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Arizona Geological Survey
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inquiries@azgs.az.gov

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Set up File

November 10, 1970

DOVER MINE

An investigation of the Dover Mine property near Morenci reveals ownership by Auto Specialty Manufacturing Company, located at 643 Graves Street, St. Joseph, Michigan - (616) 983-2521.

This company produces hydraulic jacks, malleable iron castings, and disc brakes. It has five plant locations - three in Michigan, one in Ohio and one in Canada. It has a Dunn & Bradstreet credit rating of AAA1. A D&B is being forwarded by Van Aman.

Guy Anderson reports that the owner of the company and the mining property was a Mr. Tesconia. Mr. Tesconia is dead and his widow lives in Tucson. Other relatives in the Safford area have approached Guy regarding disposition of the property. He is checking this further.

H. Lanier:td

File
Dover Mining Co.

POSSIBLE TERMS

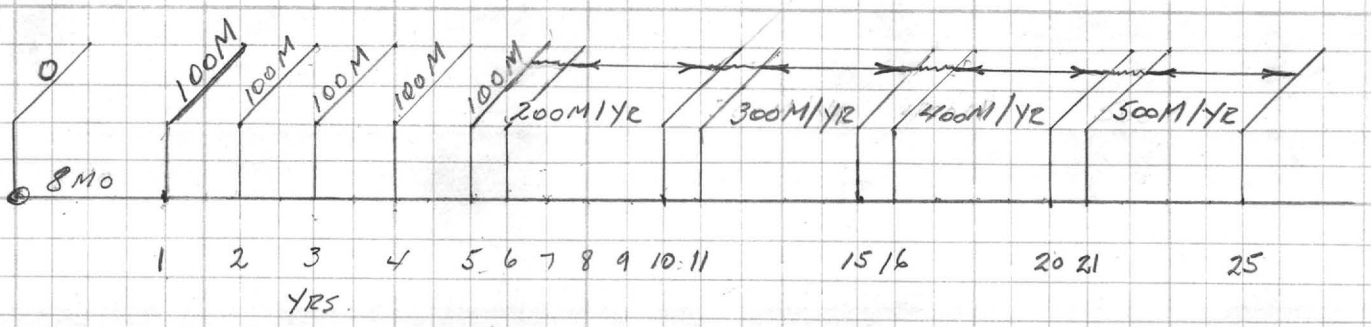
DOVER LEASE AND OPTION

May 8, 1972

240 Days No Fee

Years	1 - 5	$ 100,000 year
	5 - 10	200,000 year
	10 - 15	300,000 year
	15 - 20	400,000 year
	20 - 25	500,000 year
	Total	$7,500,000

5/8/72



WANTED PRESENT WORTH DISCOUNTED @ 8% INTEREST.

I PW = (21-25) = 500 + 500 (3.31213) = (500 + 1656) = 2156 (.21455) = $462.6 M

II PW = (16-20) = 400 + 400 (3.31213) = 400 + 1325 = 1725 (.31524) = 543.8 M

III PW = (11-15) = 300 + 300 (3.31213) = 300 + 994 = 1294 (.46319) = 599.4 M

IV PW = (6-10) = 200 + 200 (3.31213) = 200 + 662 = 862 (.68058) = 586.7 M

V PW = (1-5) = 100 + 100 (3.31213) = 100 + 331 = 431 (1.0000) = 431.0 M

2614.5

PW = at 0 = 2614.5 X .94232 = $2463.7 M

P.W. TO DAY → $2,463,700 Discounted at 8%

CEO

5/8/72

VI 0 - 240 DAYS FREE

V then $100,000 PER YR. 1-5 YRS

IV 200,000 " " 6-10

III 300,000 " " 11-15

II 400,000 " " 16-20

I 500,000 " " 21-25

} Present-Worth discounted at 10%

I PW = (21-25) = 500 + 500 (3.16987) = [500 + 1585] .14864 = $ 309,900

II PW = (16-20) = 400 + 400 (3.16987) = [400 + 1268] .23939 = 389,700

III PW = (11-15) = 300 + 300 (3.16987) = [300 + 951] .38554 = 482,300

IV PW = (6-10) = 200 + 200 (3.16987) = [200 + 634] .62092 = 517,840

V PW = (1-5) = 100 + 100 (3.16987) = [100 + 317] 1.0000 = 417,000

$ 2,116,740

VI PW = 2,116,740 × .93972 = $ 1,989,140

CEO

File Dover Mining Co.

1723 Skyview Drive
San Leandro, Ca. 94577
May 29, 1972

SXM

MAY 31 1972

RECEIVED

Mr. Paul Eimon
Essex International, Inc.
1704 West Grant Road
Tucson, Arizona 85705

Dear Paul:

This will confirm our appointment in your office at 1:15 pm, Thursday June 8, 1972, for further talks regarding the Dover Copper Mining Company. Should there be any change in plans from this end, I will immediately contact you. I plan to arrive at the Tucson airport at 11:15 am, that day, via Airwest Flight Number 941.

Sincerely

David Jones
Mining Engineer

POSSIBLE TERMS

DOVER LEASE AND OPTION

May 8, 1972

240 Days No Fee

Years	1 - 5	$ 100,000 year
	5 - 10	200,000 year
	10 - 15	300,000 year
	15 - 20	400,000 year
	20 - 25	500,000 year
	Total	$7,500,000

Memorandum from . . .

HOWARD LANIER

Terri —

Do we have a prospect file & number for DOVER.

This should be filed there

PLEASE NOTE WHETHER NAME, BUSINESS AND STREET ADDRESS CORRESPOND WITH YOUR INQUIRY.

Dun & Bradstreet® ANALYTICAL REPORT

RATING UNCHANGED

SIC	D-U-N-S	© DUN & BRADSTREET, INC.	STARTED	RATING
37x14 37 29 33 22	00-511-9748 AUTO SPECIALTIES MANUFACTURING COMPANY (INC) CASTER MFG (DIV)	A AD 89 OCT 30 1970 PARTS FOR MOTOR VEHICLES & AIRPLANES	1909	Aa A1 Also Branches

H

643 GRAVES ST.
ST. JOSEPH, MICH 49085
TEL 616 983-2521

LESTER C. TISCORNIA, PRES, TREAS & CHIEF EXEC

SUMMARY

PAYMENTS	GEN PPT
SALES	$41,828,435
WORTH	$11,348,667
EMPLOYS	2,200 (2,000 HERE)
RECORD	BUSINESS
CONDITION	STRONG
TREND	UP

PAYMENTS

HC	OWE	P DUE	TERMS	SEPT 20 1970	SOLD
12700			1 10 & 25	Disc	Over 3 yrs
10000			2 10th prox	Disc	Over 3 yrs to 7-70
2000	2000	1000		Disc Cash our Request	Over 3 yrs to 8-13-70
150000				Ppt	Over 3 yrs to 8-22-70
30000				Ppt	
6000			Standard	Ppt	
160	150		N 30	Ppt	1 yr to 8-21-70
50	50		N 10	Ppt	Over 3 yrs to 8-12-70
10000				Ppt Cash own Option	Over 3 yrs to date
30000	22000		½ 10 30		Over 3 yrs to 8-11-70

HIGHLIGHTS

	JULY 31 1967	AUG 4 1968	AUG 3 1969
Current Assets	$ 8,607,671	$10,295,053	$10,866,310
Current Liabilities	4,669,985	4,341,789	5,101,672
Working Capital	3,937,686	5,953,264	5,764,638
Worth	10,252,542	10,772,198	11,348,667
Sales	34,000,000	35,245,584	41,828,435
Profits	220,000	589,212	618,382

This well established company dates back to 1909. Financial statements under review have continued to reflect a strong condition. Sales and profits increased during the last fiscal year and an overall upward trend is indicated.

CHANGES A warehouse is now maintained at Stockton, California.

CURRENT On Oct 30 1970, L. E. Gerber, Assistant Controller, deferred a late financial statement. Volume is reported to continue generally steady and to compare at favorable levels with the prior year.

Banking

Six into low seven figure balances maintained at local and out of town banks. Accommodations have been extended and handled as agreed. Relations are satisfactory.

11-3-70 (730-76) (1-16) (110)

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AUTO SPECIALTIES MANUFACTURING COMPANY (INC)
ST. JOSEPH, MICH

The following figures were submitted with an attached letter dated and signed by L. E. Gerber, on Feb 20, 1970. Accountants: Price Waterhouse & Co., CPA's.

	JULY 31 1967 (Individual) (Fiscal)	AUG 4 1968 (Individual) (Fiscal)	AUG 3 1969 (Individual) (Fiscal)
Cash	$ 968,052	$ 1,423,156	$ 1,367,970
Notes Receivable			200,000
Accounts Receivable	2,701,614	3,476,485	3,494,878
Inventory	4,607,502	4,949,078	5,272,957
Ppd Exps	) 330,503	) 446,334	263,068
Other Current Assets	)	)	267,310
TOTAL CURRENT ASSETS	8,607,671	10,295,053	10,866,310
Fixed Assets	6,535,740	6,713,962	6,989,204
Investments	1,098,624	1,105,283	958,298
CV Life Ins			54,179
Other Assets	133,492	85,689	56,348
TOTAL ASSETS	16,375,527	18,199,987	18,924,539
Due Banks	1,000,000		
Accounts Payable	1,246,259	1,603,111	1,115,360
Accruals	2,023,726	2,118,678	1,774,936
Taxes (Exc Fed Inc)			441,651
Federal Income Taxes			763,667
Long Term Liabilities (Curr)	400,000	620,000	620,000
Other Current Liabilities			386,058
TOTAL CURRENT LIABILITIES	4,669,985	4,341,789	5,101,672
Long Term Liabilities	1,453,000	3,086,000	2,474,000
Common Stock	8,383	8,383	8,383
Earned Surplus	10,244,159	10,763,815	11,340,284
TOTAL LIABILITIES	16,375,527	18,199,987	18,924,339
NET WORKING CAPITAL	3,937,686	5,953,264	5,764,638
CURRENT RATIO	1.84	2.37	2.13
TANGIBLE NET WORTH	10,252,542	10,772,198	11,348,667
SALES	34,000,000	35,245,584	41,828,435
PROFITS	220,000	589,212	618,382

At Aug 3 1969, receivables less allowance of $50,000 for doubtful accounts. Inventory valuation at the lower of cost of market. Fixed assets less depreication of $12,922,666.

(CONTINUED)

SUPPLEMENTAL DATA At Aug 3 1969 investments of $958,298 consisted of investment in other corporations. Long term liabilities, current portion of $620,000, consisted of notes payable bank. Long term liabilities of $2,474,000 consisted of the following: notes payable to the bank of $1,300,000 and notes payable other of $1,174,000.

Notice of financing statement filed with the Secretary of State's office on Jan 9, 1969, #859321. Debtor: Auto Specialties Manufacturing Company (Inc). Secured Party: Matierals Handling Equipment Corporation, South Bend, Indiana. Collateral: Specific equipment.

HISTORY Started: This business was started by members of the Tiscornia family at San Francisco, California in 1909. In 1910, the plant moved to Chicago, Illinois but later transferred to Joliet, Illinois and in 1917 to St. Joseph, Michigan. For many years the business was conducted as a corporation with a California charter but in 1929 was transferred to a Michigan corporation.

Incorporated: Michigan Jan 29 1929.
Authorized Capital Stock: 4,999 shares of $10 par value common stock composed of 4,899 shares Class A and 100 shares Class B stock.
Outstanding Capital Stock: 784 shares Class A and 54.25 shares of Class B at July 31 1965.

This company met with reverses during the depression years of the early 1930's and in 1932 creditors granted an extension on the then existing indebtedness. According to the company's letter to creditors, the total secured indebtedness amounted to $886,015 on Dec 31 1932. The balance of the extended debt was to mature Dec 31 1934 but another extension was granted at that time and final payment on remaining extended obligations was completed by May of 1938.

Control: All of the capital stock of this company is reported held or controlled by the Tiscornia family. Insurance of an undisclosed amount is carried on the lives of certain officers. Full particulars are not available.

Acquisitions: In September, 1969, Auto Specialties Manufacturing Company (Inc) acquired Caster Mfg. Corp., Barberton, Ohio. That business continues to be operated as a division: Caster Mfg (Div).

OPERATION Products: Manufactures components for motor vehicles, including tractors and including patented "Ausco Lambert" disc brakes and clutches (75%) and mechanical hydraulic and crub jacks. Also manufactures malleable and steel castings as well as brakes and other componetns for aircraft.

Distribution: Over 50% of sales are to leading automotive manufacturing concerns and dealers. The company also sells to aircraft and agricultural implement industry.
Number of Accounts: Over 1,500 accounts in all, but it is stated that not more than about 25% of the output is sold to any one account.
Territory: United States and a nominal amount is export.
Terms of Sale: To automobile manufacturers net 10th and 25th prox, jobbers 2% 10 and net 30 days.
Salesmen: 10 salesmen cover the automobile, tractor and other industrial trades in the sale of castings. Sales are also effected through the manufacturers agents.
Seasons: Volume fluctuates with the demand in the auto industry. However, diversification in recent years has minimized variance.
Employees: 2,200.

Divisions: Caster Mfg Div. at Barberton, Ohio.

(CONTINUED)

OPERATION (Cont'd) Branches: Branches are maintained at Hartford, Michigan; Riverside (Benton Harbor) Michigan; and Barberton, Ohio.

Facilities-Location: Owns and occupies a series of buildings housing general offices, machine shops and foundry. Plant is situated on a large tract of land in an industrial area and is serviced by a siding of the Chesapeake & Ohio Railroad. Buildings are in good repair.

SUBSIDIARIES Auto Specialties Manufacturing Company (Inc) has two subsidiaries. Both are wholly owned. Inter-company relations are stated to consist of occasional merchandise transactions on regular terms. It is stated that there are no inter-company loans, endorsements or guarantees. The subsidiaries are briefly described as follows:

Auto Specialties Manufacturing Co. (Canada Ltd), Windosr, Ontario, Canada, was organized in 1938 to succeed a direct company branch started in 1920. This business manufactures a line of products similar to those of the parent.

Lambert Brake Corporation, St. Joseph, Michigan, is an inactive name holding subsidiary. The parent company manufactures and sells on a royalty basis certain patented articles under an exclusive license granted by this subsidiary.

(CONTINUED)

+LESTER C. TISCORNIA, PRES & TREAS
+S. C. STANLEY, V PRES & CONTR
A. F. DEXEL, ASST SEC
LOREN E. GERBER, ASST CONTR
+STEPHEN H. PAUL, EXEC V PRES
+W. B. LAETZ, V PRES-MFG & SEC
E. S. PFTLICK, ASST TREAS
DIRECTORS: The officers marked (+) with Roland Mewhart

MANAGEMENT BACKGROUND

L. C. TISCORNIA was born in 1910 and is married. He is a nephew of the former president and has been associated here since 1947. From 1924 to 1947 he was a tax auditor for the State of California. He is also a director of Peoples State Bank, St. Joseph, Michigan.

PAUL was born in 1905 and has been associated here since 1935.

LAETZ was born in 1915 and is married. He is a graduate of Michigan State University and has been associated here since 1937.

STANLEY was born in 1912 and is married. He has been associated here since 1951 and was elected to his present office in 1964. Prior to 1951 he was employed in accounting capacity by A. M. Castle & Co., Chicago, Aparatus & Co. and Philco, also located at Chicago.

MEWHART is Chairman of the Board of Manufacturers National Bank, Detroit, Michigan.

PFTLICK and DEXEL have been employed by Auto Specialties Manufacturing Company (Inc) for a number of years and are active here in the capacities as indicated by their title.

GERBER has been associated here since 1969. Prior to that time he was associated with Clevite Corporation and Weatherhead Company in various plant controllership functions.
3-2-70 (546-88) (1-16) (85)
3-5-70 (88)

SPEED MEMO

To Marvin Neff. At Credit Dept. Ft. Wayne, Ind.

Subject D. & B. Report. Date 11/9/70

Howard James has requested that we send a D & B report to him on Auto Specialties (SPECIALTY?) Mfg. Co., 643 Graves Street, St. Joseph Michigan. Howards address is Essex International, Inc.; Copper Operation

PLEASE REPLY TO → Signed ~~Signed~~ Jerry VanAmon At Ft. Wayne.

1704 West Grant Road, Tucson Arizona Zip 85705.

He will do some work on Dover Mowing Company before we do or take any other action. Will you send the requested information this week if possible?

Date Signed

REPLIER—RETURN THIS COPY

Dover Prop.

CONTENTS and GENERAL INDEX

Exhibits:

* Supplemental Geology and General Economic Reference. . . . . .

* The above references may be had upon request to the Company's office, 643 Graves St., St. Joseph, Michigan

ABOUT THE AUTHOR

J.E. Busch, a registered Mining Engineer was born in Leadville, Colorado, lived in Aspen and Cripple Creek, and attended the Colorado School of Mines.

He worked in and around mines, assay offices, mills and ore-reduction plants when still a boy, and has spent his whole life in the mining industry and related activities in all parts of the western USA and in Alaska.

For thirty years he was employed on mining and mineral problems and trespasses by the United States Department of Interior. The work included examinations of all kinds of mining property, metallic and non-metallic, and adjudication of titles under the land and mining laws.

Following his retirement from the Government service, he was employed by the Arizona Department of Mineral Resources as a mining and mining-law consultant. During this time he prepared a booklet for the State Department on Mining Law and Regulations that has gone through its third edition.

At present he is doing private consulting work. His home is Tempe, Arizona.

TRANSMITTAL LETTER

30 E. 6th Street
Tempe, Arizona
February 24, 1954

Mr. W. V. Tiscornia
c/o Auto Specialties Manufacturing Co.
St. Joseph, Michigan

Dear Waldo:

In accordance with your instructions, I have prepared and transmit herewith a report on the mining property of the Dover Copper Mining Company. In addition to the geology and mineralization, I have sought to prepare somewhat of a composite report, in which, among other things, certain economic factors affecting copper mines have been set forth. Such data lengthens a report: however, it is pertinent because of today's rapidly changing conditions.

The report does not strictly follow standard patterns. Technical terms have been avoided wherever possible, though it is hoped at no sacrifice of clarity. Exact scientific meaning requires special terms. To assist in perusal of the report, I have attached a short glossary that will elucidate certain words and phrases. An index of the report will facilitate reference to any one subject, or claim group.

The appended maps are such as have heretofore been prepared by the Dover Company, excepting the one marked "Map No. 2." This is a surface geology map, adapted from that of this district by Dr. Waldemar Lindgren. As you are aware, my weakened heart condition precluded examination of old mine workings (i.e., stopes, old shafts, winzes, etc.), hence I could not submit any underground or assay maps upon my own surveys and sampling.

Further, most of my knowledge of the property was gained prior to the heart attack when I was examining the various claims for title (patent) purposes. The sole object then was an adequate "discovery of mineral in place," and the sufficiency of the mining improvements to satisfy the law and the U.S. Land Office. This did not necessitate such study of the geology and mineralization as would be required for economic purposes. In other words, that examination was solely for administrative purposes.

For readers not interested in details, I have endeavored to give an over-all synopsis in the "Abstract of Report," pages 1-2, and in the "General Summary," pages 66-67.

When one considers the large area of the property, its very promising indications of underlying ore bodies, its favorable geology and mineralization as proven by the history of the district, its location with respect to the second largest copper-producing ore body in the

U.S.A.; and, considering further, that one vein above the 400 ft. depth has yielded nearly 2,000,000 lbs. of copper, plus about $25,000 in gold and silver, and that only superficial underground work has been done elsewhere on the nearly 1900 acres of mining claims, the Dover property offers an exceptionally attractive area for legitimate and systematic mining exploration.

Respectfully submitted,

J. E. Busch
Mining Engineer

(Map Envelope)

LIST OF MAPS

PHOTOS

No.	
1	Silver Basin-Tom Wal Group
X-1 & X-2	Aerial view (X-2) of Clifton-Morenci district, and, (X-1) Geology of same area
2	St. Joe Basin (Storm Group)
3	St. Joe Basin (Storm Group)
4	St. Joe Basin (Storm Group & west portal, Line Star Tunnel)
5	Portion of Dover road; Pinkard Gulch and parts of Margot and Tucky Groups
6	St. Joe Basin area
7	Portal of Kimberly cross-cut (Keating)
8	Vein (Margot Group)
9	Vein Outcrop (Margot Group)
10	Part of Tucky & Margot Groups
11	General View of St. Joe Basin & Parts of Tucky & Margot Groups
12	St. Joe Basin - Storm Group
13	St. Joe Basin - Storm Group
14	St. Joe Basin - Storm Group
15	St. Joe Basin - Storm Group
16	Phelps-Dodge 'pit'
17	Portion of Mine Workings Bell No. 4
18	Wilhelmina Claim Vein Outcrop
19	Wilhelmina Claim Vein Outcrop
20	Wilhelmina Claim Vein Outcrop

PURPOSE OF REPORT

The primary purpose sought to be attained by this report is a comprehensive general history and description of the Dover Copper Mining Company's Arizona property.

To accomplish this purpose, it was necessary to include material not ordinarily found in a mining report. Much of the data thus given is in an appendix, with proper references thereto in the test. This includes a short glossary of mining terms and phrases. The layman will thus have non-technical explanations covering some of the subjects, and, at the same time, the engineer may avoid this part of the report.

ABSTRACT OF REPORT

The property comprises a nearly compact area of about 3,000 acres of land. Of this acreage, mineral patents cover 1,818.03 acres; 158.62 acres additional mineral land are approved mineral surveys and have the required statutory mining improvements for patent purposes; 32.711 acres are patented millsites; 784.66 acres are patented non-mineral lands, and approximately 207 acres of isolated, non-mineral land will be purchased from the government under the "Isolated Tract Law" as soon as official supplemental township plats are approved. Thus, the Company has title to all except the 207 acres of isolated non-mineral land. All taxes are paid. No liens or lawsuits are of record. No company stock is in the hands of the public.

The property is located in the Morenci (Arizona) mining district. That district is now the largest copper producer in the leading copper-producing state (Arizona), and is, moreover, the second largest copper producer in the U.S.A.

All of this copper comes from the Morenci mining operation of the Phelps-Dodge Corporation, and the Dover mining claims adjoin the Phelps-Dodge Morenci property on the west for about 2.6 miles (15,000 ft.).

The past production from the Dover property totals 1,989,079 lbs. of copper, and about $25,000.00 in gold and silver. Practically all the copper was mined from one vein, and above the 500 ft. depth on that vein. This vein (Keating) is the only one of many outcropping and well-defined veins upon which systematic development work has been done. There are several other well-defined veins warranting exploration. And, there is an area of considerable promise for low-grade disseminated ore bodies that should be prospected and systematically drilled. This area is west of the Phelps-Dodge open pit and contains surface exposures of the seamed, shattered, leached, and feebly mineralized monzonite porphyry that is the principal host rock of the great Clay ore body of the Phelps-Dodge Corporation, now being

mined at the rate of about 50,000 tons per day. The "pit" is over a mile wide, and part of its western edge is only 800 feet distant from the Dover ground.

All of the property is within the area covered by U. S. Geological Professional Paper #43, "The Copper Deposits of the Clifton-Morenci District, Arizona," by Dr. Waldemar Lindgren.

U. S. Geological Survey Folio #129, also by Lindgren, covers the same region.

Dr. Lindgren's report is now out of print. For that reason I have condensed a later report of the same district made by B. S. Butler and Eldred D. Wilson, both of the Arizona Bureau of Mines, University of Arizona, Tucson. Both geologists are well known to the mining fraternity. Dr. Butler was with the U. S. Geological Survey for many years. By reference to this copy, attached as Exhibit No. 1, "Supplemental Geology Envelope," the reader will have a reliable report on the geology and mineralization of this district. It will be noticed that the opening statement in the Butler and Wilson report is, "The following description of the Clifton-Morenci district is summarized from Dr. Lindgren's classic report."

These official sources form the basis of the geology and mineralization as given in this report. Dr. Lindgren is quite generally conceded to be one of America's foremost geologists. And while his above-cited publications were written nearly 50 years ago, their fundamental facts and conclusions have not changed, though, of course, subsequent developments in the district have modified some details.

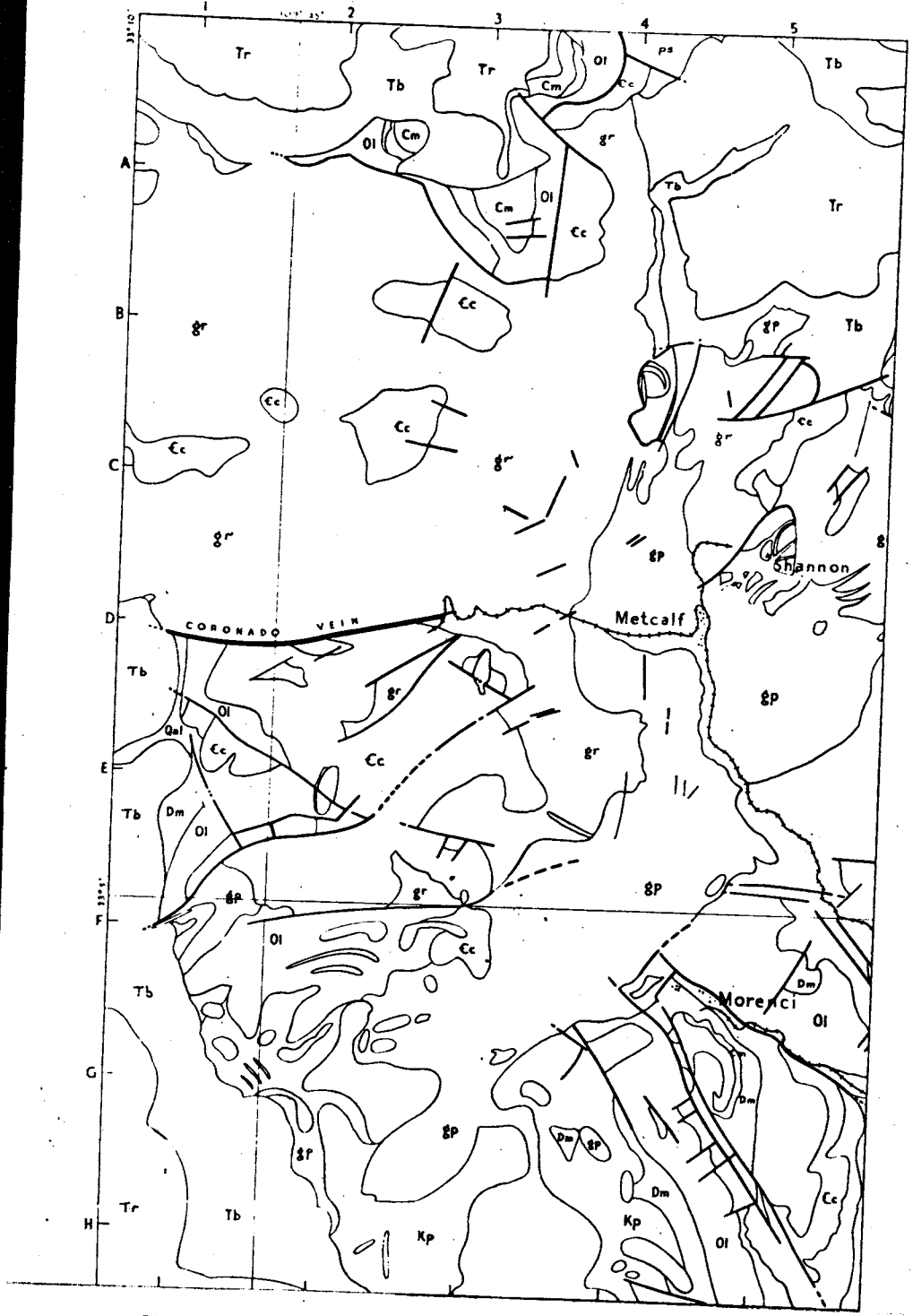
When one considers the large area of the property, its very promising indications of underlying ore bodies, its favorable geology and mineralization as proven by the history of the district, its location with respect to the second largest copper-producing ore body in the U. S. A.; and, considering further, that one vein above the 400 ft. depth has yielded nearly 2,000,000 lbs. of copper, plus about $25,000 in gold and silver, and that only superficial underground work has been done elsewhere on the nearly 1900 acres of mining claims, the Dover property offers an exceptionally attractive area for legitimate and systematic mining exploration.

LOCATION AND ACCESSIBILITY

The Dover property is all located in Greenlee County, Arizona, and roughly one to three miles west and northwest of the town of Morenci.

By legal description, the property lies within Sections 1, 11, 12, 13, and 14, Tp. 4 S., R. 28 E.; and Sections 6, 7, 17, 18, 19, 20, 21, 28, 29 and 33, Tp. 4 S., R. 29 E., G&SRM, Arizona.

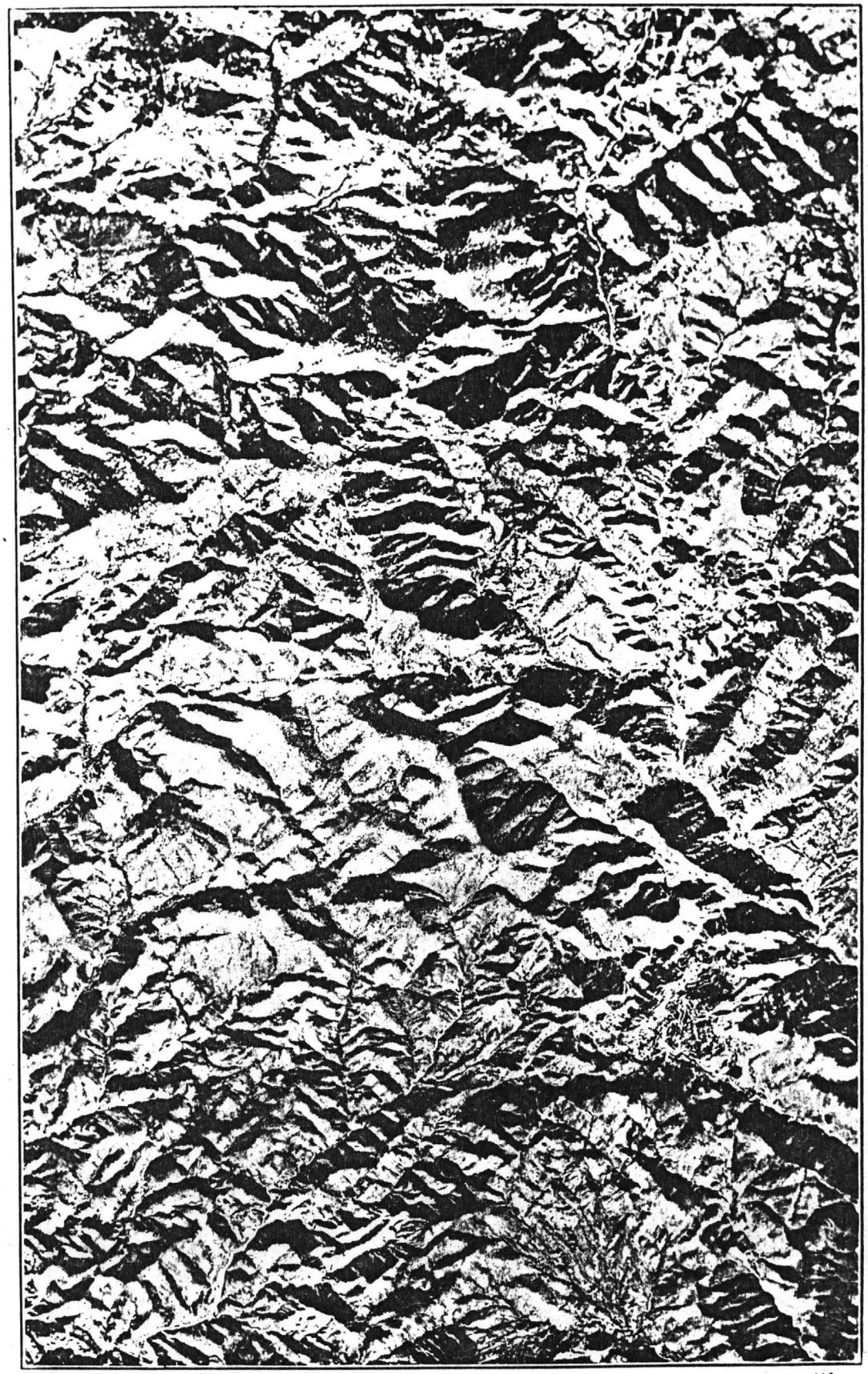
X-1



Shows principal areal geology features of Morenci-Metcalf region. View opposite is aerial photo of the same area. Figure (1) is Soto fault; (2) open 'pit' (P-D); (3)St. Joe Basin; (4)Apache fault; (5) Micawber fault; (6)Silver Basin area. Compare Map No. 9.

FILING BROS. EVERARD TEC. OFFICE OUTFITTERS, ALBANY, ZOO, PHONE 5-0197

No. X-2



Courtesy Fairchild Aerial Surveys, Los Angeles, Calif.

FIG. 1.—CLIFTON-MORENCI AREA ARIZONA.

Morenci, a town of about 6,500 population, is the nearest post-office, telegraph and supply point. A branch of the Southern Pacific Railroad from Lordsburg, New Mexico, to Clifton, Arizona, affords rail transportation. From Clifton to Morenci is a further extension of this railroad; however, most of the commercial freight, other than that of the Phelps-Dodge Corporation, is handled through Clifton. Clifton is seven miles from Morenci by paved auto road.

Most of the Dover property can be reached from points along the Dover Road. This road branches off of the Morenci-Eagle Creek Road at a point 2.6 miles from Morenci and goes across claims and surveys 4230, 4282, 4283, 4256A and 4284. The balance of the Dover property, namely, the Wilhelmina, Tom Wal groups and the Scrip land, are accessible from the Eagle Creek Road.

TOPOGRAPHY

The area is mountainous land. It varies from the rolling hill type to the rugged topography found principally on the Margot Group and to the north from that group to Horseshoe Gulch. Photographs attached as Exhibits show both types above-cited.

A good idea of the entire region may be had from the attached aerial photograph, which is a photostat copy I had enlarged from the original. It was taken to illustrate faults and geological structure but it likewise serves to give a picture of the mountainous character of the area. The Morenci quadrangle of the U. S. G. S. shows the contours, and such topography is likewise found on Lindgren's geology maps although it is somewhat obscured on such maps by the colored overlay. (See Photos Nos. X-1 and X-2.)

The average elevation of the Dover property is about 4800 feet.

CLIMATE

The climate is typical of the arid Southwest, with relatively hot summers and about 12 inches of annual precipitation. While there are occasional snowstorms in winter, it is very rarely that any one storm brings enough snow to seriously retard mining operations. In fact, such operations are carried on the year around at Morenci. The elevation makes for cool nights even in the hot summer months and the climate can be said to be good the year around. The average annual temperature is 67 degrees and the average rainfall is 11.84 inches (for Clifton).

GENERAL INFORMATION

Elsewhere in this report is a discussion under the title of "Economic Factors." These include labor, water, power, taxes, and in addition, a description of the nation's copper production and consumption, together with estimates on the future demand for copper.

HISTORY

Keating Mine and Dover Property

Introduction:

"Background" is a potent factor in any appraisal of a man, a business, or an institution. So, too, with a metal mine. We may learn much from its past history and production, the habits (so to speak) of its ore bodies, and the character of the host rocks containing them. It is pertinent, therefore, to give a brief resume of the early day, or pre-Dover history of at least that part of the property known as the Keating mine.

The early history of the property is traceable back to 1896 when some of the claims now in the Keating Group were located by Kasimiro Rodela. Some of the other claims of the same group were located in 1900-01 by William J. Keating. These locations were under different claim names from those now covering the same property.

Wm. J. Keating acquired full ownership shortly before his death - date not known - and in 1913, Daniel Grant, as administrator for Keating, conveyed the claims to the Keating Copper Syndicate, Ltd. of London, England. The Syndicate retained Clifton attorneys, had the claims surveyed (M. S. 3175), and applied for patent in the name of The Keating Mines Co., an Arizona corporation (Phoenix Land Office No. 028882). The patent application was rejected because the abstract failed to show conveyance from the Syndicate to the Keating Mines Co., as one reason, and for further reason, that a showing was required that the Arizona corporation was not controlled by aliens. Apparently, the matter was dropped.

About this time (1915-1916) Daniel Grant operated the Keating mine under a lease. The records indicate at least $50,000.00 worth of ore was shipped"...in the last four years" (from letter dated in 1915).

The period of 1916-1922 seems to have been one of some leasing, and some ore shipments, but the tonnage or value, or by whom mined, is not known.

In July 1923, the above-surveyed claims were located by L. N. Callicotte because of failure on part of prior owner to do the required annual assessment work. The Dover Co. acquired this part of their

property in 1925. Subsequently, the Company acquired other claims, land and water rights, aggregating 3003 acres, per Title Chart attached as Exhibit 3, Map Envelope. By use of the claim map, Exhibit No. 1, Map Envelope, the Title Chart data will be more informative.

History - general:

For the early day history of the district prior to 1904 the reader is referred to Lindgren's report. From 1904 an excellent review of mining development will be found in The Copper Era, Clifton, Arizona, Victory edition, of April 21, 1943. This review also contains pre-1904 history, and it is more in story form than Lindgren's. Its value to the mining fraternity stems from the full and complete story of the development of the Morenci mine (Phelps-Dodge). Not only are the mine development plans and methods detailed, and the ore treatment processes described, but there is likewise a factual and instructive article on the geology and ore deposition.

This 'Victory edition' is out of print; however, the writer owns a copy which may be borrowed for making photostat copies of pertinent pages.

For your ready reference, I attach as Exhibit "N", Reference Data Envelope, mimeographed copy of an article by the Arizona Department of Mineral Resources entitled "Story of the Morenci Orebody." It gives a good resume of the history of the district, the development of the Clay ore body, and the methods of mining and of ore reduction. Some idea of the magnitude of the Morenci mine can be gleaned from the data copied below from page 7 of this pamphlet:

> "Total Production from the Morenci orebody from 1939-1951, incl., was as follows:
>
> | | |
> |---|---|
> | Total tons ore mined | 127,326,400 |
> | Total lbs. copper recovered | 2,354,391,000 |
> | Total ounces gold | 66,050 |
> | Total ounces silver | 4,197,000 |
>
> A total of approximately $76,500,000 has been expended for the purchase, development, capital additions and improvements on the Morenci enterprise to the end of 1951."

It is of interest to calculate the gross value of the metal production cited above. Copper at 24¢ equals $565,053,348.00; gold at $35 per oz. equals $2,310,000.00; silver at 90¢ per oz. equals $3,777,300.00. The combined value is $571,141,140.00, gross, for

the 12 years named (1939-1951). This nearly equals the total combined mineral value production of the Cripple Creek and the Leadville districts in Colorado.

OWNERSHIP AND TITLE

The Dover Copper Mining Company was incorporated under the Arizona State Laws in July 1925. In July 1950 the charter was renewed for another 25-year period. The head office is in St. Joseph, Michigan. W. V. Tiscornia is President and active managing director. Elmer C. Coker is the Arizona attorney for the Corporation and the Company's attorney-in-fact for Arizona. No stock is in the hands of the public.

For purposes of this report, I attach a Title Chart, Exhibit 3, Map Envelope. It summarizes present day status of property titles. For purposes of clarity, the following comments and explanations are offered, viz: There are 106 patented mining claims and 23 unpatented. With two exceptions, i. e., Anita No. 22 and Margot No. 11, the unpatented claims are on the outer edge of the Company holdings and are more or less 'protection' claims. Most of such have served their purpose in protecting valuable claims from jumpers, etc., until patent was obtained. A few such, because they are lava covered, hence without surface indications, have been relinquished to the Federal Government and the same area is now in a pending land-purchase application.

The portal of the Kimberly crosscut, and the ore bin and sheds nearby, are upon a claim called the "Kimberly" and owned by Phelps-Dodge Corporation. The Dover Company hold a 10-year surface right lease thereon.

The Victor, Foxey, Missing Link and Lackawanna claims, all patented, were purchased from the Phelps-Dodge Corporation. The deed contains clauses re-easements, roads, etc., and likewise contains a "vertical planes" proviso. The last three claims above-named are along and upon the Soto-Producer fault zone and any mining thereon should be with due regard to the restrictive clauses.

A grazing lease for a 10-year period from July 1, 1950 was granted to Fay Rabb, 325 W. Gardenia Drive, Phoenix, Arizona. Mr. Rabb runs cattle in the general region and it is believed he holds a similar grazing lease covering many Phelps-Dodge claims. His foreman, Mr. Larson, lives near the Wilhelmina claim of the Dover Company.

An easement agreement with the Phelps-Dodge Corporation, and covering the Dover Road, gives that corporation mining rights under the road right-of-way wherever the said road crosses any of their properties.

Land in Sec. 11, T. 4 S., R. 28 E., totaling 139.56 acres, was purchased from the Federal Government.

The particular area is lava covered, hence without surface evidence of mineralization. But the land is, nevertheless, of prospective value for mineral deposits because (1) it is directly on the strike of the Keating and Victor veins, and (2) it could possibly conceal the covered portion of the western portion of the Coronado fault-fissure. It would be costly to prove or disprove these surmises, and not warranted at this time, but it is a future possibility to consider. Both veins were formed prior to the outpouring of the lava flows.

The following listed claims are unpatented:

Name of Claim	Mineral Survey
Anita No. 1	4283
" 2	"
" 3	"
" 4	"
" 5	"
" 8	"
" 22	4256A
Margot 11	4282
Tom Wal 29	4353

They are part of approved mineral surveys but were withdrawn from their respective patent applications because of technical difficulties that at the time could not be adjusted without undue delay in securing patent for the balance of the claims in the same survey.

The Company plans to reapply for all of these claims and they can, of course, use the same survey. About the only additional cost will be the re-advertising, posting of notices, etc., because all of the claims have within their own lines or for their common benefit the required statutory mining improvements.

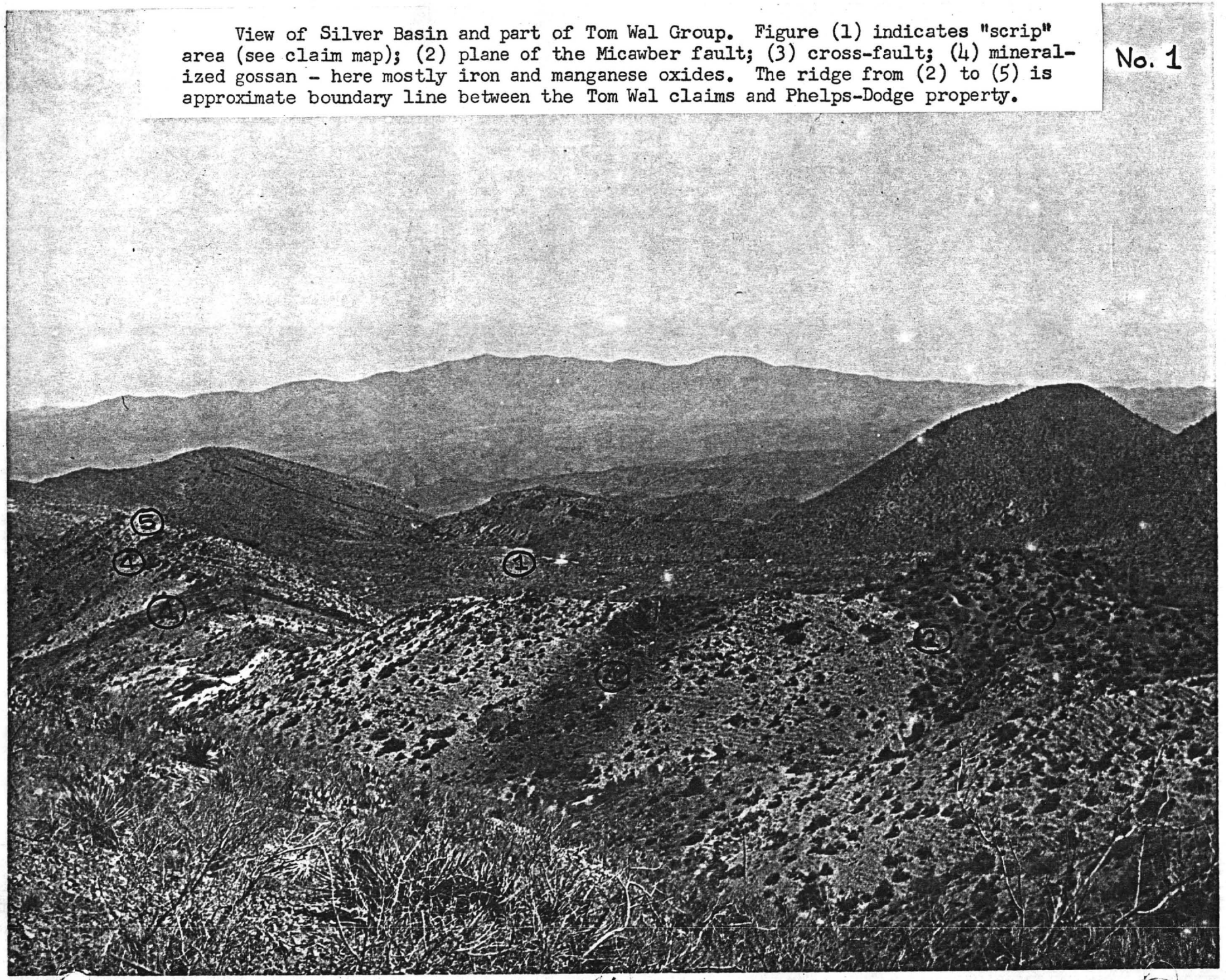
The following listed claims are surveyed for patent and the survey is approved, but to date no patent application has been filed:

Name of Claim	Mineral Survey
Victory Fraction	4284
Anita No. 16	"
Anita No. 18	"
Anita No. 32	"

All of these unpatented mining claims are held under the mining laws by annual assessment work.

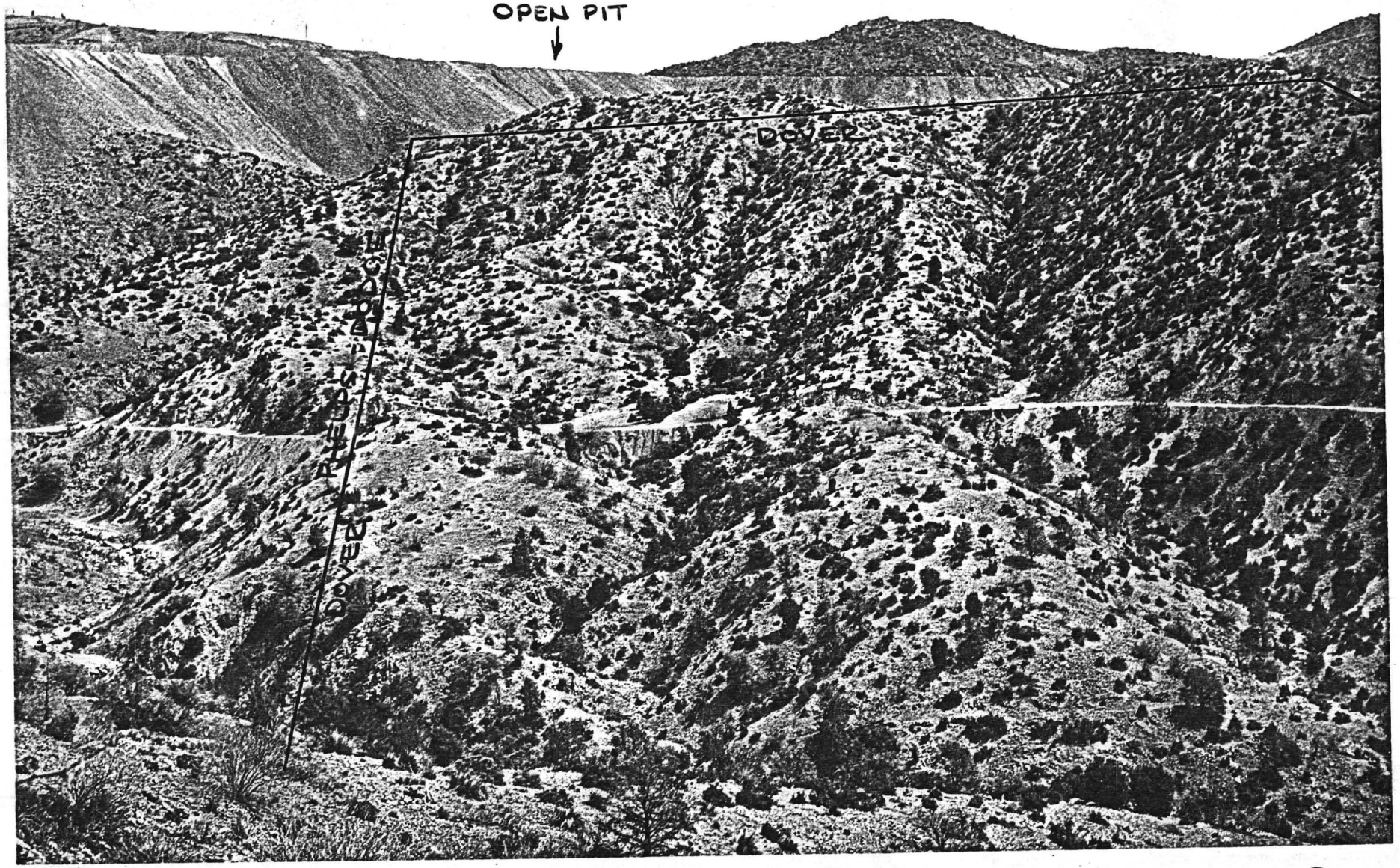
View of Silver Basin and part of Tom Wal Group. Figure (1) indicates "scrip" area (see claim map); (2) plane of the Micawber fault; (3) cross-fault; (4) mineralized gossan - here mostly iron and manganese oxides. The ridge from (2) to (5) is approximate boundary line between the Tom Wal claims and Phelps-Dodge property.

No. 1



No.2

View looking easterly from St. Joe #7 claim. Greater part of view is of Storm Group; boundary lines shown are approximately correct. The Dover road gives a surface-section across typical seamed, shattered, and feebly mineralized porphyry; identical to that originally capping the Clay orebody (Phelps-Dodge). The 'open pit' is just over ridge at the arrow. Compare Photo #16 for view of other side this ridge. The dumps shown are part of the lean and leached over-burden being stripped from higher parts of ore body.



The claim map shows a number of mining claims known as the "Silver Basin Group." These are all within a topographic feature generally termed the Silver Basin. See Photograph No. 1, in Photo Envelope.

These claims are old and abandoned locations and the same area they covered is now patented as non-mineral land. It is designated on the map by the word 'script.' The claims were once the subject of a contest and hearing before the U. S. Land Office and were by that Bureau adjudged non-mineral land. Subsequently, the Company applied for the same area under the "Indian Exchange Act" and now have patent.

There is one other area of approximately 170 acres being applied for under the Public Land Purchase Law. This application covers all of the vacant public land in Section 7, T. 4 S., R. 29 E., and all public land in the South 1/2 of Section 12, T. 4 S., R. 28 E. The application as filed conflicts in part with some of the claims in Mineral Survey 4284. No patent application was ever made under that Survey, nor will such be made as to the claims in conflict, for the reason that they are practically all lava covered and therefore the requisite mineral discovery could not be made. This Public Land Purchase application has already been inspected in the field by the land office examiner.

DEVELOPMENT WORK

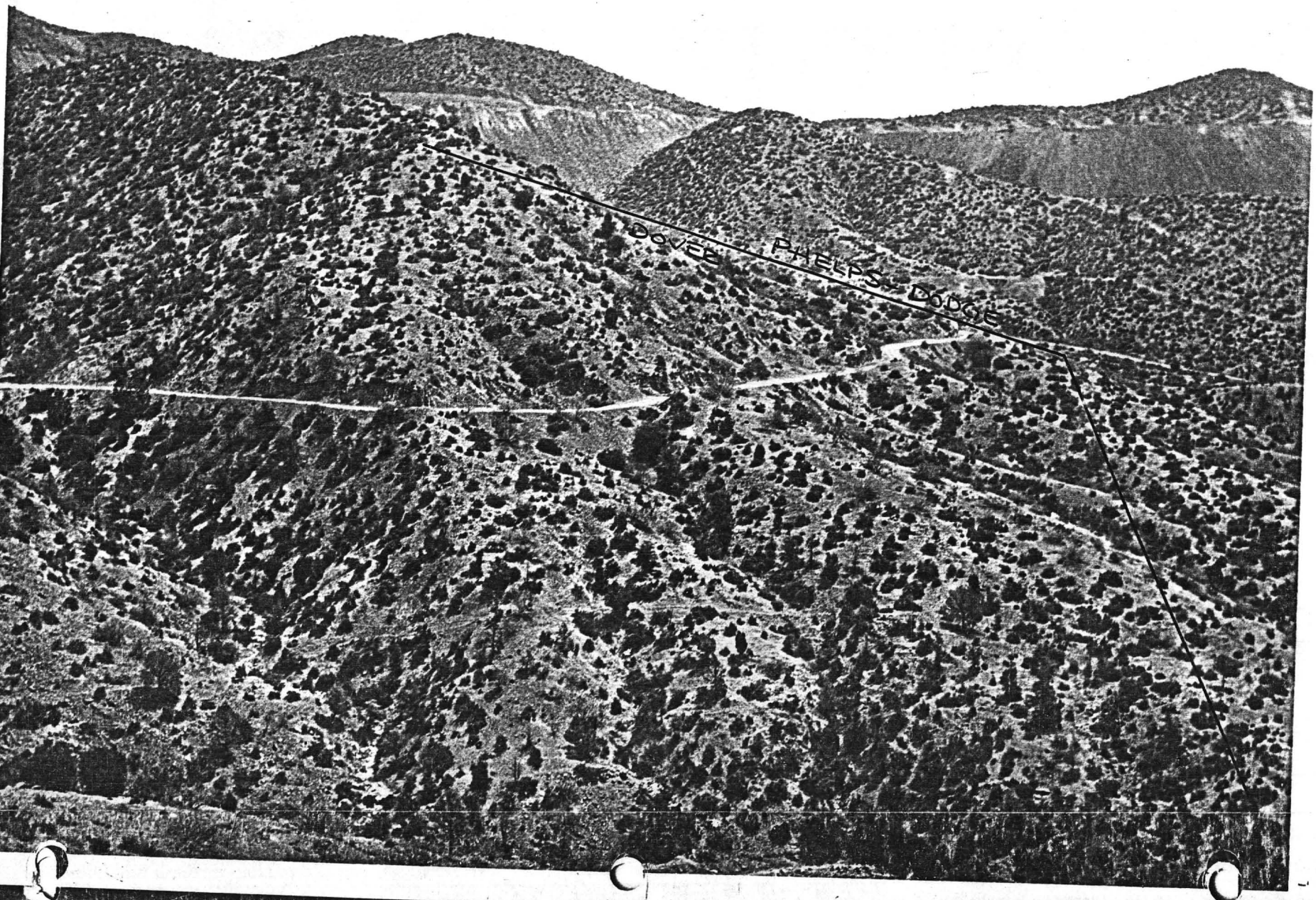
Most of the mine workings are those found on the Keating vein. They comprise the usual type of mine work on a vein-type of deposit, i.e., shafts, drifts, adits, crosscuts, stopes and winzes. In the aggregate this work would total a huge footage but for present purposes no description thereof appears warranted. Nor could it be accurately given because some of the drifts and stopes are caved and the shafts inaccessible. The Kimberly crosscut is open and safe, and it gives access to the vein, to the 100-ft. winze, and to some parts of the stopes southwest of the cross cut. The northeast drift is caved about 80 ft. from the Kimberly crosscut.

On the Margot No. 19 claim there is an adit (tunnel) over 1200 ft. in length, with some cross-cutting therefrom. This is known as the Copper Plate tunnel. Most of this work was done years ago by Ambrose Burke, deceased, and prior to Dover ownership. Development work on this vein by the Dover Co. has been slight, probably because the drift follows a fault-fissure, and the fault, in turn, nearly parallels a deep gulch. Hence, comparatively little depth was gained.

In Pinkard Gulch and Gold Gulch, and in numerous side gulches

View nearly same as Photo #2; the two views overlap. Claim lines shown are nearly correct; angles and off-sets deleted.

No.3



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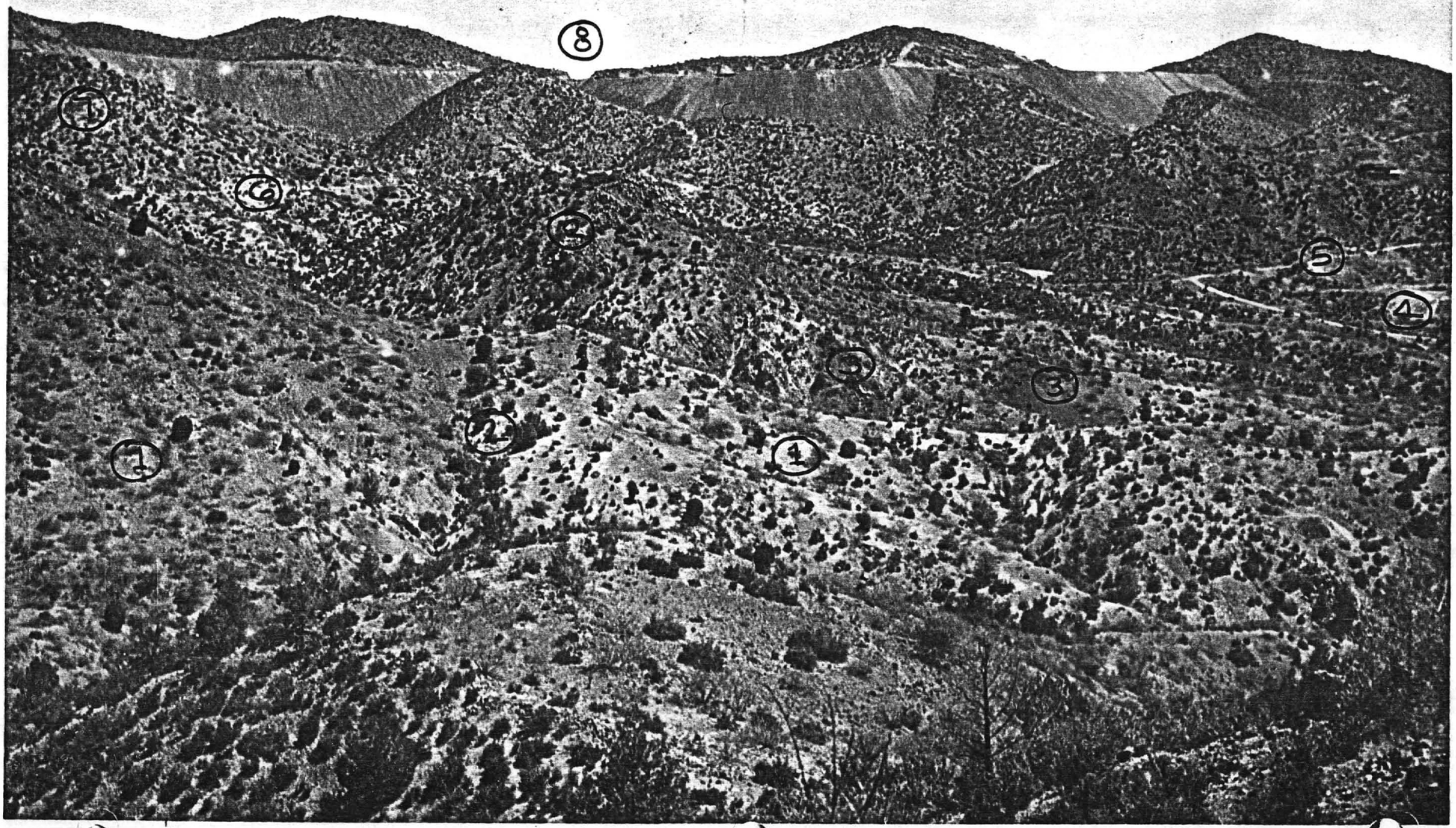
No. 4

View looking easterly from St. Joe #8 claim. Figure (1) indicates typical area of the "St. Joe Basin"; (2) mineralized vein; (3) outcrops of mineralized gossan; (4) western portal and dump of Lone Star tunnel (Phelps-Dodge); (5) Eagle creek road; (6) Dover road; (7) eastern part of Storm Group; (8) Phelps-Dodge open pit is just over ridge.



therefrom, there are many small mine development workings consisting of drifts on veins, crosscuts, and prospect shafts. These are of varying lengths and depths. They are mostly the early day prospecting work, or work done later for patent purposes. To describe all such would unnecessarily lengthen this report.

In addition, there are literally hundreds of surface trenches, open cuts and shallow pits. In the aggregate these would total an impressive footage (or yardage). All such work, excepting the Keating, or at least 95% thereof, can be found described in the official field notes of the mineral surveys, and its location is shown upon the official plats. Both notes and plats are available in the Public Survey Office (US) at Phoenix, Arizona. Copies of the official plats are in the Company files in Phoenix.

Finally, there are several miles of trails and the 'Dover Road'-local name. This road leaves the Morenci-Eagle Creek road at 2.6 miles from Morenci, and thence winds northerly 5.8 miles to the ore bin on the Kimberly claim. Photos Nos. 2, 3, 4, 5, 12 and 15 show portions of this road.

The road is practically all 'rock work' and was largely constructed by hand labor. It can usually be traveled by ordinary car or truck. At this writing it is in poor shape.

****

That so large an area of favorably located mineralized territory should have so relatively little mine exploration work deserves comment.

There are many inter-related reasons, not all known to this writer, but a few important ones may be stated.

(1) The property owners are manufacturers. They are not miners. Mining is not their business.

(2) About the time of the depression, in the early '30s, and while operating the Keating mine, they were faced with
   (a) developing new ore bodies;
   (b) low price of copper;
   (c) financial reverses in their own business.

(3) Necessity of perfecting titles, i. e., patents. This has been costly, due to protests, contests, lawsuits, delays on part of mineral surveyors, etc. One contest resulted in a 2-weeks hearing. The transcript covered 1700 pages and there were some 200 exhibits --- in itself proof that someone else considers portions of the property valuable.

(4) Under 'war stimulation' the property (Keating) was operated again in 1942 and 1945. This was under a lease from the Dover Co. to the Auto Specialties Manufacturing Co., which company is owned by the Tiscornia interests, and they likewise control the Dover Co.

(5) This lease operated at a loss despite government subsidy price on copper. One can easily understand this, too. Because of the war, skilled miners could not be had, hence workers were recruited from untrained or old men. They had to be transported back and forth from Morenci daily. The old workings were caved. Retimering was necessary and costly. Air-raises had to be made for ventilation and safety under the State Mine Code. There were many delays and difficulties because of 'priorities' and attendant 'red tape.'

(6) After the shut-down of the lease operation in 1945, no other work has been done excepting that required under the law for patent, or annual assessment on the unpatented claims, and to keep the Dover road passable.

Thus, it is that the property at this time cannot be said to have any "ore in sight." There may be some low-grade ore in some of the old back-filled stopes, but of this I have no certain knowledge.

It is regretable that the Superintendent of the lease operation failed to sample backs of stopes, faces of drifts and crosscuts, or the 100 ft. winze level, before closing down the mine.

Available maps appear to have been kept current with the work, but my search of both the records of the Dover Co. and of the Auto Specialties Manufacturing Co. failed to disclose any sample map or assay chart.

To compensate for lack of such data we have records of ore shipments. This is the best evidence of ore values. The "acid test" of any ore is what the smelters pay for it--not what it may assay per owner's samples. And this value is attested by the tabulated statement of ore shipments hereto attached, Exhibits 4 and 5, Map Envelope. They show tonnage, gross and net values, and net receipts.

Record production prior to Dover ownership for the period 1913-1925 was 646,003 lbs of copper and 1889 oz. silver, per U. S. Bureau of Mines' figures.

Copper production totals 1,989,079 lbs plus about 500 oz. gold and about 9500 oz. silver (gold and silver not tabulated).

The metal content of the ore shipped prior to 1913 is unknown. High grade ore (up to 35-40% copper) was mined and shipped by the then owners and lessees. In his report on the property made in 1929

Newton E. Emmons, mining engineer, mentions early-day production of $380,000.00, but in such terms I am unable to determine what portion thereof may be included in the 1913-1925 U. S. Bureau of Mines figures herein cited. At today's metal prices, the copper alone would have a gross value of $556,920.00.

Tabulated returns from other parts of the property (not Keating) as shown on settlement sheets, totals $6,235.00. Later shipments of gold-silver ore mined from part of one claim of the Bell Group under lease to Gomez Bros. and not shown on production sheets, had a gross value of about $7,000.00. Incidentally, it is noteworthy that the Gomez Bros. are both about 68 years old. They did not work steadily nor a full shift per day. They used only hand steel (drills) and their mining was in the nature of "chloriding," i.e., taking only best part of the vein.

These shipments do not represent all the ore production from the claims now under Dover ownership. Early-day prospectors shipped gold-silver ores from the Bell, Tucky, St. Joe groups, and from the Wilhelmina claim. It is difficult to estimate the value of such shipments because one must rely upon hearsay evidence. Very few of the miners of that early time are alive. Lindgren, and others, noted the prospecting activity; but because of its relative unimportance at the time it was given but a few lines in his report.

CHARACTER OF ORE AND METHODS OF TREATMENT

Copper is the principal and nearly sole metal in the ores of this district. Some silver and gold are recovered but they are not of economic value in the average ore, considered by themselves and on a per-ton basis. Their aggregate value, however, adds to the total metal recovery under large scale operations.

No complex metallurgical processes are necessary for ore treatment. Reduction and recovery methods have been well worked out, standardized, and proven in daily practice at the Phelps-Dodge concentrator and smelter in Morenci. There is ample published literature on methods, etc., and it is not considered necessary to discuss in detail at this time. Ore reserves must first be developed; treatment processes and costs can come later.

Up-to-date data on the overall Phelps-Dodge process is summarized in an article by L. M. Barker, Mgr., Morenci branch, as published in "Pay Dirt" of June 19, 1953. Copy is attached as Exhibit "O", Reference Data Envelope.

GENERAL GEOLOGY

Dr. Waldemar Lindgren, of the U. S. Geological Survey, studied

the Clifton-Morenci district about 1903 and his report was published, as Professional Paper #43, in 1905. It is a thorough and excellent work.

In 1916, L. E. Reber, Jr. described the district in "Economic Geology" Vol. 11, pp. 528-73.

In 1938, B. S. Butler and Eldred D. Wilson, of the Arizona Bureau of Mines, published a report on the geology and ore deposits of the Clifton-Morenci district as part of Bulletin 145, Arizona Bureau of Mines, entitled "Some Arizona Ore Deposits." I have copied much of this excellent report and attach such excerpts hereto as Exhibit No. 1, "Supplemental Geology Envelope."

Additional data on the geology and ore deposits of the region can be found in many special articles published in the mining and technical journals at different times and by many geologists.

Several such articles are cited in the attached bibliography and reference list.

Summarized, the geology may be described as a peneplaned pre-Cambrian granite, upon which about 900 feet of Paleozoic quartzite, limestones, and shales have been deposited. Upon the eroded surface of the Paleozoic sediments, a variable thickness of Cretaceous sandstones and shales were laid down. The Cretaceous sediments are commonly separated from the underlying formations by sills and laccoliths of diorite porphyry.

The older formations were then intruded by post-Cretaceous porphyritic rocks (granite porphyry, quartz monzonite porphyry, diorite porphyry and diabase in this sequence of magmatic differentiation). Most of the available information indicates that primary mineralization closely followed the monzonitic intrusions. The intrusives generally came as stocks, dikes, sills and laccoliths.

Two volcanic epochs occurred in the Tertiary; an earlier group (rhyolite, andesite and basalt) and a considerably later group (rhyolite, rhyolite tuff, volcanic breccias, etc.). Each, in turn, blanketed parts of the region.

Vigorous erosion during the volcanic activity, and subsequently, deposited great thicknesses of coarse, sub-angular fragments of all the rocks, with irregular lenses of sand and coarse gravels. This gravel is termed the "Gila Conglomerate."

Reference is here made to a photostat copy of Lindgren's Geologic Map, Exhibit 2-A, Map Envelope. The colors could not be photographed, hence the map is not clear as is the original. But since the bulletin is out of print it was deemed advisable to include this map for reference. It gives geologic cross-sections.

Map #9 is also by Lindgren and is a 'generalized geologic map' of this district.

Map #2, Map Envelope, shows aerial geology of the Dover property. The coloring and faults are emphasized for report purposes, but, as the "legend" on said map explains, it is copied from Lindgren's geologic map.

STRUCTURE

Two major structural divisions are believed to be regionally and locally dominant. The oldest consists of northeast faults, sheeting, and orientation of the intrusive porphyries. This same northeast trend is common in several localities in the southwest, and is generally believed to be due to the reopening of great persistent crustal lines of weakness of pre-Cambrian age. The younger group of faults trends north-northwest and is associated with the giant Basin and Range block faults of the Tertiary. Numerous local faults have complicated the original structures. The result is a mosaic of tilted and crushed blocks and shatter zones. The later faults displaced some of the enriched ore bodies. However, it was migration of mineralizing solutions along the earlier faults, sheeting and intrusives, that is most important in this district.

Numerous re-openings of the faults and sheeting are evident. In general, the shatter patterns of the area have had a most important role in the control of enrichment of the primary ore bodies, as well as the oxidation of the enriched ores.

Reference is also made to geologic cross-section line E-E', Lindgren's Map, Prof. Paper #43. This geology section is roughly parallel to the east property line of the Dover Co. See Map No. 2-A for line of above cross-section.

CLASSIFICATION OF THE ORE DEPOSITS

The ore deposits of this area are divided into the following types:

(1) Contact-metamorphic and replacement deposits in the sediments adjacent to the intrusives.
(2) Veins and disseminated copper deposits in the porphyry and the intruded granite.
(3) Fault fissure veins of the "Coronado" type.
(4) Placer gold deposits.

For the purpose of this report, it is deemed advisable to quote rather extensively from Lindgren as to the ore deposits. His classical report, as stated, is out of print. Accordingly, I attach as Exhibits 3, 4, 5 and 6, respectively, "Supplemental Geology Envelope," excerpts entitled

3. Ore Deposits and Their Minerals.
4. Principal Characteristics of Deposits.
5. Veins connected with Diabase.
6. Genesis of the Copper Deposits.

Reference is likewise had to the Butler & Wilson report under the heading of "Ore Deposits" - pp. 4-7, Exhibit 1 (Supplemental Geology Envelope).

GEOLOGY AND MINERALIZATION

Dover Property

The preceding description of the geology and mineralization is deemed sufficiently complete for practical purposes. For the reader interested in full details and for petrographic studies and chemical analysis of the rocks and ores, reference is had to Dr. Lindgren's Professional Paper No. 43.

Coming now to the Dover property and its mineralization, it is impractical to describe the entire area as a unit. It is deemed advisable to do so by groups. These groups will include the claims under a particular mineral survey number as follows:

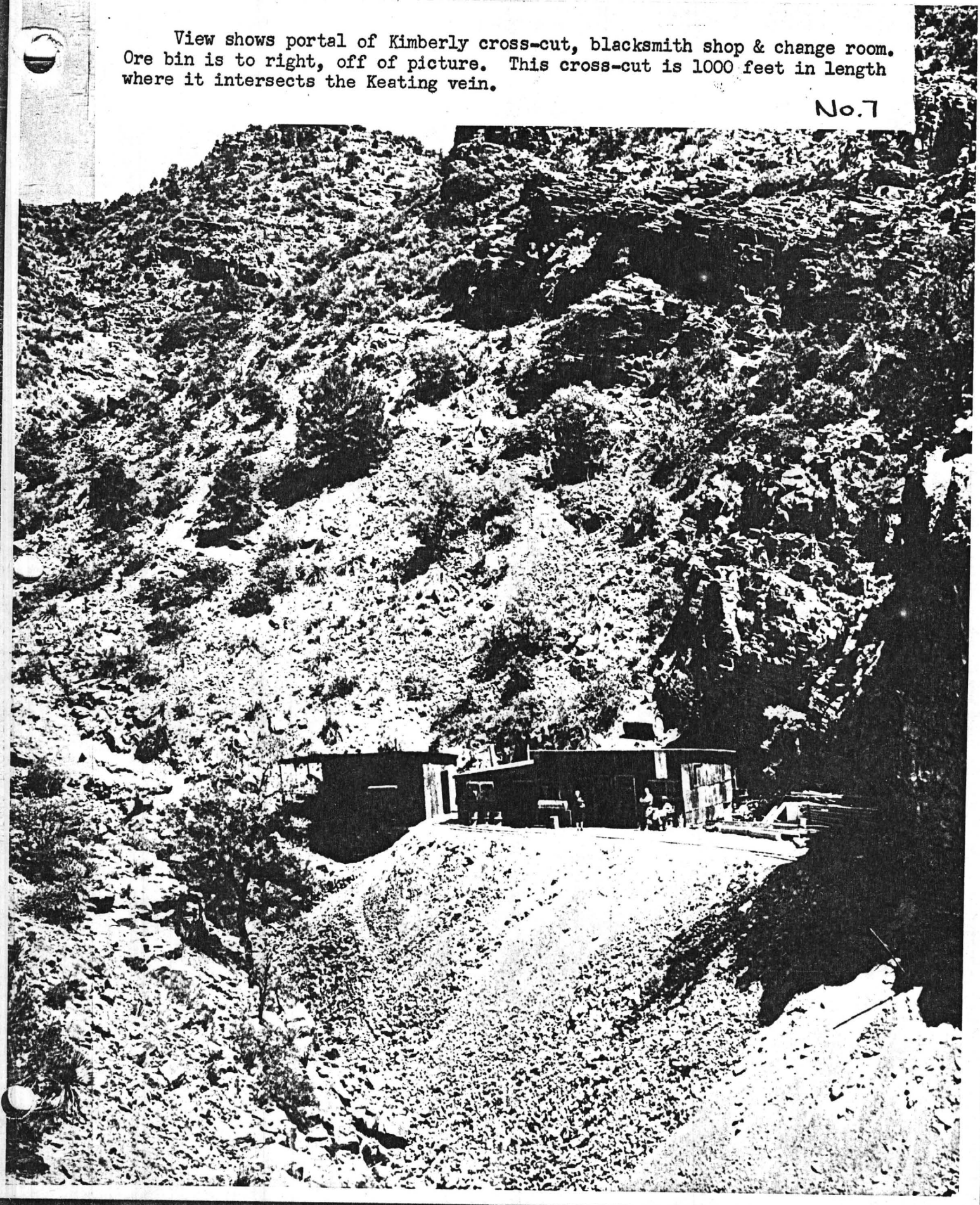
Keating Group	M.S. 4256A
Anita Group	4283
Margot Group	4282
Foxey & Tucky Groups	3376 & 4266
Storm Group (includes part of Tucky & St. Joe Groups)	4230
Bell Group (includes part of St. Joe Group)	4267
Wilhelmina Group	4229
Tom Wal Group	4353
Other Dover Claims	4284 and Unsurveyed

The groups as named are better known to you than are the individual claims because the Dover Company employees have for years thus referred to portions of the property.

The geology and mineralization of the groups, however, must necessarily be reiterated in part because of the fact that veins or mineralized outcrops on a particular group in many instances extend into claims of another group as here designated. For example: The mineralized porphyry area on the Storm group extends westward well

View shows portal of Kimberly cross-cut, blacksmith shop & change room. Ore bin is to right, off of picture. This cross-cut is 1000 feet in length where it intersects the Keating vein.

No.7



over much of the St. Joe group. Veins on the Bell Group extend eastward into the St. Joe Group, etc.

KEATING GROUP

This is the most northerly group of Dover Co. claims. It has likewise been the most productive area thus far and contains the greater part of the underground workings, most of which are those of the Keating mine.

The major portion of mine development work has been done on the Keating vein. It is on the 'New Queen' claim and at north end of the property. Early-day workings comprised shafts and drifts on the vein outcrop. Hand-sorted ore was packed over trails to Morenci on mules. Later, a main haulage crosscut 1,000 ft. in length, known as the Kimberly crosscut, was driven from near the bottom of Horseshoe Gulch to its intersection with the Keating vein. It cuts the vein 400 ft. below the apex. A short distance from the portal of this crosscut is an ore-bin and two small sheds housing an engine and compressors.

Reference is here made to a photostat copy of map made in 1929 by Newton W. Emmons, mining engineer, and hereto attached as Map No. 6, Map Envelope. Photo No. 7, also copied from Emmons' report, shows the portal of the Kimberly crosscut.

Underground development on the Keating vein was the usual drifts, crosscuts, raises, and stopes. There is also a winze 100 ft. deep below the Kimberly level, and about 500 ft. of drifting on the winze level.

The underground workings of the Keating mine are partially shown on a vertical section map made by F. W. Sherman in 1943. Mr. Sherman was then superintendent of the Auto Specialties Manufacturing Co. lease operation. A photostat copy of the map is attached as Map No. 7, Map Envelope. It is enlightening in that it outlines the portions of the Keating vein mined at different periods. It is incomplete because it does not show the source of mined ore between date of map -- October 1, 1943 -- and termination of the lease -- about April 1945. In that time, the Company records show shipments of 7,509 tons of ore containing net smelter returns of 599,170 lbs. of copper, $4,463.30 in gold, and 11,598 oz. in silver.

It should be pointed out that of the gold recovered from this tonnage -- 253 oz. -- the lessee should have received the equivalent of $32 per oz. or $8,096; whereas they received only $4,463.30. Likewise for the 11,598 oz. of silver contained in this same tonnage, the lessee should have received about 70¢ per oz. or $8,118.60 as against the $4,083 actually received. In other words, the lessee received from the

smelter only about 46% of the gold content of the ore and about 51.4% of its silver content.

Referring further to the Sherman map, a noteworthy fact disclosed thereby is the ore length along the vein. This is about 1100 ft.

The stopes marked "A" to the left of the Keating shaft would indicate an ore shoot about 400 ft. long and only partly mined. This was doubtless the enriched portion of the vein mined up to 1928 -- ore that would then stand costs of hand-sorting and pack-animal transportation.

Winze:

Because of a bad heart, the writer cannot descend old shafts by aid of ropes, etc., nor safely climb ladders. Hence, the dearth of personal knowledge regarding the backs of old stopes, or the bottom of old shafts or winzes.

The Company records contain a "report on progress" during sinking of the 100 ft. winze. This report indicates ore shipments from first 20 ft. depth of the winze, and some ore from the 70 ft. depth. It mentions "some ore still in bottom" opposite 30 ft. depth. At 90 ft. it states "copper stain only," and at 100 ft. a $60.00 assay is cited -- "Mostly gold and silver."

As stated, there does not appear to be any assay chart; however, it so happens that some information as to the 100 ft. winze level and the drifts therefrom was given me in confidence by a mining engineer who was down the winze about two years ago.

He told me the exploratory work in and from this winze was substantially as shown on Map No. 8; that the ladder from the Keating level down the winze was then in fair shape and safe; that the air was not bad although rather dead and stagnant. He took only a few samples and could not ethically give me results of all assays nor, of course, his conclusions. But he did advise me that one sample from the 70 ft. level of the 100 ft. winze contained trace in gold, 0.27 oz. silver, and 9.22% copper. He said this was an 18 ft. 'chip' sample from a crosscut 30' northeast of the winze. Both walls of the veins are here in granite.

Another sample was chipped across 35 ft. in a crosscut that is 60 ft. northeast of the winze on the 100 ft. level. This assayed trace in gold, 0.21 oz. silver, and 0.21% copper. He said granite is the wall rock on the 100 ft. level.

The writer places full reliance on this volunteered information, though I cannot quote its sources. It is significant that 9.22% copper is contained in the vein material 70 ft. below the Keating level. The Company records indicate ore shipments from the winze below the Keating level that contained 8% copper. Consequently, this 9.22% assay is not apt to be a selected or picked sample. Indeed, I would

say quite otherwise, knowing the methods of the engineer.

The sample from crosscut at 60 ft. northeast of the bottom of the winze contains silver and copper, though not of commercial value. The important facts, however, are: (1) that the Keating vein is well exposed on the 100 ft. winze level; (2) that it is mineralized; (3) that both its walls are granite. This means it is a true fissure and not likely to 'cut off.' The vein has not been bottomed. No sound geological reason is apparent to preclude its containing other ore shoots; at least for another 500 feet depth, or to the same depth of the lean pyritic zone in the nearby Coronado vein.

> "Few veins are payable through the entire length of the strike or dip, the profitable ore being ordinarily limited to certain portions of the vein. Such masses of valuable ore are called pay shoots and in many veins form tabular bodies of fairly elongated outline."
> (United States Geological Survey - "Handbook for Field Geologists," p. 112)

By way of information, I attach hereto as Exhibit No. 8, Supplemental Geology, a photostat copy of letter by Newton W. Emmons, mining engineer, under date of September 30, 1931, transmitting his report on the Dover mine. Of the 17 carload shipments of ore he cites the lowest copper content was 5.25% copper, the highest 11.09% copper.

It should be noted here that strong veins of this type, and character of mineralization, often show intense alteration of the enclosing wall rocks for some distance from the vein proper.

Thus, at Butte, Montana, alteration has been found to extend as much as 100 feet into the wall rocks (granite).

The Keating vein should be prospected and sampled with this fact in mind. Thus, the writer discovered at least one place where the ore had not been mined to full width of the vein; and at this particular place, a "selected" sample showed 31% copper upon assay.

A further factor to be borne in mind is that a strong vein of this type is seldom formed at one time. The vein filling usually represents several successive periods of mineralization; and in the formation of the vein there is commonly movement or fissuring parallel to the first fracturing. This sometimes results in "false walls." Crosscuts should always extend far enough to encounter the unaltered rock.

No mining property can be properly judged apart from surrounding geological conditions and the history of adjoining mines.

It is pertinent, therefore, to mention the Coronado mine which adjoins the Keating on the north. This great fault-fissure is at least 2 miles long in an east-west direction. In places the vein was 70 ft. wide

and the ore shoots therein were mined to about 1100 foot depths. In an effort to ascertain the total production of the Coronado, I wrote the U. S. Bureau of Mines and am advised that

> ".... the production of the Coronado mine from 1873 to 1921 as follows: 870,000,000 pounds of copper having a total value of $142,000,000.00."

Copy of the Bureau's letter is attached as Exhibit "P", Reference Data Envelope.

Dr. Lindgren has quite fully described the geology and mineralization of the Coronado Mine in Prof. Paper #43, U.S.G.S. and reference is hereby made to that report because, in this writer's opinion, the Keating vein is the same type of vein as the Coronado in its structure, vein-filling, mineralization. I do not say it is as wide, or as rich. I do feel, however, it is an "adjustment fissure," or fault-fissure, of perhaps contemporaneous origin.

Summed up, therefore, I conclude the Keating vein warrants development, vertically and laterally, and preferably from the 100 ft. winze level. Perhaps it could be prospected by diamond drill from the Kimberly crosscut. The track and air pipe line are intact and most of the crosscut is in even-grained quartzite. This would assure good drilling and core recovery; at least until the vein is cut. Core recovery would likely be poor thereafter due to the softened vein material.

COPPER PLATE

This is the name given to an adit (tunnel) of about 1300 feet length whose portal is on the Margot 19 claim of the Keating Group, about one mile southwesterly from the Keating.

Most of this adit was driven many years ago by a man named Ambrose Burke, now deceased, and prior to Dover ownership. It follows a fault-fissure of NE-SW strike, and the fissure is nearly parallel to a deep gulch. Consequently, despite its length, this adit does not attain much vertical depth beneath the outcrop.

This fault fissure is briefly described by Lindgren on page 345 of Prof. Paper #43 as cutting "....first granite, then quartzite conglomerate and quartzite; the ore consists of a dike of Metcalf porphyry, 3 feet wide, with disseminated malachite."

Arthur Houle, Mining Engineer, in a letter report made for J. D. Douglas in July, 1936, copy of which is in the Dover files, mentions this fissure and work as follows:

"Copper Plate Vein - Copper Plate Tunnel

The surface exposures of this vein are attractive. I believe the tunnel was driven to the right of the vein and a few short crosscuts driven North 40° West would be justifiable development work.

The vein is a fissure similar to the Keating. The strike of the vein is also N 50° E. A dike of diabase follows the vein and that is typical of the Coronado and Keating veins. The surface ores are siliceous, showing spots of copper glance surrounded by silicates, oxides and carbonates.

The vein fissure cuts through the old granite and upward through the surface outcrop - Cambrian quartzite. The ore makes in the granite porphyry and diabase filling and following the fissure.

The northeast face of the Copper Plate tunnel is just entering into the Margot No. 22 claim. The distance from this face to the Keating tunnel and vein below this tunnel level is about 3000 feet.

The Dover group of claims, south and west of the Copper Plate tunnel, is limestone cut by dikes of monzonite porphyry. The surface outcrops show very little mineral although greenish epidote is common."

The writer has never been underground in this workings. The company files contain a map based upon a survey by J. William Waara and made for the evident purpose of determining the distance and depth from end of this adit to the Keating mine. That distance is given as 2,850 feet. However, the Dover Company did very little work here, and the development done under Mr. Sherman for the Auto Specialties Manufacturing Co., lessee, appears to have been some crosscutting at several points from the tunnel level. Here again the Company files and maps fail to show any assay-chart. The dump at portal of the adit shows some heavy pyritic ore of about 1% copper content, on an average, with some scattered copper silicate and carbonates.

This fissure is a strong vein. It is traceable about 2000 feet northeasterly from the tunnel portal where it appears to end against a NW-SE fault. It is traceable southwesterly into the Anita No. 9 claim, but is here somewhat broken, and, after leaving that claim, is buried under a basalt lava.

Detailed mapping and study of this fissure and the underground workings, and of the immediate region, is warranted. Cross-faults, or junctions of other veins, should be mapped in detail. Thus, on this same claim, Margot No. 19, there is an 8 ft. vein exposed in Improvement No. 4 (Mineral survey plat) that has an indicated strike

of N. 80 degrees E. If that strike is maintained the vein should intersect the Copper Plate fissure at approximately 800 feet from the portal.

Other Keating Group Claims:

Detailed descriptions of the other claims in this group are being omitted because most of such claims have little development work beyond that necessary for patent purposes. Some of this work has uncovered mineralized veins, mostly of the prevailing NE-SW strike, and a few showing encouraging assays. Thus, on the Anita No. 20 claim, Company records indicate assays for patent purposes up to 20% copper. There is visible mineralization on the purchased Victor claim, considered part of this group, and the vein is believed to be the southwesterly extension of the Keating vein. Fracture zones found on some of the other claims in which diabase has been intruded do not appear to have had close prospecting, despite the proven role of the diabase with respect to the Coronado and the Keating ore bodies, i.e., some mineralization took place after intrusion of the diabase.

Between the Keating mine and the Copper Plate adit there is a promising area adjoining the Keystone group of the Phelps-Dodge that should be examined and studied in detail.

ANITA GROUP

The dominant feature of this group, as regards its mineral possibilities, is a very strong fault fissure on the common side line of the Margot 13 and Margot 14 claims.

The fissure strikes nearly east and west and its prominent outcrop is easily traceable eastward into the Margot 12 claim, and thence easterly into the Keystone claims of the Phelps-Dodge Co. District geology maps show this as one of the larger fissures radiating from the Clay ore body.

Going westerly from the above cited workings this fissure splits, with one branch of north-westerly strike toward the Copper Plate fissure (described under Keating Group), and another branch swinging south-westerly across the Anita 3 and Anita 2 claims. On the Anita 3 claim this fissure is further broken by several cross faults, resulting in a complex structure whose details are further obscured by intense alteration of the rocks. The fissure continues south-westerly into the adjoining property of the Eagle Gold (Gold Belt).

This fissure is well mineralized on the Margot 13 and Margot 14 claims. In addition to copper, there is some gold and silver in the vein material. The writer happened to find one piece of ore, or vein material of a rather soft clayey texture, wherein 'free' gold was visible to the

No. 8

Face of open cut on Margot No. 14 claim; shows width of vein as here exposed. (1) Enriched portion of fissure; (2) fault breccia; (3) limestone; (4) granite porphyry.

THLING BROS. EVERARD CO. OFFICE OUTFITTERS, KALAMAZOO, PHONE 50137

No. 9

View taken from the cut shown in Photo #8, across gulch. Figure (1) indicates outcrop of fissure. It continues easterly (toward top of photo) for about 1800 feet where it enters the Keystone group of Phelps-Dodge; thence continues easterly into region of Clay orebody.

unaided eye. The rock itself was dull white, but the gold occurred in the green part (copper-enriched) of the specimen thus gave a contrasting background different from the usual quartz. The specimen is now part of the mineral display in the Mineral Building, Fairgrounds, Phoenix, Arizona.

An ore pile on the dump of this old shallow working was sampled for informative purposes and assayed $3.49 in gold and silver and 1.22% copper. However, Company records show samples of 5%-20% copper, 1.36 oz. silver, and $14.00 gold from the "pay streak" exposed in this working, and two others a short distance west.

Another factor of importance with respect to ore deposition in this immediate vicinity is a second fault fissure of nearly NE-SW strike that is traceable from the Margot 12 claim to the general region of the Coronado Mine. I cannot say this second fault fissure connects with the rich Coronado vein, but it is fair to assume the same period of faulting, fissuring and mineralization for both; and to assume, further, migration of mineral-bearing solutions from the same magma.

The general appearance of this fissure, its structure, its vein-filling, its "gouge" and its walls, plus the abundant evidence of mineralization, will impress any practical mining man. It is worthy of development, and, in the light of the mining history of this district offers more than average chances for finding an ore body. It is interconnected with the Clay and Keystone ore bodies, and, doubtless, enriched mineral-bearing solutions migrated from said ore bodies in and along this fissure.

Photo No. 8, in Envelope, shows this vein in the face of an open cut. Photo No. 9 shows the outcrop on opposite side of gulch from Photo No. 8.

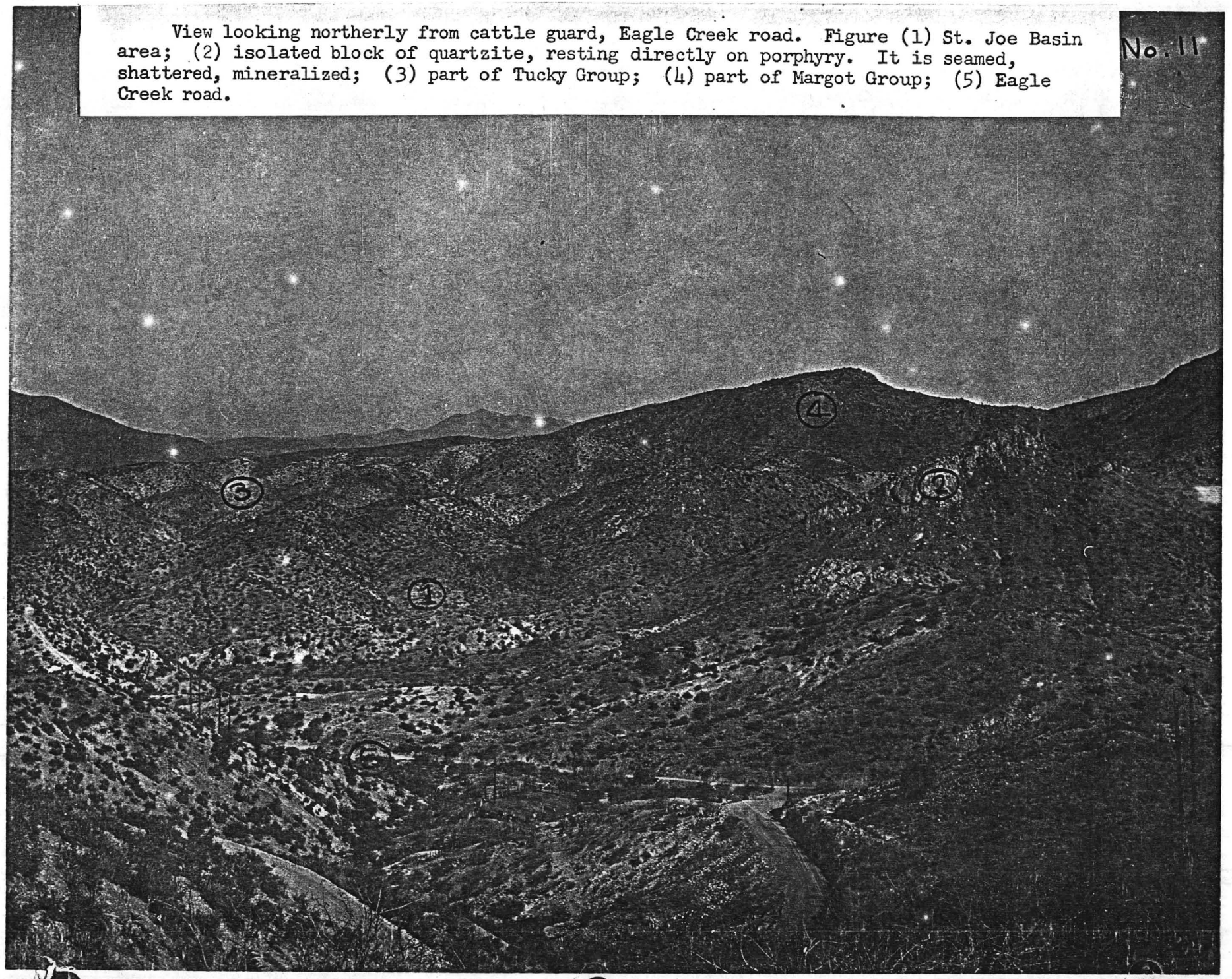
The other claims in this group are not of equal promise, although the Anita No. 9 shows a faulted segment of the Copper Plate vein. And near the southwest corner of this claim is a strong quartz-breccia vein. The development work is practically surface work and not nearly what the vein croppings warrant.

Corner #2 of the Margot No. 16 claim is set on a well defined vein of nearly E-W strike and showing the usual leached outcrop. Assays show some gold and silver in this leached vein matter.

A somewhat similar but better mineralized outcrop in the western part of Margot No. 17 claim assayed 6.98% copper in addition to some gold and silver.

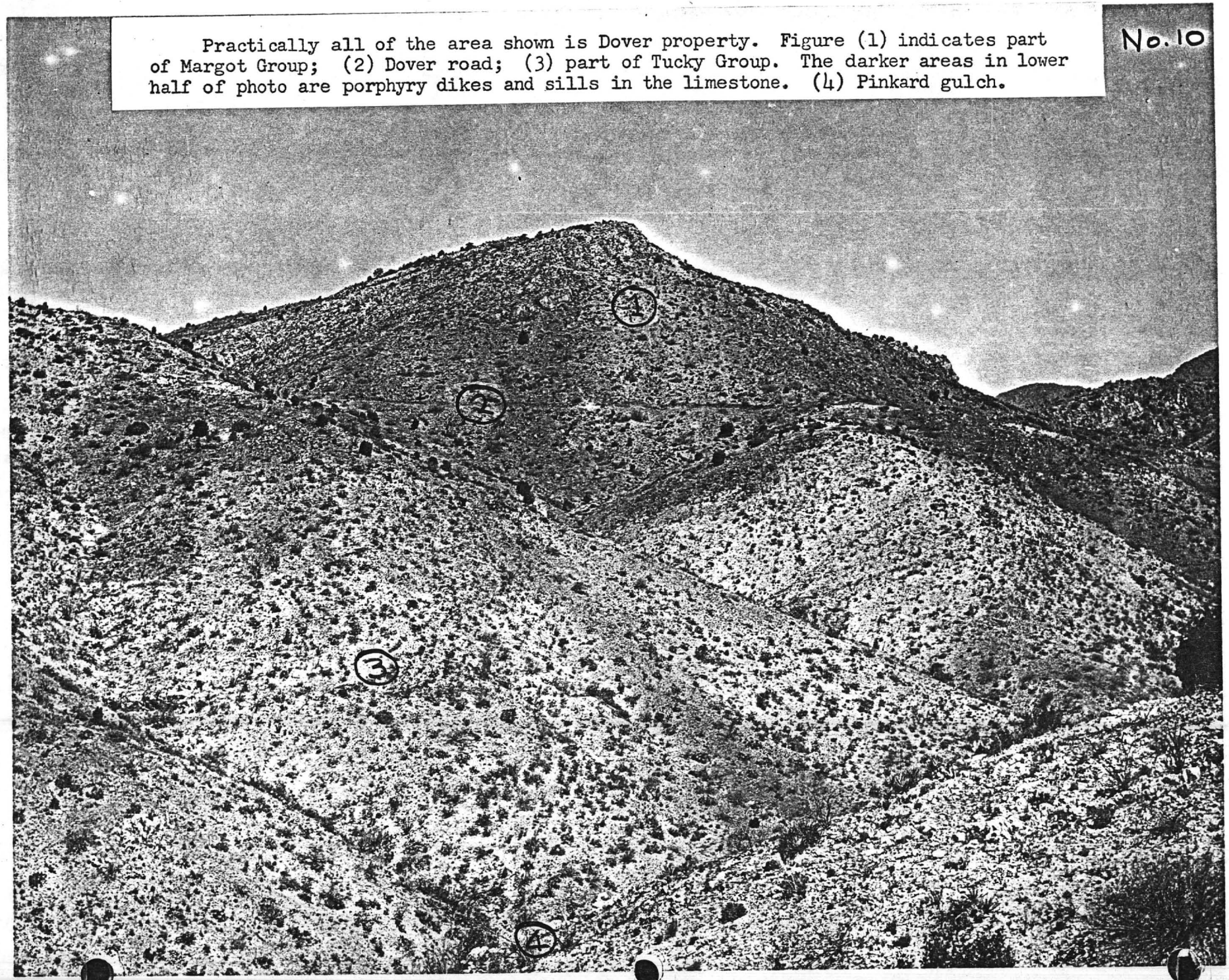
The general area covered by Anita Nos. 1, 2, 3, 4, and Margot 15 claims is of such a 'shatter-pattern' by reason of faults and cross faults as to form a fault mosaic. The rocks are intensely altered, and at least some of the faults contain characteristic surface evidence of leached-out copper, i.e., residual limonite, "gossan," etc.

No. 11



View looking northerly from cattle guard, Eagle Creek road. Figure (1) St. Joe Basin area; (2) isolated block of quartzite, resting directly on porphyry. It is seamed, shattered, mineralized; (3) part of Tucky Group; (4) part of Margot Group; (5) Eagle Creek road.

No. 10



Practically all of the area shown is Dover property. Figure (1) indicates part of Margot Group; (2) Dover road; (3) part of Tucky Group. The darker areas in lower half of photo are porphyry dikes and sills in the limestone. (4) Pinkard gulch.

Detailed mapping and sampling of this area is warranted because it has been traversed by fault fissures that have proven to be ore-bearing in adjoining properties. The resultant detail map may reveal the effects of cross-faulting and likewise determine their extent, or perhaps even their source. One such cross-fault exposed on the Anita No. 1 claim is believed to be related to the important Soto-Producer vein system.

MARGOT GROUP

This group of 11 claims covers a high and rather broad ridge that lies between Copper Plate gulch on the north and the Soto fault area on the south. Its eastern limit is roughly upper Pinkard gulch, and on the west the group joins the property of the Eagle Gold (Gold Belt). Photos Nos. 10 and 11 show a part of the eastern end of the group.

If an observer views this group only from the Dover road he is unimpressed. Its surface rock is almost wholly quartzite. But when the claims are closely examined they are found to contain fissure veins, most of which contain good copper ore. These veins cut the quartzite on a NE-SW strike. They vary in width but are relatively narrow as compared to the fault-fissures of the Coronado, Keating, or Margot-Keystone veins. However, their mineral content is usually of much higher grade. An example would be on the Margot No. 10 claim, about 150' southwesterly from Cor. #4, where assay samples show as high as 31% copper. On the Penker No. 1, and on the Margot Nos. 1, 7 and 8 claims, chalcocite is found in some of the veins.

The Margot Nos. 9 and 11 claims are relatively 'weak' as to mineral indications. Some carbonate ore shows on the dump of an old shaft almost due north of Impr. #3, Margot No. 9, but no visible mineralization was noted on the Margot No. 11 claim. The Margot No. 11 claim is unpatented.

One factor that applies to this group, and one whose importance appears to have been overlooked in this district, is the presence of porphyry directly underneath the quartzite. Porphyry shows in such position on the Margot No. 11, on the north of the group, and on the Margot No. 2 claim on the south. Normally, granite underlies the quartzite; and may be the underlying rock beneath the quartzite cover of these claims. But it is possible that this block of quartzite, lying as it does between two great faults, rests directly on part of the great intrusive porphyry mass - the exposed part of which is "9 miles long by 2 to 4 miles wide." (Lindgren.)

The quartzite itself is about 200 feet thick, and a hard, brittle rock; but it is well fractured on these claims. These fractures are not merely clean breaks, or 'adjustment faults.' Instead, they are mineralized veins of the NE-SW vein system. Some such contain good copper ore

but in general the outcrops are the porous, silicified, iron-stained material, of the copper-barren leached type that are the favorable surface indications of probable underlying ore bodies.

Lindgren states, Clifton Folio #129, page 13,

> "In any case the metals must have been derived from the porphyry, or from the deep-seated sources below the porphyry, for, as stated above, the presence of porphyry is the only common factor in all occurrences."

Butler and Wilson reached the same conclusion.

If, therefore, the porphyry in these veins forced itself into and along these fissures in the quartzite, and upward at least 200 feet to surface, and that porphyry is mineralized, as we know it is, why then isn't it possible for a porphyry mass beneath the quartzite to be of itself a commercial ore body?

To state the matter differently, there is a possibility that the porphyry underneath this quartzite could of itself contain a large body of commercial ore. If so, such ore would be of higher copper content because it has not been subject to long leaching and oxidation as with the porphyry ore of the Clay ore body.

I mention this as a possibility. It deserves detailed study in any overall prospecting or development plan. Such study should include the fault zones and fault fissures bordering this group on the north, and the important Soto (Producer) fault on the south. This last named fault is described under the Tucky and Foxey groups.

Other than the Margot No. 11, the claims of this group all show good surface mineralization, and outcropping veins of the NE-SW vein system. In this district the NE-SW veins and fissures have a much higher copper content; and this is likewise true of mineralization in the open pit of Phelps-Dodge.

The Margot No. 10 claim shows a strong fault-fissure, with the typical fault-breccia, quartz, and iron-stained porphyry. The topographic features are such that depth could be gained quite rapidly by drifting on the fissure. I have been told, and so believe, that the fissure connects with the Clay ore body, though it has not been so traced out by this writer.

FOXEY & TUCKY GROUPS

The Foxey, Missing Link and Lackawanna claims, were patented under Mineral Survey 3376 before the survey of the Tucky group, hence are not included in Mineral Survey 4266 (Tucky Group). They were purchased by the Dover Co. under an exchange agreement with the Phelps-

Dodge Corporation.

For purposes of this report these three claims are considered as part of the Tucky group. They are important claims because of their location along the Soto-Producer fault. That fault, in fact, is not only one of the major structural features of the Morenci district, but is likewise one of the most promising parts of the Dover property.

Lindgren mentions and describes this fault on pages 89, 90 91, 230, 295; also on page 297 under description of the Cayuga and Soto claims. (Prof. Paper #43, U.S.G.S.) Plate 1 shows this fault as being of nearly east-west direction for 1-1/2 miles from its western end, then curving in a northeasterly direction for about 3/4 of a mile. However, the fault is not designated on Plate 1 as the "Soto" fault, but it does have that name in the Clifton Folio #129, U.S.G.S., also by Lindgren. Reference is had to this Folio, and to Fig. 2, page 9 thereof, and the description of this fault in same Folio. A photostat of said Fig. 2, Clifton Folio, is attached as Exhibit No. 9, Map Envelope.

Note from this generalized map that the Soto fault is almost directly west of the important Concentrator fault, and, in fact, may be the western end of the Concentrator fault. The Concentrator fault is directly connected with the Clay ore body. So, too, in this writer's opinion is the Soto fault.

Arthur Houle, mining engineer, in letter-report to J. D. Douglas under date of July 20, 1936, refers to this area in the following terms:

Soto Fault - Eagle Gold

"South of the Margot claims of the Dover and the south boundary of the Pitts group, we encounter the Soto fault, one of the outstanding fault planes of the Copper Mountain Mining District. This fault strike East-West cuts through the clay ore body and joins the concentrator fault which strikes East-West. This is the center of the ore bearing area.

On the west end of this fault is located the patented claims of the Eagle Gold - Gold Belt group. Small pockets of copper ore have been mined from the Eagle property. The ore occurs as replacement deposits in a narrow belt of limestone on the south side of the Soto fault. The workings are badly caved and shaft timbers in four of the shafts are badly rotted. I have been unable to check any of the underground workings. The owners state that assay record and liquidation sheets of shipments from this property were destroyed in the Central Hotel fire at Clifton some years ago.

Going eastward from Eagle along the Soto Fault can be observed a mineralized zone which is marked by strong outcrops on the De Soto, Cordova, Irving, Producer of P.D.,

then Stevens group, and again into P. D. ground through the Tough Nut, Esperanza, Clay, Waterloo claims and on to Chase Creek. Adjacent to and south of this fault is the big copper ore area of the district. This zone has been extensively developed on the east side of American Mountain."

Lindgren's map (Plate 1) shows as surface rocks Coronado quartzite (Cambrian) on the north side of the Soto fault and Longfellow limestone (Ordovician) on the south side, excepting an area in and adjacent to Pinkard gulch where granite lies on the north side. This is shown on the geology map herewith, Map No. 2, which, as its legend states, follows Lindgren's geology.

It is not to be assumed the conditions are as simple as the foregoing brief statement would imply. Rather, they are more comparable to the Coronado fault, nearly 2 miles to the north. That is to say, the Soto fault shows fault breccia, diabase, and altered and mineralized porphyry in parts of the fissure as does the Coronado. It was not formed by a single fault movement. There were several fissuring stresses. True, the Soto fault (in area under discussion) has not produced ore; neither has it had exploratory development work on the Dover claims. There are old workings along, or close to the fault, on both the west and the east side of Pinkard gulch. These are briefly described in Lindgren's report on page 297 as follows:

"One mile up from the mouth of Pinkard Gulch are the Soto and Cayuga claims. The former is developed by a tunnel driven on the fault fissure between limestone and granite, but on this nothing of importance has been found, though some oxidized ore had previously been encountered in the limestone; this is probably due to contact metamorphism along a porphyry dike in this limestone.

On the ridge east of the Soto claim are several small ore bodies in limestone. The Cayuga showed a good body of carbonate and silicate ore along a vein with an east-west strike and southerly dip of 55°, which has a foot wall of quartzite and a hanging wall of limestone. This fissure is not unlikely the direct continuation of the Soto fault. The structure in this vicinity is complicated. In general, the porphyry has a tendency to form intrusive sheets between the sediments.

Half a mile father east-northeast the Producer vein, which is, very likely, the continuation of the Soto fault, crosses the north branch of Gold Gulch. Going up the slope toward the main divide, between Eagle Creek and Chase Creek, the outcrops of this vein are strongly marked by sheeted ferruginous rock, copper stained in places. The fissure which seems to mark the contact of porphyry and granite dips 45° SSE."

The Producer vein, in above quotation, has produced considerable ore since Lindgren's report was made (1904). In fact, the Phelps-Dodge engineers usually refer to the Soto fault as "the Producer." However, I have deemed it advisable to follow Lindgren's nomenclature. Lindgren reports ore on the Cayuga (see quotation above). And the Eagle Gold (Gold Belt) property, on the westerly end of the Soto fault has produced "at least $80,000.00 from one ore body, mined out by a leaser named McCoy" (oral communication of Edward Fitzgerald, County Treasurer, Clifton, Arizona).

Mr. Fitzgerald's statement is corroborated by Peter Riley, of Clifton, and for many years a public official. Both citizens are highly respected and have lived in the Morenci district about 40 years. Lewis A. Smith, Asst. Geologist, Phelps-Dodge, Morenci, corroborates statement about ore production but is not certain of its value.

This ore production is emphasized because it establishes the fact that the Soto fault-fissure is ore-containing; that mineral-bearing solutions have circulated in and along said fissure, and that they have formed ore bodies under favorable conditions.

Concrete evidence of this fact can be found today along this fissure, and upon Dover property. On the Tucky No. 2 claim, near the NW corner, and close to the north sideline, visible copper minerals are exposed in shallow cuts found in bottom of a gulch. The fissure here appears to be porphyry-filled, and of undetermined width because of the heavy mantle of talus and detrital material on the north. Silicified and altered limestone is exposed on the south. A sample of the ore exposed in the most easterly cut was taken by the writer and upon assay found to contain 7.2 oz. silver and 5.85% copper -- about $35 per ton gross value at present metal prices. There is said to have been an old 70 ft. shaft here (Statement of Thos. Cocks, deceased) but its collar cannot be seen now -- probably caved and washed in, being in bottom of the gulch. Company records indicate other samples from this area, taken by Mr. Sherman for patent purposes, contained up to 10 oz. silver and up to 7% copper.

The width of the fissure here is unknown, being masked on the north by rock and soil mantle, and, because of that fact, the north wall rock is uncertain. My belief is it is granite. On the south the wall rock is limestone. This is a favorable condition for replacement ore bodies in the soluble limestone. Not only do we find here actual mineralization, and in a fissure similar to others in this district that have hielded huge tonnages of ore, but, in addition, the fact that both to the east and to the west commercial ore has been mined from the same fissure. This area certainly justifies exploratory development work. Such work should be preceded by a study of the Coronado Fault-Fissure because both fissures were formed at same period of faulting (Lindgren). It is logical to assume contemporaneous mineralization. Indeed, the Soto fault offers the added factor of being traceable directly

into the Clay ore body, and, therefore, a channel for migrating mineral-bearing solutions from the main central mineralization of this rich district.

It is pertinent here to digress for a moment from this particular district and to compare the geological conditions found elsewhere in Arizona with those of the Soto fault area. An example known to the writer is the Magma mine at Superior, Arizona. It is now producing from about the 5000 ft. level, and its great ore bodies are found as replacement deposits of crushed wall rock within two fault zones of an east-west system. Its original outcrop was inconspicuous. One ore body, known as the West ore body, was discovered accidentally. Its stope length was about 250 feet, average width 15 ft., average copper content 7%, plus some gold and silver. Another ore body (Koerner) was without surface expression. On the 4000 ft. level this ore body showed ore for about 900 ft. in length with average width of 9 ft., and average grade of 5% copper.

All ore bodies of the Magma are associated with an east-west fault fissure. The ore occurrences are genetically related to porphyry intrusions. A significant fact, too, is that the fissure sometimes has both walls of diabase, and, where this occurs, the stope length of the ore body is greatest.

Please note the similarity of conditions, i.e.,

a. an east-west fault fissure;
b. inconspicuous outcrop;
c. replacement of the wall rock;
d. ore bodies related to porphyry intrusion;
e. role of the diabase (see Lindgren on Coronado mine, etc., as to diabase in Morenci veins.).

The writer does not presume to say that comparable ore bodies will be found in and along the Soto fault as in the Magma. An ore body, like an oil pool, can only be found with the drill. Geology is far from an exact science. Neverthless, the exposed porphyry in the Morenci district is vastly greater than at Superior, and is far richer, too. Or, perhaps I should say, its mineral content has been exposed and uncovered over a greater area. The Magma is practically the only mine in the Superior district, whereas the Morenci-Metcalf district has a greater number nearly all of which are now owned by a single company -- Phelps-Dodge.

Please bear in mind that the Magma is a vein mine. It is not a "disseminated deposit." To the end of 1951 the tonnage mined totaled 8,823,770 tons, and from this tonnage there was recovered 946,000,000 lbs. of copper, 61,132,027 lbs. of zinc, and considerable silver and gold. It is still a rich mine.

Interested readers are referred to the attached "Story of the Magma Mine" as prepared by the Arizona Department of Mineral Resources,

Exhibit "J", Reference Data, herewith, or to the references therein cited.

The Dover property along and adjacent to the Soto fault fissure is mining ground of above average possibilities. This would include the Foxey, Missing Link, and Lackawanna claims, and the adjoining Tucky claims Nos. 1, 2 and 3.

Other Tucky claims:

Tucky claims Nos. 4, 5, 7, 8, 10 and 11 have not been much prospected if one judges by the work found. The surface rock is mostly limestone with irregular outcroppings of porphyry. The porphyry occurs as both dikes cutting the formation, and as sills in the limestone. Assays, of 4.73% copper in one place, and of 8.36% copper in a second cut on the Tucky No. 11, and 2.84 oz. silver and 4.34% lead on the Tucky No. 10, are proof that the area is mineralized. But these particular claims are west of Pinkard gulch, and, for one reason or another, claims to the west of that gulch seem to have been neglected by prospectors.

Nevertheless, to a mining engineer or geologist the presence of much intrusive porphyry in the limestone is a favorable condition for ore bodies, especially where the porphyry appears as dikes, or filling fissures, rather than as sills. Contact metamorphism is very pronounced in this district--

> ".... wherever we find the porphyry adjoining the limestone or the shales of the Paleozoic series....(and) this alteration is particularly observable at Morenci...." (Lindgren).

Typical contact minerals are noticeable along limestone-porphyry contactsexposed at several places within these claims.

Tucky Nos. 3, 6, and 9, and St. Joe No. 8 claim are crossed from north to south by Pinkard gulch, and, roughly, in their east-central part. On either side of the gulch are numerous prospect cuts, trenches, shafts and drifts. Most of such are on mineralized veins, or porphyry-filled fissures, or on contacts between limestone and porphyry. Company records indicate assays of 4.5 oz. silver, and 0.54% copper, Tucky No. 3; 3.14% copper, Tucky No. 6; 11.6 oz. silver and 6.56% copper, Tucky No. 9; 5.92% copper, St. Joe No. 8. The samples were likely taken for patent purposes. No systematic sampling appears to have been done, nor are there geology maps whereon veins and ore occurrences are platted in detail. Such maps often suggest a 'pattern,' or indicate cross-fissures, or veins of converging strike where ore shoots are often found. The dearth of systematic prospecting in this part of the Dover property is very noteworthy to anyone familiar with such mining camps as Leadville, Colorado where the "lime and porphyry" contacts were so productive. This is true of other mining areas as

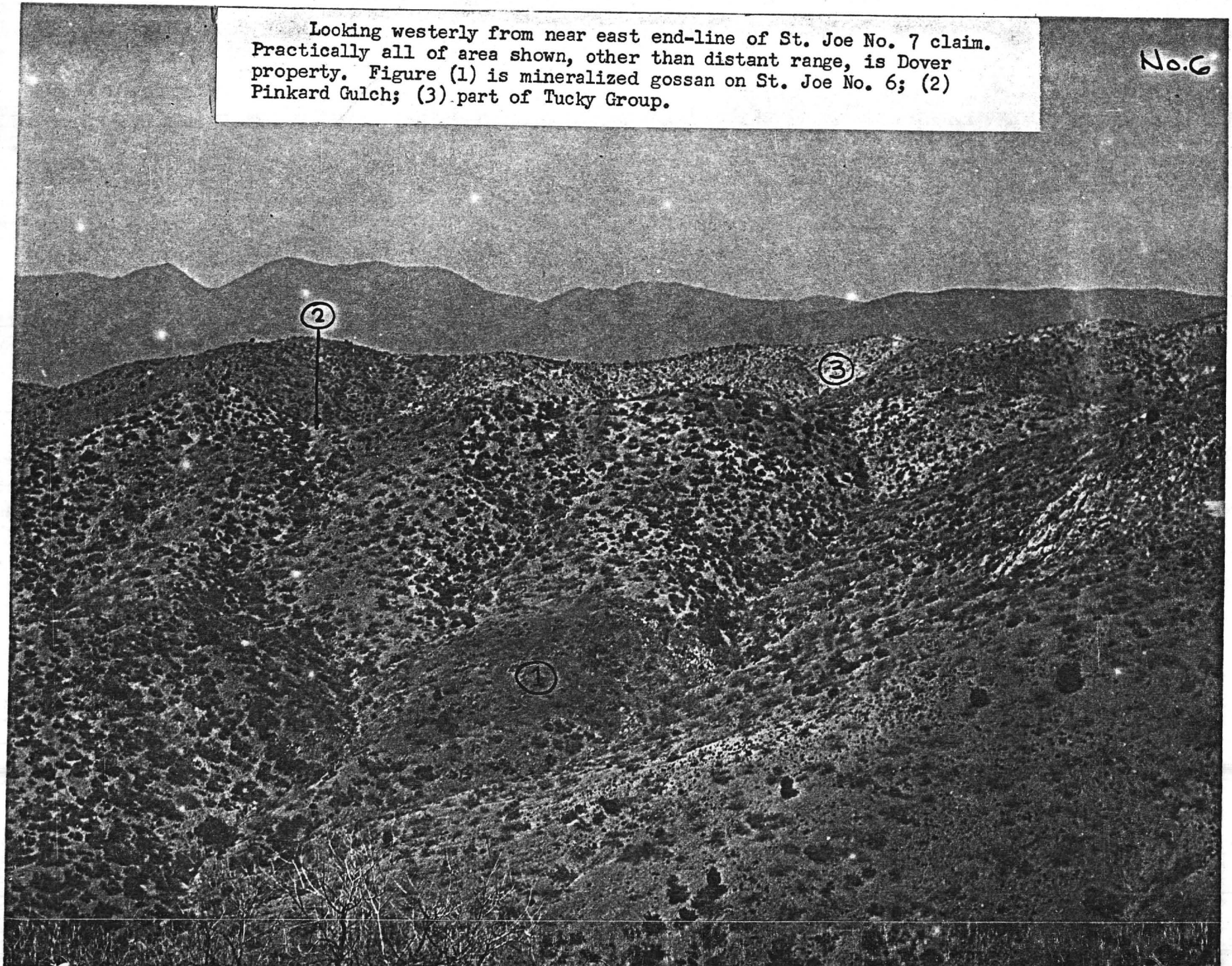
Photo No. 16
Remove from pocket
and spread out

THE PROSPECTOR

PUBLISHED BY PHELPS DODGE CORPORATION, MORENCI BRANCH
MORENCI, ARIZONA

. 5 MARCH, 1953 No.

Photo No. 16: Note: Remove from cellophane pocket and spread out.
Date of photo not known; probably taken from a point on east side of Chase Creek, looking westerly. Figure (1) is Chase Creek Road, i.e., U.S. #666; (2) American Mtn; (3) ridge between Phelps-Dodge and Dover ground. This is east side of same ridge



Looking westerly from near east end-line of St. Joe No. 7 claim. Practically all of area shown, other than distant range, is Dover property. Figure (1) is mineralized gossan on St. Joe No. 6; (2) Pinkard Gulch; (3) part of Tucky Group.

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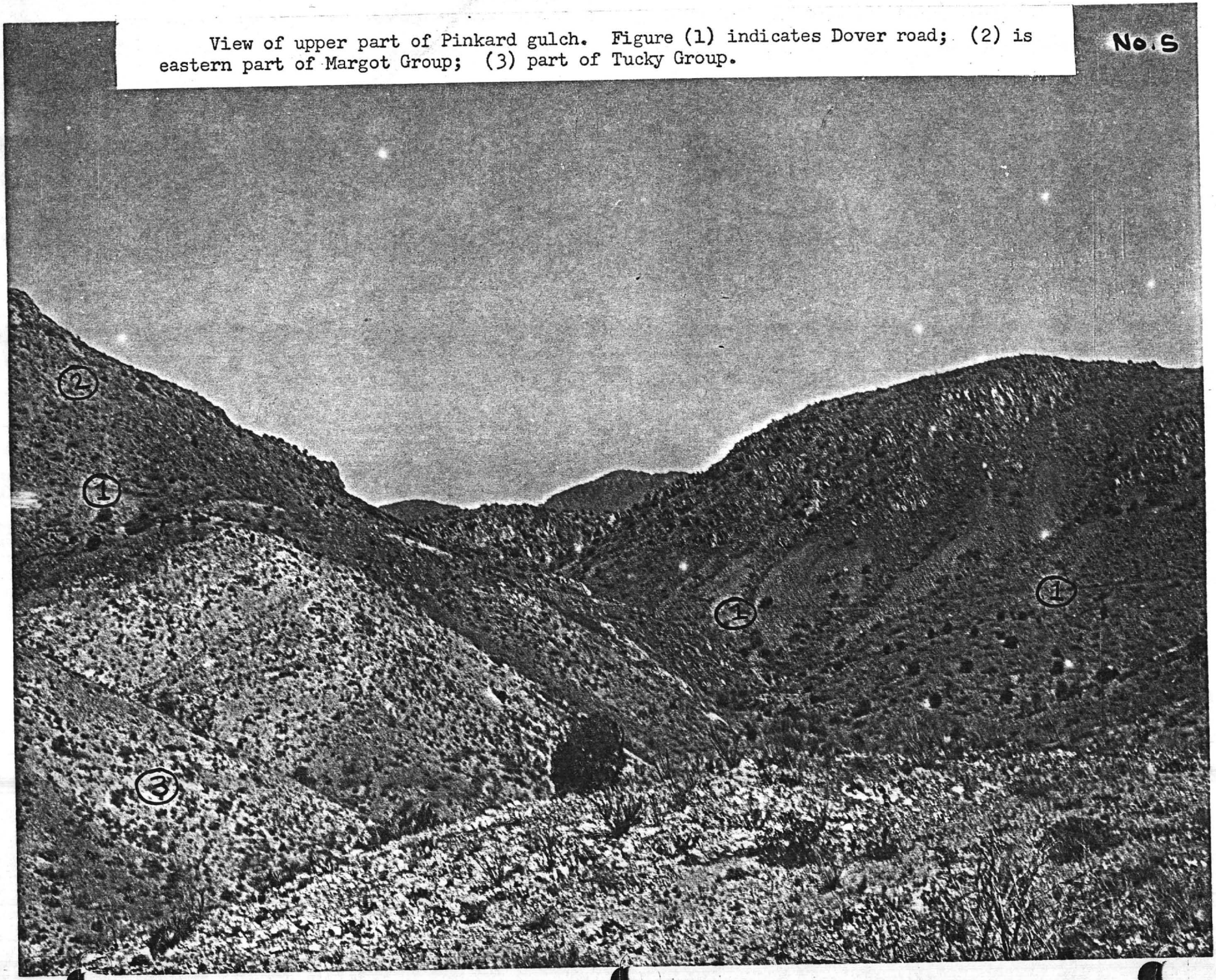
View of upper part of Pinkard gulch. Figure (1) indicates Dover road; (2) is eastern part of Margot Group; (3) part of Tucky Group.

No. 5



well in many parts of the west. Photo No. 10 shows some of the limestone-porphyry contacts.

Bourbon No. 1, Bourbon No. 3, St. Joe No. 6, St. Joe No. 7, and St. Joe No. 9 claims, the remaining claims of the Tucky Group, M.S. 4266, will be discussed in connection with description of the Storm Group.

STORM GROUP

This group comprises 5 claims under M.S. 4230, but for purposes of description I am including all adjoining claims of what Dover officials term the "St. Joe Basin." The name is derived from the fact that many of the claims are the numbered St. Joe's. The area so covered is not a topographic "basin," although lower than the mountains bordering it on the north, east and northwest. It is rather a series of low ridges, nearly parallel and with intervening gulches that drain southerly into Gold Gulch.

The following listed claims are considered as "St. Joe Basin" areas, and are included with the Storm Group of five claims for descriptive purposes:

Mineral Survey 4266:	Bourbon No. 1	
	Bourbon No. 3	
	St. Joe No. 6	
	St. Joe No. 9	
	St. Joe No. 10	
	Tucky No. 9	(as to portion
	St. Joe No. 8	(lying east of
	Tucky No. 6	(Pinkard gulch.
Mineral Survey 4267:	Bourbon No. 2	
	St. Joe No. 1	
	St. Joe No. 2	
	St. Joe No. 4	
	St. Joe No. 5	
	St. Joe No. 7	
	Bell No. 6	
	and	
	Bell No. 5	(as to portion
	Bell No. 7	(lying east of
	Bell No. 8	(Pinkard gulch.
	St. Joe No. 3	(
	Tucky No. 13	(

The claims thus listed cover about 400 acres. In an east-west direction, from the Cyclone claim to Pinkard gulch on the Bell No. 8 claim is about 6000 feet. In a north-south direction, from the north line of Tucky No. 9 claim to the south line of Bell No. 6 is 4300 feet. Photos Nos. 2, 3, 4, 11, 12, 13, 14 and 15 show this 'basin' area topography.

As will be observed from the claim map the eastern part of the area thus outlined is relatively narrow; and this, too, is the portion nearest the great Clay ore body (open pit) of the Phelps-Dodge Corporation. That company is mining low grade copper ore from the 'pit' at the rate of about 50,000 tons per day; and to get this tonnage of ore they must also remove about 87,000 tons of leached and 'lean' overburden. In the year 1952 the total daily tonnage removed was 137,386 (company report).

The east boundary line of the Storm group is only 800 feet from the western edge of the 'pit,' hence this part of the Dover property has strategic location with respect to the second largest open pit mining operation in the USA. Nor is this location the sole or greatest value. The surface shows the same monzonite porphyry that constitutes the principal ore of the 'pit.' On these claims it is leached, sericitized, kaolinized, shattered, and criss-crossed by innumerable veinlets. The principal sheeting of the porphyry is NE-SW, and that is the strike of most of the mineralized veins in the district. As stated by Butler and Wilson, ".... drifts that follow northeast fissures have much higher average copper content...." (bibliography - and Exhibit No. 2, Supplemental Geology).

There are a number of distinct NE-SW veins and fissures in the porphyry of this group, and some of such contain visible copper mineralization. On the whole, however, their outcrop is marked by rusty iron oxides - hematite, limonite, etc. - and more or less quartz and silicified porphyry. Copper is found as films and specks at many places in the porphyry itself. Again, there are a number of places where the copper content is 5% or better, and a few of such occurrences will be mentioned later. The important fact is that this particular area offers such good indications of an underlying ore body of the disseminated type. The conditions are similar to those obtaining with respect to the Phelps-Dodge 'pit,' insofar as leached and altered porphyry, northeast fissuring, the shatter-pattern, and the surface outcrops are concerned. The 'pit' partly comprises previously worked ore bodies of the vein, or the replacement type. And, doubtless, its "rusty" gossan covered a much larger area.

It is not to be inferred, and I do not imply, that a second Morenci 'pit' underlies the area under discussion. I am simply saying that it is not only possible, but indeed very probable, that a segment, or an outlier,

No. 13

View taken from point on Eagle Creek road. Gold gulch in center foreground. Figure (1) indicates part of Storm Group; (2) is easterly part of St. Joe Basin, (3) Phelps-Dodge open pit just over ridge.

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No. 14

Looking north-westerly from near cattle guard on Eagle Creek road. Practically all of area shown, other than lower foreground, and range in the distance, is Dover property. Figure (1) gives a good idea of porphyry hills of the St. Joe Basin area.

or an 'island' of this intensely mineralized porphyry may underlie these claims. Such probability is not without supporting evidence, namely, the "Petaluma" ore body, which, on Plate XVI, Butler and Wilson report, is shown as separate from the Clay ore body. See photostat enlargement of PlateXVI herewith as Exhibit No. 1 - "A", Supplemental Geology, and by reference to the claim map you will observe that the Petaluma No. 3 claim (Phelps-Dodge) adjoins the Storm group of the Dover Co. I feel safe in asserting that mineralization did not stop at the property line. And I do feel strongly that prospecting by systematic drilling of this area is amply justified as being much above the average mining venture. The district is a proven one, and produces more copper than any other Arizona district (quite a record, considering Ajo, Miami, Inspiration, Ray and Bisbee, are all Arizona copper mines of great present-day production record). The nearby 'pit' of the Phelps-Dodge is, to quote Lyle M. Barker, Mgr., at Morenci, about ".....one mile square and has a maximum thickness of 850 ft. The mining operation will ultimately extend for a vertical range in excess of 1300 ft." ("Copper From Low-Grade Material" -- copy attached as Exhibit "O", Reference Data Envelope.)

Purely as a matter of information, I quote below from a paper on the San Manuel ore body (Arizona) by Wesley P. Goss, Gen. Mgr., written in 1948:

> "A prominent hill of monzonite, stained red with iron oxide, attracted early prospectors to the property but shallow prospecting and two churn drill holes put down in 1915 failed to discover anything of economic interest. Most of the area surrounding the red hill is covered with a layer of conglomerate. Two small outcrops of copper silicate stained monzonite lie at the base of the hill. The largest of these outcrops covers less than two acres in a triangular shaped patch."

The same paper describes the methods of drilling used, the spacing of the holes, sampling procedures, etc., and cites the rather uniform distribution of copper values throughout the ore body in both vertical and horizontal directions. Mr. Goss continues --

> "The size, shape and extent of the ore body was established by systematic drilling..... The full extent of the ore body is not yet known because, having developed 460,000,000 tons, we stopped drilling."

For a clearer understanding of the basis for my opinions re this particular area, as briefly outlined above, it is advisable to discuss here the general theories re copper enrichment. What here follows is largely abstracted from "The Enrichment of Sulphide Ores," by W. H. Emmons, U.S.G.S. bulletin No. 529, and "Copper Mining in North America," (see bibliography) in addition to Lindgren's report on this district, and to the later Butler and Wilson report on Morenci.

Primary copper ores commonly contain abundant pyrite, and are actively attacked by oxidation. The sulphates thus formed are very soluble, but yield their copper readily as secondary sulphides upon coming in contact with fresh pyrite at water level. As a result of these conditions, copper is peculiarly susceptible to solution and enrichment, and the best defined types of secondary deposits are those of copper.

Chalcopyrite is the usual starting point, being the most abundant primary copper mineral. Bornite, enargite, tetrhedrite, tennanite, and occasionally chalcocite, are primary copper minerals of lesser importance.

The secondary copper sulphides are chalcocite, chalcopyrite, enargite, bornite and covellite -- the last probably being exclusively secondary in origin.

Chalcopyrite, which may be considered the original form of copper ore, carries one atom of iron, and one of copper, held together by two atoms of sulphur. The breaking up of the granule of chalcopyrite not only releases copper, for redeposition in the form of enriched sulphide, or as a silicate, carbonate, or oxide ore, but also releases the atom of iron, which may be carried upward or downward, or left in place, but which usually appears as hematite, or limonite, disseminated throughout the outcrop of the vein. This is the 'gossan,' or 'iron hat.'

The final stage in copper enrichment is chalcocite, and it is economically the most important copper mineral.

Where outcrops of copper deposits have been subject to long and thorough leaching they consist of quartz, usually white, much kaolin, iron and perhaps manganese stains, and oftentimes chryscolla, etc. These conditions are favorable for chalcocite enrichment in depth, especially where there is residual evidence of good primary mineralization, a porous or brecciated structure, and post-mineral fracturing.

* * * * * * * *

Reverting now to the Storm group area, we not only find surface evidence of secondary enrichment but we have positive proof thereof only a few hundred yards away on an adjoining property. An observer can view the west end of the 'pit,' note the disseminated mineralization,

see the strike of the veins exposed in the 'pit' and then note that all this is simply on the east side of a low ridge on which, on its western slope, is the Storm Group. Photo No. 16 (Phelps-Dodge) shows the western segment of the 'pit.' The arrow indicates the ridge above-cited.

Copper Mineralization on the Storm Group:

Copper ore shows on surface at numerous places, only a few of which will be mentioned here.

Beginning with the most easterly claim, and considering the other claims as one goes westerly over the area, we find copper showing on

Cyclone:	near discovery work, 50 ft. from Phelps-Dodge line.
Tornado:	near Impr. #3, and 150 ft. westerly therefrom.
Hurricane:	along Dover Road, in seamed, shattered and kaolinized porphyry. A sample across 20 ft. showed copper content of 0.60%. (note--much of the ore from the 'pit' is about 0.85% Cu).
Rainy Day:	along Dover Road.
Storm:	along Dover Road.
St. Joe No. 9:	at 600 ft. S-W'ly from Cor. 4, and 70 ft. N. of the south sideline is point of sampling that showed 6.3 oz. silver and 18.18% copper.
Bourbon No. 3:	assay of 4.51% Cu from 60 ft. S-E'ly of No. 1 Impr.
St. Joe No. 6:	copper shows along east side of gulch in SE part of claim. Impr. #1 shows a strong contact vein between limestone and porphyry; assays of 2.03 Cu, plus some Au and Ag.
St. Joe No. 10:	copper assays of 3.12% from cropping 600 ft. on S. 87 E. course from Cor. #2.
Bourbon No. 1:	2.44% Cu, and 0.16 oz. Au, from cropping 170 ft. N. 44E. from Cor. #3.
St. Joe No. 5:	copper in several places in SW part of claim and on east side of Gold Gulch.
Bourbon No. 2:	copper in SW part of claim on west side of Gold Gulch.

St. Joe No. 7:	in eastern part of claim, and on east side of gulch, Cu shows in altered porphyry over a width of 50 ft. (N&S). A sample across 20 ft assayed 3.8 oz. silver and 5.7% copper.
St. Joe No. 4:	copper shows in several places in part of claim. In one instance the copper is in a hard tight rock (dike) that appears to be a much fresher phase of monzonite porphyry than usually found.
St. Joe No. 2:	in about the center of this claim, assays of 14.6% Cu obtained; and about 225 ft. S-E'ly from above assays of 4.64% Cu.
St. Joe No. 1	copper of 1.3% assay shows near west end of claim and just above floor of Gold Gulch. From here for about 800 ft. N-E'ly, up the gulch, evidence of intense alteration.
St. Joe No. 8:	copper shows in several places in and near the workings on eastern part of claim. Assays up to 5.92% Cu obtained here. Chalcocite shows in thin seams in places.
Tucky No. 9:	copper assay of 3.14% from Impr. #3.
St. Joe No. 3:	copper shows along Pinkard Gulch.
Bell No. 8:	copper shows along Pinkard Gulch, and near east endline.
Bell No. 7:	copper-Ag-Au ore shows in workings on both sides of Pinkard Gulch.
Bell No. 5:	Au-Ag ore, with copper stain in places, shows in many cuts along Pinkard Gulch.
Bell No. 6:	copper-Ag-Au found in west end of claim, south of Gold Gulch.
Tucky No. 13:	copper ore shows in workings on both the eastern and the western parts of this claim.

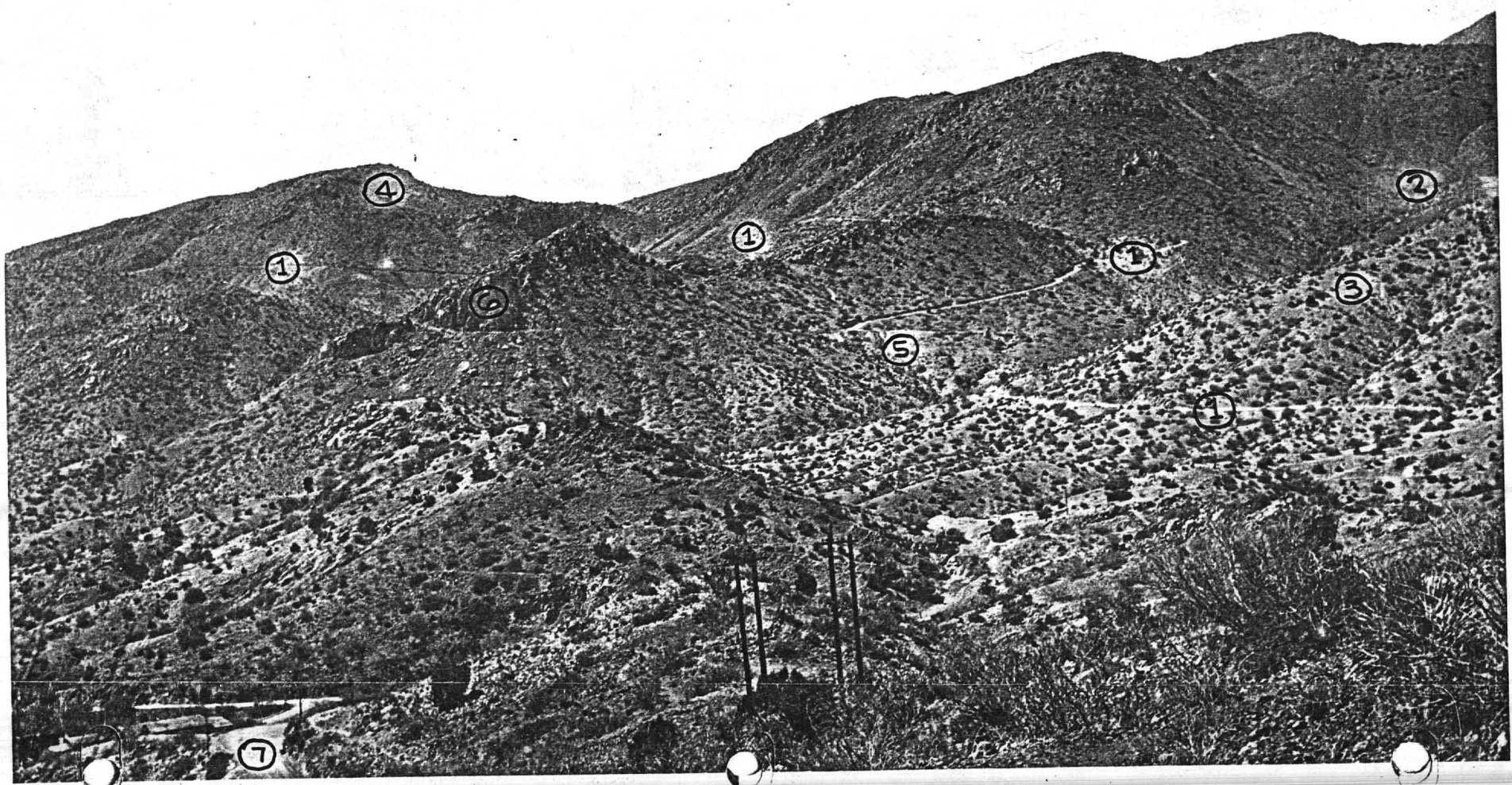
It should be here stated that the area adjacent to lower Pinkard gulch, and also along Gold gulch, contains more gold and silver in the ore than copper. This is particularly true of the St. Joe No. 1, and the Bell Nos. 5, 6, 7 and 8 claims. Shipments of gold-silver ore from the Bell No. 5 were made by a lessee in 1950-51. Further data will be given under the description of the Bell Group.

No. 15

View from Wilhelmina claim, looking northerly. High peak is American Mtn. Figure (1) is outcrop Wilhelmina vein; (2) Eagle Creek road and pipeline; (3) upper Gold Gulch; (4) Dover road; (5) Storm Group; (6) boundary line between Cyclone claim (Dover) and Petaluma claim (Phelps-Dodge).

No.12

Figure (1) indicates Dover road; (2) upper Gold Gulch; (3) Storm Group; (4) part of Margot Group; (5) Wattles mine shaft; (6) quartzite cliff--south face; western side same cliff shown in Photo 11; (7) Eagle Creek road.



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Discussion: Storm Group

The mention of a few assay results, as given above, does not mean that the point of sampling is the only place within the particular claim where mineralization is found. Nor is it asserted, or to be implied, that the particular samples represent an ore body. They are samples of "mineral in place," and, for the most part were taken for patent purposes. The purpose in citing such samples is rather to give an idea of the extent of the area wherein copper ore is exposed on surface or a few feet below surface in shallow workings. And these exposures are practically all in porphyry. Such sedimentary rocks as are found in the area under discussion (limestone, quartzite, shales) are small blocks, detached from the main mass of sedimentary rocks, and engulfed in the porphyry. This condition occurs in the 'pit' also. (See Butler and Wilson report.) And even as to these blocks we find mineralization therein. Thus, the west end of the St. Joe No. 9 contains part of a high bluff showing quartzite as the surface rock. The quartzite is much shattered and broken, and copper films and stains are found in this quartzite which here has vertical faces on the south and west sides. Underneath this quartzite is porphyry, and in the porphyry we find the typical mineralized fissures of NE-SW strike. This condition is likewise found in about the center of St. Joe No. 5 claim, and here, too, are copper stains in the quartzite, and mineralized porphyry underneath the quartzite.

This area is within the unit described as "Gold Creek Basin" in Lindgren's report, beginning on page 292. On page 293 he writes:

> "Porphyry. -- Porphyry of the Morenci types occupies nearly the whole of the upper valley of Gold Gulch, and is also intimately mingled with sedimentary rocks as stocks, sheets, and dikes on the lower slopes toward Eagle Creek... At the head of Gold Gulch, toward the Morenci divide, the rock is rusty and shows indications of mineralization by quartz cementation and pyritic dissemination..." (1902).

On succeeding pages, Lindgren mentions that the prospects in the Gold Gulch area, while containing some copper, had been located and worked for the gold ores; that placer gold had been mined from the Gulch gravels as far back as about 1880; that in 1902 "very little work was being done, and there was little opportunity to studying the deposits."

Attention is called to the Lone Star tunnel described by Lindgren on pages 279-280 of Prof. Paper #43. The east portal is near the town of Morenci and the west portal is on the Copper Bar claim of Phelps-Dodge Co. At the west portal the dump is heavily copper stained - practically all "blue vitriol," or chalcanthite, the hydrous copper sulphate. Such

copper ore is believed to be derived from original copper sulphide by oxidation. It is not an important source of copper; however, its importance in this instance is the proof it gives of the copper-containing character of the material comprising the dump at the west portal of this tunnel.

Lindgren's description indicates that the western 2000 ft. of this 2700 ft. tunnel is in porphyry. This porphyry contains some copper as the dump proves. And even though such copper be low grade, it is an important factor as regards the Dover property. The west portal of the tunnel is about 1000 feet from the south line of the Storm Group, and the dump of this tunnel is proof positive of mineralization in the porphyry, even though it be relatively feeble.

Photo No. 4 shows the west tunnel portal and the ridge the tunnel penetrates. The tunnel is used for water pipelines from Eagle Creek pumping station to Morenci.

On the other side of the Storm group (north and west) we find good exposures of the mineralized porphyry along the Dover road on the Armada Extension claim (P. D.). Veinlets and seams of copper ore are evidence of its mineralization.

The point is: to the south we have the mineralized porphyry as proved by the Lone Star dump at the west portal. To the north we find the porphyry mineralized along the road grade. The porphyry is yielding about 50,000 tons of 1% copper ore daily from the 'pit' to the east. And, on the west we have abundant surface evidence of copper mineralization. Therefore, as stated on page 31 hereof, "I feel strongly that prospecting by systematic drilling of this area is amply justified as being much above the average mining venture."

In lower Pinkard gulch, on the Bell Nos. 4, 5 and 7 claims, are many old mine workings, mostly adits and crosscuts on the NE veins, or along a limestone-porphyry contact. Some such will be described under the "Bell Group," but are mentioned here to cite the fact that at least six such distinct veins can be seen along Pinkard gulch and on the above cited claims. They all have the NE-SW strike. They vary in width, but rarely exceed 4 or 5 feet between walls, although some show much alteration of wall rock that is itself feebly mineralized. And between these veins the intervening porphyry is more or less altered, though not in the same degree as upper Gold Gulch. The 'big idea' however, is that the porphyry contains mineral-bearing veins, and that it is itself mineralized, and, therefore, in the light of mining history and developments in the district, has possibilities for disseminated ore bodies.

As to gold-bearing veins themselves, they may be copper-bearing at depth.

"Unlike copper, the gold in outcrops does not migrate. It is not dissolved by the products of oxidation of pyrite or by ordinary weathering. As other elements are removed by weathering there is a mechanical concentration of gold in gossans. Some gossans are worked for their gold content where the underlying sulphides are relatively low in this metal. The Highland Boy mine, at Bingham, among others, was first worked as a gold mine. At depth, copper was found, and the property has been a producer of this metal for many years. Likewise, the first copper veins at Butte were worked for gold and silver in the oxidized zones. As most copper ores contain some associated gold, this element in a gossan encourages deeper exploration."

(Dr. B. S. Butler; Geology of Copper Deposits of North America. In "Copper Mining in North America," U.S. Bureau of Mines Bull. 405 - 1938, p. 93)

These veins are persistent on their strike, they contain both iron and sometimes manganese oxides, much quartz, gold and silver values, and sometimes a little copper. They are in a favorable host rock that is itself feebly mineralized in many places. Conditions are favorable for copper ore bodies at greater depth. Diamond-drill prospecting is warranted in the lower Pinkard Gulch area, because it is believed core recovery would be good; at least much better than in the more altered and shattered porphyry in upper Gold Gulch where churn drilling appears more feasible.

BELL GROUP

Mineral Survey 4267

This group, per mineral survey, comprises 20 claims, all patented. Seven of such claims, and a portion of five others, have been included under the description of the Storm Group. The western limit of the Storm Group was arbitrarily fixed as Pinkard Gulch. This was done to help define the "St. Joe Basin"; and Pinkard Gulch was named as a convenient limit on the west. Because of this division the area within the Bell Group that is east of Pinkard Gulch has already been partially described, and only such reference thereto as is necessary will here be made.

On the basis of such division, then, we have the following named claims to here consider, namely,

Bell No. 1
Bell No. 2
Bell No. 3
Bell No. 4
Bell No. 9
Bell No. 10
Bell No. 11
Tucky No. 12
and
Bell No. 5) as to the portion of said claims
Bell No. 7) west of Pinkard Gulch
Bell No. 8)
St. Joe No. 3)

Bell Nos. 1 and 3 claims contain considerable old mine workings, all done prior to Dover purchase, although the Dover Co. cleaned out some drifts and cross-cuts for measurement thereof by the mineral surveyor prior to patent application. According to the survey notes there is some 405 feet of underground work in one place, and 286 feet of same in another place, both on Bell No. 3. Similar work on the Bell No. 1 totals 128 ft. The portals are caved at this time.

The work mentioned was done on quartz-iron veins of NE-SW strike and evidently for the gold-silver ores.

Bell No. 4 claims likewise contain much old time mine workings that total about 500 feet underground. Most of this is found in Gold Gulch and a portion thereof is shown in Photo No. 17.

This work, together with similar work found along Gold Gulch on Bell No. 5, and much similar work found on both sides of Pinkard gulch on Bell Nos. 5, 7, 8, and 9 claims, was done on (a) quartz-iron veins in the porphyry, nearly all of NE-SW strike, or, (b) contact veins between limestone and porphyry, or, (c) small replacement ore bodies in limestone.

Some of the veins (a) are traceable from Pinkard gulch on a NE course into the shattered porphyry area of the Morenci 'pit' region. As they reach this more altered porphyry they seem to 'horse tail' or finger-out, so that it is difficult to trace any one particular vein.

Such veins contain gold and silver ores, and frequently some copper. The probabilities are that the gold-silver values are "spotty" and irregular; that the pay shoots are not large, or pay ore confined to relatively narrow streaks. This is an assumption based upon statements of a few "old timers" who are somewhat familiar with the area, and the fact that little work was being done at date of Dover acquisition. That gold-silver ore was shipped from the area is well known, but the total production or its value cannot now be determined. Evidence of pay

ore being mined and shipped under Dover ownership is had in the form of smelter settlement returns made to Cy Gomez, lessee, for ore he mined from Bell Nos. 4 and 5 claims in 1950-51. A typical shipment totaled 152.08 tons, for which the lessee received $2,392.84 in settlement.

In my examination of these claims for patent purposes, I took a few samples for assay. These were more as a check on the "panning" samples, nearly all of which showed 'colors' or tiny nuggets. Assay results ranged from $1.75 per ton, gold and silver, to $192.33 per ton for one sample of selected ore. This sample contained 95.4 oz. silver, value $67.73, and 3.56 oz. gold, value $124.60.

W. A. Snyder, employed by the Dover Co. for annual assessment work in 1948, took 11 samples from this general area for his personal information. These ranged in value from a low of 62¢ gold-silver, for 2 samples, to a high of $44.49 in gold-silver. One of the 62¢ samples contained 2.37% copper. I have a copy of the assay certificate but do not know the points of sampling, except that it was in this general area.

Gold-silver ore, and, in places, copper ore is found in eastern part of the Bell No. 9 claim and on either side of a gulch that drains into Pinkard gulch. Copper is noted on the Bell No. 10, Bell No. 11 and Tucky No. 12 claims. All such showings above named are found west of Pinkard gulch and are proof that the mineralization extends west of said gulch. However, there is less of it, in general, and the porphyry here is less altered and more blocky.

Reference is here made to the description and discussion under the Storm Group with respect to these gold veins, pages 35 & 37. In addition to the quotation from Dr. Butler it may be added that at Bingham, Utah, outcrops of lodes were traced with difficulty because of shattered and discolored rock, but that at many places the rusty and siliceous outcrops carried gold values. Other examples could be cited, though perhaps of less well known mines. Butte veins were largely silver-bearing in surface outcrop.

It is well known to the mining fraternity that where more or less parallel veins are persistent on their strike they are more apt to come together in depth than to divide. Further, they are more apt to become more regular in their strike, dip, and width, although they are commonly narrower in their deeper part. This is assumed to result from the fact that the deeper and more compact rock is less affected by fissuring stress as compared to near surface where the lighter overburden permits greater dissipation of the stresses among irregular fractures. Further, where parallel veins outcrop on surface, and not too far apart, such veins may have a common root system at depth.

This is a general statement but is submitted here in support of my previously expressed idea that diamond-drill prospecting is warranted in this area. A drill hole could be run from Gold Gulch and would intersect

several veins at right angles, and at depth, depending upon the slope of the hole. It is believed good core recovery could be made. If so, it would reveal the vein structure, and whether gold or copper containing, as well as the character of the enclosing rock. If such a porphyry, as I believe it is, it could well contain disseminated copper ore.

WILHELMINA GROUP

This group comprises 4 claims of a total acreage of 63.78 acres. It lies on the north side of the Tom Wal group, but only one of the claims, Petite 37, adjoins that group. On the Lucky 38 claim are two frame houses, shed, etc., owned by the Dover Company, and now occupied by John Tysoe and family.

These claims, broadly speaking, are between the main porphyry mass of the district, on their north side, and the shales and limestones of the Pinkard formation on the south. Copper ore is found on the Petite 37 in a fissure in the diorite-porphyry. On the Perfect 36 claim both the shale and the diorite have been intruded by monzonite porphyry in the form of a dike. In and along this dike films and stains of copper are found, together with much relief limonite, and "gossan." Locally, some miners call this the Copper Mt. Dike. On the south side of the dike contact minerals - epidote, etc. - are found. The monzonite in the dike itself is strongly sheeted in a NE-SW direction, which is the predominant sheeting in this district.

The Wilhelmina claim contains a strong vein with prominent outcrop, as shown in Photos Nos. 18, 19 and 20. The quartz and vein filling is 6 feet wide, on an average, and heavily stained with manganese oxide. Ore was shipped from this vein prior to Dover ownership but its value is unknown to me. A shipment of 36.82 tons made by a lessee in 1947 contained $22.06 per ton in gold and silver, and a second shipment the same year paid at $15.32 per ton.

This same vein, on the Zorilla property adjoining this group on the southwest, was mined by lessees right up to the Dover property line. A number of shipments were made, and the ore bin, track, etc., are still on the ground, but no work is now being done because of owner's refusal to renew the lease.

The Wilhelmina vein deserves development. Such work as has been done by leasers has been 'gophering' and 'chloriding,' i.e., seeking out the richer parts of the vein and mining it out with the least amount of work, and without due regard to future work, proper timbering, etc. Moreover, such work has hardly given 50 feet vertical depth below outcrop.

The presence of much quartz and manganese oxides in this strong vein is a factor that does not appear to have been properly evaluated.

Looking westerly down Gold Gulch from just below its junction with Pinkard Gulch. Figure (1) is part of Eagle creek-Morenci water pipeline; (2) early day mine workings for gold-silver ores -- now on Bell No. 4 claim; (3) Eagle Creek road.

No.17

HILING BROS. EVERARD CO. OFFICE OUTFITTERS, KALAMAZOO, PHONE 5015

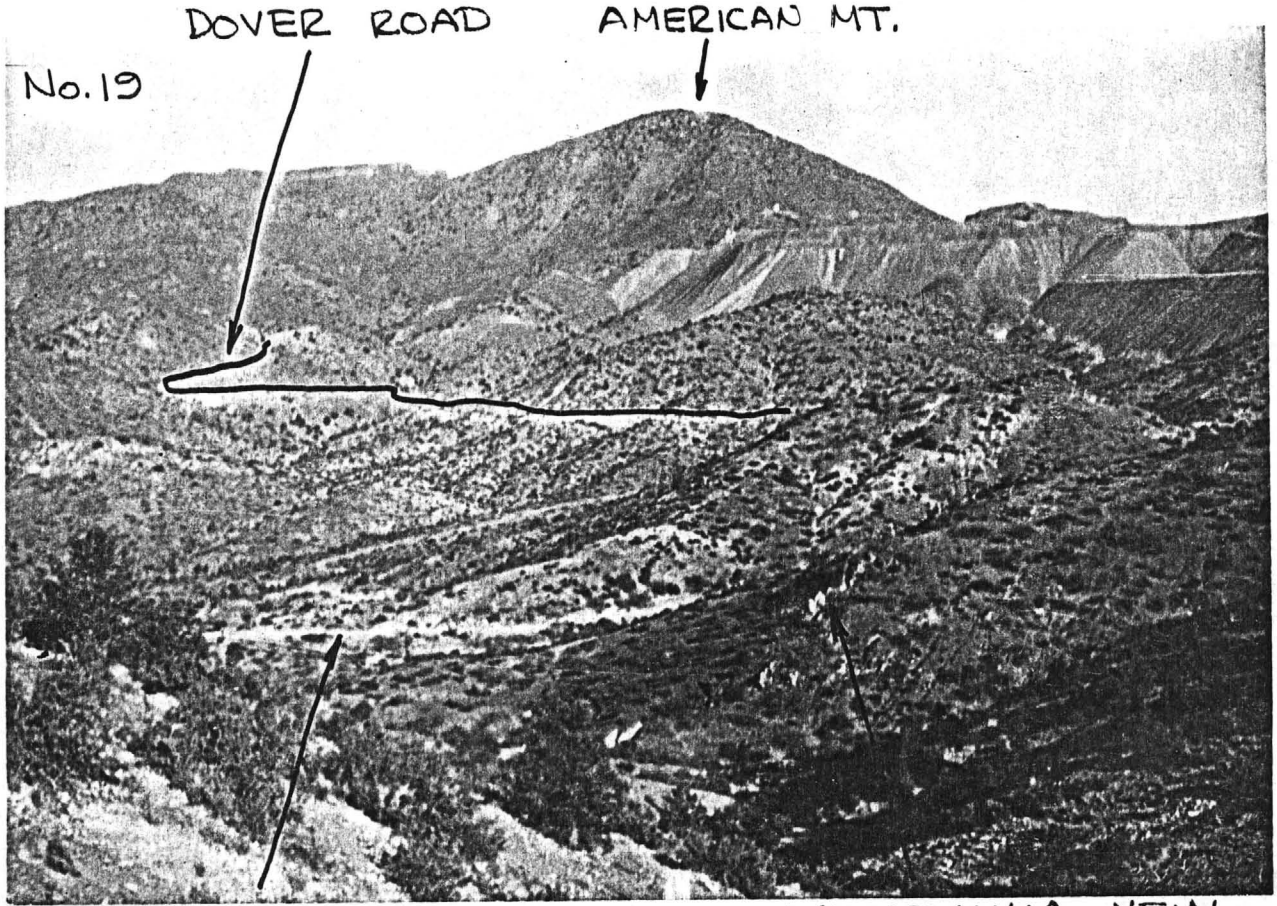
OUTCROP OF WILHELMINA VEIN

No. 18

DOVER ROAD

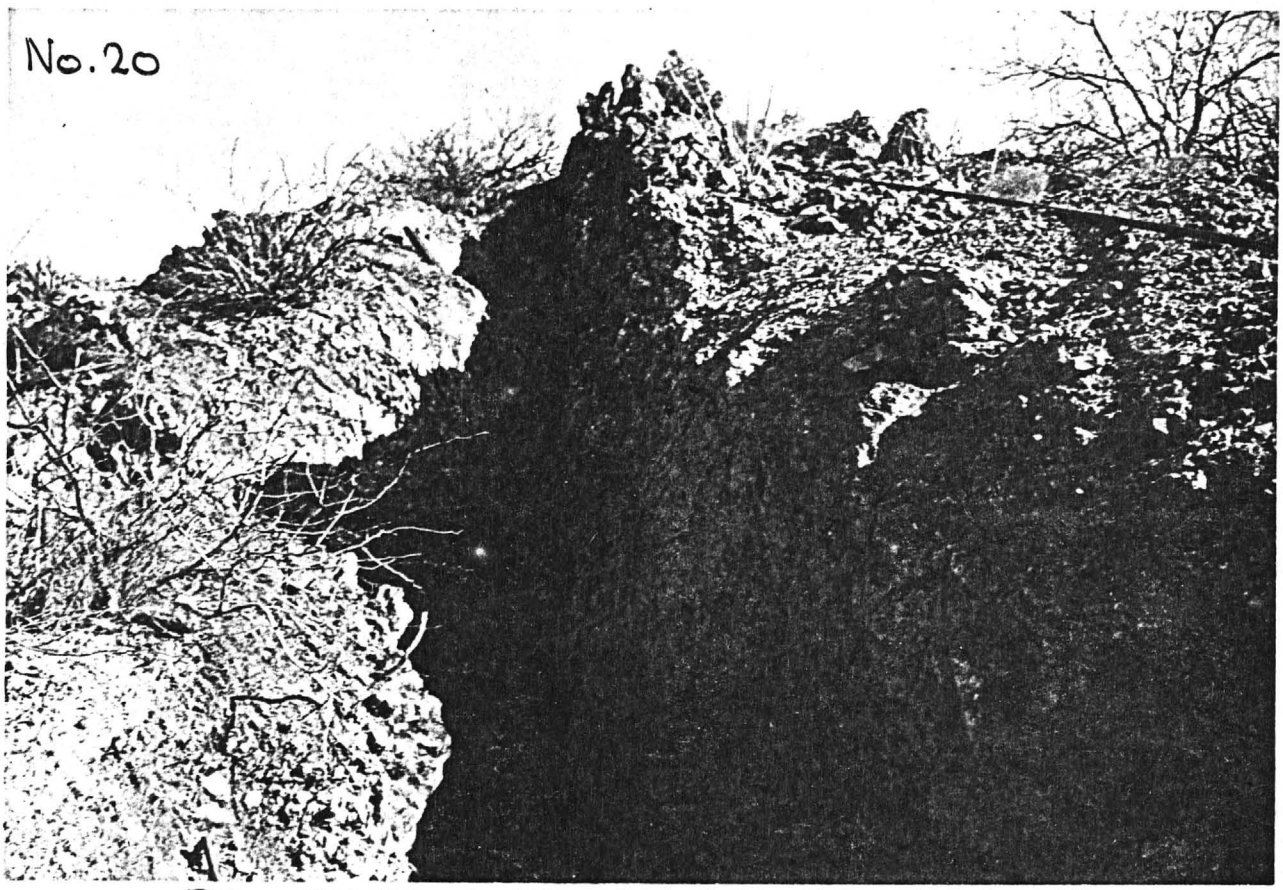
AMERICAN MT.

No. 19



EAGLE CREEK RD.

WILHELMINA VEIN



PROSPECT CUTS ON WILHELMINA VEIN

Emmons states that in the presence of such oxides ".... gold is not only dissolved in acid solution, but the conditions under which it is precipitated may be delayed." (Bulletin #529, U.S.G.S., p. 128.)

To the miner this means that gold in such veins will continue downward, and the vein is not apt to be differentially enriched at or near surface as is often the case where iron oxide is heavy in the vein outcrop. In the latter case, the gold remains. It is not dissolved, hence, good surface ores. This condition and characteristic of gold veins is further discussed under the description of the Bell Group.

TOM WAL GROUP

This group comprises 17 claims of which 16 are patented. The Tom Wal No. 29, of about 8 acres area, was withdrawn from the patent application and is held by possessory rights under the mining law.

The claims cover a portion of an intermountain valley of depression known as Silver Basin, and a portion of the hills bordering the basin on its north and its east side. Photo No. 1 gives an excellent view of this basin.

The geology is somewhat more complex than on other Dover groups because of

(a) faults of north-west and south-east course bordering, or close to the east line of the group;

(b) considerable areas within the claims where the Pinkard shales (Cretaceous) overlie older rocks and are almost barren of surface mineralization;

(c) masses of the diorite phase of the porphyry that show relatively poor veins, fewer of them, and but little of the alteration and leaching found on the Storm claims.

The areal geology is shown on Lindgren's geology map, and the section C - C^1 on that map shows the structure. See photostat copy, Exhibit 2-A, Map Envelope.

Tom Wal Nos. 1, 2, 3, 4 and 17 claims are crossed in their eastern portion by a NW-SE fault, locally known as the Micawber fault. It is parallel to a similar fault one-half mile to the east and mapped and described by Lindgren as the Apache fault.

Lindgren writes, page 230,

> "Apache Gulch is followed by a double fault with the direction of north 30 degrees west. The east side of this had dropped about 800 feet .....

> Parallel to this fault and half a mile distant to the west is the fault along the east side of Silver Basin, which shows a downthrow on the west side of about 200 feet. "

This "parallel" fault is the fault now called Micawber fault.

Arthur Houle, Mining Engineer, now deceased, in a letter report to Thos. Cocks, also deceased, under date of Jan. 30, 1937, in describing the Tom Wal claims, and the then-owned Silver Basin claims, states

> "The assessment work to date has outlined the contact between a grano-diorite intrusive formation cutting through and into beds of shale and thin beds of limestone. Underlying the shale and thin beds of limestone, will be found the favorable ore bearing limestone beds which have produced good copper ores of the Morenci district. Deep development of this area is warranted..."

The area at that time (1937) was involved in a title contest and it is believed Thos. Cocks, then Dover manager at Clifton, expected to have Mr. Houle for one of his witnesses - the issue of the case being the mineral or non-mineral character of the land.

Attention is here directed to pages 279-280 of Lindgren's Prof. Paper #43, wherein, under description of the Lone Star tunnel, he states that at a distance of 235 feet from the portal a fault is encountered which he believed is identical with the Apache fault above mentioned. He then states:

> "Bunches of cuprite ore occur all along this fault plane from the surface down, and fair, though not very wide, bodies of payable ore have been found in a drift southwest of the tunnel. This is one of the few instances at Morenci of copper ores occurring on one of the principal faults."

Special emphasis is placed upon Lindgren's statement as above quoted, for two reasons: first, that "....cuprite ore occurs all along this fault plane from the surface down"; and, second, "This is one of the few instances at Morenci of copper ores occurring on one of the principal faults."

An appraisal of the text of Lindgren's report makes it clear that he referred to the NW-SE faults in the statement last above quoted, rather than the NE-SW fault fissures that are well mineralized in general and in fact have produced considerable ore, notably the Coronado fault fissure.

In the same report, and again on pages 279 and 280, Lindgren states that at 290 feet west of the Apache fault, as disclosed in the Lone Star tunnel, porphyry is encountered and continues from that point through the

tunnel to the western portal. He mentions small veins being cut by the tunnel, from 300 to 400 feet below the surface, in which some "show several inches of rich chalcocite ore, and in one 5 feet of payable ore is exposed."

While I have never been underground in the Lone Star tunnel, I believe from Lindgren's map and from the claim maps of the district, that one of the small veins he mentions could be the Northwest extension of the Micawber fault. The fault would not find expression in the porphyry, as it does in limestone on surface. That is, the porphyry is a relatively soft rock and absorbs a fault stress with perhaps only some shearing, whereas the hard, brittle limestone is broken.

This surmise should receive consideration and study in any detailed examination of the Tom Wal Group. If the Micawber fault has a displacement of about 200 feet (Lindgren), or possibly of about 400 feet (Houle), and that fault is of a vein structure type in the porphyry cut in the Lone Star tunnel, we can assume it is of that character in the porphyry in the Tom Wal Group claims, and particularly under Tom Wal Nos. 1, 2, 3, 4, and 17.

However, the mineral showing at the present time is hardly of enough economic importance to warrant such development work as would prove or disprove underlying ore bodies. The Micawber fault is mineralized on the claims last above named and the porphyry is doubtless the source of the mineralization, although it may not be the porphyry mass underneath these claims. The mineral bearing solution could have migrated along the fault from some distant source.

On the claims named, Nos. 1, 2, 3, 4, and 17, and in and along the Micawber fault, but principally in right-angle fractures to that fault, mineralization is found in limestone, and under heavy "gossan," or capping, that here contains much manganese oxide (pyrolusite). Company records show good assays in gold-silver-copper from these claims. On the Tom Wal No. 17 there is an ore pile on the dump of an adit, from which a 'grab' sample taken by the writer showed $4.20 gold and $6.66 in silver, or $10.86 per ton value.

On the Tom Wal No. 8 copper ore outcrops on surface and is found in shallow cuts. Company assays show up to 4.3% copper.

Tom Wal Nos. 9 and 10 records indicate copper assays as high as 12% and 26.3% respectively. I was unable to duplicate such assays when the claims were examined for patent; however, there are a number of small fracture seams on both claims and it is probable some such contain high grade ore. Tom Wal No. 9 is credited with an ore shipment from which a net return of $341.49 was received, but I rather feel at least part of the ore was from Tom Wal No. 6 where a well-defined vein is exposed. This vein is the eastern extension of the Free Coinage vein from which shipments were made in the early days. It is worthy of note that the Free Coinage ore occurs in a NE-SW fissure

and is approximately 3000 ft. southwesterly on the Micawber fault. (Note-the Free Coinage claim belongs to Phelps-Dodge Corporation.)

Tom Wal Nos. 11, 22, and 23 claims show copper ores in and along contact veins between porphyry and baked and metamorphosed shale. Assays up to 11% copper can be obtained from selected ore.

It should be noted that the mineralization on the Tom Wal Nos. 8, 9, 10, 11, 22 and 23 claims, above mentioned, is all west of the Micawber fault.

In other words, that fault did not cut off or limit the mineral bearing area. This is significant in view of the opinion of some geologists that the NW-SE faults are post-mineral.

Tom Wal Nos. 5 and 25 claims are without surface evidence of mineralization, although there is a rather weak iron-stained porphyry-filled fissure on the No. 25.

Tom Wal No. 29 claim is so covered with talus and detrital material that mineralization sufficient for patent purposes could not be found in the shallow workings. Hence, this claim was withdrawn from the patent application. It is favorably located with respect to the strike of a mineralized fault that crosses Nos. 1, 2, 3, 4 and into Tom Wal 17, and further work is planned to undercover this fault within the Tom Wal No. 29.

The Tom Wal No. 12 claim is of interest because of the unusual ore occurrence found near the SW end line. There is here exposed in the old workings a "breccia-pipe" in the diorite porphyry. Copper mineralization is evident, and, indeed, assays of 18% copper have been obtained. It is not apparent on surface that this 'pipe' is connected to other mineral showings in the vicinity by any vein or fissure.

Some geologists familiar with the Morenci district assert that all of the mineralization is allied to the monzonite-porphyry; that the diorite porphyry is not ore producing or ore containing; that areas of diorite-porphyry should be totally disregarded, etc.

This "breccia-pipe" is an eloquent and forceful offsetting argument to such theory or conclusion. The enclosing rock is practically unaltered diorite porphyry. I have had specimens classified by the University of Arizona mineralogist. Yet there is definite mineralization of up to 18% copper content in selected samples, and with diorite as the enclosing rock.

In geology, as in any other physical science, one hard, stubborn little fact will offset the most beautiful theory. And we have here on the Tom Wal No. 12 claim concrete evidence that ore DOES occur in the diorite.

It is conceded that the diorite is far less favorable than monzonite as a host rock for ore bodies in this district. And one should not ignore the mining history of a district nor the habits of its good ore bodies; hence, other things being equal, areas of unaltered diorite should be avoided in any development campaign. On the other hand, they should not be classi-

fied as entirely worthless. Lindgren's report mentions an occurrence of carbonate ore "on the contact of the porphyry and the Cretaceous sandstone and shale 'on a hill' 1 mile south of the junction of Pinkard and Gold gulches." (p. 297.)

This location is about 4000 feet westerly from the 'breccia-pipe' on the Tom Wal No. 12, and still further away from the main mineralization of the district, and with diorite as the porphyry contact.

It is pertinent here to comment on the great 'pipe' ore body of the United Verde mine at Jerome, Arizona. Dr. B. S. Butler describes it as

> "This mass is nearly 500 to 800 feet in horizontal diameter, plunges at an angle of about 68 degrees in a northwesterly direction, and has been mined to a depth of more than 3000 feet with no essential change in character. The pipe lies in an embayment in the diorite, with that rock as the hanging wall." (p. 52, Bibliography (h).)

The same authority mentions the 'pipe' ore deposits (copper) of the Capote, Duluth, and Colorado mines at Cananea, Sonora, Mexico - the Colorado pipe occurring in a "quartz porphyry." (p. 82 above citation.)

Other examples of valuable ore bodies in diorite can be cited, such as the Treadwell mine in Alaska (gold), and the Miami copper mine in Arizona, in part at least. The Ajo, Arizona, copper deposit has a "shell of diorite porphyry," and the Engles copper deposit in California is largely in quartz diorite.

In summary, the Tom Wal Group offers far less promise of good ore bodies than other parts of the Dover property. The well mineralized fractures in the limestone on the Tom Wal Nos. 1, 2, 3, 4, and 17 offer prospecting inducements. Development of this group should be confined to said claims for the present. The areas within the group that are wholly within the Pinkard formation (shales, thin limestone) should be avoided. That formation is unpromising.

OTHER DOVER CLAIMS

The claim map shows some mining claims that are not within any of the Groups as described herein.

Part of such claims are within Mineral Survey 4284. This survey has been approved, as to the survey itself, but no patent application was ever filed thereunder.

The Anita Nos. 8, 10, 11, 12, 13, 14, 15, 16, 19 claims are now wholly or in part embraced within a land-purchase application filed in the Phoenix U. S. Land Office on April 18, 1952, and now pending for further action. The application includes all public (Government) land

within Section 12, T. 4 S., R. 28 E., and Section 7, T. 4 S., R. 29 E. The area involved totals about 174 acres. When purchase has been completed it will "square up" this part of the property and eliminate some small "slivers" and triangles between patented claims.

The basic reason for making this land-purchase application rather than apply for mineral patent is that the claims involved lack sufficient surface evidence of mineralization to afford the requisite "mineral discovery" required under the mining laws.

There remains under M. S. 4284 the Victory Fraction, the Anita No. 16, in part, Anita Nos. 18 and 32, and for which patent will be sought later. The claims have sufficient mining improvements.

The Anita No. 17, this survey, will probably be held under possessory rights until extra work can be done thereon for "discovery" purposes.

GENERAL DISCUSSION

The preceding description of the claims as "groups' is a summarized version. The Dover property is a huge area. To give detailed description of each of the 129 claims would unnecessarily lengthen this report. Nor would present objectives be achieved thereby. The endeavor is to present broad outlines, and with suggestions as to the portions of the property warranting detailed investigation. This suggested investigation should include a large scale map of the particular area upon which can be shown surface geology, contour lines, cuts and mine workings, assay values, etc. The base for such map could be the official survey plats. Company maps of the Keating, Copper Plate, and other underground workings, could be checked. I am sure they are accurate as of the time made.

With the foregoing in mind as a necessary procedure for any contemplated development program it is pertinent to

(a) summarize the geology and mineralization;
(b) discuss geological methods and tools, including geophysics.

Summary
of
Geology and Mineralization

* * *

In summary it need only be repeated here that after the deposition of the Paleozoic beds upon a granite basement, and deposition of the later Cretacious beds thereupon, an invasion of granitic and monzonitic porphyries, with attendant faulting, fracturing and fissuring, enriched portions of the region.

The ore bodies occur as

1. replacement bodies in limestones or shales, generally near porphyry.
2. in veins and shear zones.
3. disseminated deposits in porphyry.

The reader is again referred to the "Supplemental Geology" herewith, Exhibits 1 to 6, inclusive.

Resumé of favorable areas on Dover Property

****

The most favorable portions of this large acreage of mineralized land are listed as follows:

1. the Keating vein.
2. the Soto (Producer) fault-fissure zone.
3. the Storm Group, as to the "St.Joe Basin" especially.
4. the Margot-Keystone vein system.
5. certain portions of the Bell Group.

The first three above listed should have priority in any exploration program. Certainly they deserve detailed study, and perhaps close sampling. This is not suggested in the hope of finding any "grass roots" ore body. Rather, the purpose would be to eliminate the less promising areas, and to thus save mining costs; also, to avoid a "black eye" for the property if haphazard mining is done.

I do not assert the procedures suggested will find an ore body. But they should eliminate unlikely areas and thereby add to chances of success. I have reiterated that with an ore body concealed beneath the surface, as with an oil pool, the final test is the drill. And with non-magnetic minerals, as with oil, geophysics is a help only if the data thus obtained is properly recorded and interpreted.

> "Since geophysics indicates only local abnormalities in the earth's physical properties, and since such anomalies may exist for many reasons besides the presence of a valuable mineral deposit, geophysics has greater indirect value in the search for ore than in direct discovery.....
>
> "Application of the related science of geochemistry to the search for mineral deposits is relatively new. Geochemical methods are, consequently, in an early stage of development.....(and) Because this application of the science is new, the attempt to develop and apply it soundly requires careful analysis

and definition, both in regard to possible scope of application and to objective."
(Dr. Samuel G. Lasky; U.S.G.Survey)

Both geophysics and geochemistry are comparitively new as applied to the search for base metals, other than magnetite, etc. Different rocks and ores have different electrical conductivity and their chemical analyses differ. Both are complex subjects, and their use by other than the most expert technicians is not recommended.

For reference and instructive information on geophysics, etc., I attach a very good description of its use, methods, and advantages and disadvantages, and prepared by the California Division of Mines under date of March 1, 1953. The portions marked in red are especially pertinent as to the Dover property where the fracturing, fissuring, and rock alteration are so intense in certain areas. See Exhibit No. 7 - "Supplemental Geology" envelope.

In this district where the geology has been well worked out, and where the habits of the ore bodies are fairly well known, an experienced mining geologist familiar with copper ores, and their oxidation, leaching and enrichment, would be much preferable and of more value to the property than a geophysical survey.

Such geologist would be familiar with rock associations, the known facts of migration and accumulation, the pattern of distribution of copper minerals, and the usual geologic features. It has been aptly said that "Mineral deposits have regional habits, district habits and local habits; and, in the final analysis, the geologist must determine these habits with enough reliability to form the basis of prophecy." (Lasky)

The experienced geologist - and I wish to stress the word 'experienced' - will know that ore bodies in mineralized veins occur in what are called ore shoots; and that when an ore shoot has been mined out it does not mean that the vein is barren of other such ore shoots. This can apply in either horizontal or vertical direction. It is well known that in many important mining districts, such as Bingham, Butte, or Bisbee, ore shoots bottom or pinch out, but often are succeeded in depth by others of equal or greater value. This is true of gold veins no less than copper, such as Grass Valley or in Cripple Creek. Thus, in the Portland mine, Cripple Creek, the ore was bottomed at 1200 feet, then new ore found 300 feet deeper and continued to the 2100 ft. level. The shaft was sunk to the 2700 ft. level where a good ore body was found that continued to the 3000 ft. level - permanent water level. (Note -- Cripple Creek data from Dr. G. F. Loughlin, U.S. Geological Survey.)

These examples are here cited for their application to the Keating vein, and the other strong fault-fissures found on the Dover property.

Once more I wish to emphasize that geology is not an exact science, and that the risk factor in mining cannot be eliminated. It can only be

reduced. The late Dr. F. L. Ransome, for many years with the U. S. Geological Survey, and one of the most able geologists know to the mining fraternity, expressed these same ideas as follows:

"

Practical Conclusions

To men interested in the mining development of the Oatman district, answers to certain questions are of great importance. Some of these questions are as follows: Are the ore deposits confined to any particular rock or rocks? What are the chances of finding additional ore bodies below or at greater depth than those now known? At what depth will the known productive veins be found in pre-Cambrian granite, gneiss or schist? At what depth will veins now worked in the Oatman andesite go out of that rock, and what will be found below it? Are the large ore bodies confined to any particular area, or may they be reasonably sought for in other parts of the district?

Unfortunately, none of these questions can be positively and definitely answered. The geologist cannot see below the surface, and in spite of all the study given to ore deposits, the conditions that determine why a certain vein should contain an ore shoot worth millions of dollars while others are barren remain practically unknown. Ore deposition takes place under circumstances that cannot be reproduced in the laboratory. No one knows with certainty where the gold comes from or what delicate balance of complex circumstances determines its deposition in a particular place. We know that there is a connection between the occurrence of most gold ores and igneous activity. It is generally supposed, with considerable evidence in favor of this view, that the solutions which deposited the gold came wholly or in part from solidifying igneous material or magma. But notwithstanding the vigor and ability with which this opinion has been maintained by many geologists, it is certainly very far from being so completely demonstrated as is, for example, the general theory of organic evolution or the dependence of certain diseases upon particular bacteria."

(Geology of the Oatman Gold District, U.S.G.S. Bulletin #743 - Dr. F. L. Ransome.)

MINING COSTS

Estimates of mining costs are not being submitted at this time. Until the Company decides upon a development program such estimates would

be premature and probably misleading.

If the Keating mine is reopened costs must be based upon the requirements of underground mining methods, and, further, the type of development undertaken. If the winze is deepened, or drifting be done along the vein from the Keating level, or the 100-ft. winze level, costs can be closely approximated. If diamond drilling is done, such work can be contracted.

In either case, the Dover road must be repaired and made safe for truck haulage. The pipeline from the ranch must be checked, possibly replaced in places, and a new pump installed. The springs need cleaning out to assure a better flow of water.

Development of other than the Keating vein, i.e., Copper Plate, Margot-Keystone, Soto fissure, Wilhelmina, etc., would mean to either (1) start shafts from surface, (2) extend old drifts, or (3) run cross-cuts from the Copper Plate tunnel. Shaft sinking is more costly but it also holds more promise of encountering good ore bodies. As depth below the surface leaching and alteration zone is gained in this district the chances for ore bodies increase. Not much depth can be attained by any cross-cuts from the Copper Plate tunnel, except in one area, and in that area there is only one vein exposed on surface. This vein contains some surface ore, and may, at depth, contain an ore body. However, such prospect work should be considered only as a future possibility. If the Copper Plate tunnel is cleaned out for detailed sampling and study it can then be ascertained if, from the tunnel, it would be more advisable to diamond drill for this and other veins prior to the more expensive cross-cutting.

The St. Joe Basin "porphyry" area should be prospected by properly spaced and located churn drill holes. This type of development work is susceptible of close cost estimates, depending, of course, on the spacing and the depth of the drilling. The procedure is "tried and tested" and equipment and methods more or less standardized. This work could be contracted; however, in view of its importance to the Dover Company, a contractor would have to be of unquestioned reliability.

The Bell, Wilhelmina, Tom Wal groups, being of vein-type ore occurrences, will require shafts. Surface ores are "spotted" in values and irregular in occurrence. Depth is needed to prove or disprove these claims. Diamond drilling is practical in favorable locations. Some of the strong veins, like the Wilhelmina, justify regular mine development. That vein has already yielded considerable ore to shallow depths, and its promise of deeper ore zones are above the average.

I repeat: the development program must first be outlined ere it is practical to make cost estimates.

ADJOINING MINING PROPERTIES

Mention has been made of the Coronado mine - pages 17&18. The Coronado vein adjoins the Keating mine of the Dover Co. on the north, and the Keating vein is no doubt one of the spurs or branches of the main Coronado fault fissure.

The Coronado mine is credited with a production of 870,000,000 lbs. of copper, valued at $142,000,000.00 per U. S. Bureau of Mines figures. See copy of their letter attached as Exhibit "P", Reference Data Envelope.

The Keystone property, before merged with Phelps-Dodge, was a producing mine but exact production figures are not available because some such production was included in that credited to the prior owners. This property adjoins the Dover claims on the east, and the Margot fissure (Margot Nos. 12 & 14 claims) is the westerly extension of the Keystone vein.

The "Pitts ground" (i.e., mining claims, not to be confused with the Phelps-Dodge 'pit' in this report) joins the Dover ground at the head of Pinkard gulch. Shipments of high grade ore were made via pack animals in the early days but their aggregate value is unknown. The veins from which such ore was mined are traceable into the Dover ground.

South of the "Pitts ground," and adjoining the Dover claims, we have the Producer vein system. When owned by the Detroit Copper Co. this area yielded much ore. Producing figures are included with that of other mines in the district then owned by the Detroit Copper Co., hence not segregated from total. The company was dissolved and records are not available. (The Phelps-Dodge now owns the property.)

South and east of the Producer area we have the great Clay orebody, i.e., the Morenci 'pit' of the Phelps-Dodge. This is today not only the greatest copper mine in Arizona, but is likewise the second largest open pit mine in the world. Production today is at the rate of 251,978,047 lbs. copper for 1952, per P-D annual report.

"Significant current data on the concentrating operation are:

Average daily tonnage	49,000
Grade of ore, Cu per cent	0.95
Ratio of concentration	30.0 into 1
Recovery, Cu per cent	83.0
Tons treated per man shift	98.0
KWH per ton	15.0 "

* * *

"In the 15 years since open-pit mining was started, a total of 435 million tons of material have been moved. Of this 143 million tons were ore from which 2.5 million pounds of copper have been recovered. The

> relative tonnages of ore and of copper recovered in the two epochs bring out quite emphatically the importance of the fundamental concept of mass production in the treatment of low-grade material and also demonstrates that at Morenci the words of Hammond again apply -- 'They literally had to make something out of what was nothing of economic value....'"
>
> (Copper from Low-Grade Material, by L. M. Barker, Mgr., Morenci branch, Phelps-Dodge, Exhibit "O", Reference Data Envelope.)

Thus, we find that the entire eastern part of the Dover property, excepting the Tom Wal group, joins claims that have produced great tonnage and wealth in the past, and, as to the open pit area, produces today at an impressive value.

The Wilhelmina Group, as noted herein, has produced gold-silver ore. And the Wilhelmina vein, on the adjoining Zorilla property to the west, yielded about $15,000.00 while under lease by Salcido, et al.

On the west of the Dover ground the records are not clear. However, shipments of ore valued at about $100,000.00 were made from the Eagle Gold (Gold Belt) property which adjoins part of the Dover claims on the west. The importance of this to the Dover is not the value of the ore; it is in the fact that such ore proves the existence of ore bodies along the Soto fault zone. That zone has produced heavily to the East (Producer, et al); hence, on both ends of the Dover property along this zone there are proven commercial ore bodies. No sound geological reason is apparent why similar ore occurrences should not be encountered in, along, or adjacent to this fault fissure in the 3500 feet thereof that is within Dover lines.

To the southwest of the Bell Group there is an old mine known as the Lakenan property. It produced rich silver-gold ore in the early days, but, like many early-day mines in the region, no records are available. Presumably the ore body was 'pockety' because the property has been idle many years.

To the west of the Bell group some early-day gold ore was milled in arrastras, and in small units of one-and-two stamps. The ruins of one such mill can be found just over the ridge from the west end of Bell No. 10 claim.

All this data re adjoining production is to emphasize the fact that the Dover property is in a well mineralized region; that ore has been produced from the mining properties surrounding the Dover, except, only, to the south and west of the Tom Wal group. And, as to that group, see the description thereof, page 41, for its own mineralization.

MINES IN OTHER DISTRICTS

The references herein to other mines elsewhere in this state, and in other states as well, is for comparative and informative purposes. I reiterate that no inference is to be drawn from such references that the Dover will develop into a comparable mine. But we are warranted in compiling information from all sources as to similar geological conditions, rock structure, vein formation, etc., as an aid and guide in development programs.

This is not a story of "the other fellow's mine." It is a curious 'quirk' that brings such expressions with reference to a mining property, whereas, with a real-estate development, it is not only proper, but indeed expected, that full data will be given about neighbors, region, city. No business man would erect a business block without careful inquiry of surrounding conditions, both local and city-wide. Neither should a mine development program be undertaken without similar investigation.

ECONOMIC FACTORS

Under this heading I am citing the principal factors to consider in development of a mining property. Pages could be written on some such factors; however, the important thing is that they be kept in mind rather than to here attempt full discussion. The economic picture changes too rapidly now for any hard-and-fast figures or predictions.

Labor:

There is very little surplus labor to be had at either Morenci or Clifton. In the past few years, the Dover Company has had difficulty in getting enough men for the necessary annual work on their unpatented claims. Such labor is the older men not employed by the Phelps-Dodge Corporation and usually Mexicans.

Mine labor would have to be recruited from El Paso, Phoenix and Tucson. Just at this time skilled miners could be had because of the recent shutdown of many lead-zinc mines in Arizona. This kind of miner is needed for any underground work contemplated on the Dover property because of such labor being experienced in the vein-type of mining.

Mining pays the highest wage scale of any industry in Arizona, and because of that fact it attracts the better class of workers, the average wage now being about $1.80 per hour with an average work week of 45 hours. If we use 1940 as a wage index (1940 = 100), the index in 1951 was 261.1 as against the cost of living index from the same period of 184.3. A new wage increase recently granted brings the wage index to 279.2. Pursuing these figures a little further, we find that while the cost of living as of June 30, 1953, had increased 14% over the 1947-1949

base period, the average hourly earnings of the copper miner in the same period had increased 41.2%. To this increase we must add the important factor of "fringe" benefits which, according to some authorities, now average about 16% of the total payroll for copper mines.

All of this leads up to the primary fact that labor costs are high and probably will not be lowered in the foreseeable future. As an offset, the big mining companies find it necessary to install more efficient equipment in order to reduce the direct labor cost of producing copper. They recognize the deplorable and regretable fact that notwithstanding the generous wage increases, the average man now employed around the copper mines and smelters is less efficient than of a generation ago.

Corroborative of the above are figures recently published by the National City Bank, New York, summarizing a survey of the one hundred largest companies in this country. This survey shows that there is an average capital investment of $15,000.00 per employee. I do not have figures applicable to the copper mining industry, but they would total close to the figure above given.

The greater efficiency of modern tools and methods results in increased tonnage mined per man hour, particularly in the copper mines. Thus, in 1880 only 6/10ths of a ton of ore was produced per shaft per man. By 1936, this had increased to 8.8 tons per shift per man. It is difficult to give an average as of today, because the greatest part of our copper production is mined from open pits where, of course, the tonnage per man would be very much greater than in the vein type of mining. It can be assumed that about 1-1/2 tons of copper ore can be mined per man per hour with modern equipment and open pit mining.

It is interesting to note that the financial paper, Barron's, in a late article on copper (July 5, 1953), gave as a rule of thumb that a 25% raise in wages means a three cent a pound increase in the copper mining costs. The article does not give the basis for such deduction and it is mentioned here as informative only.

Labor cost data applicable to Arizona is submitted as Exhibit "V", Reference Data Envelope. The data is from the Arizona Dept. of Mineral Resources.

Water:

Water for operating the Keating mine was pumped from the Ranch property located in Horseshoe Gulch and nearly two miles southwesterly of the mine. The water supply here is a perennial spring and afforded sufficient water for the then mine operation. The Company holds a water right certificate from the State and the Ranch property was patented many years ago. Consequently, the title to the water is perfect. The flow of the spring varies with wet and dry years, and it is therefore difficult to state that this supply would be sufficient for year-around operations of the Keating on any considerable scale of mining.

It is probable additional water could be developed inasmuch as the source of the present flow appears to be a porous tuffa bed. This rock is an excellent water reservoir, though great quantities of water can hardly be expected.

The overall water situation is not promising because all available nearby supplies have already been appropriated and are in use by the towns of Clifton and Morenci, and by the Phelps-Dodge Corporation. The problem will require considerable field investigation, and covering areas outside the mining district where there are possibilities of obtaining or developing ample water supply. It may here be mentioned that this problem has already been considered by the Dover Co. but the data is of a confidential nature. I am advised that when ore development warrants it the necessary water will be obtained.

Considerable water could be impounded by building relatively small dams in some of the V-shaped canyons. These would store flood waters during the summer rains, and run-off from the normal winter rains and light snowfall. The summer rains are usually short, violent storms, yet the precipitation is sometimes heavy even if "spotted." The volume of water flowing in some of these gulches is astounding to one unfamiliar with this type of storm. If such flood water, plus the normal run-off, could be stored it would afford a very considerable supply.

Sites for such dams and reservoirs can be found in Horseshoe, Copper Plate, Pinkard and Gold gulches. Due regard would have to be taken in selecting a site that the stored waters would not interfere with mining, and that a compact underlying rock structure would prevent undue seepage losses.

There is some additional water in old mine shafts at the south end of the property, on what is now known as the "Scrip" land. This would be sufficient for camp or domestic uses but insufficient for mine operations. Moreoever, this water is too far away from the promising parts of the property, and would involve too much of a capital outlay for pipeline and pumping equipment to be economically feasible as based on the present flow of water.

As a "rule of thumb" it requires about 100 gallons of fresh water per ton of ore treated. This contemplates about an 80% water recovery from tailings pond settlement, and the use of any run-off impounded in canyons and water courses. This water requirement does not include domestic and camp uses.

Housing:

Housing facilities are practically non-existent in Morenci. Available space is alloted to Phelps-Dodge employees; that company having built many of the houses for their employees. Conditions are much the same in Clifton as to rentals. Therefore, any development program

would have to provide shelter for employees, other than the few men available in the area who have their own homes.

There are two frame houses in lower Horseshoe Gulch that could be made habitable at moderate expense. If one such was utilized as a boarding house, then framed tents could be used for sleeping quarters as a temporary camp.

Another possibility would be frame tents on the Wilhelmina claim. There is a nice plot of level ground and water could be had from the nearby pipeline. The road is traveled daily and employees would be but two miles from Morenci, hence better satisfied.

Power:

In the writer's opinion, power would have to be developed by anyone operating the property. This statement is based on the fact that the State at large has a power shortage. Power is supplied in this state from the Salt River Project, the San Carlos Project, and the Hoover, Davis, Parker, Imperial and Laguna Dams on the Colorado River. Part of this power is handled for the Reclamation Service by the Arizona Power Authority, and constitutes about one-third of the state's present power supply.

As to the Salt River Project, it is because of the sale of their surplus power to the mining industry that the project has been such a good success from an economic standpoint. In other words, the project goes in debt as to the distribution of its irrigation water, but through the sale of its power has been steadily paying off its debt to the government and expanding its plant facilities.

In the attached Exhibit "Q" in the Reference Data Envelope, is an informative statement relative to Arizona's mining industry and power development. It was prepared by the Arizona Department of Mineral Resources and states in its conclusion that the mining industry would probably purchase the electric power of the whole distribution system sometime in the future and that this power, if available, will replace that now being generated by the mining companies to supplement their power needs above the quantity they are able to purchase at this time.

Fuel:

The towns of Clifton and Morenci are supplied with natural gas through the pipelines of the El Paso Natural Gas Company. It is not known whether that company could furnish extra gas for mining and smelting purposes above that required by the present huge scale operations of the Phelps-Dodge. In other words, it is believed that Phelps-Dodge would purchase under their contract all of the surplus gas that the present pipelines can deliver over and above municipal use.

Taxes:

At the present valuation of the Dover property, being a non-producer, the state and local tax rate is moderate and the taxes on the property are not heavy.

I am advised that the assessed valuation of the mining property in Arizona is determined by the State Tax Commission by computing the present worth of the expected annual profits over the estimated life of the property.

Plants and production work are generally appraised by the county assessors. Properties with a gross metal production of less than $50,000.00 yearly value are exempt from property tax by the Commission except for plant improvements and the nominal tax on the surface. It may be added that under the Arizona system of valuation, producing mining properties are assessed at a higher valuation than the same properties would be assessed in other western mining states, with the possible exception of Utah. That state has recently adopted a new valuation system.

To illustrate, and using $10,000.00 value of product for the years 1946 through 1950, the Arizona tax on such value would be $463.00 as against Montana's $201.00, Nevada's $179.00, New Mexico's $307.00, and Utah's $341.00. In addition, Arizona would pay a state severance tax of $94.00 as against $71.00 for Montana, $1.00 for Nevada, $73.00 for New Mexico, and $71.00 for Utah. The mining industry in Arizona, in addition to paying the highest wage scale, likewise pays about one-third of the total state taxes.

However, few people realize what great taxable wealth the mining industry has created in Arizona by the combination of huge capital outlay and a high degree of technical skill, whereby very low grade ores have been converted into commercial metal. Thus, for illustration, Phelps-Dodge, at Morenci, took approximately six years of time, and an investment of nearly one hundred million dollars, to bring the property to its present state of production, through utilization of a huge deposit of otherwise worthless rock.

The same might be said in a lesser degree of Inspiration, Ray and Ajo; and it is true at the present time of the newly developed San Manuel property, to exploit which the government itself loaned some ninety million dollars. This, of course, adds taxable wealth to the state.

It is pertinent here to quote the well-known mining engineer, J. R. Finlay, who once made an appraisal of New Mexico's mining properties for taxation purposes. In his report he mentioned the huge resources of coal within that state, but added:

> "....I find no warrant for putting a value upon the undeveloped coal of the state; one might as well put a value on limestone or granite. Is not limestone made into lime and cement, and granite into buildings and statues? Have not fortunes been

made out of cement factories and granite quarries? The Rocky Mountains are made up of granite and limestone, why not value them at so much an acre? The answer is that all these resources are worthless until a plant and an industry are started upon them."

It is well recognized that our present-day tax structure does not encourage venture capital. Thus, not many years ago a $100,000.00 income had $70,000.00 left to invest after taxes. Now the same income leaves only $10,000.00 for the same purpose. In effect, "it costs to be thrifty," and, at the present time, taxation and governmental interference with business add road-blocks to individual investment in venture enterprises.

The mining industry in both Canada and Mexico receives a much better treatment on their investment dollar than in this country. In Canada, for instance, a mining investor is tax free until his capital has been recovered. This is one reason why Canada has had such phenominal mining activity, as against the gradual decline of small operations in this country.

While it is perhaps an extraneous subject, yet it is not amiss to here quote from mining executives who are at present burdened with the excessive taxation problem. It would apply, in degree, as soon as the Dover is productive:

"We are helping backward countries ... with efficient machinery and equipment by means of gifts and loans ... When the programs are accomplished and our subsidies cease these nations must "export or die." Where does that leave us?

For nearly a generation private initiative has been handicapped by restrictive legislation and confiscatory taxation. And as for venture capital, the more successful its efforts to produce and support the more abundant life, the more it finds itself penalized by tax collectors and abused by politicians..... And so exploration to find new mineral wealth is discouraged, development of mines slows down, and State Department economists in Washington reach the conclusion that we have become a "have-not" nation. Tariffs must be cut and millions of dollars of taxpayers' money made available for the development of foreign mines."

(Otto Heres, Jan. 31, 1949)

* * *

"But no matter how patriotic or enthusiastic we may be, we cannot explore, develop and produce without access to a substantial fund of American dollars. Moreover, we cannot continue in these activities if the tax law takes the major portion of the winnings of those who are successful. Inherent in the job, is the obligation to plow back earnings (after taxes) into the speculative business of prospecting. Unless this is done, the ore deposits are depleted and the venture folds."

(Granville S. Borden)

It has been well said that taxes have become the most powerful factor in our economy, and that no investment can be made today without full consideration of taxes.

To the reader interested in pursuit of this subject, as regards Arizona taxes, mining valuations, etc., there are attached hereto as Exhibit Nos. "R", "S", "T", Reference Data Envelope, the following data, all compiled by the Arizona Department of Mineral Resources:

"R" Mine Taxation.
"S" Arizona Mining Industry Taxes...1947-1952, incl.
"T" Comparison of property taxes...and production taxes... paid by mining industries of Arizona, Montana, Nevada, New Mexico and Utah.

Assay offices:

Reliable custom assay offices are located in Douglas, Phoenix and Tucson, Arizona; El Paso, Texas; Los Angeles, California.

Smelters:

Smelters purchasing custom ores are those of the American Smelting & Refining Co., at Hayden, Arizona, and El Paso, Texas, and that of the Magma Copper Co., Superior, Arizona.

Freight:

Freight rates on ore varies with its gross value. The rate from Morenci to El Paso is about $3.75 per ton on ordinary medium grade crude ore, plus switching charges, etc.

There are no public loading platforms or ramps at either Morenci or Clifton at the present time. A private ramp of Stevens Bros., located a short distance south of Clifton, could be used for trial shipments under a nominal charge.

Truck haulage:

A local firm in Clifton will contract ore haulage but advise that rates cannot be quoted until the Dover Road has been repaired, and until a mini-

mum, tonnage per day or per month can be assured.

Available plant sites:

The most favorable area for townsite, mill, etc., is in the Silver Basin, i.e., the "scrip" area on the map. This includes some of the Tom Wal claims. It would require but little work to construct a road from the present Eagle Creek-Morenci road, though a portion of such road would cross Phelps-Dodge claims -- if the shortest route is utilized.

Much would depend upon the source of the ore. If from the Keating, and that part of the property, and using the present Dover road, then perhaps a route of permissable grade could be worked out via the Wilhelmina group into the west end of the basin. This might be feasible and remain entirely on Dover property. This contemplates truck haulage. An electric haulage system would require some 10-11 miles from Keating to the basin. Moreover, such track would cross Eagle Gold and Phelps-Dodge claims.

This would apply, likewise, though in lesser degree, to ore haulage from the Soto fault zone. From that area it would be possible to construct a truck road to the Eagle Creek road and be entirely within Dover property lines.

The "St. Joe" basin is not too rough for camp and mill site purposes. However, it is not advisable because of the possibilities of the area for future open pit mining.

There is an area to the west of Pinkard gulch, on the Tucky claims, that probably could be advantageously used as a central plant site. It is of uneven contour as compared to the Silver Basin or the St. Joe Basin but, in comparison with many mining camps in the west, could be classed as a desirable site.

In short, the Dover property contains areas suitable for town and plant sites. Obviously, such would not be planned or laid out until ore reserves justify such program.

COPPER

Commodity, Production, Consumption, Prices, Future

* * * * * *

In this age of machines, of steadily increasing use of electric power, and expanding electronic machinery, copper plays an important role. One can almost term it the "indispensable metal."

The ordinary uses of the 'red metal' are well known. These stem from its superior electrical and thermal conductivity, ductility, malleability and resistance to corrosion. It is difficult to visualize what may

be wrought in the future by and because of electronics. In the home one need only mention television, door controls, electronic ranges, etc. And in industry and commerce the list ranges from electronic microscopes to motors, from accounting machines to rectification of alternating current. In all these, copper is "the" one necessary ingredient.

War tension is world-wide and our national safety dependent upon a constant semi-war footing. This means enormous use of metals for military purposes alone; and the vital need of copper is described by former Secretary of War Patterson as follows:

> "An army without copper would be an army without speed, maneuverability, fire power or communications. It would not last a day in battle."

It is, therefore, pertinent to discuss copper as a commodity; to study production and consumption trends; to briefly review its present status as to supply and demand, both of the world, and of the USA, and to consider, also, competitive metals, such as aluminum.

The United States' production and consumption of copper in tons of 2000 lbs. during the past five years, and the world production and consumption, exclusive of the USA, are both given in the attached Exhibit "M", Reference Data Envelope, entitled "Arizona, United States, and Free World Mine Production of Recoverable Copper, Lead and Zinc - Years 1949, 1950, 1951, 1952."

Of the total world production, the United States produces 36%, based on the past four years' average production, and consumes about 51%, including stockpiles. The United States' consumption has exceeded domestic production for many years. It is not known how much copper has gone into the War Minerals stockpile. Presumably, the stockpile is not yet up to its goal, even though copper is not now on the list of "strategic minerals." Some 77,000 tons of copper had to be released between the summer of 1951 and the spring of 1952 to care for shortages in the United States. However, it is prudent to assume that, short of a "hot war," government stockpiling will level off, decline, or perhaps disappear. In such event, the copper market could change from one of short supply to one of ample stocks. It could, conceivably, follow other commodities -- wheat, cotton, butter, eggs -- all now in over-supply, with, however, this difference:

(1) copper is without 'parity,' or price-support level, but
(2) neither is it subject to weevil damage, wheat rust, mould, nor become rancid, rotten, or unfit for use.

It should here be noted that there are a few new copper developments that, in effect, have price-support because of Government floor contracts. These were given at a time when the ore supply appeared

inadequate. Examples are the San Manuel project, Arizona, and the White Pine in Michigan.

This brings us to the question of future copper supplies. I append a list of projects, both in the United States and elsewhere, excluding Russia, wherein the estimated tonnage and year of production are shown. The list gives an impressive total increment of 865,600 tons, of which 320,500 tons is from U. S. sources.

Of the properties on this list, some are really replacement of ore bodies no longer workable. Thus, Chuquicamata (Chile) is a switch from the oxide to the sulphide ores. It is estimated it will increase the company (Anaconda) output by about 75,000 tons; not the 250,000 tons given in the table. Further, there will be a decline in production from some of the older mines.

Company	Project	Annual Copper Production	Year of Full Production
	United States		
American Smelting	Silver Bell, Ariz.	18,000	1954
Anaconda Copper	Greater Butte Proj., Mont.	45,000	1954
Anaconda Copper	Yerington Nev.	33,000	1954
Bagdad Copper	Bagdad, Ariz.	13,500	1955
Calumet & Hecla	Osceola Mine, Mich.	7,000	1954
Kennecott Copper	Deep Ruth, Nev.	18,000	1954
Kennecott Copper	Kimbly Pit, Nev.	9,000	1954
Magma Copper	San Manuel, Ariz.	70,000	1956
Miami Copper	Copper Cities, Ariz.	22,500	1954
Miami Copper	Miami Extension, Ariz.	11,500	1955
Phelps-Dodge	Lavender Pit, Ariz.	38,000	1955
White Pine Copper	White Pine, Mich.	35,000	1955
	CANADA		
Campbell-Chibougamau Mines	Merrill Island, Que.	18,600	1955
Noranda Mines	Gaspe Copper Mines, Ltd., Que.	25,000	1955
Sherritt-Gordon Mines	Lynn Lake, Man.	4,000	1955
Ventures	Opemiska Copper Mns., Ltd., Que.	6,000	1954
	SOUTH AMERICA		
Chile Copper Co.	Chuquicamata, Chile	250,000	1954
American Smelting	Toquepala, Peru	100,000	Indefinite

Company	Project	Annual Copper Production	Year of Full Production
	AFRICA		
Mufulira Copper Mines	Chibuluma, N. Rhod.	19,000	1956
Mufulira Copper Mines	Baluba, N. Rhod.	24,000	Indefinite
Rhokana Corp.	Bancroft Mine, N. Rhod.	48,000	1954
Rhokana Corp.	Leach Plant, N. Rhod.	40,000	1956
	AUSTRALIA		
Mt. Lyell Min. & Ry.	West Lyell	10,500	1956

Nevertheless, an increased copper production in the free world of about 500,000 tons can be expected in the next four or five years. To this must be added the increased secondary-copper recovery output.

A copper price of 12¢ during World War II was feasible because of cost elements. Since that time economic changes have resulted in

(a) loss of purchasing power of U.S. currency (and other nations).

(b) great increase in wages and cost of supplies.

To this we must add the decreased copper content of U.S. ores, now mostly under 1%. Next are taxes, "57 varieties," direct and indirect. Production costs must now carry an additional burden of "fringe benefits" to employees -- about $700 per year each for miners in Arizona. See Reference Exhibit No. "K" - "Fringe Benefits Paid by Arizona Copper Mines."

Competent authorities state it is no longer possible to produce domestic copper profitably under 18¢ per lb.; that a price decline to that level would force a shut-down of most "porphyry copper" mines, and perhaps other types also. It is wise to be realistic; to recognize the fact that wages seldom, if ever, go down; that the average miner has been thoroughly sold on the 'welfare state' idea, guaranteed annual wage, cradle-to-grave security, etc.

I am not here discussing the merits or demerits of social trends. I simply call attention to their existence as an all important factor of production costs, now and for the indeterminate future. It should here be noted that copper production costs per pound have increased in other parts of the world. Chile, with about 15% of total world production, has had a cost increase of about 120% since 1945. With taxes included, their costs are now about 19¢ per lb.

Northern Rhodesia, with about 11% of world production, has cost increase from .053¢ in 1945, to .113¢, or about 113% (Roan Antelope Mine figures).

In the Phillipines, the costs at Lepanto Con. M. Co., the largest copper producer, now average .185¢ before depreciation.

In these figures we should find some factual off-setting data to the spectre of "cheap foreign copper." They prove that the wage spiral is world-wide. And, further, we should remember that the foreign copper producer is in far greater danger of having his property expropriated. Chile is on the "ragged edge" of such procedure at this writing. Rhodesia may not be far behind because of the increasing dangers of a "black uprising."

Consideration must likewise be given to the increasing use of aluminum in place of copper. This is largely in transmission cables, wiring, autos, window screens, cooking utensils, flashings and building drains, exterior finish and hardware, etc. This increase has resulted because copper prices have been relatively high in late years compared to the more stable aluminum prices. Further, aluminum is not in short supply and its production is on the increase. It is more persistently advertised and the cumulative result may adversely affect the future per capita consumption of copper. Copper, however, has many advantages over aluminum that insures its continued wide use. Some such are cited in Reference Exhibit No. "H" - "Copper and Aluminum."

There can be no question as to the harm done the copper industry by the hysteria in Washington during the last few years and the continual propaganda re "copper shortage," and the urgent plea made to industry to use substitutes. This rebounded to the good of aluminum and to the detriment of copper producers and fabricators.

Thus, in 1940, the Government pegged metal prices, including copper, at near depression levels. And this was done, too, in the face of rising costs of all kinds. It was apparent shortly after Pearl Harbor that the copper industry was indeed "hamstrung," but the stupidity of the policy would not be admitted. Partial relief was afforded in late 1942 by the "premium price plan," but this plan was based upon "quotas," and the quotas were fixed at almost capacity production.

The costly and bloody experience of two world wars should teach us (1) that foreign metals are not available when urgently needed, but are dumped on our markets when surpluses appear; (2) if we preserve our lives and system of government we must not only have adequate mineral reserves, but, in addition, conduits from underground reservoirs into the processing manufacturing ore bins.

And it has been well said that "These tasks, vital to our destiny... cannot be performed with socialized mining; the jobs must be done by private enterprise."

Future copper consumption has been the study of several commissions, among which the Paley Commission is best known to the public. That commission projects U.S. consumption for 1975 as about 45% above the 1950 level. This appears to be based upon an estimated doubling of

national output of goods and services.

The Paley Report has been subject to some severe criticism, and, I must say, much of the criticism is well based. There are some grievous errors in that report. Thus, on page 31, vol. 1, a graph showing "Total value of four metals produced by states-1950" gives Utah first place, whereas Arizona's metal production for that year was some $55,000,000.00 above that of Utah. For many years past, Arizona has led all states in value of metals produced, exclusive of iron and iron-ore products.

Ira Joralemon, a well-known mining engineer, says

> "... the Commission (Paley) advocates a 'planned economy' on a scale that has never been dreamed of....".

"Mining World" magazine, for November 1952, discussing the Paley report, comments as follows:

> "Is this part of an overall conspiracy? There are those that say it is; that it is part of an overall plan, and that the Paley report with its advocacy of foreign minerals is a part."

I cite the above in support of my statement that the Paley report contains some grievous errors as to the USA mineral situation. It should be used with caution, and with critical analysis. Its authors, with one exception, are not mining men. I much prefer the report "Investigation of National Resources," made by a sub-committee of the U.S. Senate, Public Lands, May 1947 -- at least from the practical standpoint. And for exhaustive detail, analysis, pertinent and sensible comment, the reader is referred to "The Domestic Mining Industry of the United States in World War II," by John Davis Morgan, Jr.

Informative in the premises is an article from the Engineering and Mining Journal, September 1953, on "U.S. Mining Today and Tommorrow." A reprint copy of this article is attached as Reference Exhibit "G". It cites the Paley Report, with some comments thereon, and it is enlightening data for anyone interested in the future of metal mining.

Some of the "studies" on copper fail to note the vastly more complex preparation necessary for new copper production than for steel or aluminum. With steel, for every ton produced there is used, roughly, a ton of iron ore, the balance coming from scrap. About 4 tons of bauxite are needed to produce a ton of aluminum. But new copper production in the USA is coming mostly from 1% ore, hence it takes 100 tons of ore to produce one ton of copper metal. And to secure the 100 tons of ore the Morenci 'pit' operation must first remove 185 tons of waste (i.e., lean and leached overburden). This copper producer, therefore, handles 142 times more material per ton of finished product than the steel maker, and 71 times as much as the aluminum producer.

COPPER SUMMARY

We may present the copper situation this way:

US copper consumption,	1952,		1,339,000 Tons
US copper production,	1952,	924,469 Tons	
US copper imports, (includes matte, refined, etc.)	1952,	618,825 "	
US copper supply,	1952,	1,543,294 Tons	
US copper exported,	1952,	205,373 "	
Net remaining copper supply		1,339,921 Tons	

The 921 tons difference is because of different methods of accounting by Copper Institute and Bureau of Mines data.

In any case, we imported 46%, plus, of our apparent consumption, including stockpiling. And, we have imported in the neighborhood of 40% of our copper needs for the past ten years.

Some authorities place our known copper reserves at about 25,000,000 tons. They likewise estimate our long term depletion rate at about 800,000 tons annually. Assuming these figures to be correct, then the United States is in a position to absorb all of its domestic copper production, plus some world copper, for many years to come.

GENERAL SUMMARY

The Dover property is not just one vein, or one mineralized area. It contains many veins, fault-fissures, contacts, and a very promising mineralized porphyry area that may prove to contain a disseminated ore body. Practically all of the veins have a Northeast-Southwest strike and this is into and toward the main center of mineralization of the district. All such veins are conceivably (a) channels for the migration of mineral bearing solutions from the presently known central parent ore body, or (b) represent the leached and residual surface evidence or ore bodies directly beneath or close to such outcrops.

We know the intrusive porphyry mass is "two to four miles wide and about nine miles long (Lindgren)." We know further that this porphyry is not only the principal mineralizing agent but is itself a repository for ore bodies. It is neither good geology nor good sense to say this great mass of porphyry deposited all of its mineral load in one spot or even stopped at a property line established by human agency eons afterward.

In other words, we can assume commercial ore occurrences beneath the leached and feebly mineralized porphyry exposed on the Storm group and in part of the "St. Joe Basin." Or stated otherwise, we are warranted in assuming commercial ore will be found beneath the shattered

and leached porphyry on the Storm group immediately across the line from the Phelps-Dodge ground and not far from their open pit. As stated, this porphyry extends well on to the Storm and St. Joe groups. It shows visible copper mineralization at various points on both groups. One sample taken by the writer across a 20-foot width along the Dover Road on the Hurricane Claim assayed 0.60% copper. This is encouraging for surface sample. Another sample from a 20-foot section on the St. Joe No. 7 claim, and 2000 feet further west of the Hurricane sample, assayed 0.7% copper and 2.1 oz. silver.

Much of the ore mined from the Phelps-Dodge open pit averages only 0.85% copper; and in most areas in the pit the ore is of that grade only after removal of about 200 feet of leached and lean overburden.

A picked, or selected, sample of the same porphyry on the St. Joe No. 7 claim showed copper content of 2.21%.

These are not isolated showings. They are but two of many such outcrops in this area, and until careful and systematic drilling has proven otherwise, I feel warranted in assuming that the mineralized porphyry on these claims contains underlying disseminated copper ore of commercial grade; that the surface showings are not merely local and superficial "copper stain," but are instead such as have been proven by the mining history of this district and elsewhere in the west to overlie important ore bodies.

In addition to the above-average chance for underlying ore bodies of the disseminated type in the St. Joe Basin, as herein outlined, there are the possibilities of ore bodies of either the vein type, or as replacement bodies, in and along the Soto (Producer) fault-fissure. Any examining engineer should take due note of Lindgren's report, both as to the Coronado fissure itself, and likewise his conclusions as to structure and faulting. And, it must be remembered, too, that the Soto fault-fissure connects with the largest and most intense mineralization of this rich district, and, therefore, can be assumed to be an important channel for the migration of mineral-bearing solutions. In this respect at least, it is of better promise than the Coronado vein.

Note on Map No. 9, Map Envelope, the relation of the Soto fault to the Concentrator fault (Lindgren). The Clay ore body (Phelps-Dodge open pit) is between these two faults.

The possibility of other ore shoots in the Keating vein, both laterally and horizontally, has been discussed elsewhere in this report.

The Margot-Keystone fault-fissure warrants development. It is a strong fissure, easily traceable, and rather well mineralized. It is connected with the Clay ore body area, although this writer did not attempt to trace it from Dover lines to the 'pit.'

The Copper Plate adit follows a fault fissure that is mineralized. The workings are believed to be accessible and should be carefully examined and sampled. They have not gained much depth, as herein

explained, but they do afford points from which diamond-drill prospecting or cross-cutting could be done that would attain depth on parallel veins. One or two drill holes on the Copper Plate vein itself should be put down from the adit level before any extensive underground work is done at this point.

In the writer's opinion the areas above-cited offer the most favorable indications for undercovering ore bodies. There are portions of the Bell Group, and the Wilhelmina vein, that, in most mining districts, would have shafts and development on comparable indications. A plane table map, and perhaps a few diamond-drill holes, seem warranted.

I am not unmindful that an ore body is never a certain physical fact until it is found in the ground -- not on charts, or maps, or in reports. Nevertheless, we have here the indications and conditions that have proven to be criterions for finding ore bodies in this same district, and elsewhere in the USA and the world.

Once again I must advocate a detailed mapping of the veins, contacts, and mineralized outcrops. The map should be on such scale that assay results of sampled areas can be plotted thereon. Its value would be less in showing where good assays might be obtained than in the "pattern" of the veins and disseminations, and the suggestions offered as to most favorable areas for ore bodies. It is important, for the future of the Dover property, that such mapping and sampling be done by an experienced engineer, and one familiar with copper ores, their leaching, residual surface indications, etc.

The engineer assigned such job must likewise be forewarned as to all the "road blocks" apt to be encountered in this one-company district. He should anticipate derogatory statements as to geology, worth of the property, economic conditions, and, of course, the familiar comment always heard in a one-company mining camp, i.e., "if the property was of any value the big company would have acquired it."

GENERAL CONCLUSIONS

It is not amiss to here cite two proverbs, both of which have a pertinent present-day application, namely,

"Human nature does not change," and
"History repeats itself."

The second proverb was doubtless spoken first when the unvarying truth of the first one was recognized.

"History repeats itself." The invasion of Europe by various Mongolian hordes in early historical times was followed by Attila and his legions in the fifth century. In the 13th century Genghis Kahn overran Asia

Minor, Russia, Poland -- with a kingdom stretching from the Volga to the Pacific, from Siberia to the Persian Gulf. It took Europe about 400 years to check his influence.

Today, hordes of men, mostly Asiatic in origin and hereditary background, stand ready to strike at an opportune moment. They are armed with modern weapons, and they have a zeal for a cause that they believe warrants world domination.

These hordes can only be held in check by a superior force or power. They respect nothing else.

Moral: this is a war-mad world. Wars are fought with metals. Metals must be won from the earth. They cannot be grown in the field. And, ore bodies are an occurrence of very great rarity, considering the mass of the earth's surface; hence, any mining property with unusual surface promise of underlying ore deposits is certainly of economic value and importance.

The costly and bloody experience of two world wars should teach us that foreign metals are of no value in time of emergency. And, even though we are accumulating a stockpile of minerals and metals, we are still depending upon outside sources for most of our manganese, chrome, tungsten, and much of our copper.

This fact alone adds value to any mining property that has produced copper, and that has undeveloped possibilities for further production. And, aside from any future war needs, we have an increasing population and a steadily increasing per capita use of the metals.

> "The US, with only 7% of the world's population, consumed 42% of the world's output of lead, 46% of the zinc, and some 50% of the copper production during recent years." (Otto Heres, Jan. 1949)

It is quite possible that specialists can care for the growing population as to its food requirements, but they can not do anything about metals. An ore body is a rare occurrence, considering the area of the earth's surface, and when once mined out or exhausted, it cannot be replaced. Another crop, or even another forest can be grown in time, but an ore body -- never.

One wonders, too, what will happen when the other 93% of the world's population becomes industrialized (with aid of our money and machines) and where will the metals come from? Foreign ore bodies are susceptible of exhaustion just as our own.

One must always keep in mind that the mere possession of an ore body in the ground is not a source of revenue. The metal must be recovered from the crude ore; and few metals, except gold and platinum, occur in their native state. They (metals) are in the ore, i.e., chemically combined with other elements.

It has often been stated that the value of a mining property, broadly, rests upon

(a) tonnage and value of the ore reserves.
(b) the capital and time necessary to bring the mine into production.
(c) ultimate cost per unit.
(d) average market value of the product.
(e) life of the ore body.
(f) depreciation.
(g) taxes.
(h) amortization.

RECOMMENDATION

The favorable geological features, and the location of the property with respect to the second largest copper producing mine in the USA, warrant exact planning and thorough exploratory work as prerequisite to an overall mine development program.

Any operator undertaking such development program must have not only ample capital, but, in addition, experienced engineering talent. The potential possibilities of the property justify employment of the very best consultants. A long range program should be planned. Not otherwise can the property be given fair exploration.

Mines must be made; they are not found ready-made in Nature (with a few exceptions in the past). Metal mining is a complex business whose success, for copper at least, requires both heavy capital outlay and skillful technical labor.

The most favorable places for ore occurrences in this large area of mineralized ground have been described herein; and I have likewise supplied supporting data as to geology and mineralization from Lindgren and other high authorities.

An ore body, like an oil pool, can only be proven by the drill:

> "Despite the wealth of geological information available to the oilman today, together with the scientific geophysical devices and techniques, only the drill bit can tell if oil sand or "suitcase rock" lies hidden thousands of feet beneath the surface of the earth."....

> The best that an oilman's scientific knowledge and instruments can do is to point to certain underground geological structures which may or may not contain oil or gas. However, the only sure way to find oil is to drill a hole and see if there is oil at the bottom of it.

In 1952, a total of 6,697 'wildcat' wells were drilled in an effort to discover new oil fields. Of this number, 5,957 resulted in dry holes. In other words, it was necessary to drill nine wells, on the average, to bring in one producer in those areas where oil had never been discovered preveiously."

(quoted from "Searching for Oil," by American Petroleum Institute, 50 West 50th St., NY City, NY)

All of which is quoted to emphasize this fact; namely, the Dover property has many times more surface indications for underground ore bodies than has any lately discovered oil field of its oil pool. Yet many mining men condemn a mining property after one attempt to make a mine, whereas, the oil man tries eight more times for his producing well.

Respectfully submitted,

J. E. BUSCH
Mining Engineer

GLOSSARY

ANDESITE	A lava of widespread occurrence, usually of dark-gray color and intermediate in chemical composition between rhyolite and basalt.
BASALT	A common lava of dark color and of great fluidity when molten. Basalt is less siliceous than granite and rhyolite and contains much more iron, calcium, and magnesium.
BORNITE	A sulphide of copper and iron having when freshly broken a characteristic metallic brown tint which soon changes, on exposure, to various bright colors. From the latter circumstance the mineral gets one of its common names, "peacock ore." Bornite contains about 55% of copper, 16% of iron, and 28% of sulphur.
BRECCIA	A mass of naturally cemented angular rock fragments. Breccias are of various kinds. Some are formed by the crushing of the rock along a fault, some by explosive volcanic eruptions, and others have been deposited by running water where the fragments were not carried far enough to round them.
BROCHANTITE	Basic sulphate of copper, usually occurring as darker enamel-green crusts on limonite or porphyry in Morenci district.
CHALCANTHITE	"Blue vitriol copper," usually as coatings, or effloresceenes in veins and lodes. May occur in form of stalactites.
CHALCOCITE	A mineral composed of sulphide of copper and containing about 80% of copper and 20% of sulphur. Chalcocite is what is known to chemists as the cuprous sulphide of copper, in which two atoms of copper are combined with one atom of sulphur, whereas the blue sulphide of copper, covelite, is the cupric sulphide containing one atom of copper to one atom of sulphur, or 66.4% of copper to 33.6% of sulphur. Chalcocite is of metallic appearance when freshly broken and of dark lead-gray color. It is easily cut with a knife. The mineral is the characteristic and most valuable product of the downward enrichment of copper ores and is the chief source of copper in the Ray and Miami districts.

CHALCOPYRITE — A brass-yellow mineral consisting of sulphide of copper and iron. It contains 34.5% of copper, 30.5% of iron, and 35% of sulphur. A common source of copper and probably the mineral from which much of the copper in the Ray and Miami ore bodies was originally derived. Distinguishable from pyrite by its greater softness, being easily cut or scratched with a knife.

CHRYSOCOLLA — A mineral consisting of hydrous silicate of copper and containing about 36% of copper and 20% of water. Generally green or blue-green, in curved layers suggestive of the structure of agate. A product of the oxidation of sulphides containing copper. Some varieties are brown or black in consequence of impurities such as manganese oxide.

CORRELATION — In geology, the age relationships between the rocks of different areas; especially, with reference to stratified rocks, the relation of having been deposited at approximately the same time or by processes continuously in operation, under identical conditions from one area to another. Fossils constitute the chief evidence in problems of correlation.

CROSSCUT — A horizontal opening, like a tunnel, and running through country rock or ore at an angle to the strike of the formation.

CRYSTAL — Most matter, when it passes from a dissolved or melted state into the solid state, tends to form regular faceted or flat-faced bodies known as crystals — that is, it tends to crystallize. The resulting solid mass may be a single crystal or an aggregate or group of crystals.

DIABASE — A dark, heavy, intrusive rock having the same composition as basalt, but, on account of its slower cooling, a more crystalline texture.

DIKE — An upright or steeply dipping sheet of igneous rock that has solidified in a crack or fissure in the earth's crust.

DIORITE — An even-grained intrusive igneous rock consisting chiefly of the minerals feldspar, hornblende, and very commonly, black mica.

If the rock contains considerable quartz, it is called quartz diorite. Quartz diorite resembles granite and is connected with that rock by many intermediate varities, including quartz monzonite and granodiorite. The feldspar in diorite differs from that in granite in containing calcium and sodium instead of potassium.

DIP — The slope of a rock layer, vein, or fissure, measured by the angle made with a horizontal plane.

DRIFT — A horizontal opening, like a tunnel, lying in or near the vein or ore body, and parallel to its strike.

EPIDOTE — A mineral silicate consisting chiefly of calcium, aluminum, and iron, generally of a peculiar yellow-green color and of prismatic crystal form. A common product of rock alteration and so what is generally termed a secondary mineral. It may occur in limestone as a result of metamorphism by an intrusive igneous rock.

FAULT — A movement or displacement of the rock on one side of a fracture in the earth's crust past the rock on the other side. If the fracture is inclined and the rock on one side appears to have slid down the slope of the fracture the fault is termed a normal fault. If, on the other hand, the rock on one side appears to have been shoved up the inclined plane of the break, the fault is termed a reverse fault.

FAULT BLOCK — A part of the earth's crust bounded wholly or in large part by faults.

FAULT SCARP — The cliff formed by a fault. Most fault scarps have been modified by erosion since the faulting.

FISSURE — An extensive crack, break, or fracture in the rocks. A mere joint or crack persisting only for a few inches or a few feet is not usually termed a fissure by geologists or miners, although in a strict physical sense it is one.

GANGUE — Certain minerals of metallic or non-metallic character associated with the economically

	valuable minerals in most veins are collectively termed "gangue" material, or usually, just "the gangue."
GOSSAN	"The iron hat" of a vein or ore body. In the case of copper veins it is usually of residual limonite and other iron oxides.
HYPOGENE	Applied to ores or ore minerals that have been formed by generally ascending waters as contrasted with supergene ores or minerals.
INTRUSION DISPLACEMENT	Faulting coincident with the intrusion of an igneous rock.
LACCOLITH	Intrusive magma that spreads laterally and is not confined between walls as in dikes. This mass is usually dome-shaped.
LIMONITE	A brown mineral consisting of hydrous oxide of iron and containing, when pure, 85.6% of iron and 14.4% of water. The mineral is earthy or of irregular form, never occurring in distinct crystals. It is the usual product left behind in the oxidation of pyrite.
MALACHITE	The green carbonate of copper. A beautiful deep-green mineral occurring generally in long, slender crystals which may be closely crowded into radial sheaves or crusts. It contains about 57% of copper and 8% of water. A product of the oxidation of sulphides of copper.
MELACONITE	The soft, earthy, mineral form of the black oxide of copper, containing 79.8% of copper.
METAMORPHISM	Any change in rocks effected in the earth by heat, pressure, solutions, or gases. A common cause of the metamorphism of rocks is the intrusion into them of igneous rocks, or, more accurately, of magma. Rocks that have been so changed are termed metamorphic.
MONZONITE	An intrusive igneous rock of general granitic appearance but containing a larger proportion of calcic feldspar than granite. There is commonly quartz present and the rock is then a quartz monzonite. Quartz monzonite is intermediate in composition between granite and quartz diorite.

ORE DEPOSIT	Ore deposit — a portion of the earth's crust enormously enriched as compared with the rest.
PORPHYRY	Any igneous rock in which certain crystals (phenocryses) are distinct from a fine-grained matrix (groundmass).
PYRITE	The familiar pale-yellow mineral sulphide of iron containing, theoretically, 46.6% of iron and 53.4% of sulphur. The common crystal forms are cubes, octahedrons, 12-sided solid figures with 5-sided faces (pentagonal dodecahedrons), or combinations of these. Often without complete crystal form.
QUARTZITE	A rock composed of sand grains cemented by silica into an extremely hard mass.
RAISE	A shaft excavated upward from an interior point in the mine.
RHYOLITE	A lava, usually of light color, corresponding in chemical composition to granite. The same molten liquid that at great depth within the earth solidifies as granite would, if it flowed out on the surface, cool more quickly and crystallize less completely as rhyolite.
SEDIMENTARY ROCKS	Rocks formed by the accumulation of sediment in water (aqueous deposits) or from air (Eolian deposits). The sediment may consist of rock fragments or particles of various sizes (conglomerate, sandstone, shale); of the remains or products of animals or plants (certain limestones and coal); of the product of chemical action or of evaporation (salt, gypsum, etc.); or of mixtures of these materials. Some sedimentary deposits (tuffs) are composed of fragments blown from volcanoes and deposited on land or in water. A characteristic feature of sedimentary deposits is a layered structure known as bedding or stratification. Each layer is a bed or stratum. Sedimentary beds as deposited lie flat or nearly flat.
SHALE	A rock consisting of hardened fine mud deposited in thin layers that may be split apart.
SILL	A sheet of igneous rock intruded in an attitude more nearly horizontal than vertical

and as a rule between beds of sedimentary rock.

SPHALERITE — Zinc blende, the common crystallized mineral sulphide of zinc. A black, brown, or yellow mineral of resinous luster which splits (cleaves) into pieces having very smooth, even, and shining flat surfaces. Zinc blende contains 67% of zinc and 33% of sulphur. It is one of the chief sources of zinc.

STRATIGRAPHY — The branch of geology that deals with the order of deposition and regional relations of the strata of the earth's crust.

STRUCTURE — In geology, the forms assumed by sedimentary beds and igneous rocks that have been moved from their original position by forces within the earth, or the forms taken by intrusive masses of igneous rock in connection with effects produced mechanically on neighboring rocks by the intrusion. Folds (anticlines and synclines) and faults are the principal effects considered under structure. Schistosity and cleavage are also structural features.

SUPERGENE — Applied to ores or ore minerals that have been formed by generally descending water. Ores or minerals formed by downward enrichment.

TALUS — The mass of loose rock fragments that accumulates at the base of a cliff or steep slope.

VEIN — A mass of mineral material that has been deposited in or along a fissure in the rocks. A vein differs from a dike in that the vein material was introduced gradually by deposition from solution, whereas a dike was intruded in a molten condition.

WINZE — An opening like a small shaft, sunk from an interior point in the mine.

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