling costs.
2/ Prepared jointly by Anderson, W. A., and Farnham, L.L.

inclined raises to determine accurately the footwall and hanging wall of the mineralized zone and thickness of the ore lenses. Diamond drilling would not be fruitful because of the friable nature of the sulfide ore.

The applicant was informed of the procedure for obtaining an exploration loan on a matching basis, and at the time of the writing of this report, (June 5, 1951), the applicant has shown no interest nor desire to participate in an exploration loan. The grade of the exposed sulfide ore is too low in relation to the potential tonnage of the deposit to encourage an exploration program unless the applicant would be assured of a higher price for copper. Therefore, it is recommended that no consideration be given at this time to an application for an exploration loan on the Yuma Copper mine.

The surface showings on the Arizona group of claims are not sufficiently encouraging to recommend exploration on those claims.

ORO MINING CORPORATION
YUMA COPPER MINE
YUMA COUNTY, ARIZONA

APPENDIX

Sampling Results

YUMA COPPER MINE

200 Level - Sulphide Mineralization[1]

No.	Width Feet	Assay Ounces Gold	Assay Ounces Silver	Assay Percent Copper
1	7.0	0.06	0.20	1.00
2	7.0	0.04	0.20	1.43
3	6.7	0.06	0.30	0.87
4	6.3	0.05	0.30	0.76
5	7.1	0.04	0.20	0.65
6	8.2	0.04	0.30	1.30
7	9.0	0.02	0.20	1.34
8	5.5	0.04	0.20	1.36
9	9.0	0.06	0.30	1.30
10	9.0	0.05	0.30	1.34

20 Samples average: 7.1 Feet - 0.04 Ounces Gold - 0.2 Ounces Silver - 1.22 Percent Copper

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1/ Sampled by L. L. Fanshawe in July 1941.

TUNA COPPER MINE

435 Level - Sulphide Mineralization [1]

No.	Width Feet	Assay Ounces Gold	Assay Ounces Silver	Assay Percent Copper
11	6.0	0.04	0.20	0.87
12	5.0	0.04	0.30	0.92
13	7.2	0.38	0.20	0.87
14	7.0	0.05	0.30	1.14
15	4.0	0.03	0.10	0.70
16	Center Mine - No Sample			
17	4.5	0.04	0.20	1.52
18	7.0	0.02	0.20	1.09
19	4.5	0.01	0.20	0.90
20	6.5	0.02	0.30	2.01
21	6.4	0.02	0.30	0.43
22	6.0	0.02	0.30	0.[illegible]
23	3.6	0.01	0.20	0.[illegible]
24	5.8	0.01	0.30	1.30
25	5.5	0.02	0.30	0.74
26	6.1	0.03	0.30	0.87
27	6.0	0.03	0.30	0.87
28	10.2	0.03	0.30	1.90
29	5.6	0.03	0.30	1.30

15 Samples average: 6.4 Feet - 0.03 Ounces Gold - 0.22 Ounces Silver - 1.10 Percent Copper

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1/ Sampled by L. L. Farnham, July 1946.

YUMA COPPER MINE

Bottom Level - Sulphide Mineralization[1/]

No.	Width Feet	Assay Ounces Gold	Assay Ounces Silver	Assay Percent Copper
XI	8.2	0.01	0.30	1.47

1/ Sampled by L. L. Fanham, July 1948.

ORO MINING COMPANY, YUMA COPPER MINE
YUMA COUNTY, ARIZONA

Geology and Ore Reserves

By Charles A. Anderson
Geologist, U. S. Geological Survey

Geology

GRO MINING COMPANY, YUMA COPPER MINE
YUMA COUNTY, ARIZONA

CONTENTS

	Page
Geology and Ore Reserves	
General Geologic Setting	1
Ore-Bearing Formations	2
Occurrence of Ore	2
Ore Reserves	4
Conclusions	6

ILLUSTRATIONS
(Accompany Engineering Report)

Fig. 1 Location Map

Fig. 2 Composite Level Map, Yuma Copper Mine

Fig. 3 Sketch Section

GEOLOGY AND ORE RESERVES

General Geologic Setting

The Yuma Copper mine is located in a sequence of metamorphosed sedimentary rocks that were largely sandstone and shale, and were recrystallized to quartzite and quartz-mica schist. Intercalated limestone beds have been metamorphosed to marble and tactite. The tactite contains garnet, actinolite, chlorite, epidote, and tremolite.

The metamorphism of the sedimentary rocks is related presumably to a large intrusive body of granite exposed a mile or more to the northwest, as the metamorphic assemblage in the limestone is typical of contact metamorphism. No exposures of the granite were observed near the Yuma mine.

Dikes and sills of diabase are common in the area, and some of the larger masses, 50 to 100 feet in thickness, are medium- to coarse-grained in texture. The dikes, in general, strike west of north, and in the mine, range from several inches to 30 feet in thickness. The diabase dikes are clearly younger than the ore, for they are fresh and non-mineralized and contain inclusions of ore.

Very little information is available concerning the regional geology of this area. The meta-sedimentary rocks are probably of Paleozoic or Mesozoic age, and the presumption would be that the intrusion of the granite and mineralization took place at the close of the Cretaceous, similar to much of the copper mineralization in Arizona.

Ore-Bearing Formations

At the Yuma mine, the ore occurs in metamorphosed limestone, 50 to 100 feet in thickness. Reconnaissance studies suggest that the limestone is thicker at the mine and thins to the east and to the west. In detail the bedding in the limestone is highly contorted, and variable in dip, although the regional dip of the formation is to the north, ranging from 25° to 30°. The regional strike is east-west with some local variation. It appears that the garnet-rich layers of the metamorphosed limestone are more common on the footwall side. Actinolite-rich layers are present throughout the sequence.

About a mile to the southwest of the Yuma mine on the Arizona group of claims, the metamorphosed sediments strike north and dip 30° west. A bed of limestone, 200 feet thick, is exposed, and at the base of the limestone, 10 to 15 feet of magnetite is present that replaced the limestone parallel to the bedding. The magnetite is not pure as lime silicates and calcite are interstitial to the magnetite grains. Several prospect pits reveal copper carbonate stains, forming scattered mineralized zones several inches to a foot in thickness. Above the magnetite, the limestone is buff-colored and contains some lime silicates of metamorphic origin.

Occurrence of Ore

In the upper levels of the Yuma mine, the copper is present as carbonate and some of the higher grade copper ore that has been shipped came from stopes in this part of the mine. This oxidized ore forms lenses parallel to bedding, 5 to 8 feet thick. Some

of the oxide ore came from the footwall of the limestone and some from near the hanging wall. These lenses are separated by barren limestone and tactite. Apparently, most of the minable oxidized copper ore has been removed.

The potential copper ore from the Yuma mine is sulfide ore, exposed on the 350-foot level, 70 feet east of the main winze, and exposed on the two lower levels east of the winze and shaft (fig. 2). This sulfide ore consists of primary minerals, pyrite and chalcopyrite with local coatings of covellite on chalcopyrite. The pyrite and chalcopyrite occur as small granules, disseminated and instreaks parallel to and transverse to the bedding. The gangue consists of a friable aggregate of calcite, garnet, actinolite, tremolite, chlorite, epidote, and sparse quartz. The richer sulfide portions appear to be concentrated where garnet or actinolite are important constituents so that the gangue is brown or greenish-gray in color. Sulfide content appears to be lower where calcite or tremolite are the main constituents.

The ore breaks down readily to a sand because of the friable nature of the gangue, and horses of waste in the ore-zone consist of hard massive tactite or limestone. Outside of the ore-zone, the limestone formation is hard and massive, suggesting that friable gangue is an indication of probable sulfide occurrence.

Intense crumpling and crushing of the limestone in the ore-zone suggests that deformation of the limestone may have been an important control in the localization of the sulfide minerals.

The limestone is not completely mineralized in the zone where sulfide minerals are present, so that the ore-zone is of variable thickness; but the underground workings are too limited in distribution to expose the complete zone of mineralized rock.

The western boundary of the mineralized zone in the limestone rakes eastward, between 40° and 50°, as shown by the western margin of the stopes and occurrence of copper minerals in the drifts. The heaviest zone of gossan at the surface is exposed about the portal area of the adit level, also suggesting the eastward rake of the ore-zone. The surface outcrops show little gossan or friable gangue to the east of the portal area, indicating that the horizontal length of the mineralized zone is limited, although the eastern margin of the sulfide zone has not been reached in the present underground workings.

In a private report, attached to the docket, J. S. Coupal has suggested that a zone of enrichment may be encountered in depth. No evidence in support of this view has been found. Only primary sulfides, except for local covellite coatings, have been found, and it is well known that in the presence of carbonate gangue, copper does not migrate far. Therefore, no hope of higher grade copper in depth can be entertained.

Ore Reserves[1/]

In the private report attached to the docket, J. S. Coupal has suggested that the present underground workings indicate approximately 300,000 tons of sulfide ore. This is based on the assumption that the ore is in a block 400 feet long, 130 feet down the dip, and 70 feet thick.

1/ Prepared jointly by C. A. Anderson and L. L. Farnham.

The eastern limit of the ore body and its depth and thickness are not known. Sulfide ore is exposed at the eastern face of the 350-foot and 415-foot levels. A horizontal length of 400 feet is indicated on the 415-foot level. The bottom level is caved 60 feet from the inclined shaft, and only 30 feet of ore is exposed on this level, but the exposed ore does indicate a slope distance of 130 feet. The thickness of 70 feet used by Coupal, is unduly optimistic. In the sulfide stope, the local thickness of the mineralization is possibly 60 feet, but to the east in the 415-foot level, where one crosscut exposes the ore, a thickness of only 20 feet of ore can be observed, and this thickness appears to be a better estimate for the average thickness of the ore-zone as a whole. Using this thickness, the tonnage estimate would be approximately 100,000 tons of measured, indicated, and inferred ore. A breakdown into these three classes of ore is difficult owing to the lack of information as the actual thickness of the ore.

The detailed channel sampling by Farnham gives the best measure of the grade of the sulfide ore exposed in the drifts because the ore that has been shipped obviously does not include some of the lower grade portions that are present on the dump at the portal of the adit. The average of Farnham's samples is as follows:

350-foot level	0.06 oz. Au/ton	0.2 oz. Ag/ton	1.12% Cu
415-foot level	0.03 oz. Au/ton	0.22 oz. Ag/ton	1.10% Cu

Farnham has calculated the weighted average of the sulfide ore by using the grade and tonnage of ore mined from the sulfide stope, and tonnage represented by the above samples. This weighted average is as follows:

0.03 oz. Au/ton 0.3 oz. Ag/ton 1.32% Cu

Additional tonnage of sulfide ore can be expected by exploration to the east in all three levels, and in depth. Sulfide replacement bodies in limestone are notably erratic in form, and not enough information is available to predict the form of the known sulfide ore-zone. Surface indications are unfavorable for a long lateral eastward extension, and the best estimate of the potential tonnage of the ore-bearing limestone in the Yuma mine is of the order of magnitude of 300,000 to 500,000 tons, an estimate that is believed to be optimistic as to extensions in depth and in length. Considering the low grade of the copper content in the exposed sulfide ore, this potential tonnage is low for the anticipated grade of copper.

Conclusions

Conclusions are included in the engineering section of this report.