MME Form 9
Rev. Nov. 65

UNITED STATES
DEPARTMENT OF THE INTERIOR
Geological Survey

OFFICIAL DOCKET FILE Contract No. _____ Docket No. 6607

Application
- [x] Denied
- [ ] Withdrawn

Contract
- [ ] Terminated - Not Certified
- [ ] Terminated - Certified
- [ ] Cancelled
- [ ] Royalty Agreement

The records contained in this file are marked (x) and arranged in this order:

Folder No. 1:

Left Side

- [ ] Royalty Audits
- [ ] Certification of Discovery
- [ ] Closing Letter
- [ ] Cost Audits
- [ ] Termination Notice or Agreement
- [ ] Recision Notice
- [ ] Assignment of Contract
- [ ] Contract Amendments
- [ ] Contract with all exhibits and annexes
- [ ] Owner's Consent to Lien and Subordination Agreement
- [x] Application and Attachments

Right Side

- [ ] Project Summary (final)
- [ ] Work Completed Analysis (final)

All other material filed in chronological order including the following reports if checked:

- [ ] Field Team Semiannual Report for Certified Project
- [ ] Final Field Team Report (Tab)
- [ ] Operator's Final Report (Tab)
- [ ] Interim Field Team Reports
- [ ] Operator's monthly reports and all attachments
- [x] On-site Exam. Report (Tab)
- [ ] Settlement Sheets
- [ ] Drill Logs

Additional Folders:

Left Side

Folders No. _____: Reports

- [ ] Analysis of Semiannual Inspection Reports
- [ ] Project Summary (Interim) by MME Engineers

Right Side

- [ ] Field Team Semiannual Report for Certified Project
- [ ] Field Team Interim Reports
- [ ] Operator's Monthly Reports with Transmittal, Narrative and Maps

Folders No. _____: Maps (Use pocket folder or envelope)

Folders No. _____: Settlement Sheets

Folders No. _____: Drill Logs

Folders No. _____: Royalty Material

72195-65

IN REPLY REFER TO:

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

OFFICIAL COPY
O. M. E.
RECEIVED
MAR 24 1967
INITIALS | CODE

Memorandum

March 22, 1967

To: Chief, Office of Minerals Exploration
Washington, D. C.

From: Field Officer
Region II

Subject: New Application (Silver)
William S. Hubbard
Silver Bow Mine-Calico Mining District
San Bernardino County, California

Enclosed is an application from Mr. William S. Hubbard, Civic Center Bldg., 175 W. 5th Street, San Bernardino, California, for assistance in an exploration project at the Silver Bow Mine in the Calico district.

Part of the work proposed, such as raises to the surface on each vein, is more development than exploration but this could probably be modified. The estimated costs for drifting and crosscutting ($30 per foot) and raising ($20 per foot) are probably too low unless the applicant plans to do most of the work himself and not charge his labor to the cost of the work.

Calico is one of California's principal silver districts and has yielded between 15 and 20 million ounces of silver. Production from the Silver Bow Mine is not reported, but it has probably been small. The ore also contains some lead and the barite gangue also has a local market.

If you wish a field examination, I am planning a trip to southern California about the second week of April to make a final examination of the Pacific Mining Corp. (OME-6490) project and could schedule an examination of this application at that time.

H K Stager

H. K. Stager

Enclosure

APPLICATION FOR FINANCIAL ASSISTANCE

IN MINERALS EXPLORATION

OFFICIAL
COPY
O. M. E.
RECEIVED
MAR 24 1
INITIALS

Submitted by:
William S, Hubbard
Civic Center Building
175 West Fifth Street
San Bernardino, California

WILLIAM S. HUBBARD
STATE INHERITANCE TAX APPRAISER
CIVIC CENTER BUILDING
175 WEST FIFTH STREET
SAN BERNARDINO, CALIFORNIA
TELEPHONE TURNER 9-1068

(Personal)

March 15, 1967

Mr. Harold K. Stager, Geologist
Field Officer
U.S. Geological Survey
Office of Minerals Exploration
345 Middlefield Road
Menlo Park, California 94025

Dear Mr. Stager:

Enclosed please find the original and one copy of an application, together with supporting material, for financial assistance in an exploration project at the Silver Bow Mine, Calico Mountains, Barstow, California.

While I have proposed a definite program, I am flexible and would stand ready to modify the exploration plan in any way that would make it a more acceptable project to the Office of Minerals Exploration.

I look forward to meeting you and stand ready to furnish such additional information as you may require.

Respectfully,

William S. Hubbard

WSH/sf

MME Form 40
Jan. 65

Budget Bureau No. 42-R1308
Approval expires Dec. 31, 1968

OFFICIAL COPY
RECEIVED
MAR 24 1967
INITIALS | CODE

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

APPLICATION FOR FINANCIAL ASSISTANCE IN MINERALS EXPLORATION

Pursuant to Public Law 85–701 (72 Stat. 700; 30 U.S.C. 641)

NAME OF APPLICANT *(Full legal name and mailing address as they should appear on contract if one is executed.)*

William S. Hubbard
Civic Center Building
175 West Fifth Street
San Bernardino, California 92401

APPLICANT DO NOT USE THIS BLOCK

DOCKET NUMBER: 6607

DATE RECEIVED: 3/24/67

REGION: II

DIVISION CODE:

BUSINESS ORGANIZATION *(Check one)*

- INDIVIDUAL [X]
- CORPORATION [ ]
- PARTNERSHIP [ ]
- OTHER *(Specify)* [ ]

STATE IN WHICH FIRM IS ORGANIZED: N/A

LIST CORPORATE OFFICERS OR PARTNERS HERE, IF APPLICABLE

NAME	ADDRESS	TITLE
N/A		

MINERAL(S) FOR WHICH YOU WISH TO EXPLORE: Silver

ESTIMATED COST OF PROJECT: $ 67,000.00

PROPERTY NAME	LOCATION COUNTY	STATE
Silver Bow Mine	San Bernardino	Calif.
Silver Bow Annex		

GENERAL INSTRUCTIONS

Before filling out this application, please read the *OME Regulations for Obtaining Federal Assistance in Financing Explorations for Mineral Reserves* (30 CFR Chap. III). To assure prompt action, your application must provide all applicable material and information specified on the back of this application form. Avoid unnecessary correspondence and delays by submitting complete and accurate information. *Please submit two copies of this application and all accompanying papers* except as otherwise noted. Place your name and address on each sheet. Each item of information, maps, and reports required as a part of this application is described on the back of this form. Identify each attached statement by the item number to which it applies. If an item does not apply to your application, show the item number on your statement and after it write "not applicable." Maps or sketches should be used to supplement narrative descriptions of the property location and boundaries in item 2, existing mine workings and geology in item 3, and the proposed exploration work in item 5. When this information is not too complex, all of it may be shown on one map or sketch. All documents and other attachments submitted as a part of this application, except those in item 3(g) which you mark to be returned, become the property of the Government and will not be returned to the applicant. Send true copies, *not originals*, of leases, contracts, and other documents which are an essential part of your business records. *File this application with the Office of Minerals Exploration, Department of the Interior,* ~~Washington 25, D.C., or with the nearest OME Field Office.~~ Washington, D. C., 20242, or with the nearest OME Field Office.

CERTIFICATION

The undersigned, whether as an individual, corporate officer, partner, or otherwise, both in his own behalf and acting for the applicant, certifies that the information set forth in this form and accompanying papers is correct and complete, to the best of his knowledge and belief, and that he would not ordinarily undertake the proposed exploration under current conditions and circumstances at his sole expense.

March 15, 1967
DATED

BY *(Signature)*

William S. Hubbard - Owner
TITLE

A wilfully false statement or certification to any Department or Agency of the United States Government is a criminal offense. U. S. Code, Title 18, Sec. 1001.

INFORMATION REQUIRED WITH THIS APPLICATION

1. Financial Eligibility:

(a) Submit evidence of efforts made within 90 days preceding the filing of this application to obtain credit from your bank of account and at least one other banking institution or other private source of credit. Such evidence shall include true copies of correspondence which show: (1) date of loan request, (2) amount and terms requested, (3) proposed use of loan funds, and (4) the replies from credit sources. If the loan was offered under terms which you consider unreasonable, state why you consider them so.

(b) List names and addresses of affiliated, parent, or controlling companies or organizations and state extent and nature of their interest.

(c) State how you propose to furnish your share of the cost of the exploration work.

2. Applicant's Rights in Land:

(a) State your interest in the land and mineral rights, whether owner, lessee, purchaser under contract, or other. If you are not the owner, submit one true copy of the lease, contract, or other document (with address of owner) under which you control the property. Describe all liens, mortgages, or other encumbrances on the land and state book and page number and official place where recorded.

(b) State the legal description (section, township, and range; metes and bounds; patent number of claims) of the land upon which you wish to explore and all adjacent land which you own or control. Describe any part of the land or workings which should not be subject to Government royalty and liens. If the land consists of unpatented claims, state book and page number for each recorded location notice, including amended locations, and official place where recorded. State all the names by which you know the property.

(c) For all land or mineral rights encumbered or not owned, submit five copies of Lien and Subordination Agreements on MME Form 52. If the agreements cannot be obtained, state reasons and provide copies of letters of refusal.

3. Physical Description:

(a) Describe in detail and illustrate with maps or sketches all mining or exploration operations which you know have been or are being conducted upon the land. Include existing mine workings and all production facilities.

(b) State your interest, if any, in operations described in (a).

(c) State, if you know, the past and current production, supporting your statement with copies of settlement sheets, mine records, or published data if available.

(d) Describe known ore reserves, giving quantities and grades and sampling methods used. Support your statement with copies of assay certificates and assay maps if available.

(e) Describe by narrative and maps or sketches the geologic features of the property, including ore minerals, geologic formations if known, and type of deposit (vein, bedded, etc.).

(f) State your reasons for expecting to find ore, and if you have sampled the area you propose to explore, show where the samples were taken, describe sampling methods used, and provide copies of assay certificates.

(g) Send with your application at least *two* copies of all geologic or engineering reports, assay maps, or technologic information which you have, indicating whether you require their return.

4. Accessibility of Property:

(a) To aid the OME representative who may examine the property, state name and address of person who will meet him; give directions for reaching the property; and describe accessibility of property and of any mine workings.

(b) Name the shipping and supply points and state the distances to the property.

5. Exploration Work:

(a) Describe fully the proposed exploration work giving individual footages and sizes of openings *for each item of work.* Use narrative, maps, plans, and sections as necessary. Show location of the proposed work as related to geologic features such as veins, ore-bearing beds, contacts of rock formations, etc. Show also the relation of the proposed work to any existing mine workings and to *land boundaries* or to the closest identifiable corner.

(b) If an access road must be built, show the proposed location on the property map and state the length, type and construction methods proposed.

(c) If an OME contract is executed, state how soon thereafter work would be started and finished. State your anticipated average daily or monthly rate of progress for each type of work.

6. Experience:

State your operating experience and background to conduct this exploration work and also that of the person who will supervise the work.

7. Estimate of Costs:

Furnish detailed estimates of the necessary costs *for each item of the work proposed in 5(a)* under the headings listed below with a total for each heading and the estimated total cost of the work. Costs for any work to be performed by an independent contractor should be listed separately under category (a) below. Costs for any work that is not to be performed by an independent contractor should be listed under categories (b) through (g).

(a) Independent contracts. State the total cost of any proposed independent contract for all or any part of the work, and the number of units and the unit cost for each type of work, such as per foot of drilling, per foot of drifting, per hour of bulldozer operations, or per cubic yard of material moved. Cost estimates should be supported by bids from three contractors if possible. (*Note*—If none of the work is to be contracted, write "none" after this item.)

(b) Personal services. The cost of supervision, engineering and geological services, outside consultants, and labor should be itemized by numbers and classes of employees; rates of wages, salaries or fees; and periods of employment. State whether these services are available.

(c) Operating materials and supplies. List items of material and supplies giving quantity and cost of each. Include under this heading power, water, and fuel, and units of equipment and tools costing less than $50 each.

(d) Operating equipment. List items of equipment and tools costing $50 or more per unit. Give specifications and indicate how each item is to be acquired—i.e., rented, purchased or provided by the applicant. If rented or purchased, state the estimated rental or purchase price. If furnished by the applicant, state condition and present fair market value.

(e) Initial rehabilitation and repairs. Describe the type and the cost of *initial* rehabilitation or repair of existing buildings, fixtures, installations (exclusive of mine workings), and movable operating equipment now owned by the applicant which will be used in the exploration work.

(f) New buildings, fixtures, installations. Describe each building, fixed improvement, and installation to be purchased, constructed, or installed for the exploration work, stating specifications and cost including labor, materials, and supervision.

(g) Miscellaneous. Describe the type and estimate the cost of repairs and maintenance of the operating equipment listed in 7(d). Do not repeat initial repairs listed in 7(e). Show also the costs of analytical work, accounting, workmen's compensation and employees' liability insurance, payroll taxes, and other required costs that do not fall within the previous categories. [*Note*—The Government will not contribute to costs incurred before the date of the contract, or to costs of or incident to: (1) acquiring, using, or possessing land and any existing improvements, facilities, buildings, installations, and appurtenances, or the depreciation and depletion thereof; (2) general overhead, corporate management, interest and taxes (other than payroll and sales taxes); (3) insurance (other than employees' liability insurance); and (4) damages to persons or property (other than authorized repair to or replacement of equipment or other property used in the work).]

INT.-DUP. SEC., WASH., D.C

RE: Item [illegible]-a

March 7, 1967

Mr. Richard W. Steiler
President
Standard Mortgage Company
247 East Highland Avenue
San Bernardino, California

Dear Dick:

Knowing that you have numerous private investors, as well as institutional lenders, induced me to call you with reference to a loan I need for a special project.

Per our conversations, I own the Silver Bow Mine, 15 miles NE of Barstow. I plan to further develop this property by 2750 feet of drifts, crosscuts and raises. Based on past figures I estimate a cost of $30.00 per foot for drifting and $20.00 per foot for the raising.

A loan of $67,000.00, 6% interest, due in 2 years is requested. There is an excellent probability of encountering new ore bodies and enriched zones of lead-silver ores.

I will be happy to supply you a complete package on the proposed development and its feasibility.

Sincerely,

William S. Hubbard

WSH/sf

RE: Item [illegible]a

March 7, 1967

Mr. Stan Lemmond
Bank of California
Real Estate Department
Highland-Arrowhead Branch
San Bernardino, California

Dear Stan:

Knowing that you have numerous private investors, as well as institutional lenders, induced me to call you with reference to a loan I need for a special project.

Per our previous conversation, I own the Silver [illegible] Mine 15 miles NE of Barstow. I plan to further develop this property by 2750 feet of drifts, crosscuts and raises. Based on past figures I estimate a cost of $30.00 per foot for drifting and $20.00 per foot for the raising.

A loan of $67,000.00, 6% interest, due in two years is requested. There is an excellent probability of encountering new ore bodies and enriched zones of lead-silver ores.

I will be happy to supply you a complete package on the proposed development and its feasibility.

Sincerely,

William S. Hubbard

WSH/sf

247 East Highland Avenue
P. O. Box 107
San Bernardino, Calif. 92402
TUrner 2-1761

Standard Mortgage Company, Inc.

Real Estate Loans - Trust Deed Investments

March 9, 1967

William S. Hubbard
Civic Center Building
175 West Fifth Street
San Bernardino, California

RE: Silver Bow Mine

Dear Mr. Hubbard:

As we stated before, due to the fact that we are only brokers for many private investors, and being that they are very cautious about making this type of loan we still feel that we won't be able to help you at this time.

NG.

Very truly yours,

STANDARD MORTGAGE COMPANY, INC.

R. W. Steiler
President

RWS/kw

Offices in all three Pacific Coast states

THE BANK OF CALIFORNIA *National Association*

HIGHLAND AVENUE OFFICE: 296 West Highland Avenue, San Bernardino, California 92406

Telephone 889-9931

March 10,1967

William S. Hubbard
175 West 5th Street
San Bernardino, California

Dear Mr. Hubbard:

We are very sorry, but at this time because of the market conditions, we would not be able to entertain an application for a loan, on the Silver Bow Mine for your proposed mineral exploration program.

Sincerely yours,

S. N. Lemmond
Assistant Cashier

SNL:jm

RE: Item [illegible]-b

FINANCIAL ELEGIBILITY

This item does not apply inasmuch as there are no affiliated, parent, or controlling companies or organizations.

This applicant is the sole owner as stated in Item #2-a.

RE: Item #1-

STATEMENT AS TO HOW APPLICANT PROPOSES

TO

FURNISH HIS SHARE OF WORK

1. Applicant has demonstrated his ability to furnish one-half the cost of the proposed exploration by having paid all the cost of development since 1958, totaling over 500 feet of drift and 350 feet of raises.

2. Applicant will personally supervise operation.

3. Fixed costs have been paid for already by applicant, as follows:

   a. Mine is operating now.

   b. Mine is fully equipped to include:

      (1) Compressors

      (2) Fairbanks Morse Hoist

      (3) Generator

      (4) Air and water pipe to face of drift

      (5) Mine wired

      (6) Slusher

      (7) Mining car and rails

      (8) Diesel Loader-dozer

   c. Equipment and installations are in good order.

   d. Existing buildings to include shop, hoist house, and trailers for living quarters do not need repair.

   e. Applicant has on hand, considerable operating supplies.

   f. Applicant has on hand necessary small tools.

4. Applicant will utilize his present bookkeeper and accountant for:

   a. Bookkeeping

   b. Accounting

   c. Payroll and taxes

RE: Item #1-c

STATEMENT AS TO HOW APPLICANT PROPOSES

TO

FURNISH HIS SHARE OF WORK

Personnel presently employed by applicant will be able to administer the proposed project at no appreciable increase in expense.

Applicant will furnish financial statement upon request.

Applicant is a recognized mining operator in this district. (See enclosed State of California, Mineral Information Service Bulletin, Volumn 19, Number 5, May 1966, page 79.)

RE: Item #2-a

APPLICANT'S RIGHTS IN LAND

The applicant, WILLIAM S. HUBBARD, is the sole owner of the mining clain whereon exploration work is proposed.

RE: Item #2-b

APPLICANT'S RIGHTS IN LAND

See copies of location notices,

chains of title and proof of labor.

LOCATION NOTICE

QUARTZ CLAIM

NOTICE IS HEREBY GIVEN: That the undersigned citizens of the United States, in compliance with the requirements of Chapter VI, Title 32, of the Revised Statutes of the United States, and the local customs, laws and regulations, has this day located and claimed fifteen hundred linear feet along the course of this lead, lode or vein of mineral-bearing quartz, and three hundred feet in width on each side of the middle of said lead, lode or vein together with all mineral deposits contained therein, and all timber growing within the limits of said claim, and all water and water privileges thereon or appurtenant thereto.

The general course of the vein is Easterley and Westerley Situated in the Bellerville Mining District, County of San Bernardino, State of California, and more particularly described as follows, to wit:

COMMENCING AT This Monument and running 750 ft in an Easterley direction and 750 ft in a Westerly direction and claiming 300 ft on each side of this initial Monument. This Claim lies about 1½ Miles Westerly from the Sue Mine and was formally known as the Silver Bow

The date of discovery of this lead, lode or vein is the ..... day of ....., 193..

The date of location of this lead, lode or vein is the 19th day of Aug, 1939

It is named and shall be known as the Silver Bow Mine Claim

WITNESS | LOCATORS

Quitclaim Deed

Irene Pearl Reber

In consideration of Ten Dollars

does hereby REMISE, RELEASE and FOREVER QUITCLAIM unto

J. F. Reber

all that real property situate in the Belleville Mining District

County of San Bernardino, State of California, described as follows:

That certain mining claim known as the Silver Bow Mine which was located by J. F. Reber, A. Reber, and Harry Cumins on or about the 19th day of August, 1939, and a quartz claim was recorded on September 7, 1939, in Book 270, Page 457, Mining Records of San Bernardino County.

Quitclaim Deed

Harry William Cummings

in consideration of One dollar ----------

Dollars,

to Cash *in hand paid, the receipt of which is hereby acknowledged do hereby Remise, Release and forever Quitclaim to*

J.F.Reber

all that real property situated in the

County of San Bernardino, *State of California, described as follows:*

The Silver Bow Mine-Located in the County of San Bernardino, State Of California. Situated in the [redacted] Belleville Mining District.

Quitclaim Deed

I, Joseph F. Reber

in consideration of One Dollar

One *Dollars,*

to me *in hand paid, the receipt of which is hereby acknowledged, do hereby*

Remise, Release and forever Quitclaim to David R. Lightfoot

One half Interest

all that real property situated in the Bellville Mining District, West Calico

County of San Bernardino, *State of California, described as follows:*

One half interest in that certain unpatented mining claim named "Silver Bow" in Bellville Mining District, West Calico. said County of San Bernardino, State of California.

The location Notice of said Claim being recorded in Book 270, page 457 of Mining Claims, Records of said County.

To Have and to Hold to the said grantee

308 PAGE 264

This BLANK furnished FREE by San Bernardino County

FEE FOR RECORDING LOCATION NOTICES, $1.00 EACH, PAYABLE IN ADVANCE

Return to Ted R. Carpenter, County Recorder, San Bernardino, Calif.

LOCATION NOTICE

QUARTZ CLAIM

NOTICE IS HEREBY GIVEN: That the undersigned citizen of the United States, in compliance with the requirements of Chapter VI, Title 32, of the Revised Statutes of the United States, and the local customs, laws and regulations, has this day located and claimed fifteen hundred linear feet along the course of this lead, lode or vein of mineral-bearing quartz, and three hundred feet in width on each side of the middle of said lead, lode or vein together with all mineral deposits contained therein, and all timber growing within the limits of said claim, and all water and water privileges thereon or appurtenant thereto.

The general course of the vein is N. Westerley and S. Easterly direction. Situated in the Bellville Mining District, County of San Bernardino, State of California, and more particularly described as follows, to-wit:

COMMENCING AT this Discovery Monument Thence 100 ft in a Northerley Direction thence 750 ft West thence 600 ft Southerly Thence 1500 ft East thence 600 ft Northerly thence 750 ft West thence 100 ft Southerly to point of [illegible]

RECORDED AT REQUEST OF
LOCATOR / OWNER 191

JUL 18 1949 AT 3 53 PM INDEXED

BOOK 308 PAGE 264
MINING RECORDS
San Bernardino County, Calif.
TED R. CARPENTER, Recorder

INDEXED
COMPARED

1 0/4

Delmar Nelson
DEPUTY

This claim can be identified by its proximity to the following natural object or permanent monument, to-wit: This Claim joins the Silver Boss on the South Westerly side

NOTICE IS ALSO GIVEN that the discovery work as required by law has been performed.

The date of discovery of this lead, lode or vein is the 15th day of June, 1949

8 pt. type or larger

BOOK 4473 PAGE 123

Quitclaim Deed

FOR A VALUABLE CONSIDERATION, receipt of which is hereby acknowledged,

J. F. Reber and David E. Lightfoot

do hereby

REMISE, RELEASE AND FOREVER QUITCLAIM to

Thomas J. Welter and William S. Hubbard

the real property in the Belleville Mining District County of San Bernardino State of California, described as:

That certain mining claim known as the Silver Bow Mine which was located by J. F. Reber, [illegible] Reber, and Harry Cummins on or about the 1[illegible]th day of August, 1939, and a quartz claim was recorded on September 7, 1939, in Book 27[illegible], Page 457, Mining Records of San Bernardino County, and

That certain mining claim known as the Silver Bow Annex which was located by J. F. Reber and D. E. Lightfoot on or about the 1[illegible]th day of June 1949, and a quartz claim was recorded on July [illegible], 1949, in Book 308, Page 264, Mining Records of San Bernardino County.

Dated: March 28, 1958

D. E. Lightfoot

J. F. Reber

STATE OF CALIFORNIA
COUNTY OF San Bernardino } ss.

On March 28, 1958, before me, the undersigned, a Notary Public in and for said County and State, personally appeared

D. E. Lightfoot
J. F. Reber

known to me to be the person whose name

SPACE BELOW FOR RECORDER'S USE ONLY

RECORDED
REQUEST OF

GRANTEE

NO CONSIDERATION STATED

MAR 31 4 34 PM '58

BOOK 4473 PAGE 122

8 pt. type or larger

Bill of Sale

Know all Men by these Presents: That

J. F. Weber and D. E. Lightfoot

hereinafter designated as the Seller, for and in consideration of the sum of One and 00/100 **Dollars, lawful money of the United States of America, to** Selter & Hubbard **in hand paid by**

hereinafter designated as the Buyer, the receipt whereof is hereby acknowledged, does by these presents grant, bargain, sell and convey unto the said Buyer, their **, executors, administrators and assigns,**

All personal property located
of Silver Dollar and Silver Dollar Annex.

To Have and to Hold, the same to the said Buyer, their **executors, administators and assigns forever. And the said Seller does for** their **heirs, executors and administrators covenant and agree to and with the said Buyer** their **executors, administrators and assigns, to warrant and defend the title to the said property, goods and chattels hereby conveyed, against the just and lawful claims and demands of all persons whomsoever.**

Witness my **hand and seal this** 28th **day of** March **, 19**

X J F Weber

STATE OF CALIFORNIA
COUNTY OF _____ } SS.

On _____
before me, the undersigned, a Notary Public in and for said County and State, personally appeared

_____

known to me to be the person whose name
subscribed to the within instrument and acknowledged
that _____ executed the same.

SPACE BELOW FOR RECORDER'S USE ONLY

RECORDING REQUESTED BY

514

RECORDING REQUESTED BY

Pomona Mtge Co

BOOK 5825 PAGE 268

AND WHEN RECORDED MAIL TO

Name: Arlie Hubbard
Street Address: c/o 337 West Baseline Street
City & State: San Bernardino, California

DEC 27 2 00 PM '67

BOOK 5825 PAGE 268

OFFICIAL RECORDS
SAN BERNARDINO COUNTY, CALIF.

SPACE ABOVE THIS LINE FOR RECORDER'S USE

AFFIX $ _____ I. R. STAMPS IN THIS SPACE

514

TO 402 C (400)

Quitclaim Deed

THIS FORM FURNISHED BY TITLE INSURANCE AND TRUST COMPANY

FOR A VALUABLE CONSIDERATION, receipt of which is hereby acknowledged,

Thomas J. Welter

hereby REMISE, RELEASE AND FOREVER QUITCLAIM to

Arlie R. Hubbard

the following described ~~real property~~ Mining Claims in the county of [illegible] state of California:

SILVER BOW MINE & SILVER BOW ANNEX, situated [illegible] more particularly described as follows:

That certain mining claim known as the Silver Bow Mine which was [illegible] Reber, A. Reber, and Harry Cummins on or about the 19th day of August, [illegible] claim was recorded on September 7, 1939, in Book 270, Page 457, [illegible] San Bernardino County, and

That certain mining claim known as the Silver Bow Annex which was [illegible] Reber and D. E. Lightfoot on or about the 15th day of June [illegible], in Book [illegible], Page [illegible], Mining Records of San Bernardino, County.

This quitclaim deed includes all [illegible] including personal property now on the property [illegible] and any rents or other interest from the property.

Dated JUNE 1, 1962

Thomas J. Welter

STATE OF CALIFORNIA,
COUNTY OF San Bernardino } SS.
On JUNE 1, 1962 before me the undersigned

RECORDING REQUESTED BY

AND WHEN RECORDED MAIL TO

Name
Street Address
City & State

William S. Hubbard
c/o 337 W. Baseline St.
San Bernardino, California

RECORDED
BOOK 5943 PAGE 2

Jul 5 1 20 PM '63
BOOK 5943 PAGE 2
OFFICIAL RECORDS
SAN BERNARDINO COUNTY, CALIF.

SPACE ABOVE THIS LINE FOR RECORDER'S USE

AFFIX $ ... R STAMPS IN THIS SPACE

TO 402 C (400)

Quitclaim Deed

THIS FORM FURNISHED BY TITLE INSURANCE AND TRUST COMPANY

FOR A VALUABLE CONSIDERATION, receipt of which is hereby acknowledged,

ARLIE R. HUBBARD

hereby REMISE, RELEASE AND FOREVER QUITCLAIM to

WILLIAM S. HUBBARD

the following described ~~real property~~ in the ... state of California:

Silver Bow Mine and Silver Bow Annex, Belleville Mining District, ... described as follows:

That certain mining claim known as the Silver Bow Mine which was ... J. F. Reber, A. Reber, and Harry Cummins, on or about the ... and a quartz claim was recorded on September 7, 193..., in Book ..., Mining Records of San Bernardino County, and

That certain mining claim known as the Silver Bow Annex which was ... J. F. Reber and D. E. Lightfoot on or about the ... quartz claim was recorded on July 1..., 1949 in Book ..., ... of San Bernardino County.

This quitclaim deed includes all beneficial interest including personal property now on the property above described and ... or other interest from the property.

Dated June 7, 1963

Arlie R. Hubbard
Arlie R. Hubbard

STATE OF CALIFORNIA,
COUNTY OF San Bernardino } SS.
On June 7, 1963 before me, the under-

303

[illegible], San Bernardino, California.

[illegible] recording fees.

[illegible] on proof of Labor, figure $1.00 for the endorsement fee plus 10 cents for each claim, 10 cents for each locator, and 30 cents for a normal description.

RECORDED
REQUEST OF
LOCATOR-OWNER

JUN 2 9 08 AM '58
BOOK 411 PAGE 136
MINING RECORDS
SAN BERNARDINO COUNTY, CALIF.
TED R. CARPENTER, RECORDER
Hays G. Mann, Dep.

PHOTOSTATED

PROOF OF LABOR

200
1.00

STATE OF CALIFORNIA,
COUNTY OF SAN BERNARDINO, } ss.

BEFORE ME, The subscriber, personally appeared William S. Hubbard who, being duly sworn, says that at [illegible] One Hundred Dollars worth of labor and improvements performed or made upon each of the following [illegible] claims (or a total of Two Hundred Dollars)

Silver Bow and Silver Bow Annex Mining Claims.
Blasting and excavating vein outcroppings on both claims to determine extensiveness. Procuring samples and running extensive assays on interior vein material. Road work.

situated in vicinity of Barstow or Belleville Mining District, San Bernardino County, State of California, during the period from March 28, 19 58 to May 28, 19 58 Such expenditures was made by or at the expense of

William S. Hubbard and Thomas J. Welter

BOOK 420 PAGE 19

388

This BLANK furnished FREE by San Bernardino County.
Return to Ted R. Carpenter, County Recorder, San Bernardino, California.

NOTE—Legislature, by law, regulates recording fees.

When computing fees on proofs of Labor, figure $1.00 for the endorsement fee plus 10 cents for each claim, 10 cents for each locator, and 30 cents for a normal description.

RECORDED REQUEST OF PHOTOSTATED

LOCATOR-OWNER

INDEXED

JUN 10 10 48 AM '59

BOOK 420 PAGE 19

MINING RECORDS
SAN BERNARDINO COUNTY, CALIF.
TED R. CARPENTER, RECORDER

John C. Barbour Jr. DEP.

2.00

PROOF OF LABOR

STATE OF CALIFORNIA,
COUNTY OF SAN BERNARDINO, } ss.

BEFORE ME, The subscriber, personally appeared William S. Hubbard who, being duly sworn, says that at least One Hundred ($100.00) Dollars worth of labor and improvements performed or made upon each of the following claims (or a total of ..... Dollars)

SILVER BOW MINE and SILVER BOW ANNEX, Calico Mountains, Belleville Mining District, San Bernardino County.

SAID WORK CONSISTED OF: Installing new headframe, skidway, bucket, engines, air and water pipes to lower depths and levels of mine. Blocking out approximately 10,000 tons new ore reserves on 150' level, west face.

situated in vicinity of Calico or Belleville Mining District, San Bernardino County, State of California, during the period from 1 August, 1958 to 1 June, 1959. Such expenditures was made by or at the expense of William S. Hubbard and Thomas J. Walker

This BLANK furnished FREE by [illegible] Return to Ted R. Carpenter, County Recorder, San Bernardino, California.

NOTE—Legislature, by law, regulates recording fees.

When computing fees on proofs of Labor, figure $1.00 for the endorsement fee plus 10 cents for each claim, 10 cents for each locator, and 30 cents for a normal description.

BOOK 429 PAGE 582

INDEXED

RECORDED REQUEST OF

LOCATOR-OWNER

PHOTOSTATED

JUN 8 2 21 PM '60

BOOK 429 PAGE 109

MINING RECORDS
SAN BERNARDINO COUNTY, CALIF.
TED R. CARPENTER, RECORDER

Kenneth J. Matthews
DEPUTY

PROOF OF LABOR

2.00

STATE OF CALIFORNIA,
COUNTY OF SAN BERNARDINO, } ss.

BEFORE ME, The subscriber, personally appeared William S. Hubbard who, being duly sworn, says that at least One Hundred ($100.00) Dollars worth of labor and improvements performed or made upon each of the following claims (or a total of ..... Dollars)

SILVER BOW MINE and SILVER BOW ANNEX, Calico Mountains, Belleville Mining District, San Bernardino County.

SAID WORK CONSISTED OF: Drifting approximately 120 ft. on the 200 ft. level, to the West.

situated in vicinity of Calico or Belleville Mining District, San Bernardino County, State of California, during the period from 1 August 59, 19..... to 1 July 60, 19..... Such expenditures was made by or at the expense of William S. Hubbard and Thomas J. Holter

[illegible] Recorder's Use Only

[illegible] Recorded [illegible] County,
[illegible] to Ted R. Carpenter, County Recorder, San Bernardino, California.
[illegible] Legislature amended Item regulating Recording Fees. When [illegible] fees figure $2.00 for first page, not over 8½ x 14 inches, plus [illegible] for each additional page or fraction thereof.

697

RECORDED
REQUEST OF
LOCATOR-OWNER

INDEXED

AUG 24 4 35 PM '61

PHOTOSTATED BOOK 437 PAGE 520

MINING RECORDS
SAN BERNARDINO COUNTY, CALIF.
TED R. CARPENTER, RECORDER

Chas A Ferguson
DEPUTY

200

PROOF OF LABOR

STATE OF CALIFORNIA,
COUNTY OF SAN BERNARDINO, } ss.

BEFORE ME, The subscriber, personally appeared William S. Hubbard who, being duly sworn, says that at least One Hundred and 00/11 ($100.00) Dollars worth of labor and improvements performed or made upon each of the following claims (or a total of ..... Dollars)

SILVER BOW MINE AND SILVER BOW ANNEX, Calico Mountains, Belleville Mining District, San Bernardino County

situated in vicinity of Calico or Belleville Mining District, San Bernardino County, State of California, during the period from Sept 1, 1960 to Sept 1, 1961. Such expenditures were made by or at the expense of William S. Hubbard & Thomas J. Welgos

owner S of said claim S

For Recorder's Use Only

BOOK 442 PAGE 222
RECORDED
REQUEST OF
LOCATOR-OWNER

#686

INDEXED

MICROFILMED

AUG 21 4 17 PM '62
BOOK 442 PAGE 222
MINING RECORDS
SAN BERNARDINO COUNTY, CALIF.
TED A. CARPENTER, RECORDER

2.00

PROOF OF LABOR

STATE OF CALIFORNIA,
COUNTY OF SAN BERNARDINO, } ss.

BEFORE ME, The subscriber, personally appeared WILLIAM S. HUBBARD who, being duly sworn, says that at least One Hundred and no/100 ($100.00) Dollars worth of labor and improvements performed or made upon each of the following claims (or a total of ..... Dollars)

SILVER BOW MINE AND SILVER BOW ANNEX, ALSO SILVER BOW ANNEXES 11, 12, 13, 14, 15 and 16, Calico Mountains, Belleville Mining District, San Bernardino, County.

Situated in vicinity of Calico or Belleville Mining District, San Bernardino County, State of California, during the period from September 1, 1961 to September 1, 1962. Such expenditures were made by or at the expense of

WILLIAM S. HUBBARD.

[illegible] Recorder's Use Only

·699 BOOK 445 PAGE 312

RECORDED REQUEST OF

INDEXED LOCATOR-OWNER

JUL 24 3 37 PM '63

BOOK 445 PAGE 312

MINING ~~COUNTY~~ RECORDS
SAN BERNARDINO COUNTY, CALIF.

Ted Risbenter
RECORDER

2.00

MICROFILMED

[illegible] Recorder's Use Only

[illegible] Recorder's Use Only

[illegible] Recorder's Use Only

PROOF OF LABOR

STATE OF CALIFORNIA,
COUNTY OF SAN BERNARDINO, } ss.

BEFORE ME, The subscriber, personally appeared WILLIAM S. HUBBARD who, being duly sworn, says that at least One Hundred and no/100 ($100.00) Dollars worth of labor and improvements performed or made upon each of the following claims (or a total of ..... Dollars)

SILVER BOW MINE and SILVER BOW ANNEX, also SILVER BOW ANNEXES, 11, 12, 13, 14, 15 and 16, Calico Mountains, Belleville Mining District, San Bernardino County.

situated in vicinity of Calico or Belleville Mining District, San Bernardino County, State of California, during the period from September 1, 1962 to September 11, 1963. Such expenditures were made by or at the expense of WILLIAM S. HUBBARD,

owner of said claim or for the purpose of holding said claim or

[illegible] BLANK furnished FREE by San Bernardino County, [illegible] to Ted R. Carpenter, County Recorder, San Bernardino, California. [illegible] Legislature amended laws regulating Recording Fees. When [illegible] Fees, Figure $1.00 for first page, not over 8½ x 14 inches, plus [illegible] for each additional page or fraction thereof.

For Recorder's Use Only.

BOOK 448 PAGE 690

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RECORDED
REQUEST OF
LOCATOR-OWNER

BOOK 448 PAGE 690
AUG 4 2 00 PM '64

MINING RECORDS
SAN BERNARDINO COUNTY, CALIF
Ted R Carpenter
RECORDER

INDEXED

MICROFILMED

PROOF OF LABOR

STATE OF CALIFORNIA,
COUNTY OF SAN BERNARDINO, } ss.

BEFORE ME, The subscriber, personally appeared William S. Hubbard

who, being duly sworn, says that at least One Hundred ($100.00) Dollars worth of labor and improvements performed or made upon each of the following claims (or a total of ..... Dollars)

Leviathan
Leviathan Extension No. 1
Leviathan Extension No. 2
Gryphean
Leviathan Lode Mining Claim #5
Greater Leviathan
Greater Leviathan #3
Greater Leviathan #4
Greater Leviathan #5
Greater Leviathan #6
Leviathan #6
Leviathan #7
Leviathan #8
Leviathan Tunnel Site
Leviathan Mill Site No. 1 and Dump Site
****

situated in vicinity of Calico or Belleville Mining District, San Bernardino County, State of California, during the period from September 1, 1963 to date, 19..... Such expenditures were made by, or at the expense of William S. Hubbard

691

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Note—1957 Legislature amended laws regulating Recording Fees. When computing fees figure $2.00 for first page, not over 8½ x 14 inches, plus cents for each additional page or fraction thereof.

For Recorder's Use Only.

BOOK 448 PAGE 689

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RECORDED
REQUEST OF
LOCATOR-OWNER

BOOK 448 PAGE 689
AUG 4 3 00 PM '63

MINING RECORDS
SAN BERNARDINO COUNTY, CALIF
Ted R. Carpenter
RECORDER

INDEXED
MICROFILMED

PROOF OF LABOR

STATE OF CALIFORNIA,
COUNTY OF SAN BERNARDINO, } ss.

BEFORE ME, The subscriber, personally appeared William S. Hubbard who, being duly sworn, says that at least One Hundred ($100.00) Dollars worth of labor and improvements performed or made upon each of the following claims (or a total of ..... Dollars)

Silver Bow Mine, Silver Bow No. 1 Tunnel Claim,
Silver Bow Annex, Silver Bow No. 2 Tunnel Claim,
Silver Bow Annexes 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24,
25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43,
44, 45, 46 **********

situated in vicinity of Calico or Belleville Mining District,
San Bernardino County, State of California, during the period from Sept 1, 19 63 to date, 19..... Such expenditures were made by or at the expense of
William S. Hubbard

owner of said claims for the purpose of holding said claims

690

This BLANK furnished FREE by San Bernardino County.
Return to Ted R. Carpenter, County Recorder, San Bernardino, California.
Note—1957 Legislature amended laws regulating Recording Fees. When computing fees figure $2.00 for first page, not over 8½ x 14 inches, plus 50 cents for each additional page or fraction thereof.

For Recorder's Use Only.

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BOOK 452 PAGE 607

RECORDED AT REQUEST
LOCATOR OWNER

'65 AUG 4 PM 4 01

BOOK 452 PAGE 607
MINING RECORDS
SAN BERNARDINO CO. CALIF.

Ted R. Carpenter
COUNTY RECORDER

MICROFILMED

781

PROOF OF LABOR

STATE OF CALIFORNIA,
COUNTY OF SAN BERNARDINO, } ss.

BEFORE ME, The subscriber, personally appeared William S. Hubbard **********

who, being duly sworn, says that at

least One Hundred ($100.00) Dollars worth of labor and improvements performed or made upon each of the following claims (or a total of Four Thousand ($4,000.00) Dollars)

Silver Bow Mine, Silver Bow No. 1 Tunnel Claim,

Silver Bow Annex, Silver Bow No. 2 Tunnel Claim,

Silver Bow Annexes 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46**********

situated in vicinity of Calico or Belleville Mining District,

San Bernardino County, State of California, during the period from Sept. 1, 1964 to

dated 1, 1965. Such expenditures were made by or at the expense of

William S. Hubbard**********

This BLANK Recorded FREE by San Bernardino County.
Return to Ted R. Gasparoni, County Recorder, San Bernardino, California.
1957 Legislature amended Govt. Code regulating Recording Fees. When recording less than $5.00 for first page, not over 8½ x 14 inches, plus $1.00 for each additional page or fraction thereof.

For Recorder's Use Only

780 BOOK 452 PAGE 606

RECORDED AT REQUEST
LOCATOR-OWNER

'65 AUG 4 PM 4 01

BOOK 452 PAGE 606
MINING RECORDS
SAN BERNARDINO CO. CALIF.

Ted R. Gasparoni
COUNTY RECORDER

INDEXED

MICROFILMED

PROOF OF LABOR

STATE OF CALIFORNIA,
COUNTY OF SAN BERNARDINO, } ss.

BEFORE ME, The subscriber, personally appeared William S. Hubbard

who, being duly sworn, says that at least One Hundred ($100.00) Dollars worth of labor and improvements performed or made upon each of the following claims (or a total of $1500.00 Dollars)

Leviathan
Leviathan Extension No. 1
Leviathan Extension No. 2
Oryphean
Leviathan Lode Mining Claim #5
Greater Leviathan
Greater Leviathan #3
Greater Leviathan #4
Greater Leviathan #5
Greater Leviathan #6
Leviathan #6
Leviathan #7
Leviathan #8
Leviathan Tunnel Site
Leviathan Mill Site No.1 and Dump Site

situated in vicinity of Calico or Belleville Mining District, San Bernardino County, State of California, during the period from Sept. 1, 1964 to date, 19__ Such expenditures were made by or at the expense of William S. Hubbard

780

BOOK 458 PAGE 435

509 For Recorder's Use Only

RECORDED AT REQUEST
LOCATOR - OWNER

BOOK 458 PAGE 435

'66 AUG 10 PM 4:00

MINING RECORDS
SAN BERNARDINO CO. CALIF.

Ted R. Carpenter
COUNTY RECORDER

MICROFILMED

INDEXED

2.00/R

Recorded at the request of:

William S. Hubbard

When recorded please mail to:

Name William S. Hubbard

Street 175 West Fifth Street
Civic Center Building

City San Bernardino, California

State

PROOF OF LABOR

STATE OF CALIFORNIA,
COUNTY OF SAN BERNARDINO, } ss.

BEFORE ME, The subscriber personally appeared William S. Hubbard**********
********** who, being duly sworn, says that at least One Hundred and 00/100 Dollars worth of labor and improvements performed or made upon each of the following claims (or a total of Fifty Five Hundred ($5500.00) Dollars)

Silver Bow Mine, Silver Bow No. 1 Tunnel Claim, Silver Bow Annex,
Silver Bow No. 2 Tunnel Claim,
Silver Bow Annexes 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24,
25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43,
44, 45, 46.
Leviathan, Leviathan Extension No. 1, Leviathan Extension No. 2, Oryphean,
Leviathan Lode Mining Claim No. 5, Greater Leviathan, Greater Leviathan #3,
Greater Leviathan #4, Greater Leviathan #5, Greater Leviathan #6, Leviathan #6,
Leviathan #7, Leviathan #8, Leviathan Tunnel Site, Leviathan Mill Site No. 1 and Dump Site

situated in vicinity of Calico or Belleville Mining District,
San Bernardino County, State of California, during the period from September 1st, 1965 to September 1st, 1966
Such expenditures were made by or at the expense of William S. Hubbard

owner of said claim & for the purpose of holding said claim

APPLICANT'S RIGHTS IN LAND

All mineral and land rights are owned by the applicant and none of these rights are encumbered as stated in Item #2-a.

RE: Item #3-a

PHYSICAL DESCRIPTION

The Silver Bow Mine is an old and well known property. It was not sufficiently developed before the bottom fell out of the silver market to become an important producer. It was not located until 1890 due to a post mineral agglomerate flow covering most of the vein along its strike.

Included as a supplement to this section are maps showing the location of the mine and the topography of the area.

Also included are mappings of the Silver Bow workings. These show work completed prior to 1958 and work which the operator has done subsequently.

The production facilities at present consist of a 325' double compartment incline shaft with tunnels at varying levels as shown on the enclosed engineering drawings. The mine is fully equiped, and a list of the equipment is included as an appendix to section 7-d.

I am enclosing published data discussing the general and specific geology.

PAGE 102 & 106 VOLUME 49, NOS 1 & 2
JAN-APRIL 1953 ISSUE OF CALIF JOURNAL OF MINES & GEOLOGY

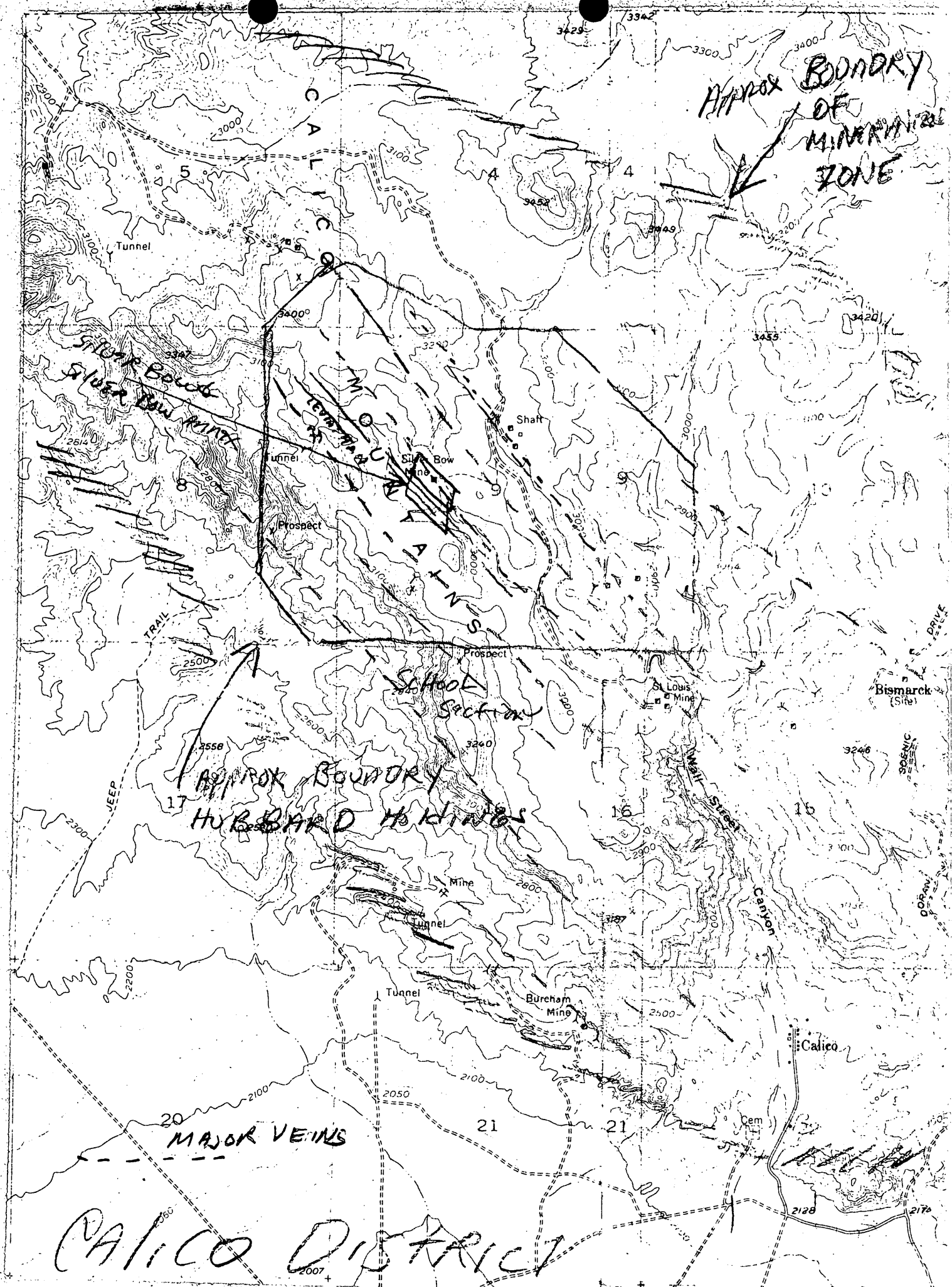
SILVER (Cont.)

MAP NO.	CLAIM, MINE, OR GROUP	OWNER NAME, ADDRESS	LOCATION SEC.	T.	R.	B & M	REMARKS
332	Santa Fe (Wortley Consolidated Mines Co.)	Worley Consolidated Mines Co., San Fernando (1943)	6	30S	41E	MD	Randsburg area. Two vertical shafts; the Santa Fe 1230 ft. deep, and the Silver Queen 1200 ft. deep passed from Rosamond sandstone into Rand schist at 850 ft. Levels at 935,1000,1100 and 1200 ft. totaled 7575 ft. in 1930. Encountered Antimony and Schist veins. Schist vein reported to average 19.36 oz. silver and 0.13 oz. gold per ton. Active in the period 1927-1937. (Hulin 25:134; Tucker 30:282,287-288; 31:355,360-361; 43:487, pl.7.)
333	Silver Bell (Silver Belle)	Silver Bell Mining Co. (1925)	6	30S	41E	MD	Randsburg area. Vertical shaft 700 ft. deep; workings on 500- and 700-ft. levels total over 700 ft. in length. All workings in Rand schist. Several siliceous veins encountered. (Hulin 25:141; Tucker 23:169; 30:283; 31:356.)
	Silver Belle						See Silver Bell.
334	Silver Bow	HUBBARD ~~J.F. Reber, 3125 Arrowhead Ave., San Bernardino~~	9	10N	1E	SB	Calico district, northwest end, adjoining Leviathon mine. Moderately dipping vein 3 ft. wide carries silver-lead ore in barite gangue; faulted off at lower levels. Explored by 230-ft. inclined shaft (50°) and 500 ft. of drifting. Several carloads of ore, from exploration work prior to 1925, reported to average 100 ozs. of silver per ton. Production undetermined. Idle.
335	Silver Contact	HUBBARD ~~B.F. Hodges, Yermo~~	9	10N	1E	SB	Calico District, northwest end. Barite vein in tuffaceous andesite [illegible] near agglomerate neck. Exposed by steeply inclined shaft more than 150 ft. deep. Second shaft 200 yds. north inclined 55° for 65 ft. Follows bedding in tuff. Production undetermined. Idle.
	Silver Giant	Silver Giant Mining Co. (1925)	32	29S	41E	MD	Randsburg area. Vertical prospect shaft, 60 ft. deep, in Tertiary sedimentary rocks. No ore encountered. (Hulin 25:141-142; Tucker 30: 284; 31:357.)

SILVER (Cont.)

MAP NO	CLAIM, MINE OR GROUP	OWNER NAME, ADDRESS	LOCATION SEC.	T.	R.	B & M	REMARKS
	Kelly Hard Extension		6	30S	41E	MD	Prospect in Randsburg area. Vertical shaft, 625 ft. deep, with 80 ft. of crosscuts at 600 ft. level. No ore encountered. (Hulin 25:136; Newman 23:104; Tucker 30:279; 31: 351.)
320	Lamar	J. Mulcahy, 998 14th St., San Bernardino	16,17	10N	1E	SB	Calico district. Adjacent to Waterloo. See in discussion of west group herein.
321	Langtr.	H. Britt and Walter Alf, Daggett	7,8	10N	1E	SB	Calico district. See in discussion of west group herein. (Crawford 96:607; Storms 93:338,343.)
322	Leviathan	~~H. Britt, Daggett~~ HUBBARD	8,9	10N	1E	SB	Calico district northwest end. Series of parallel veins up to 50 ft. wide in zone several hundred feet wide, traceable over 2000 ft. along strike on surface. Silver in barite-jasper gangue, with abundant iron oxides. Large tonnage of barite visible. Explored by 4 adit levels having 1500 ft. of workings and two winzes, and by shafts over 100 ft. deep having stopes open to the surface. Production undetermined. Long idle.
	Little Jack		7	30	41E	MD	Prospect in Randsburg area. (Hulin 25:144; Tucker 30:279; 31:352.)
	Lode Star						See Lone Star.
323	Lone Star (Lode Star)	J.B. Mulcahy, 998 14th St., San Bernardino	15	10N	1E	SB	Calico district. One of mines in upper Wall Street Canyon. (Tucker 21:pl.6.)
324	Lucky Jim	Mrs. James Menter, P. O. Box 892, Hollywood	30 25	6N 6N	18E 17E	SB SB	East slope Old Woman Mts. Quartz vein 4 ft. wide, in granite contains chlorides and bromides of silver, chalcopyrite and small amounts of argentite and ruby silver. Developed by over 1200 ft. of workings including a 200-ft. shaft, 500 ft. cross-cut and over 300 ft. of drifts. Reported $35,000 production when mine was active from

Southern Calif
Auto Club Map
Bernardino County
Superior Dry Lake
Paradise Spr.
Jack Spr.
Langford Well
Coyote Dry Lake
Coyote Well
Alvord Mtn.
Alvord Well
Calico Pk.
CALICO MTNS.
Mule Can.
Sand City
Harvard Hill
HARPER DRY LAKE
WATER VALLEY
Lockhart P.O.
The Buttes
Red Hill
Lynx Cat Mtn.
Hinkley
HINKLEY VALLEY
Kramer Hills
HAWES AUXILIARY AIRPORT
Barstow
Lenwood
Hodge
RILEY AIRPORT
Yermo
Calico Dry Lake
Mojave
Daggett
Gale
Toomey
Black Butte
Newberry
Newberry Mtn.
Troy Dry Lake
NEWBERRY MOUNTAINS
AZUCAR MINE
Lava Flow
Kane Spr.
STODDARD VALLEY
Stoddard Tank
Stoddard Well
STODDARD RIDGE
UPPER VALLEY
LUCERNE
Helendale
Oro Grande
SIDEWINDER VALLEY
Sidewinder Well
SIDEWINDER MTN.
Victorville
FAIRVIEW VALLEY MTNS.
APPLE VALLEY
Apple Valley
Dry Lake
Aztec Spr.
Willis Well
ORD MTNS.
COLD BELT MINE
GRANDVIEW MINE
RILEY MINE
RED HILL MINE
CAMP ROCK MINE
RODMAN MTNS.
HANEY & LEE MINE
SILVER BELL MINE
BLACK BUTTE MINE
Dry Lake
Fry Mountain
GRAVEL PIT
D
O
J
M


APPROX BOUNDRY OF MINERALIZED ZONE
CALICO MOUNTAINS
Silver Bow Mine
Silver Bow Mine
Tunnel
Shaft
Prospect
Prospect
St Louis Mine
Bismarck (Site)
SCHOOL SECTION
APPROX BOUNDRY HUBBARD HOLDINGS
Wall Street Canyon
Mine
Tunnel
Tunnel
Burcham Mine
Calico
Cem
MAJOR VEINS
CALICO DISTRICT
JEEP TRAIL
SCENIC DRIVE

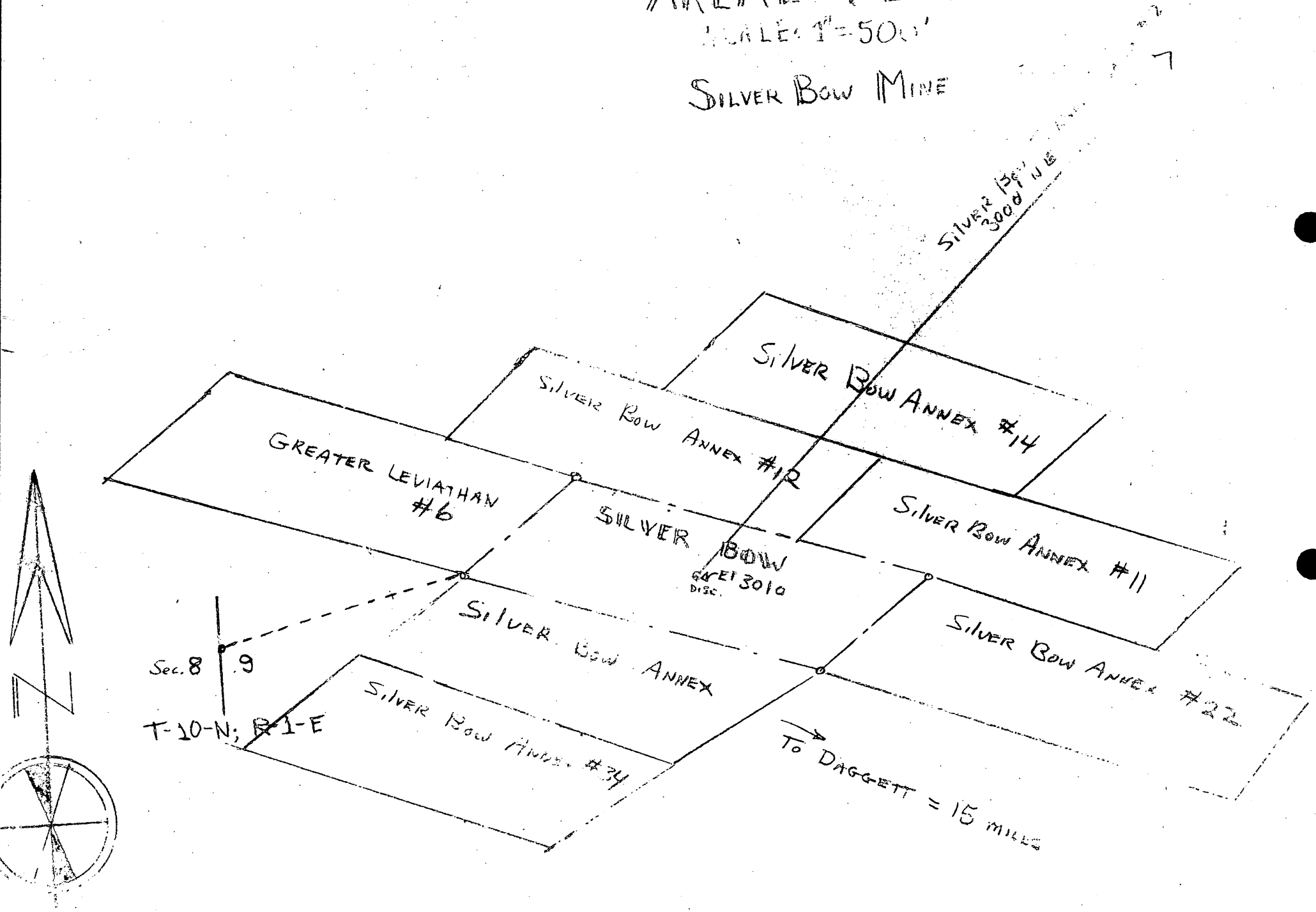
3200
3200
Shaft
Silver Bow
Mine
Silver Bow Vein
3000
3100

RE: ITEM 3.a.

AREAL PLAN

SCALE: 1" = 500'

SILVER BOW MINE



RE: Item #3-b

PHYSICAL DESCRIPTION

The applicant is the sole owner of the operation described in Item #3-a.

RE: Item #3-c

PHYSICAL DESCRIPTION

Enclosed herewith is an extract from page 106, Vol. 49, January-April, 1953 issue of the California Journal of Maines and Geology. It says, "several carloads of ore, from exploration work prior to 1925, reported to average 100 ounces of silver per ton." I am inclined to think that the ore shipped came from enriched zones and pockets in the vein. I have encountered several enriched zones near calcitic encrusted "old water courses" that ran 50-100 ounces per ton (see assays in 3g).

I am enclosing appropriate copies of State of California Mineral Information Service which indicates the Silver Bow to be one of the principal interesting silver properties in the area.

The scope of my operations at the Silver Bow can be summarized as follows:

1958 - Acquired property, installed skidways, headframes, and put the mine in operating condition. Commenced drifting on 150' level.

1959 - Sold several hundred tons crude gangue material (harite and waste) to Calada Materials Company and Oil Base, Inc. Handcobbed several tons of highgrade steel galena with good silver content and sold to Knott's Calica Ghost Town for resale as specimen silver ore.

1960 - Sold several hundred tons gangue waste to Oil Base, Inc.

1961 - Produced several hundred tons from development work (drifting on 200' level). Sold gangue and waste of silver-lead ore to Selby.

1962 - Leased the mine to Flo-How Oil Company for several months. They did some minor exploratory work.

1963 - Drifting operation continued by the undersigned on the 200' level to the West.

1964-1965 - Continuing drift on 200' level to the West.

1966 - Continuing drift on 200' level to the West to date.

is uncertain. These potash-rich rocks range in composition, and generally decreasing age, from dark biotite shonkinite through several varieties of syenite to granite. They are cut by andesitic dikes that are probably Tertiary.

The biotite shonkinite is composed of potash feldspar and more than 50 percent dark minerals. The dark mineral is mostly biotite, but augite and hornblende are common; and aegirine and soda-amphiboles, such as riebeckite, indicate alkaline affinities.

The syenites range from rocks that are nearly all potash feldspar to some that are rich in biotite, hornblende, or augite, approaching shonkinite in composition. The granite contains potash feldspar and as much as 30 percent quartz, minor sodic plagioclase, and very little biotite or other dark minerals. The rocks intermediate in composition between shonkinite, syenite, and granite, together with the wide distribution of all the varieties throughout the district, suggest their derivation from a common magmatic source.

Of the seven larger intrusives, the two nearest U. S. Highway 91 are potash syenites, with two or three percent quartz; the southeasternmost is red granite; and the other four are composite shonkinite-syenite bodies. These intrusives appear to dip southwest at moderate to steep angles. The thinner dikes, mostly two to ten feet thick, are numbered in the hundreds, and they include types from shonkinite through syenite to granite. Relations between these dike rocks throughout the district clearly demonstrate the age sequence from shonkinite, the oldest, to the lighter-colored syenites, and then the granites, followed by a few dark dikes that are referred to as lamprophyre. The lamprophyre resembles shonkinite in composition, but it is mostly fine grained except for phenocrysts of biotite. The intrusion of these dike rocks was followed by shearing by emplacement of the carbonate rocks and veins, and deposition of minerals along shear zones.

Carbonate rocks and veins are most abundant near the south and west margins of the large shonkinite-syenite body north of U. S. Highway 91, in both the intrusive and the adjacent pre-Cambrian gneiss. They are also found south of the highway, chiefly in areas where shonkinite, syenite, or granite dikes occur. The carbonate rocks are composed chiefly of calcite, dolomite, barite, and quartz. Bastnasite has been found in many of them, from the original discovery near the Mocam shaft near the north end of the district, as far south as the Windy prospects. Abnormal radioactivity found in prospects about a mile southeast of the Windy prospects indicates that the same type of mineralization extends to the southeast corner of the mapped area.

Most of the carbonate-barite-quartz veins shown on the map are one to six feet thick. They cut across the pre-Cambrian foliation and all the potash-rich dike rocks. Some appear to have been emplaced in fractures in the shonkinite-syenite intrusives. The large barite-carbonate mass near the Sulphide Queen mine is similar in general composition to the thinner veins, containing several carbonate minerals, chiefly calcite and dolomite; barite; the fluo-carbonates bastnasite and parisite; quartz; crocidolite; barite; apatite; monazite; galena; magnetite; fluorite; and other minerals. The carbonate rock in this large mass is foliated, locally contains breccia fragments of several types of older rock, and is discordant to the pre-Cambrian structure. These features, together with the wide distribution of the carbonate veins and their close association with the potash-rich dike rocks in the district, suggest that the materials forming the carbonate rocks were probably derived largely from the same magmatic source that supplied the alkalic dike rocks; but the nature of the fluids transporting the rare constituents is not yet understood.

Dikes, chiefly of andesite, and a few of felsite (rhyolite?), cut across the potash-rich dikes and the carbonate rocks. The andesitic dikes occur in swarms in four principal areas in the district and appear to have been emplaced in fractures formed distinctly later than the alkalic dike rocks and carbonate rocks. In general, the andesitic dikes have an easterly trend in contrast to the northwesterly trend of the alkalic dikes.

Unconsolidated gravels and alluvium, derived from rocks within the district, from Clark Mountain, and from the Mescal Range, have accumulated to considerable thickness near Mountain Pass and U. S. Highway 91. Ridges with several hundred feet of relief have been formed by the dissection of these unconsolidated materials. The gravels probably obscure some rare-earth mineral deposits."

Silver

Most of the silver now produced in San Bernardino County is obtained from ores mined primarily for lead and zinc. However, in two districts, Calico and Randsburg, and at several scattered mines, exist

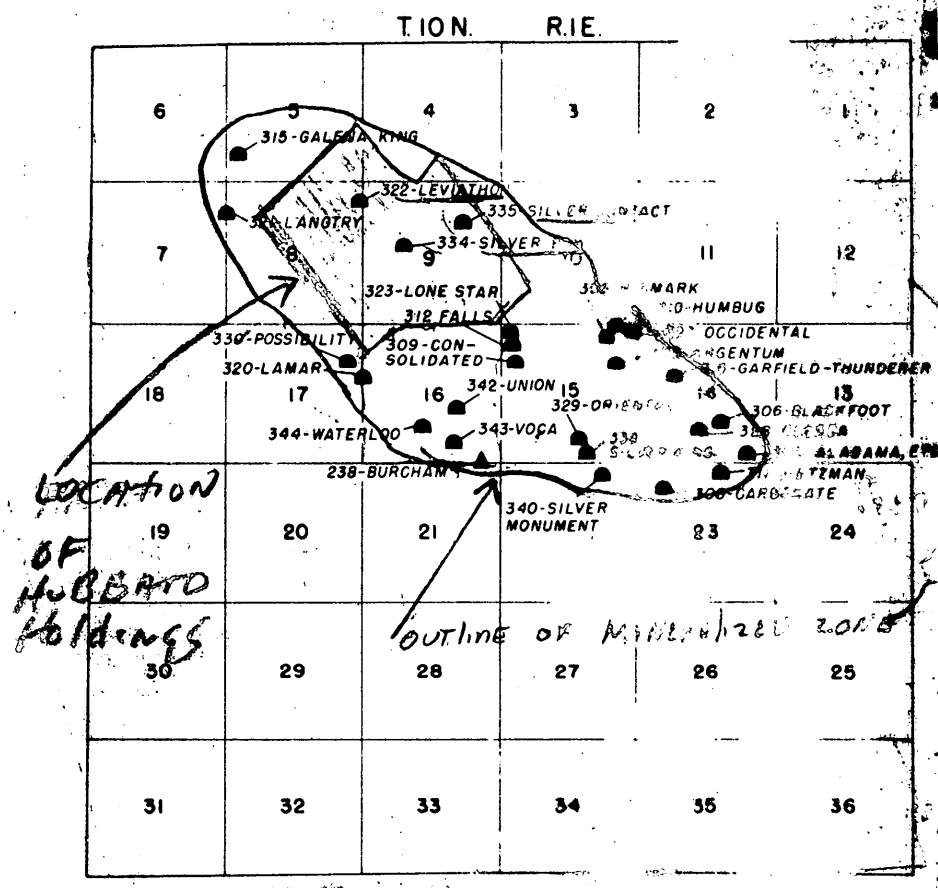


FIGURE 13. Plat of Township 10 North, Range 1 E., showing [illegible] principal mines in the Calico [illegible]

deposits in which silver is the only sign[illegible] metal. [illegible]sits near Randsburg and Calico, described bel[illegible] have been [illegible]standing sources of silver in California, but are [illegible]ally [illegible]

Only when these deposits were m[illegible] 1883-8[illegible] Calico, and 192[illegible]5 for Randsburg, did the annual silver output of San Bernardino County exceed $1,000,000. The annual output has not exceeded $100,000 since [illegible] in 1950 it had declined to less than $12,000 or about 0.03 per cent of the county's total mineral production.

Calico District

One of the most productive and colorful groups [illegible] in California is [illegible] Calico district about 10 miles northeast [illegible] During the period 1882-1896 these mines yielded silver ore with a total value estimated variously at 13 to [illegible] million dollars.[122] Rich silver ore was dis-

[illegible] statistics [illegible] Bernardino County [illegible] by Tucker, W. [illegible] R. J. Mineral [illegible] of San [illegible] County: California [illegible] the per[illegible] an output valued [illegible] ta, inclu[illegible] D., and Gardner, [illegible] the Co[illegible] San Bernardino [illegible] Calif[illegible] [illegible] 1940, cite a $20,-[illegible] figure.

covered in 1881; most of the larger deposits of the district were opened in the following year. The first output was hauled 40 miles to Oro Grande, but mills were soon installed at Calico and Daggett.

Following the bonanza operations of the first few years, mining activity was strongly influenced by fluctuations in the price of silver. In the period 1883-85 San Bernardino County yielded nearly 6 million dollars in silver, about 85 percent of the state's total, and obtained mostly from the Calico district. In 1890, at the peak of activity, mills totaling 150 stamps were treating the ores, and about 700 men were employed in the mines and mills. The monthly output of bullion was valued at about $200,000. By 1892, however, diminishing production forced the closing of two mills, one with 60 stamps, the other with 15 stamps, both at Daggett. A 30-stamp mill owned by the Silver King Mining Company remained in operation at Calico until 1896.

The drop in the price of silver from $1.13 per ounce in 1894 to 57 cents in 1896, together with the exhaustion of the known high-grade bodies, led to virtual cessation of mining. Several factors, including the richness of the ores, the belief that the bodies were shallow, and the unrestricted activities of lessees, led to improper mining practices at many of the properties. The leasing was of the type commonly known as "chloriding" in which only high-grade ores are sought and methods are unsystematic. Ore mined by lessees was treated at a custom mill, the claim owner receiving one-sixth to one-fourth of the return.

Since 1896 the district's operations have been done mostly by lessees, and have been intermittent and on a small scale. In 1920 the Zenda Company started a deep exploration program in the Silver King-Oriental properties, but this and similar projects at several other properties have produced very little ore. The falling price of silver in 1932 discouraged further exploration of the district, although the Burcham mine, a gold property, continued active until 1941. Operations in the district were very minor in 1952. Of interest, however, is a current project aimed at restoration of the old townsite of Calico as a "ghost town" of historical interest to tourists.

The Calico Mountains, which contain the Calico silver mines, are composed essentially of volcanic rocks and lake deposits, both of Tertiary age,[123] which rest upon a crystalline pre-Tertiary basement, unexposed in the silver-bearing areas. The Tertiary is broadly divisible into three units. The lower part, 3000 to 4000 feet thick and probably of Miocene age, is composed of massive tuff, tuff breccia, agglomerate, rhyolite, dacite, and andesite. Resting conformably upon the lower unit is a 1300-foot thickness of lake beds, with a subordinate fraction of volcanic rocks. It includes shale, sandstone, cherts, travertine, tuff, as well as the Calico borax deposits noted in a section to follow. This middle unit, believed to be of upper Miocene age, is, in turn, overlain with marked unconformity by Pliocene (?) ash 200 to 500 feet thick. The Miocene rocks are moderately deformed

[123] Geologic data in this section were obtained from the following references: De Leon, J. L., Geology of the Calico mining district, unpublished thesis, University of California, 1950; Erwin, H. D., and Gardner, D. L., Notes on the geology of a portion of the Calico Mountains, San Bernardino County, California: California Div. Mines Rept. 36, pp. 293-304, 1940; Lindgren, Waldemar, The silver mines of Calico, California: Am. Inst. Min. Eng. Trans., vol. 15, pp. 717-734, 1887; Storms, W. H., San Bernardino County: California Mining Bur., Rept. 11, pp. 337-345, 1893

The silver deposits exist in various sedimentary and volcanic members of the Miocene units, and are associated with tensional faults. The deposits are roughly divisible into two types: (1) those lying within or near prominent faults or fractures, and (2) those occurring as shallow, pockety disseminations.

Both types are characteristically shallow, although the veins, which are composed mostly of barite, commonly do continue below the known silver mineralization. The deepest workings are 550 feet beneath the surface; few mines exceed 200 feet in depth. Deep exploration has been hampered by water flowage, and the swelling of tuffs when exposed to water.

The silver-bearing veins consist chiefly of chlorides and chlorobromides of silver in a gangue of barite and jaspery silica. Coatings of cerargyrite and embolite are abundant. Also present are galena, sphalerite, minor proportions of chalcopyrite, and traces of gold. Barite commonly forms as much as 95 percent of the vein material.

The average value of the Calico ores was 10 to 20 ounces of silver per ton, but high-grade pockets of cerargyrite or native silver yielded ore valued at as much as $2000 per ton.[124] Ore valued below $30 a ton was considered low-grade.[125]

The mines of the Calico district[126] are disposed within an area about 5 miles long by 2 miles wide that trends northwestward. Larger mines are confined to three areas within the belt. The central group, lying within a mile northwest of the Calico townsite, includes the Silver King-Oriental and Falls (Sioux) mines in the vicinity of Wall Street Canyon. The east group, northeast of the townsite, includes the mines of the Calico-Odessa group in the vicinity of Bismarck and Odessa Canyons. The west group contains the Burcham, Langtry, Union, and Waterloo properties.

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[124] De Leen, J. L., op. cit.

[125] Lindgren, Waldemar, op. cit., p. 730.

[126] The following descriptions of the history, geology, and mines of the Calico district are largely summaries of information obtained from the following references:

Cloudman, H. E., Huguenin, E., and Merrill, F. J. H., San Bernardino County: California Min. Bur. Rept. 15, pp. 823-826, 1919.

Crawford, J. J., Mines and mining products of California: California Min. Bur. Rept. 12, p. 376, 1894.

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De Groot, H., San Bernardino County—its mountains, plains, and valleys: California Min. Bur. Rept. 10, pp. 530-531, 1890.

De Leen, J. L., Geology of the Calico mining district: unpublished thesis, University of California, 1950.

Erwin, H. D., and Gardner, D. L., Notes on the geology of a portion of the Calico Mountains, San Bernardino County, California: California Div. Mines Rept. 36, pp. 293-304, 1940.

Goodyear, W. A., San Bernardino County: California Min. Bur. Rept. 8, pp. 504-511, 1888.

Irelan, William, California Min. Bur. Rept. 8, San Bernardino County, pp. 491-499, 1888.

Lindgren, Waldemar, The silver mines of Calico, California: Am. Inst. Min. Eng. Trans., vol. 15, pp. 717-734, 1887.

Storms, W. H., San Bernardino County: California Min. Bur. Rept. 11, pp. 337-348, 1893.

Tucker, W. B., Los Angeles field division, San Bernardino County: California Min. Bur. Rept. 17, pp. 362-365, 1921.

Tucker, W. B., and Sampson, R. J., Los Angeles field division, San Bernardino County: California Div. Mines Rept. 26, pp. 271-291, 1930.

Tucker, W. B., and Sampson, R. J., San Bernardino County: California Div. Mines Rept. 27, pp. 343-345, 1931.

Tucker, W. B., and Sampson, R. J., Current mining activity in southern California: California Div. Mines Rept. 36, pp. 33-82, 1940.

Tucker, W. B., and Sampson, R. J., Mineral resources of San Bernardino County: California Div. Mines Rept. 39, pp. 475-492, 1943.

Central Group. The Silver King mine, just north of the Calico townsite, was one of the first and most productive operations in the district and had probably the longest and most successful operating history. Several other mines, adjacent to the Silver King and on the Kings vein system, were operated with it as a group by the Silver King Mining Company. One of the most significant of these was the Oriental mine; the two have been commonly referred to collectively under the name Silver King and Oriental. Other claims in the group include the Wall Street, Red Cloud, Oregon, Josephine, and Burning Moscow. A total of 35 claims were held in 1931.

The two main veins in the Kings vein system, the Oriental and Silver King, strike northwest and dip from vertical to 70° SW. The system, which is traceable for 2 miles on the surface, branches to the north and converges into a mass of crushed and mineralized rock to the southeast. In general, the veins range from 2 inches to 2 feet wide, and have well defined walls. At the southeast end of the system intensive brecciation obscures the limits of the veins. The ore persistently consists of chlorides and chlorobromides of silver in a gangue of barite and jaspery silica. Cerargyrite and embolite occur mostly as thin coatings in cracks and joints, but also are disseminated in barite. Manganese oxides are common. High grade lenses of almost solid cerargyrite valued at thousands of dollars per ton were not uncommon. The value of ore was invariably found to decrease with depth, although the barren vein continued downward. In the deep development workings the veins were found to contain chalcopyrite, tetrahedrite and pyrite.

Mine workings are very extensive. The three principal workings on the mineralized zone, the Silver King, Oriental, and Red Cloud mines, are connected at numerous places. The veins were originally worked through an inclined shaft 500 feet deep. A series of crosscut tunnels on the 4th, 6th 7th, 8th, and 9th levels connected with the Oriental mine workings. About 6000 feet of drifts and cross-cuts completed the workings during this stage. In 1926 the Zenda Gold Mining Company acquired the property and completed 815 feet of diamond drill exploration. In the operation that followed, two vertical shafts were sunk about 550 feet apart, and 340 and 530 feet deep; level work was brought to a total of at least 12,000 feet.

First opened in 1881, the Silver King and Oriental group operated continuously until 1893 when silver fell to 78 cents an ounce. During the four years 1883 to 1886 the mine yielded 37,000 tons of ore with a gross value of $1,355,000 or $36.61 per ton in silver. As recently as 1931, when the property was held by the Zenda Company, 47 men were employed. The latest production from the mine was in 1930 when two carloads of ore valued at $15,000 were shipped. From 1936 to 1941 a moderate quantity of silver was produced from remilling old tailings. In 1950 four claims of the Zenda holdings that included the old Calico townsite, were sold to the owners of Knott's Berry Farm, a restaurant in Buena Park, California. Calico is currently being restored as a historical attraction. Water is pumped from the deep shaft, now flooded to the 320 level, for this venture. No mining is contemplated.

On the west side of upper Wall Street canyon is a group of workings lying along a northwest extension of the fault system at the Silver King mine. The area is underlain mainly by andesite and acidic agglomerate

tuff and flows. These rocks are cut by mineralized fissures striking N. 25° W. and dipping 75° to 85° NE. The veins contain barite and jasper abundantly stained with iron oxides. The veins are closely spaced and free of breccia.

The Falls mine appears to have been the most extensively worked in this area; remnants of a mill remain on the property. The mine workings, high on the precipitous west wall of the canyon, are mostly confined to a zone about 100 yards wide and one-quarter of a mile long. They consist of various open stopes, shafts, and adits, and have exposed four or five veins. The easternmost vein has been extensively mined for over 500 feet of its exposed length and to depths of 300 feet.

The Consolidated (formerly St. Louis) mine, southeast of the Falls mine, has a similar geologic setting. The property is developed by about 500 feet of workings which follow six closely spaced veins.

East Group. The Calico-Odessa group consists of numerous mines rather widely distributed in an area about 2 miles northeast of Calico, mainly between Bismarck and Garfield Canyons. Included are mines formerly belonging to the Odessa group (Dragon, Dunderberg, Gobbler, Little Jane, and Odessa) and the Occidental group (Argonaut, Bismarck, Boss, Cleveland, Garfield, Invincible, Occidental, Runover, Thunderer and Veto) as well as other properties such as the Baltic, Blackfoot and Humbug. From time to time the mines now comprising the Calico-Odessa group have been organized differently. Consolidation followed the period of maximum activity.

The deposits developed by the Odessa mine are on the west wall of Garfield Canyon. Like those at the nearby Garfield-Thunderer mine, they exist in rhyolite tuff as impregnations along a zone of porous rock. The deposits are richest where the zone is cut by several faults which trend northwest and dip moderately to steeply southwest. The ore occurred in irregular pockets some of which were unusually large. The ore minerals include chlorides and chlorobromides of silver and traces of malachite and chrysocolla. The average grade of the ore was probably the highest of any silver mine in the Calico district, but it was removed rapidly and unsystematically. The mine was idle by 1896. The Odessa workings include a main tunnel driven 600 feet northwest along the main fault, two lower tunnels 150 and 200 feet long, and several inclined winzes as much as 100 feet long.

The Garfield or Garfield-Thunderer mine is on the west slope of Garfield Canyon. The Garfield claims are bordered on the west by the Thunderer and Veto properties which are, in turn, bordered on the west by the Occidental property. All are commonly referred to under the collective name "Garfield-Thunderer group." The ore bodies occur in massive rhyolitic tuff and lie near the Garfield fault which strikes west-northwest, dips steeply south, and extends westward to the Occidental and Humbug properties. A few ore bodies were found along the fault but most formed south of the fault in breccia zones and numberless, irregular fissures. The bodies are very irregular and as much as 40 feet wide. They contain cerargyrite, embolite, and minor chrysocolla in a barite gangue.

The mine was opened by short adits driven from the canyon wall. Later, two tunnels, one 100 feet above the other, were driven along the fault; the lower tunnel is 4,000 feet long, the upper tunnel is 2,500 feet long. Much of the ore was mined from two chambers, 200 and 300 feet long, 40 feet

wide, one in each tunnel. The lower tunnel cuts through the Cleveland, Garfield, Occidental No. 1, Runover, Thunderer, and Veto mines. No timber was required.

The Garfield mine was opened in December 1882; by the following April, two men had produced 11 tons of ore which yielded $5,885. Six men employed in the month of July shipped 33 tons of ore that yielded $26,440, and 233 tons that yielded $30,756. In September, 96 tons yielded $8,736 and nine tons yielded $7,200, or about 800 ounces per ton. The output from November 1883 through 1884 included 2400 tons of ore that yielded $290,400, as well as other ore not recorded. The mine was still active in 1896.

The Bismarck and Humbug mines are on a divide between the head of Bismarck Canyon and a branch of Wall Street Canyon. Here silver minerals occur along a major fault zone which strikes N. 17° W., and dips about 30° W. The zone, which can be traced to the southeast for at least a mile, separates andesite on the hanging wall from sandy tuff on the footwall.

The Bismarck ore bodies occur along a well striated plane in the fault zone. The ore was mined from shallow, irregular barite-rich masses eight inches or less wide. The Humbug workings lie about 20 to 30 feet to the east. Here silver minerals were found in barite-free disseminations at depths of less than 30 feet. On both properties cerargyrite is the principal ore mineral and is accompanied by a minor proportion of chrysocolla.

Several inclined shafts and irregular stopes, no more than 100 feet in maximum depth, comprise the Bismarck workings. The Humbug deposit was mined mainly by an open pit 30 feet or less deep. These mines have probably not been in operation since 1892.

The Blackfoot mine is on the east side of Garfield Canyon about half a mile southeast of the Garfield mine in an area underlain by andesite. The ore bodies exist as shallow deposits along a fault that strikes west-northwest and dips about 50° to 75° NW. The ore minerals are cerargyrite and subordinate lead carbonate in a jasper gangue. Ore shoots, mostly in the hanging wall of the fault, were generally six to 10 inches wide, and 300 to 400 feet long. Ore also existed as stringers in the hanging wall. Although the fissure was explored below the ore bodies, only barren jasper gangue was found at depths greater than 75 feet.

Southwest of the vein are three groups of irregular zones in which silver minerals impregnate rhyolitic tuff. The deposits follow gently dipping bedding planes in the tuff and have no apparent relation to the fissures. Chloride minerals were formed in seams and streaks in the tuff but did not continue in economic concentrations deeper than 30 feet below the surface.

West Group. The Langtry, the westernmost of the Calico mines, is in the lake sediments low on the range front about 3 miles northwest of Calico. The country rock, a sequence of nearly horizontal mud shales and argillaceous sandstones, is cut by the silver-bearing veins. This property, never an important producer, is notable because its ore bodies, unlike the others of the Calico district, are simple fissures in rock that shows little brecciation or fracturing. Two veins, 60 feet apart at the surface, strike northwest, and dip steeply toward each other. Their width ranges from a fraction of an inch to more than 10 feet on the north vein, and averages 3 or 4 feet. The veins are filled chiefly with coarsely crystallized barite

with quartz, containing iron and manganese oxides, lead carbonate and silver chlorides. The ore is reported to have averaged from 6 to 22 ounces of silver per ton.[127] Development work consists of about 250 feet of workings, including a 50-foot winze, from which about 200 tons of ore has been mined.

The Waterloo mine is the largest of the group that lies about one mile west of Calico. During its most active period the mine supplied two stamp mills operated in Daggett by the mine owners. The Waterloo was opened in 1881, was most productive in the 1880's and was being operated on a small scale in 1896.

The ore bodies lie along a fault zone separating lake beds and volcanic rocks. The zone strikes westward to northwestward, and dips moderately north. The mineralized zone has been followed laterally for about 1100 feet, down-dip for about 525 feet, and through thicknesses that range from 4 feet at the east end to as much as 70 feet at the west end. The ore bodies were irregular masses composed of chlorides and chlorobromides of silver in a barite-jasper gangue. The ore is reported to have averaged from 11 to 20 ounces of silver per ton, but some shipments assayed as high as 1000 ounces.

The Waterloo mine workings total about 10,000 feet in length. These center about a 350-foot shaft with 7 levels at 50-foot intervals. The level workings consist mostly of drifts. In 1950 work had begun on a 540-foot extension of the 7th level intended to intersect a downward extension of the principal vein at the Union mine nearby.

The Voca mine is adjacent to and east of the Waterloo. It is in line with the strike of the Waterloo vein, but the workings have not encountered an extension of this vein. Unlike most of the ore bodies of the district, those at the Voca mine have a siliceous gangue; barite is comparatively rare. Most of the mining was done before 1888. During much of its active period the mine daily yielded 10 to 15 tons of ore averaging 40 ounces of silver per ton, but the total output was small.

Northwest of the Waterloo along the same zone are the Prosperity (Possibility) and Lamar workings. These are in lake beds which here strike north 30° W. and dip 15° NE. Workings are chiefly short adits and irregular stopes along a fault zone several hundred feet wide, and half a mile long. The workings are all near the surface, and in the clays and shales. A vertical range of possibly 200 feet exists between the uppermost and lowermost workings.

The Union mine is a small operation about one mile west of Calico townsite and immediately north of the Waterloo mine. It consists of workings driven along a vein in a fault zone separating rhyolite breccia and lake beds. The vein is 6 to 30 feet wide, strikes north 50° W., and dips 50° NW., but flattens with depth. Silver and lead minerals are irregularly distributed in the breccia and are accompanied by a gangue of barite and subordinate quartz. Development totals about 1000 feet of workings, including a crosscut driven 400 feet to the vein, 2 winzes sunk 100 feet on the vein, and limited drifting. Exploration work was done as late as 1940.

The Burcham mine, also known as the Total Wreck, is about one mile west of Calico townsite. It is the only mine in the district to yield gold in appreciable quantity. It was developed several years after the peak of

[127] De Leen, J. L., Geology and mineral deposits of the Calico mining district, thesis for Mining Engineer, University of California, 1950, and Storms, W. H., San Bernardino County: California Min. Bur. Rept. 11, p. 343, 1893.

the bonanza period of Calico's history, and was worked at intervals until 1941.

The mine area is underlain by flat-lying shales and shaly sandstones and by rhyolite tuffs, flows, and tuff-breccias. The area is traversed by a northwest-trending fault which dips 40° to 80° northeast and has thrust the volcanic rocks southwestward over the shales and sandstones.

The ore bodies occur in two veins, the Burcham and the Mulcahy, which cut the volcanic rocks and are, in turn, truncated by the thrust fault. The Burcham vein strikes N. 70° W. and dips 65° SW. The Mulcahy, exposed 300 to 500 feet to the north, strikes N. 45° W. and dips 65° S., and is believed to be an eastward extension of the principal vein at the Union mine.

The Burcham vein ranges from 3 to 10 feet wide. The gold is finely divided and is disseminated in quartz. Small, irregularly distributed high grade pockets of galena and sphalerite, and of silver chloride are also present.

The Mulcahy ranges from 4 to 30 feet wide. Its ore probably averaged about $6.50 per ton in gold and silver. A substantial tonnage of ore with an average value of about $15 per ton was obtained from a zone, 26 inches wide, along the footwall.

The underground workings on the two veins total about 10,000 feet in length, and explore each vein laterally for about 850 feet. A 512-foot northeast-trending crosscut intersects the Burcham vein at 104 feet and the Mulcahy vein at 410 feet.

Randsburg District

Most of the silver mined in the Randsburg district has been obtained from a closely spaced group of veins underlying a small area within San Bernardino County and within the limits of a settlement previously named Osdick, now known as Red Mountain. The gold deposits of the district lie mainly to the east, in Kern County.

The Kelly or California Rand mine which was opened in 1919 and has a recorded output valued at about 16 million dollars, has been the largest single source of silver in San Bernardino County and in California as well. During several of the Kelly's most active years, its silver yield was the largest of any domestic mine. The Kelly workings are confined to claims covering a northeast-trending area about 4500 feet long and 1200 to 1800 feet wide.

Ore of shipping grade also was encountered in the Coyote mine, bordering the Kelly on the southeast, and in the Santa Fe mine, bordering the Kelly on the northeast. In the Red Mountain area, numerous other workings, some quite extensive, were driven in unsuccessful attempts to encounter extensions of the high-grade mineralization. These include the Big Four, Flat Tire, Fox Lease, Kelly Rand Extension, Navajo and Swastika and Silver Bell.

The silver mines and virtually all of the silver prospects in the Randsburg district are confined to an area about 2 miles long in a northeasterly direction and about 1¼ mile wide. The Rand schist, an Archean formation composed mostly of biotite schist, amphibole schist, and quartzite, and which is extensively exposed in the north part of the Rand Mountains, underlies the west central part of the area noted above.[128] In the north-

[128] The geologic data in this section were obtained in personal communication with Mr. Frank Royer and from the following reference: Hulin, C. D., Geology and ore deposits of the Randsburg quadrangle: California Min. Bur. Bull. 95, 152 pp., 1925.

RE: Item #3-d

PHYSICAL DESCRIPTION

See attached

NOTES

VEIN LAYER TO WEST

FAULTING BELOW 275' ON VEIN - 200' VERTICAL

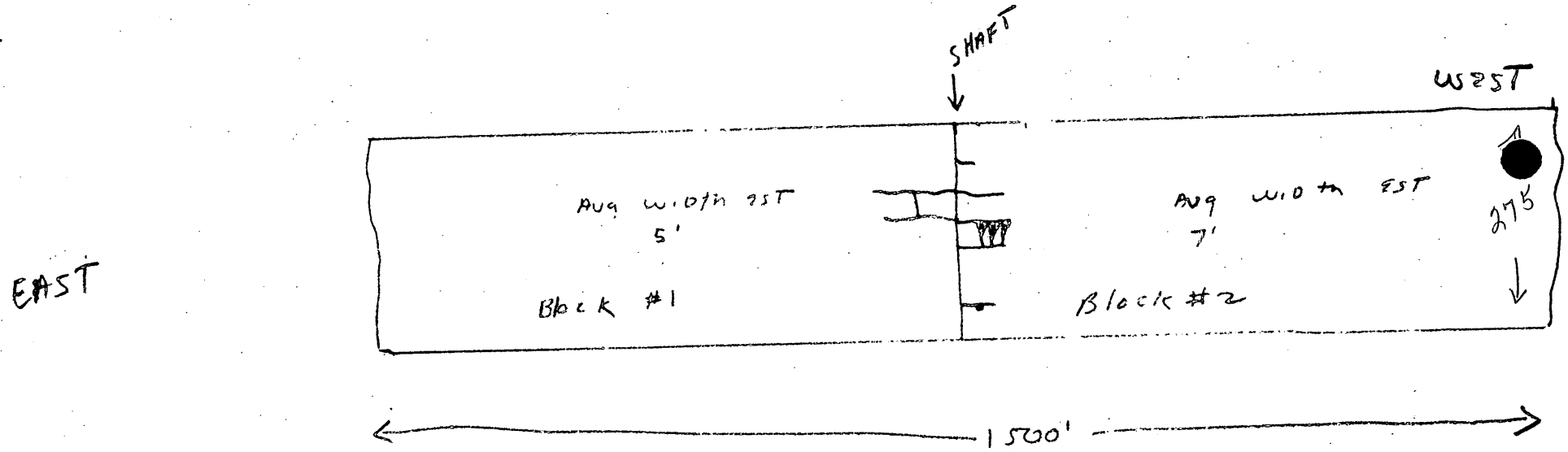
Most silver encountered in District above 200'

Barite gangue qtz/+ Block in place

Scale 1" = 200'

ESTIMATED ORE RESERVES - SILVER BOW

1 Time
3d



Block #1	115,000	tons
Block #2	150,000	tons
	265,000	tons estimated gangue

IN REPLY REFER TO:

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

345 Middlefield Road, Menlo Park, Calif.
December 29th, 1965

Mr. J. R. Collins,
3553 8 Osborne Road,
Barstow, Calif.

Dear Mr. Collins:

With reference to our correspondence during October concerning veins that contain "black calcite" in the Calico district, near Barstow, and thefour sample that you sent.

After an examination of the specimens which showed the presence of black calcite in each sample, one of them, your No.1 from the Silver Bow mine was treated with dilute hydrochloric acid and the black residue wassubmitted for spectrographic analysis; a copy of this analysis is enclosed. The residue was composed largely of a dark oxide of manganese and flakes of barite. You will note that this residue contain o.02 percent copper, 0.5 percent lead and 0.7 percent zinc; the silver sontent is 0.0007 percent or 0.14 ounces of silver to the ton. This amount of silver is too low, of course, to permit the materaial to be shipped for the silver sontent but the presence of this silver taken with the minerals present, indicate that the veins of the Calico diistrict belong to a group now known widely in the western states.

I have done much work of several kinds on the "black calcite" veins from many districts in the West and it is now clear that the silver recovered is not present in the sulphide minerals but it is present in one of several manganates which have never been identified until recently, With my assistent, we will soon publish a comprehensive description of these silver manganates, analyses and the physical properties, so they may be recognized.

I appreciate your interest and assistance in sending these samples to me.

Very truly,

D. F. Hewett

Research Geologist

AMERICAN
SMELTING
AND
REFINING
COMPANY

ASARCO

SELBY SMELTER
SELBY, CALIFORNIA

JOSEPH T. ROY
MANAGER

November 17, 1966

Mr. William S. Hubbard
175 West Fifth St.
San Bernardino, California

Dear Sir:

This will acknowledge your letter of October 28, 1966 regarding a sample of galena concentrates. This sample has been assayed with the following results:

Gold	0.14 ozs./ton	Copper	trace
Silver	11.8 "	Iron	0.9%
Lead	66.0%	Sulphur	6.6%

The above represents a very good grade of concentrates which on the basis of the enclosed open purchase schedule for lead ores and concentrates, would have a value of approximately $148.00 per ton delivered at our plant in lots of 15 tons or more. This is based on the present price of lead at 14¢ per pound.

We will be pleased to hear from you regarding shipment of these concentrates.

Very truly yours,

GEORGE H. PLUTER
Assistant Manager

GHP:cs
Enclosure

RECEIVED
MAR 12

Assay–Chemical Division

ABBOT A. HANKS

ESTABLISHED 1866

1300 SANSOME STREET • SAN FRANCISCO, CALIFORNIA 94111 • TELEPHONE (415) 434-0166

Assayers
Chemists
Spectrographers
Mining Consultation
Representatives
Inspectors
Samplers

REPORT OF ASSAY November 4, 1966

Deposited by Mr. William S. Hubbard
Civic Center Building
175 West 5th Street
San Bernardino, California

Sample of Concentrate

Labty. No.	Mark	GOLD, per ton of 2,000 lbs.		SILVER, per ton of 2,000 lbs.		Percentages
		Troy Ounces	Value at $35.00 oz.	Troy Ounces	Value at	
3825		0.10	$3.50	10.70		LEAD: 64.86%

ASSAY-CHEMICAL DIVISION
ABBOT A. HANKS
By Charles J. Taylor
Charles J. Taylor

CA-106

THE EISENHAUER LABORATORIES
316-322 South San Pedro Street
Los Angeles 13, California

ASSAY CERTIFICATE

PHONE MADISON 2-0328

Los Angeles, Calif. Nov. 26/63 19

I hereby Certify that the samples described below, received from

W. S. Hubbard assay as follows:

Origin, Mark and Sample	GOLD		SILVER		TOTAL VALUE PER TON	PERCENTAGE OF		
	OZS. PER TON	VALUE PER TON	OZS. PER TON	VALUE PER TON		COPPER	LEAD	ZINC
Silver Bow Ore	.08	$ 2.80	49.30	$ 63.60	$ 157.83		38.1	

Imperial Silver Bros High grade

(Lead Collapsing)

E. Eisenhauer

Established 1916

THE EISENHAUER LABORATORIES
316-322 South San Pedro Street
Los Angeles 13, California

ASSAY CERTIFICATE

PHONE MADISON 2-9328

Los Angeles, Calif. Aug. 12/64 19

I hereby Certify that the samples described below, received from

W. Hubbard assay as follows:

Owner's Mark and Sample	GOLD		SILVER		TOTAL VALUE PER TON	PERCENTAGE OF		
	OZS. PER TON	VALUE PER TON	OZS. PER TON	VALUE PER TON		COPPER	LEAD	ZINC
Leviathan	.08	$ 2.80	11.50	$ 14.83	$ 77.69		23.1	

GOLD @$ 35 PER OZ.
SILVER @ $ 1.29 PER OZ.
LEAD @ ~~19~~ c.
COPPER @ ____ c.

CHARGES Paid

E. Eisenhauer Jr.
ASSAYER

Established 1916

4 COPIES MADE FOR HOWARD HUGHES

THE EISENHAUER LABORATORIES
316-322 South San Pedro Street
Los Angeles 13, California

ASSAY CERTIFICATE

PHONE MADISON 2-9328

Los Angeles, Calif. Feb. 15/65 19

I hereby Certify that the samples described below, received from R. S. Caldwell assay as follows:

Owner's Mark and Sample	GOLD		SILVER		TOTAL VALUE PER TON	PERCENTAGE OF		
	OZS. PER TON	VALUE PER TON	OZS. PER TON	VALUE PER TON		COPPER	LEAD	ZINC
Silver Bow Option	.02	$ .70	.88	$ 1.14	$ 1.84		.10	
		Specific gravity----		3.66				

Silver Bow Option

GOLD @$ .35 PER OZ.
SILVER @ $ 1.29 PER OZ.
LEAD @ ____ c.
COPPER @ ____ c.

CHARGES $ 8.50
paid $ 5.00
Bal. due $ 3.50

ASSAYER

Established 1916

E EISENHAUER LABORATORIES
316-322 South San Pedro Street
Los Angeles 13, California

ASSAY CERTIFICATE

PHONE MADISON 2-9328

Los Angeles, Calif. May 6/60 19

I hereby Certify that the samples described below, received from

Mr. Hubbard assay as follows:

Owner's Mark and Sample	GOLD		SILVER		TOTAL VALUE PER TON	PERCENTAGE OF		
	OZS. PER TON	VALUE PER TON	OZS. PER TON	VALUE PER TON		COPPER	LEAD	ZINC
200'- Black	.01	$ .35	1.10	$ .93	~~$ 6.86~~		2.3	
200' -Metallic	.04	$ 1.40	1.94	$ 1.75	$31.15		32.5	

GOLD @ $35 PER OZ.
SILVER @ .93 PER OZ.
LEAD @ 3.5 c.
COPPER @ ____ c.

CHARGES Paid in full

E. Eisenhauer
ASSAYER

Established 1916

THE EISENHAUER LABORATORIES
316-322 South San Pedro Street
Los Angeles, California 90013

ED. EISENHAUER JR.
C. EISENHAUER RAYMOND
LAWRENCE EARL RAYMOND

ASSAY CERTIFICATE

PHONE 622-9828

Los Angeles, Calif. Nov. 1/66 19____

I hereby Certify that the samples described below, received from

W. S. Hubbard assay as follows:

Owner's Mark and Sample	GOLD		SILVER		TOTAL VALUE PER TON	PERCENTAGE OF		
	OZS. PER TON	VALUE PER TON	OZS. PER TON	VALUE PER TON		COPPER	LEAD	ZINC
No mark	.14	$ 4.90	11.60	$ 14.96	$ 200.93		64.67	

GOLD @ $ 35 PER OZ.
SILVER @ $ 1.29 PER OZ.
LEAD @ 14 C.
COPPER @ ____ C.

paid $10.00
CHARGES $ 6.00
Credit bal. $ 4.00

E. Eisenhauer
ASSAYER

Established 1916

AMERICAN SMELTING AND REFINING COMPANY
SELBY SMELTING WORKS
SELBY, CALIFORNIA

1-13-61

RETURNS OF ORE

RECEIVED OF
Neil Dollarhite & William S. Hub
9442 Foothill Blvd.
Cucamonga, California

SELBY LOT 2973

Shipping Point Cucamonga, California	Bulk Weighing gross		lbs.
	Tare	15320	lbs.
Carrier Donland Truck			lbs.
	Moisture 1.00 % min.	153	lbs.
	Samples		lbs.
Mark Silver Bow mine	NET DRY WEIGHT	15167	lbs.
Date Rec'd 12-5-60			

ASSAYS and ANALYSIS			PERCENTAGES and PRICES	DEBITS	CREDITS
Gold	TR	ozs. p. t.	Less % @ $		
Silver	2.3	ozs. p. t.	Less 1 oz. % @ 91 3/8¢ less 1.0¢		117
Lead	25.0	% ✓	Less 1.5 units less 10 % @ 12.00 ¢ per lb. less 1.0¢		4230
Copper	0	%	Less 1.3 units @ ¢ per lb. less ¢		
Insol	6.18	%			
Iron	1.6	%			
Zinc	1.8	%			
Sulphur	1.5	%			
Lime	0	%			
Arsenic	0	%			
Antimony	0	%	Excess Arsenic & Antimony ____ units @ 50¢ per unit.....		
Tin		%			
Bismuth		%			
			Handling Containers.....		
			Excess Moisture ____ units @ 10¢ per unit.....		
PAID TO: Above			Lead Deficiency 6.5 units @ 10¢ per unit.....	65	
			Excess Value over $ ____ @ ____ %.....		
			Base Charge	750	
			Total	815	~~[illegible]~~
			Value Per Ton		35 32
			Value of 15167 lbs. @ $ 35.32 per ton		267 85
			Sampling and Assaying ____ ~~Melting~~ ____.....	15 00	
			Freight Prepaid F.O.B. ____		
			(____ lbs.) ____ lbs. @ ____		
			Hauling ____.....		
			Representative Charge ____.....		
			UMPIRE CHARGE ____.....		
			Total	15 00	267 85
			DUE AMERICAN SMELTING AND REFINING COMPANY		
			DUE SHIPPER - NET PROCEEDS		252 85

IMPORTANT! If not advised to the contrary within days from date we shall assume that returns are satisfactory and the product covered by this statement will be [illegible] in process. American Smelting and Refining Company.

UMPIRED FOR:
Selby
Control
Umpire
SETTLEMENT

102

OILWELL RESEARCH

INCORPORATED

1539 W. SIXTEENTH ST. LONG BEACH, CALIFORNIA 90813

PHONE HEMLOCK 6-4254

DAY OR NIGHT

February 10, 1965

Macco Corporation
7844 E. Rosecrans Avenue
Paramount, California

Attention: Mr. Ed Pellegrin

Gentlemen:

The results of the analysis of the barite base sample submitted to us are as follows:

Laboratory No.	2622	
Marking	Silver Bow Mine	
Silver (Ag) Assay	0.016 %	51.2 ounces per ton
Lead (Pb) Assay	10.0 %	200 pounds per ton ✓

Potentially commercial values are contained in the above sample.

If we can assist in further evaluations of this deposit, do not hesitate to call on us.

Respectfully submitted,

T. R. Barben II

T. R. Barben II

TRB:ap

MEMBER

CORE ANALYSIS DRILLING FLUIDS DRILLING AND PRODUCTION PROBLEMS

RESEARCH TESTING DEVELOPMENT

Our letters and reports are for the exclusive use of the clients to whom they are addressed. The use of our names must receive our prior written approval. Our letters and reports apply only to the samples tested and are not necessarily indicative of the qualities of identical or similar products.

CALADA MATERIALS COMPANY
3501 DOCK STREET TERMINAL ISLAND SAN PEDRO, CALIFORNIA
HEMLOCK 5-4878

March 5, 1965 DA 66076

William Hubbard
175 W. Fifth Street
Civic Center Bldg.
San Bernardino, California

Dear Bill,

I sampled the stockpile at the Silver Bow yesterday and find that it tests only 3.76 Sp. Gr. Your uncle took me on a tour of the mine and I was surprised to see how much development work had been done since I was last there. There is considerable clean barite showing in the lower levels which should run 4.00 or better with selective mining. We expect to use about 100 tons/mo. of this grade and would pay according to the following price schedule F.O.B. the mine stockpile in minimum 100 ton lots.

Sp. Gr.	$/T.
4.00	9.25
4.10	11.25
4.20	13.25

Sincerely,

Bob Sandiford

BS:jb

STATE OF CALIFORNIA—RESOURCES AGENCY

EDMUND G. BROWN, *Governor*

DEPARTMENT OF CONSERVATION

DIVISION OF MINES AND GEOLOGY

FERRY BUILDING, SAN FRANCISCO 11

Branch Offices:

SACRAMENTO
Business and Professions Annex
1021 O Street, Zone 14

LOS ANGELES
Los Angeles State Office Bldg.
107 So. Broadway, Room 1065
Zone 12

REDDING
State Office Bldg.
P. O. Box 546

May 11, 1964

Mr. William S. Hubbard
337 W. Baseline Road
San Bernardino, Calif.

Dear Mr. Hubbard:

This is in further reply to your recent letter regarding the Silver Bow mine, and proposed drilling program.

As you have met the Division barite commodity specialist, Harold Weber, you may have learned that as one of his projects, he is making a study of the barite deposits of the state. One of the important phases of this project is a study of the surface geology and mineralogy of the barite-bearing veins of the Barstow region, including the Silver Bow and other properties of the northwest part of the Calico Mountains. When this phase of the barite project is completed, the Division may feel that a drilling program is necessary to complete understanding of the future potential of the deposits of the Barstow region.

The principal goals of such a program would be to determine the character of the veins at depth, including determination of the broad vertical and horizontal changes in the barite-silver-lead-gold mineralization. Drill hole sites would be selected on the basis of the geologic study, and probably would involve at least several properties, depending on the amount of money that could be budgeted for the program, on the anticipated cost of drilling, on the depth of the holes, and for other possible factors.

As the decision for such a drilling program in the Barstow region must await completion of the geologic study, I will advise Mr. Weber to keep you informed of the progress of the study, especially as it pertains to your property. Consequently, he also can keep you informed of any possible decision for a drilling program.

Sincerely,

Ian Campbell

Ian Campbell
Chief, Div. of Mines & Geology

cc: F.H. Weber, Jr.

EXHIBIT #11.

HEMLOCK 5-4848 HEMLOCK 6-0086

CALADA MATERIALS COMPANY

3501 DOCK STREET TERMINAL ISLAND SAN PEDRO, CALIFORNIA

December 22, 1958

Mr. William S. Hubbard
8348 Archibald Avenue
Cucamonga, California

Dear Mr. Hubbard:

With regard to your Silver Bow barite property and in accordance with our conversation of December 9, our intentions regarding purchase of barite are as follows:

1. To purchase 100 to 200 tons per month

2. To examine and test barite in stockpile at mine in 100 ton lots.

3. According to the following price schedule based upon truck load lots delivered to our Harbor City Mill.

Specific Gravity	Dollars per ton
4.25	$17.00
4.20	16.00
4.10	14.00
4.00	12.00
3.90	11.00
3.80	10.00

The barite samples I cut ranged in specific gravity from 3.95 to 4.17, with the average being 4.11. Apparently even the cleanest appearing barite contains some celestite or white limestone to cut the weight down.

I will be most happy to talk to you futher about opening up your mine for production.

Yours very truly,

CALADA MATERIALS COMPANY

Robert W. Sandiford

Robert W. Sandiford

RWS/bk

D. R. CURRY, ASSAYER
Route 2, Box 182
El Cajon, California

ASSAY CERTIFICATE

El Cajon, Calif., 1-21 1967

I hereby Certify that the samples described below, received from

Al WISREN assay as follows:

OWNER'S MARK AND SAMPLE	GOLD Ozs. Per Ton	GOLD Value Per Ton	SILVER Ozs. Per Ton	SILVER Value Per Ton	TOTAL VALUE PER TON	PERCENTAGE OF Copper	Lead	Zinc
ORE SAMPLE	0 12	4 20	40 50	52 24	97.26		15.7	
CONCENTRATES	0 20	7 00	150 00	193 50	330.50		50.0	

High Al. You may not remember who gave you this sample. I told Bud when he was down I would run it. You told me a man want some one to put a Plant on the property to work it. It was Barite with Galena in it. I believe you said it was 18 or 20 miles out of Barstow. If you know who it was and he is still interested I would come up some Sunday and look at it.

D. R. Curry
Assayer

GOLD at $ 35.00 per oz.
SILVER at $ 1.29 per oz.
LEAD at 13 c
COPPER at c

Charges None

AMERICAN SMELTING AND REFINING COMPANY
SELBY SMELTING WORKS
405 MONTGOMERY STREET
SAN FRANCISCO 4, CALIF.

W. S. REID
MANAGER

July 22, 1958

Mr. William S. Hubbard
8348 Archibald Ave.
Cucamonga, California

Dear Sir:

We have your letter of July 17, 1958 in which you advise you own the Silver Bow Mine located 16 miles northeast of Barstow, California and that in the process of mining barite you will also have some galena ore which you are interested in shipping to us.

During 1957, Oil Base Inc. sent a sample of galena ore to our Federated Metals Division which in turn was sent to us. This sample assayed as follows:

Gold	0.01 Ozs/Ton	Lead	79.4% ✓
Silver	81.0 "	"	

At that time we quoted terms for the production of this material but no shipments were ever received.

There is enclosed our Open Purchase Schedule covering lead ores and concentrates showing terms under which we will be pleased to receive your production. Based on these terms and the present price of lead at 11¢, ore as represented by the above sample would have a net value, delivered at our plant at Selby, California, of approximately $182. per ton, from which you would have to pay freight.

Thank you for this inquiry and we shall be pleased to hear from you further.

Yours very truly,

George H. Playter

GEORGE H. PLAYTER
Assistant Manager

Dc 2 2145

GHP:MB

Enc.

THE EISENHAUER LABORATORIES
316-322 South San Pedro Street
Los Angeles, California 90013

ED. EISENHAUER JR.
C. EISENHAUER RAYMOND
LAWRENCE EARL RAYMOND

ASSAY CERTIFICATE

PHONE 622-9828

Los Angeles, Calif. Nov. 1/66 19

I hereby Certify that the samples described below, received from

~~W. S. Hubbard~~ assay as follows:

Owner's Mark and Sample	GOLD		SILVER		TOTAL VALUE PER TON	PERCENTAGE OF		
	OZS. PER TON	VALUE PER TON	OZS. PER TON	VALUE PER TON		COPPER	LEAD	ZINC
No mark	.14	$ 4.90	11.60	$ 14.96	$ 200.93		64.67	

GOLD @ $35 PER OZ.
SILVER @ $1.29 PER OZ.
LEAD @ 14 C.
COPPER @ ____ C.

paid $10.00
CHARGES $ 6.00
Credit bal. $ 4.00

C. H. Eisenhauer
ASSAYER

Established 1916

MACCO CORPORATION
7844 EAST ROSECRANS AVENUE, PARAMOUNT, CALIFORNIA
NEvada 6-1261 — MEtcalf 0 5801 • CABLE: MACCOCOR

EDW. A. PELLEGRIN
VICE PRESIDENT

March 3, 1965

Mr. William S. Hubbard
Civic Center Building
175 West Fifth Street
San Bernardino, California

Dear Bill:

With reference to our letter of February 3, 1965, we are now ready to finalize our deal on the barite material discussed in the above letter. To eliminate any possibility of misunderstanding, I wish to set forth what I believe covers our discussions:

1. Macco will purchase from William S. Hubbard, and William S. Hubbard will sell to Macco Corporation, the fine tailings at the Leviathin mine for $1.00 per ton in the stockpile.

2. Macco Corporation will arrange for the loading and hauling of the above material.

3. William S. Hubbard will bill Macco Corporation for the tonnage as shown by copies of truck weight tickets.

4. Macco Corporation contemplates using approximately 200 tons per month and will attempt to load and haul in amounts of approximately 500 tons at a time.

5. William S. Hubbard agrees not to sell any of this material to any other company or person other than Macco Corporation, so long as Macco continues to draw from the stockpile in the approximate amounts as set forth above.

If the above meets with your understanding, will you kindly acknowledge receipt of this letter and return it to us.

Yours very truly,

MACCO CORPORATION

Edw. A. Pellegrin

Edw. A. Pellegrin

EAP:gw

Per telephonic agreement, 3/5/65, the undersigned reserves the right to cancell the within agreement on six months written notice.

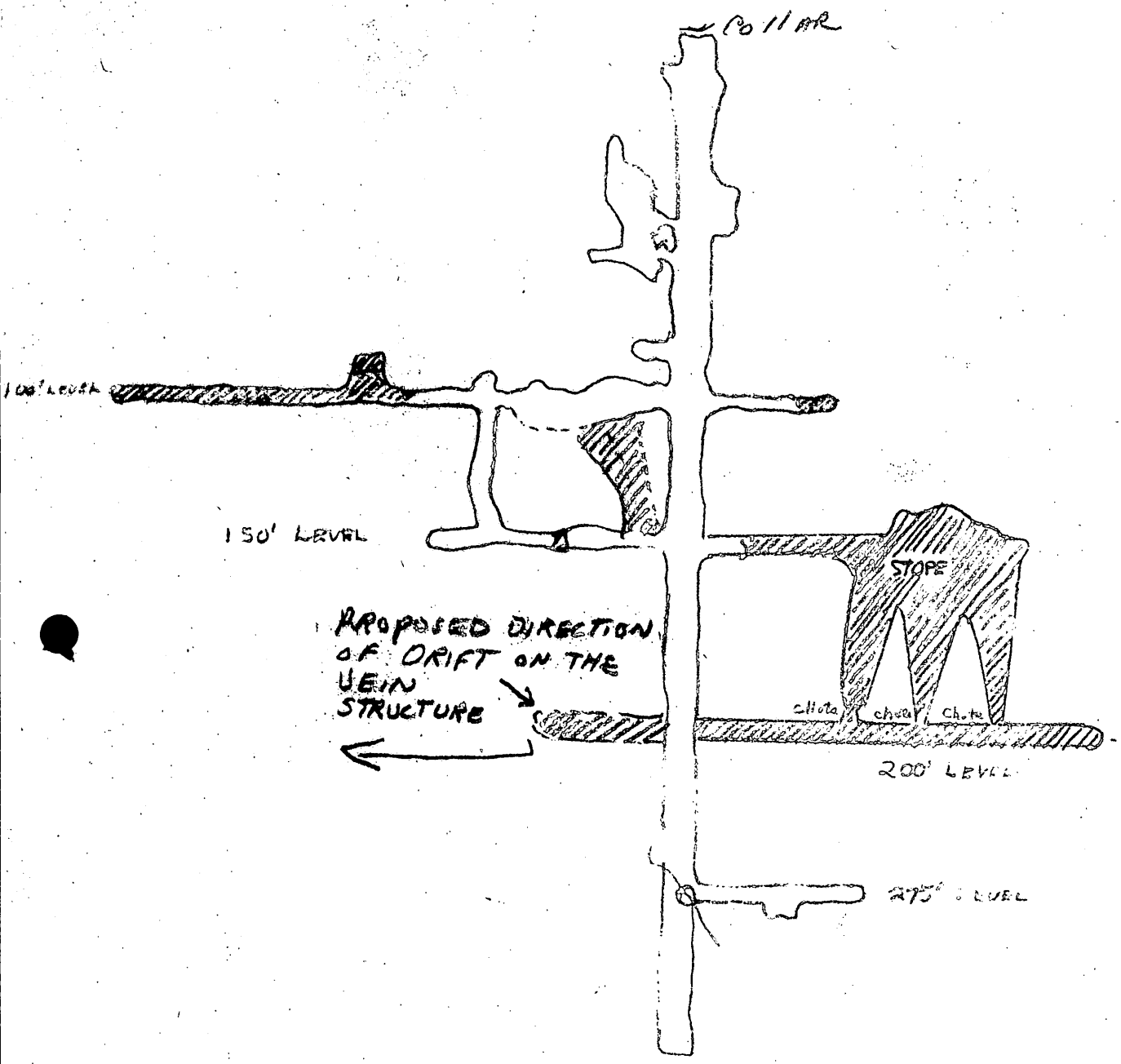
APPROVED: William S. Hubbard

Date 3/5/65

ITEM 3.2

SILVER BOW MINE

VERTICAL PLANE



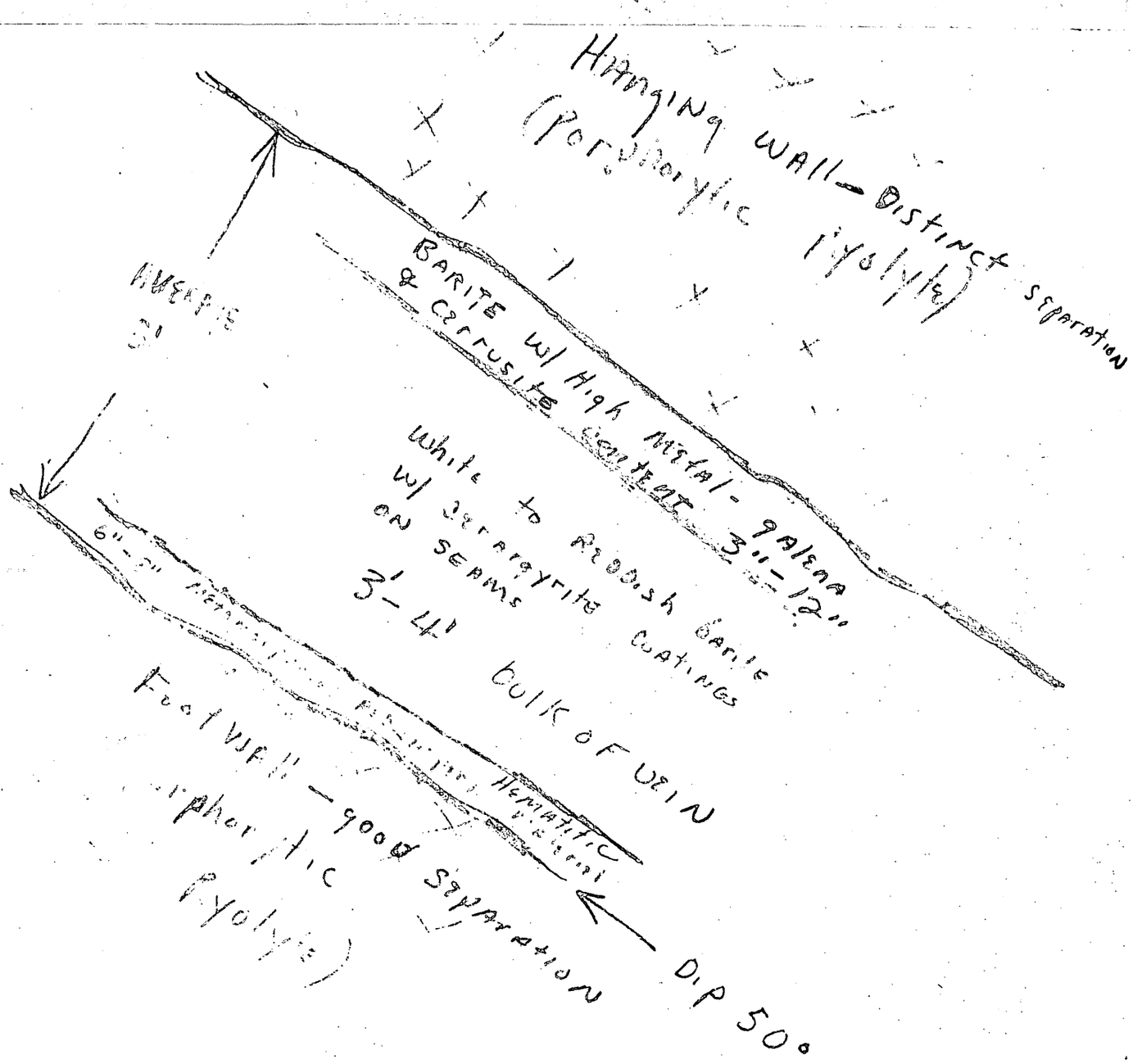
LEGEND

- EXISTING WORKINGS IN 1958.
- DEVELOPMENT WORK UNDER WILLIAM S. HUBBARD.

RE: ITEM 3-e

SILVER BOW MINE

VEIN SECTION #1



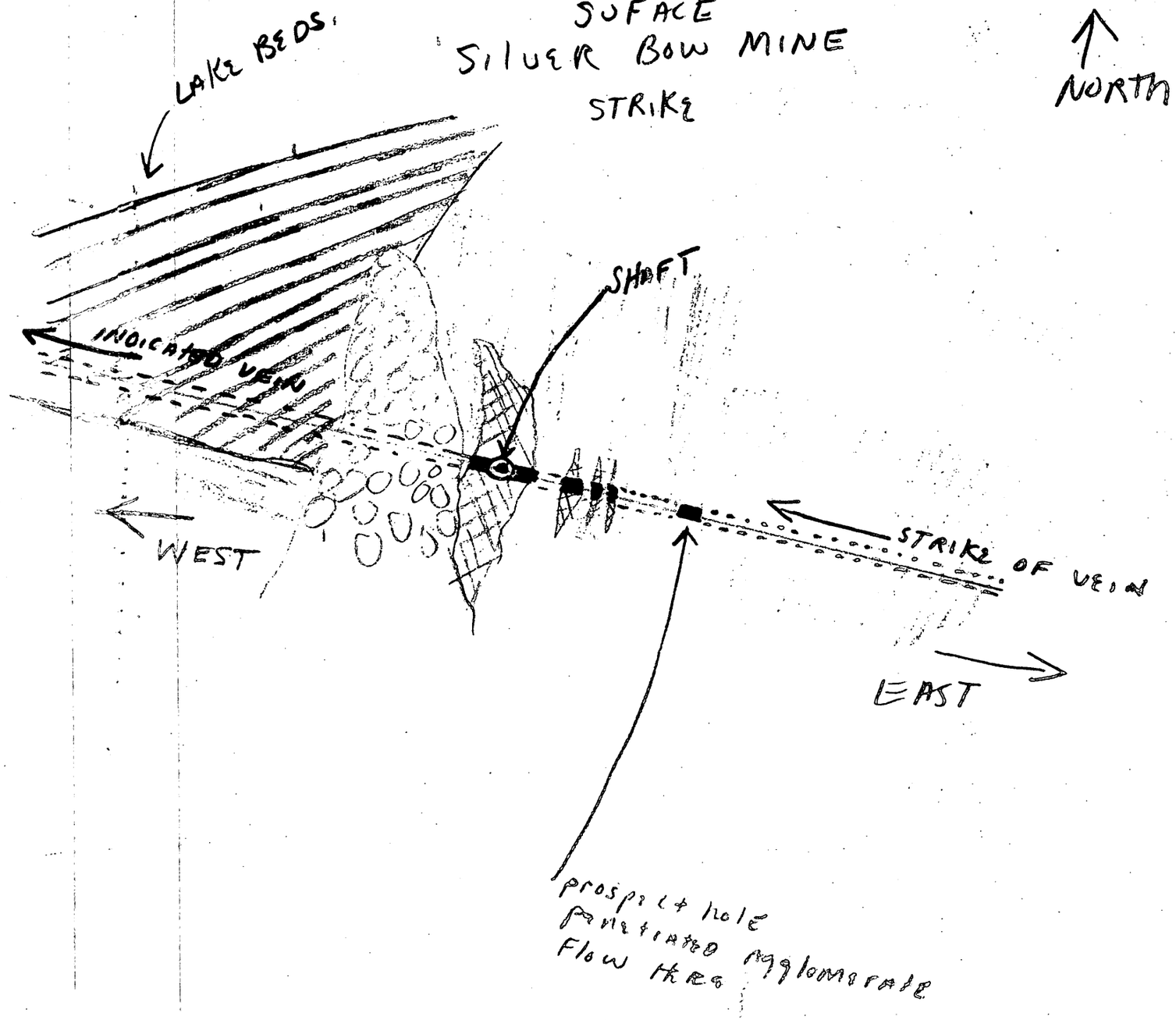
THE [illegible] VEIN IS FOUND
[illegible] ARGEST PORTION OF
[illegible]

OFFICIAL
COPY
O. M. T.
RECEIVED
MAR 24 1967

INITIALS	CODE

3e

Schematic geology of SURFACE Silver Bow Mine



THESE LAKE BEDS APPEAR TO BE PRE MINERAL - ARE QUITE THICK AND FORM A HILL UNDER WHICH THE VEIN PASSES IN ITS STRIKE TO THE WEST

LEGEND

Country Rock (porphory)

Tilted LAKE BEDS

Agglomerate Flow

Alluvial =

SCALE 1" = 200'

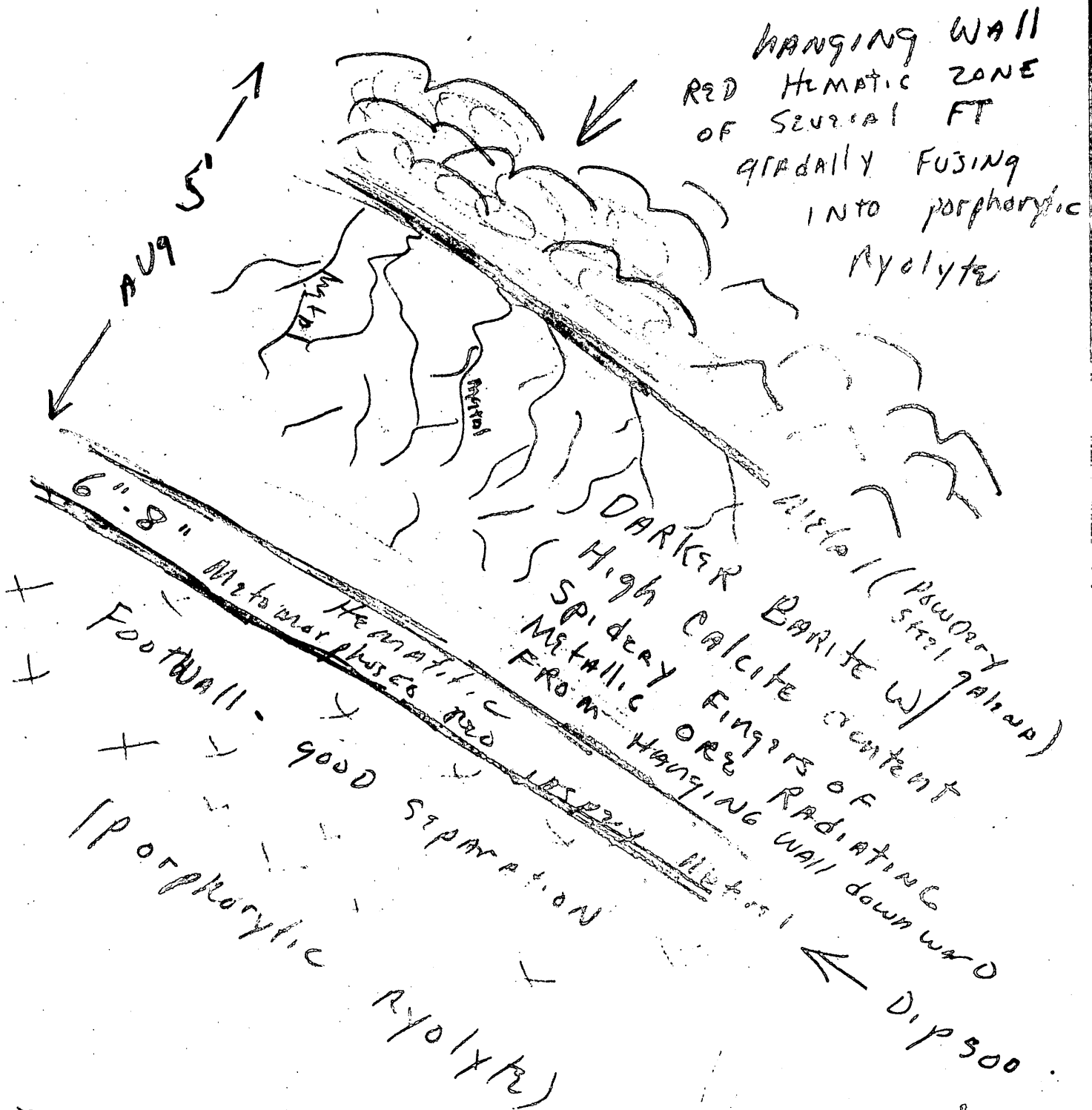
INDICATES outcropping

INDICATES INDICATED VEIN

SILVER BOW MINE

VEIN SECTION #2

3e



THIS TYPE OF VEIN
ENCOUNTERED IN LAST
30' OF 200' LEVEL WEST
DRIFT

RE: Item #3-f

"PHYSICAL DESCRIPTION"

The following are my reasons for expecting to find additional enriched silver zones:

1. The Silver Bow Mine is in a proven district with a substantial record of past production.

2. The biggest part of the proposed exploration work is in the vein and has a record of kidneys and enriched zones. If the entire vein is merely proven to be as good as the portions already encountered the ore body would merit the establishment of a beneficiation plant.

3. The district is volcanic and volcanic areas are more favorable for ore disposition.

4. There is a general absence of sulphides (except galena) and bounteous iron oxides and hematitic material.

5. Arid, moderate climate favoring vein enrichment.

6. Considerable relief yet moderate altitude, (3000').

7. No evidence of glaciation.

8. Presence of considerable galena which is not generally characteristic of the Belleville District.

9. Presence of unusual amounts of black calcite with high manganese content around the "old watercourses" (areas of past hydrothernal activity).

10. The exploratory drift to the East will follow the vein under the Agglomeate construction. (See Harold Weber's comments Re: Silver Bow, volumn 20, Number 1, MIS, page 8).

11. The drift to the Northwest goes under a striking Agglomeate flow which caps three parallel veins.

RE: Item #3-g

PHYSICAL DESCRIPTION

Included as appendixes

to subparagraphs 3-a,

b, c, d, e, and f.

RE: Item #4-a

ACCESSIBILITY OF PROPERTY

1. William S. Hubbard, the applicant herein, will meet the OME representative at whatever time and place that may be subsequently designated.

2. The address of the applicant herein is 175 West Fifth Street and the phone number is TUrner 9-1068 (San Bernardino, California.)

3. The directions for reaching the property are shown on any of several of the enclosed maps. However, for the record, the property is reached by taking the Fort Irwin Road out of Barstow, turning right on the first road past the Yermo cutoff (approximately 11 miles from Barstow), and then driving 4 miles on a good gravel road to the end of that road, which is the Silver Bow Mine.

RE: Item #4-b

ACCESSIBILITY OF PROPERTY

1. The truck shipping point is the mine. In the past, ore trucks have been loaded with a skiploader at the mine. The applicant owns a diesel dozer loader with a 4 in 1 drott bucket. It is a practice for certain of the ore buyers to bring their own skiploader.

2. The nearest metallic smelter is Selby, California, and shipments have been made to Selby by truck also. The distance is 500 miles (approximately).

3. The nearest rail siding is Yermo, California which is a distance of 12 miles.

RE: Item #5-a

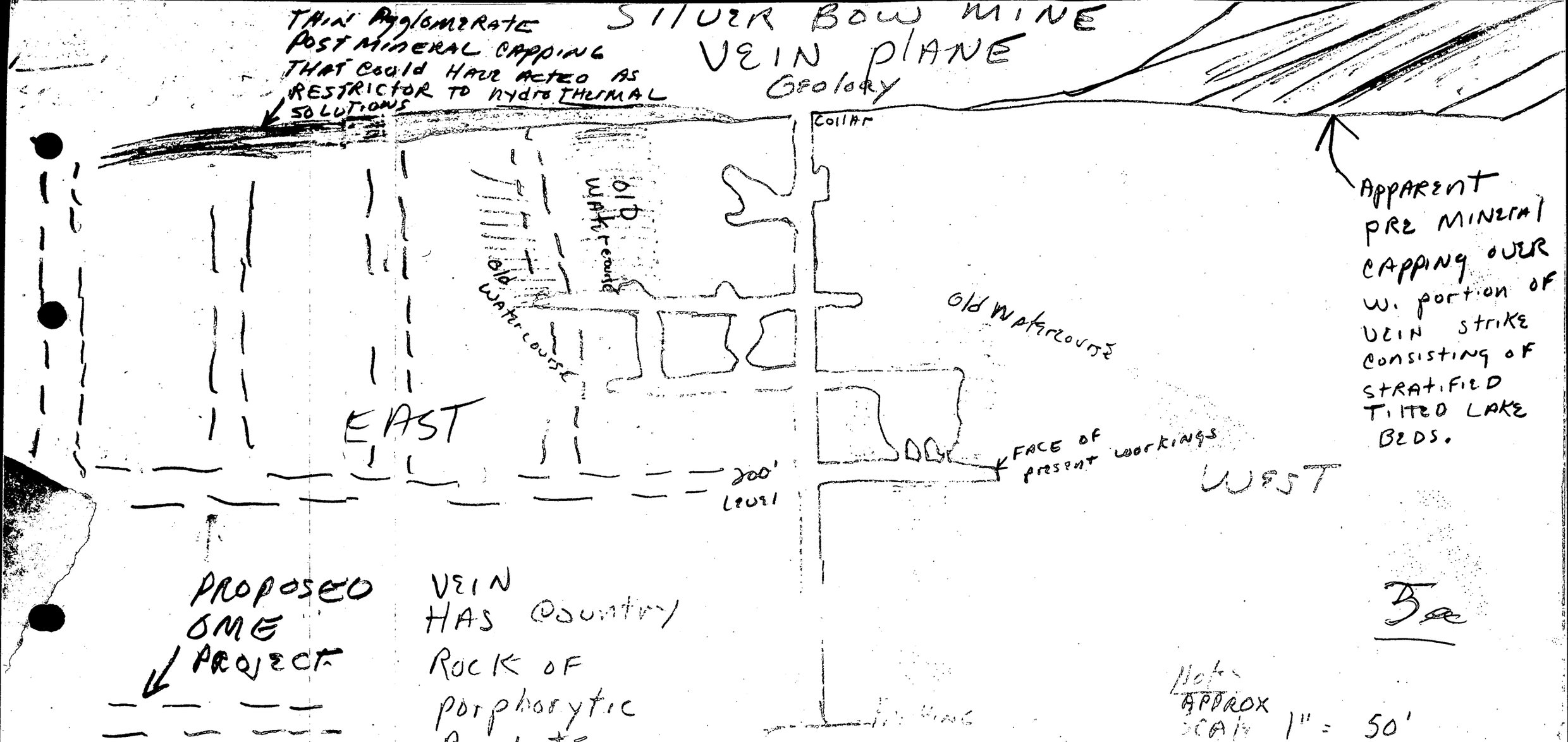
EXPLORATION WORK

The exploration work proposed is simply to follow the vein along its strike 700' East from the shaft on the 200' level on the vein structure. The reason for selecting this level is because it passes through the zone (100' - 200' from surface) in the district where the richest ore bodies have been found. The drift to the East would pass under the Agglomerate capping which could possibly have acted as solution damming medium bodies. The present development work is proceeding in this direction and although only 50' from the shaft to the west the vein has taken on new characteristics and generally darkened. The drift would be 5' wide and 7' high. Raises would be (5' x 7') driven each 190' to surface.

The second area of exploration would be approximately 500' of crosscut drift to the northwest. This would intersect three parallel veins striking under a large unusual agglomerate flow. The crosscut drift would be 5' x 7'. There would be a 5' x 7' raise on each intersected vein to the surface. This is a total of 1200' of drift and 1550' of raises.

Maps outlining this proposed exploration are included as a part of this section.

SILVER BOW MINE
VEIN PLANE
Geology

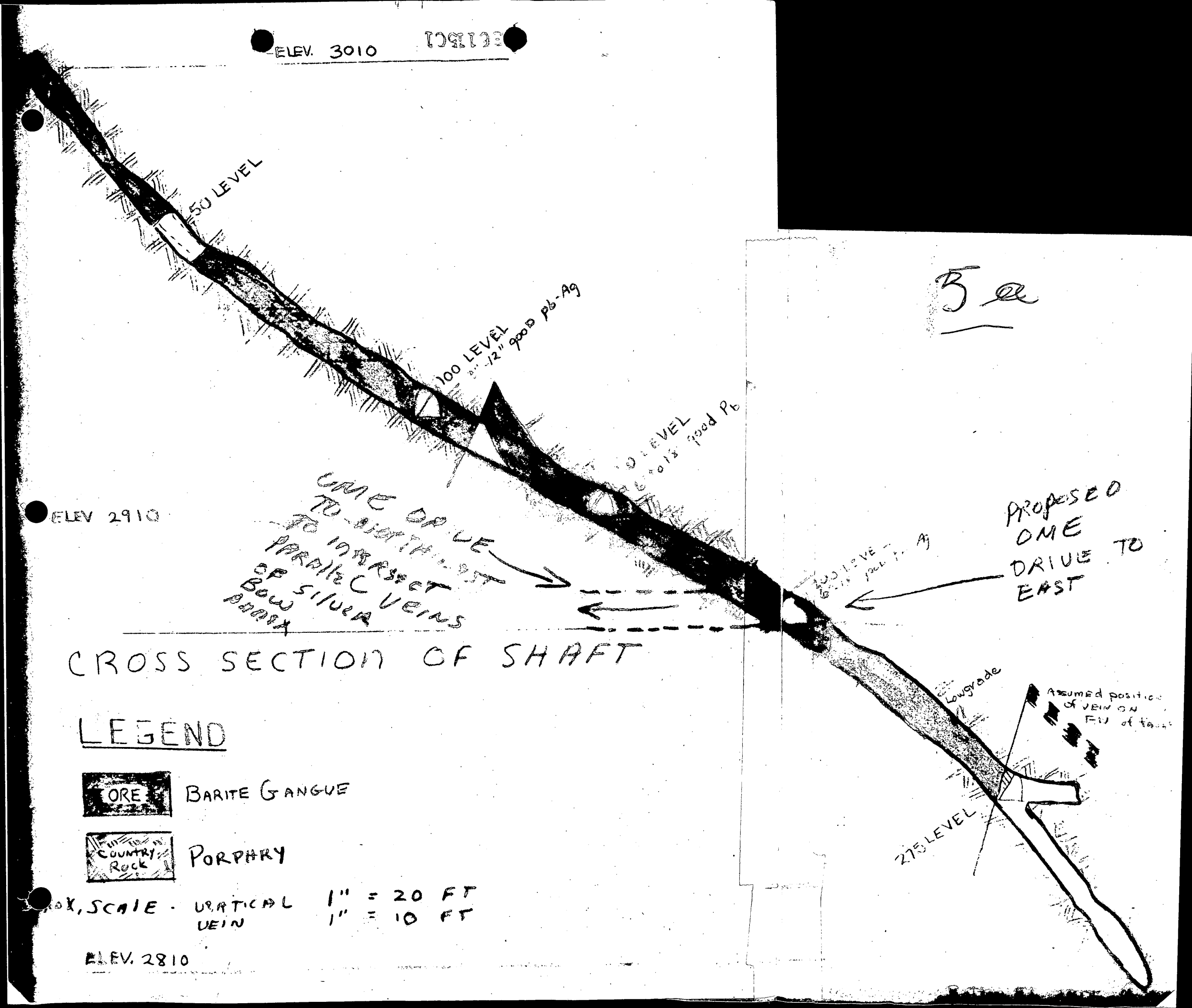


5

AROUND THE old WATER COURSE THE BARITE IS displaced by Calcite AND MUCH MORE MATERIAL COMES IN. THE MINERALIZE STRATAS OF THE VEIN WIDEN. AND POCKETS OCCUR

CONFIDENTIAL
COPY
T. M. E.
RECEIVED
MAR 24 1967

INITIALS	CODE


ELEV. 3010
50 LEVEL
100 LEVEL
ELEV 2910
PROPOSED ONE DRIVE TO EAST
Lowgrade
275 LEVEL
CROSS SECTION OF SHAFT
LEGEND
ORE
BARITE GANGUE
COUNTRY ROCK
PORPHRY
SCALE · VERTICAL 1" = 20 FT
VEIN 1" = 10 FT
ELEV. 2810

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PROFILE OF SHORT AXIS - perpendicular to THE STRIKE OF THE SILVER BOW VEIN (TOPOGRAPHICAL)

5a

SURFACE ELEV.

3200
3180
3160
3140
3120
3100
3080
3060
3040
3020
3000
2980
2960
2940
2920
2900
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2860
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2800
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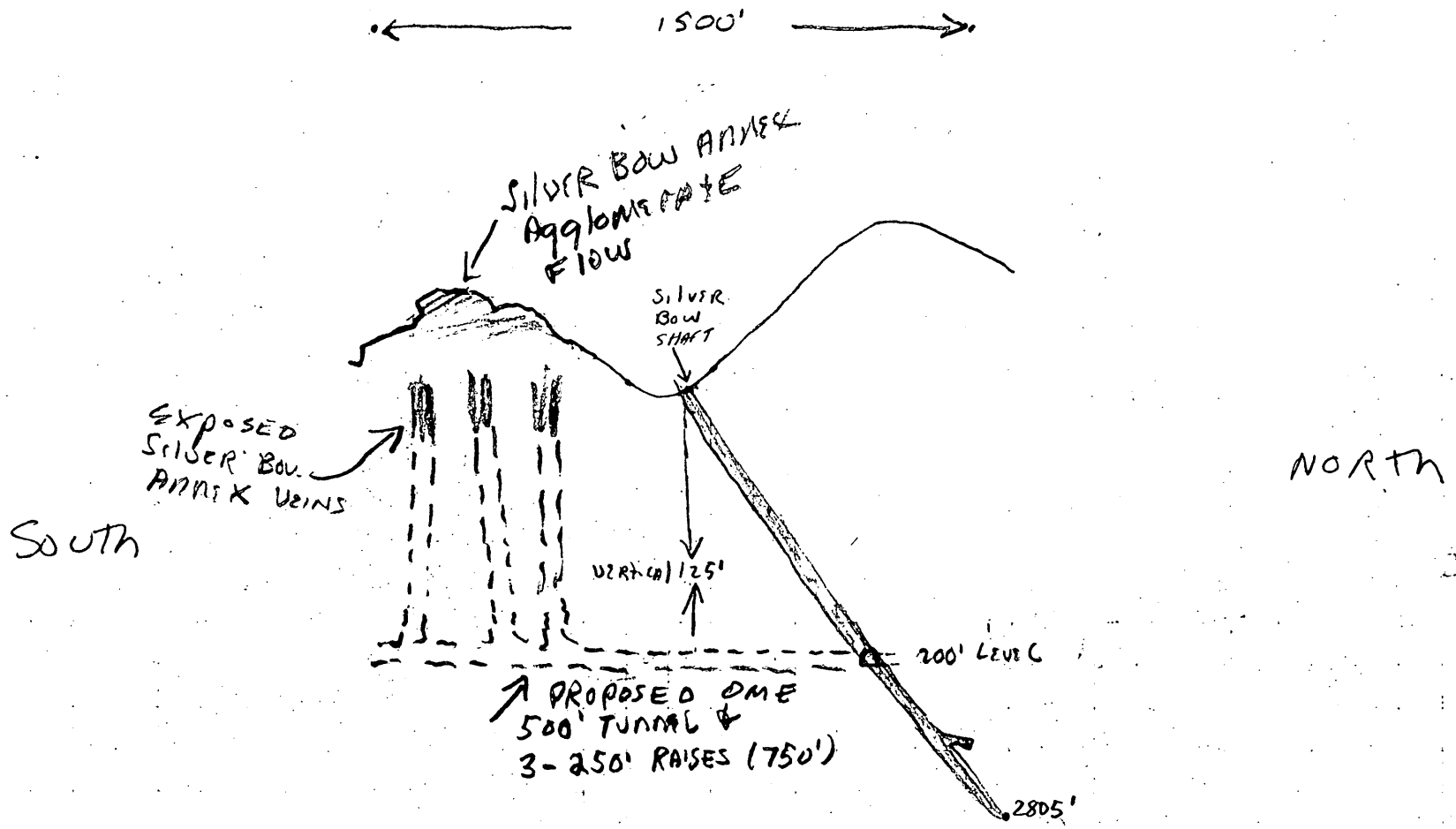


480' TOTAL

LEGEND: EXISTING ———
PROPOSED - - - -

VERTICAL SCALE: 1 SQ = 20'
HORIZONTAL SCALE: 1" = 440'

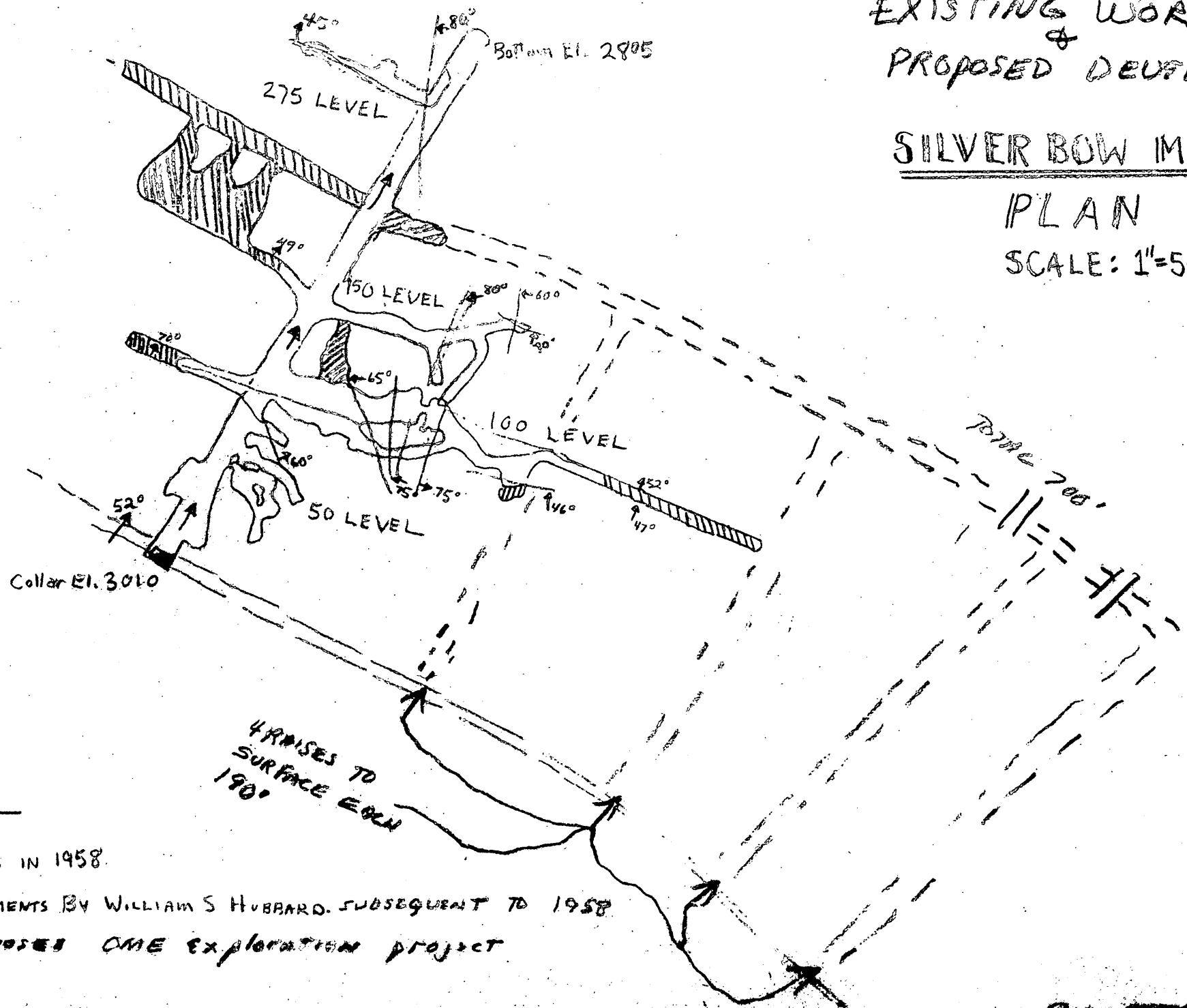
Item 3a

EXISTING WORKINGS & PROPOSED DEVELOPMENT

SILVER BOW MINE

PLAN

SCALE: 1"=50'



LEGEND

- WORKINGS IN 1958
- DEVELOPMENTS BY WILLIAM S HUBBARD. SUBSEQUENT TO 1958
- PROPOSED ONE exploration project

RE: Item #5-b

EXPLORATION WORK

It is not necessary for an access road to be built inasmuch as there is an existing one.

RE: Item #5-c

EXPLORATION WORK

The work contemplated under the OME contract is now in progress. Acceleration of this progress would commence immediately after the execution of the OME contract.

The anticipated daily average rate of progress after executing of the OME contract would be 8 feet of drift per working day or approximately 150 feet per month.

RE: Item #5-d

DRIFTING AND RAISING AS EXPLORATION TOOL

This operator favors drifting and raising over core drilling because it enables the geology to be more thoroughly examined and when ore bodies of economic value are encountered it is possible to commence mining without the large outlays necessitated in getting to ore bodies discovered by core drills.

RE: Item #6

BACKGROUND AND EXPERIENCE

of

APPLICANT

1. Childhood - The father of the applicant, E. Doyle Hubbard of Wise, Virginia, was engaged in the coal mining business in Southwestern Virginia, 1935-1946. Applicant was around mines and miners daily during this time.

2. Academic - Applicant is a graduate of Porterville College, Porterville, California (Associate of Arts Degree, 1951) and Claremont Men's College, Claremont, California (Bachelor of Arts Degree - Major in Business Administration, 1953). Also 11 units graduate work at Los Angeles State College (Business Administration Major, 1957).

   Applicant also took several optional courses in geology and chemistry in college. Business administration major equips applicant to evaluate economic possibilities of property and to administer the development progress.

3. Military - Applicant served as an Infantry officer in the US Army in activeduty, 1953-1956 and is presently a Major in the Army Reserve. Extensive map reading courses in Army schools plus years of experience in the field with maps has caused the applicant to be very adept with maps, especially in translating contour data into conceptual topography.

4. Business Experience - Since 1956 applicant has been engaged in the real estate appraising field. This has given the applicant a sound background in real estate titles, vestings, legal descriptions, matters affecting title, and generally all other facets of real estate. This is necessary in properly understanding the several aspects of ownership of mining properties.

   Applicant owns his own business and has been the State Inheritance Tax Appraiser for the past several years, which over the years, endowed him with basic business sense, proprietary responsibility and value of sound management. It has also given him exceptional freedom timewise to prosecute the subject mining enterprise and the necessary capital.

5. Actual Mining Background -

   a. While going to college, 1949-1953, prospected on weekends, visited old mines and operating mines and mills.

   b. While in the Army, 1953-1956,

      (1) Prospected in the Santa Lucia Range for Chromite and the Southern Sierras for tungsten. Located and developed a tungsten property which was sold to a mining company.

      (2) Visited numerous mines, both operating and idle, while with the U.S. Army in post-armistice Korea.

BACKGROUND AND EXPERIENCE
(continued)

c. 1956-1957 visited numerous Southern California industrial mineral deposits, both in operation and idle. I was looking for a deposit with potential.

d. 1958, Acquired the Silver Bow Mine-then idle-and put it in operation.

Applicant is a recognized mining operator in this district. (See Volumn 19, Number 15, page 79.)

RE: Item #7 General

EXPLORATION COSTS

The proposed exploration program entails 700' of drifting in vein structure, 500' of crosscut through tuff, for a total of 1550 of raises on vein structure. Through past experience the applicant prefers to use the unit cost method and estimates from past experience that the drift will cost $30.00 per foot or $36,000.00 and the raising will cost $20.00 per foot or $31,000.00. Total cost - $67,000.00.

RE: Item #7-a

ESTIMATE OF COSTS

"None"

RE: Item #7-b

PERSONAL SERVICES

"None"

RE: Item #7-c

OPERATING MATERIALS AND SUPPLIES

The applicant prefers to arrive at a valid figure of unit cost to be used in the progress of the project.

RE: Item #7-d

SILVER BOW MINE

Equipment:	Fair Market Value	Condition
Air Compressor, 80 c.f.m.	$ 700.00	Good
Air Compressor, 210 c.f.m.	2,000.00	"
Steel Cable	210.00	"
Sheave Wheel	50.00	"
Fairbanks Morse Winch & Engine	1,500.00	"
Skip Bucket	130.00	"
Mine Car	700.00	"
Water Pipe	1,000.00	"
Misc. Equipment	3,000.00	"
Air Pipe	660.00	"
Rail	700.00	"
Electrical Wiring	500.00	"
Generator	500.00	"
Diesel Dozer Loader	6,000.00	"
Tools, Shovels, Picks, Hammers, etc.	300.00	"
Flask, Balance, assaying equipment and supplies	400.00	"
Hoist House	1,500.00	"
Drills, Jacklegs, Bits	3,000.00	"
Chevrolet El Camino	2,000.00	"
Trailer 25' (House Trailer)	750.00	"
Water Trailer	300.00	"
Misc. unused lumber	300.00	"
Headframe	1,550.00	"
Skidways	800.00	"
Chutes	400.00	"
Concrete Pad	200.00	"
Ladders	450.00	"
Double Drum Slusher	1,000.00	"

TOTAL FAIR MARKET VALUE: $ 30,600.00

Note: The items listed hereon are owned by the applicant and are being used in the present development work.

RE: Item #7-e

ESTIMATE OF COSTS

"None"

RE: Item #7-f

ESTIMATE OF COSTS

"None"

RE: Item #7-g

ESTIMATE OF COSTS

There are presently no major repairs to the mining equipment needed.

Development and exploration work are presently going on and the accelerated exploration planned could proceed with present equipment.

MINERAL INFORMATION SERVICE

STATE OF CALIFORNIA DIVISION OF MINES AND GEOLOGY

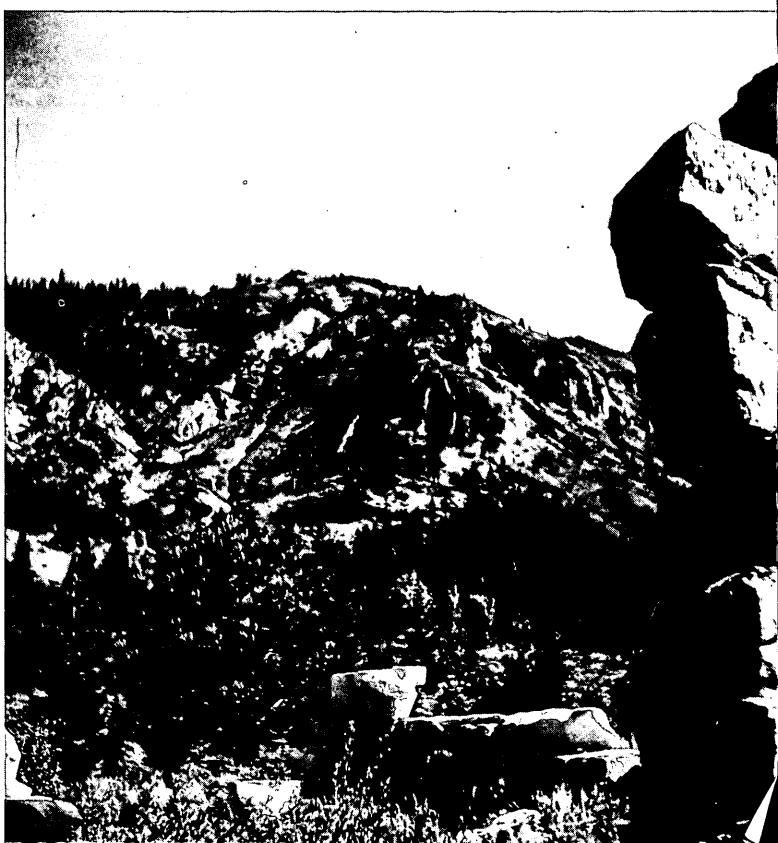
VOLUME 16 NUMBER 6
JUNE 1963

SILVER

by Mary R. Hill

Classically a twin with gold, silver was one of the first metals known to man. Silver and gold artifacts are recovered in many of the oldest archaeological sites; among the earliest of the labor unions to be established, to become specialized, and to attain political power were the guilds of silver- and gold-smiths in Greek and Roman times. Even before coinage was known as a medium of economic exchange, silver and gold were used as a system of barter. In ancient Sumeria, for example, in the third millenium B.C., the chief industrial exports were skilled metalwork in silver, gold, and copper; the businessmen of the country sent their traveling salesmen many miles with their wares. For such distant commerce, the local unit of exchange, barley, was abandoned in favor of uncoined silver and gold. One of the best known examples of the Sumerian system is the purchase of the cave of Macpelah by Abraham, who weighed out four hundred shekels of silver, "current money with the merchant." The transaction is recorded in Genesis 23.

Some of the earliest "money" made of precious metals that has been discovered as yet comes also from ancient Sumeria of about 2000 B.C., when gold and silver bars were used, though they were not of standard weight or purity. Throughout recorded history, the gold:silver ratio has been contended. Sumerian businessmen established the rate at about 8:1; this was later lowered to about 13:1 when the rich Attic silver mines were discovered. The metal bars of antiquity proved a nuisance in the Grecian world, where commerce was speeded up, and trade between nations became commonplace. They were replaced in Lydia and the Ionian cities by coins upon which were stamped the state, the weight, and the fineness. The first of these were a mixture of silver and gold called "electrum" or "white gold" – a naturally occurring compound of about 73 percent gold and 27 percent silver.



Historic Silver Mountain City, (Konigsberg), Alpine County. This city, which once housed 8000 people, was the site of a silver rush of the 1890s. Today little remains of the city but a few rhyolite blocks that once formed the jail.

MINERAL INFORMATION SERVICE

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MINERAL INFORMATION SERVICE is designed to inform the public on the geology and mineral resources of California and on the usefulness of minerals and rocks, and to serve as a news release on mineral discoveries, mining operations, markets, and statistics, and activities and publications of the Division. It is issued monthly by the California Division of Mines and Geology. Subscription price, January through December, is $1.00.

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MARY R. HILL, *Editor*

Silver and gold, then, became early established as units of exchange, and as substances of considerable value for jewelry, adornment, and other luxury items. In classic times as in recent times, the dual problems of hoarding and of deflecting the wealth of the state that could be used for commercial purposes into private stocks of silver objects perplexed the nation. During the Punic wars, for example, the use of jewelry and silver tableware was restricted – a measure designed to replenish the depleted stocks of the treasury.

From this long-established notion that silver is a prestige unit, based on its use as a measure of material wealth, comes our still current classification of silver as one of the precious metals. This definition takes its origin from the old alchemical notion that gold was the perfect end of all things; that silver was an intermediate step in the purification of gold. All other metals, according to the alchemists, were imperfect, and therefore "base."

Silver, to the alchemist, was in a curious position. Loath to classify it as a base material, yet not willing to admit that it was as perfect as gold, he allowed it an intermediate position somewhere between lead and gold. The idea was not without foundation. Silver is rarely found alone; in many deposits it is found either with gold, as electrum was in Lydia, or as in places in the Mother Lode – or in combination with gold, as it is in the gold-silver telluride ores of Colorado. In other deposits it is intimately mixed with the lead ore, galena, as it is in the ores of Inyo County's Cerro Gordo and Darwin mines.

Altogether, there are about 55 well-known silver minerals, of which six form the chief ore minerals of silver. These are native silver, 100 percent silver when pure; argentite, silver sulfide, about 87 percent silver; cerargyrite, silver chloride, about 75 percent silver; polybasite, silver-antimony sulfide, about 75 percent silver; proustite, silver-arsenic sulfide, about 65 percent silver; and pyrargyrite, another silver-antimony sulfide, about 60 percent silver.

Since the discovery of the New World, silver has been a curiously American problem. A tremendous stream of silver metal poured into Europe in the sixteenth, seventeenth, and eighteenth centuries, most of it stolen from the Incas and Aztecs in Peru, Boliva, and Mexico. The price of silver fell sharply as a result, but rose again after a peak in 1800, when the supply of easily procurable metal was depleted. From that time until the 1860's, though the price of silver was high, it was not used much as coinage in the United States, chiefly because there was not enough of it. After the discovery of the rich silver mines in Mexico and the western states in the 1860's, the Americas again took the lead in silver production, and for three-quarters of a century the western hemisphere has supplied about 80 percent of the world's silver, 65 percent of it mined in North America with Mexico presently leading with 30 percent, and the United States just behind producing 25 percent.

The story of silver mining in the United States has been an interesting, if at times, perplexing one. As early as 1650, the silver-lead mines at Middletown, Connecticut, were worked. Prospecting along the east coast continued as the nation grew. In 1792, the legal exchange ratio of gold: silver was established at 15:1.

By 1834, when silver was pouring in from the bonanza deposits of Ramos, Mexico, discovered in 1798, the exchange rate was lowered to 16:1. In the then western states of Michigan and Tennessee, the discovery of new deposits of lead and silver caused small rushes.

Meantime, in the southwest, silver mines were being worked, part of their products going to Mexico City. As early as 1680, monks of the Franciscan order worked the silver mines of El Paso, Texas. The mines were closed and hidden; though they were rediscovered in 1793, they were not reopened until 1872. Westward, in Arizona, Father Kino, a Jesuit priest, reported that

he found silver and gold among the possessions of the Yuma Indians on the Colorado River above the mouth of the Gila in Arizona as early as 1701. Late in the 18th century, the silver mines of Santa Rita, New Mexico, were shown to white men by a Yaqui Indian. The mines were intermittently worked until 1880.

The first large silver-lead mine west of the Rockies, the Mowry mine in Arizona, began operations in 1858. It is said that the mine furnished lead for Confederate bullets; at any rate, the plant of the mine was destroyed by Union troops in 1862.

In 1859, the fabulously rich Comstock lode was discovered. At first, the ore was not recognized as a carrier of silver; not until it was assayed at Ott's Assay Office in Nevada City, California, was its worth revealed: then the great silver rush began. Bonanzas in the Nevada area in the next few years came thick and fast. Before the mining was essentially terminated at the end of the century, more than two hundred million dollars worth of silver and three-quarters as much gold had been recovered.

Oddly enough, one problem of the Comstock mines derived from the great width of ore in the veins. In 1860, the Ophir mine was down a mere 180 feet, yet the ore body was 45 feet wide. The miners were at their wits end to find a way to support the back; ordinary posts and caps would not do, as they could not be procured long enough, and even if they could, they would not support the great weight.

Philip Deidesheimer, a man experienced in Californian and German mines, solved the problem. His plan to support the mines by framing timbers in cubes five or six feet square, piled together and secured—a type of timbering now known as "square set"—soon became common practice.

The heyday of the Comstock lode was in the middle 60's. In 1865, Montana silver lodes were discovered, and a smelting works for silver and lead opened at Argenta. This was the first suitable smelter for silver-lead on this continent. Ores mined earlier had been shipped to Swansea, Wales, for treatment. The next year, 1866, the Selby smelter was opened near San Francisco for processing the Nevada ores. In the late 60's, silver discoveries were made thick and fast in many of the western states: in Black Hawk Canyon, in Colorado, in the Magdalena Mountains, New Mexico, in Cottonwood Canyon, Utah, at Butte, Montana—even in the Seminole Mountains of Wyoming, where progress in mining was slow, no doubt discouraged by the fate of the discoverers, who had been killed by Indians.

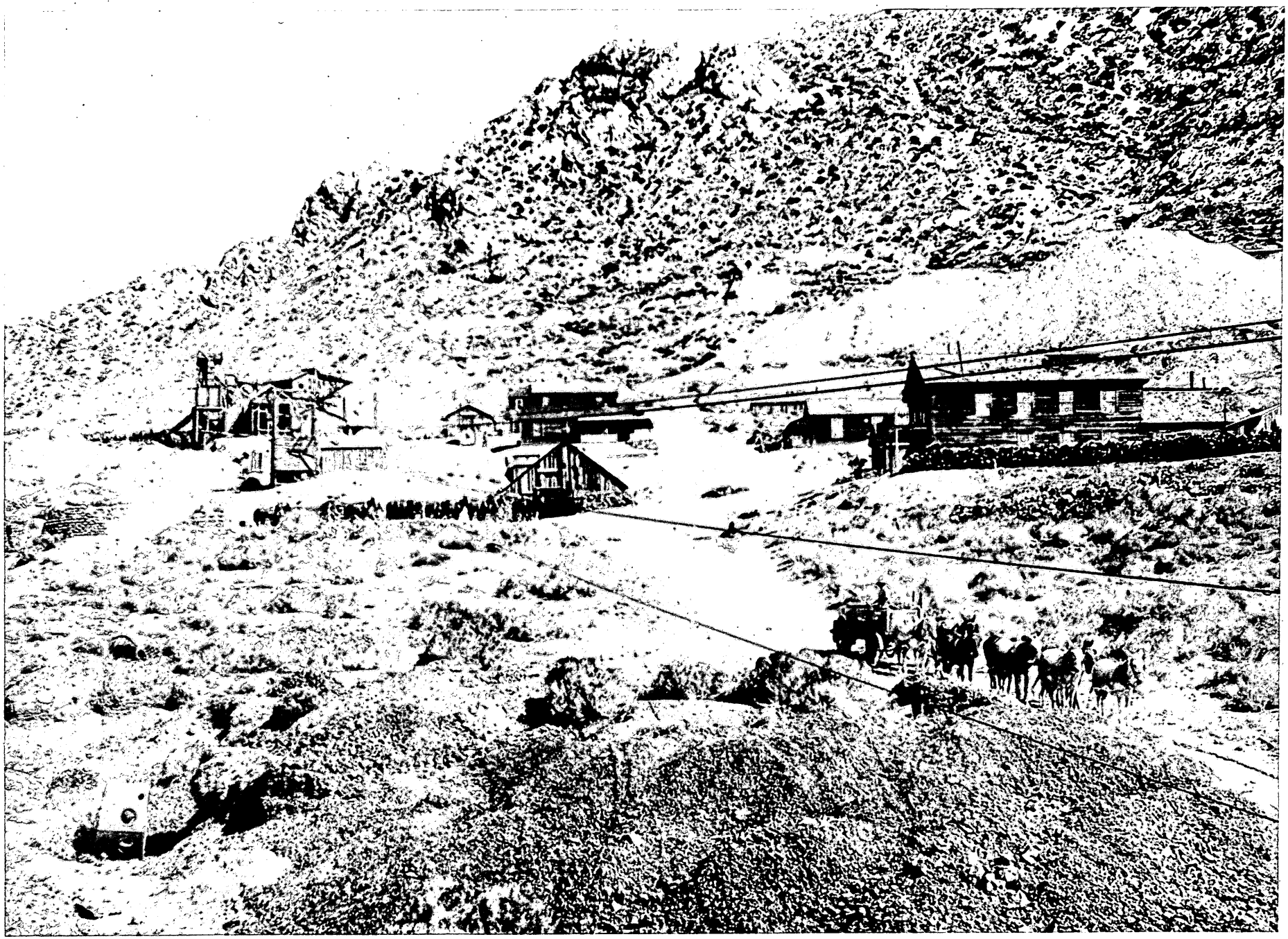
In 1873, a world-wide panic, reflected in the United States by the failure of more than 5000 commercial firms, gave rise to serious problems for the silver miner. The United States discontinued the coinage of silver dollars, which she had barely begun, and demonetized silver.

The problem did not become as serious then, however, as later. The 1870's and 80's saw the discovery and development of the great Colorado silver mines at Leadville, where the rich carbonate ore provided few dressing problems. The price of silver dropped, forcing the closing of many marginal mines. Leadville, Gunnison, and Aspen in Colorado and the silver chloride and carbonate mines of the Calico District in the Mojave Desert of California were rich enough and inexpensive enough to work to weather the storm. Leadville reached its peak in 1883; by 1891 the last shipment of lead carbonate ore left the mines and the district turned to more difficultly worked, less valuable ore.

In Leadville, as ever in bonanza towns, fortunes were changed overnight. The best known of the Leadville tycoons was H.A.W. "Silver Dollar" Tabor, who made and lost half a dozen millions in his lifetime, became Mayor of the town, Lieutenant Governor of the state, and even a member of the U.S. Senate for 30 days. In the later years of his life, at a time when he was down to his last million for the last time, he married a young entertainer, professionally called "Baby Doe." In 1899 Tabor died, and for many long and lonely years Baby Doe lived in a bare, windswept cabin on one of her claims, "The Matchless," on a mountainside overlooking the empty, windowless houses of the nearly deserted city. One bitter winter day in 1935, neighbors found her body, frozen for nearly a week.

California did not sit idly by while the rest of the country ran a fever of silver rushes. True, she has never been the top silver producing state, but her recorded total of more than 100 million fine ounces worth some 80 million dollars places her in the top ten among the states.

The history of California's silver mining is clouded in mythology. An old silver mine on the Alisal Ranch, east of the city of Salinas on the flank of the Gabilan Range, is said to have been worked as early as 1801. At any rate, at some early time a tunnel was run into the hill for 125 feet, and a winze was sunk from the end to a depth of about 50 feet. One legend says the work was done by Indians under the supervision of the Spanish Padres; another says it was the work of Chileans. A Mexican was supposed to have worked the veins in 1831; some Germans in '52. At some time one of the groups erected a small furnace on the property for smelting the ore, but after taking out some ore two



Cerro Gordo, Inyo County, at the turn of the century.

of the men went to the New Almaden mines to get an assay and never returned.

Another myth concerns the silver mines supposed to have existed around Mission San Fernando. According to reports, a Mexican, who was old in 1861, recalled that about the time of the turn of the nineteenth century a Mexican acquaintance of his was accustomed to leave the Mission loaded with a summer's supply of food and equipment. He would return in the fall with a load of silver bullion. He continued this for three seasons, but at the end of the fourth he failed to return. One interpretation of this story is that the Mexican had actually discovered the Calico mines in San Bernardino County; another interpretation is that he returned not with silver, but with antimony, which is known to occur near San Fernando, and which gave rise to silver speculation in the 1850's.

The most persistent of the lost mine rumors is the lost "Silver Gunsight." The number of variations of the story is as great as the number of tellers; it seems impossible, now, to discover the exact truth. In general, the story is something like this: In 1849, a party of emigrants searching for a short route to the gold fields through southern Sierran passes, chose to go across the Great Basin through Death Valley. At the time, they were trying to save about 500 miles of their journey by cutting directly across rather than taking the longer, better known route through Los Angeles. They entered Death Valley through what is now known as Furnace Creek Wash, and, believing the Panamints to be the Sierras, sent scouts ahead to find water and a pass for the wagons. There was no pass for the wagons, and very little water, but members of the advance group of the party – a group of young bachelors calling themselves the Jayhawkers – came upon a piece of float rock with pure metallic silver. As late as 1884, the rock was supposed to be in the possession of an old lady, one of the emigrants.

From there on the story is almost inextricably confused. The emigrants that came through Death Valley that year split into three groups: The Jayhawkers with the Briens, the Bennett-Arcane group, and the Martin and Wade parties. The Martins and the Wades continued south; the Jayhawkers, after burning their wagons, went almost due west; the Bennett-Arcane party waited – nearly disastrously – on the valley floor for two of their advance scouts to make the trip on foot to Mission San Fernando and back. There was one woman with the Jayhawker party; two with the Bennett-Arcane group; two, possibly more with Wade and Martin. Which of these was the owner of the silver, no rumor says. The "gunsight" part of the legend takes its origin from the tale that someone – one story says Captain Towne, head of the Jayhawkers, another says Ashael Bennett, another says Martin – lost the sight from his rifle while hunting for water. He fashioned a new one of pure, native silver.

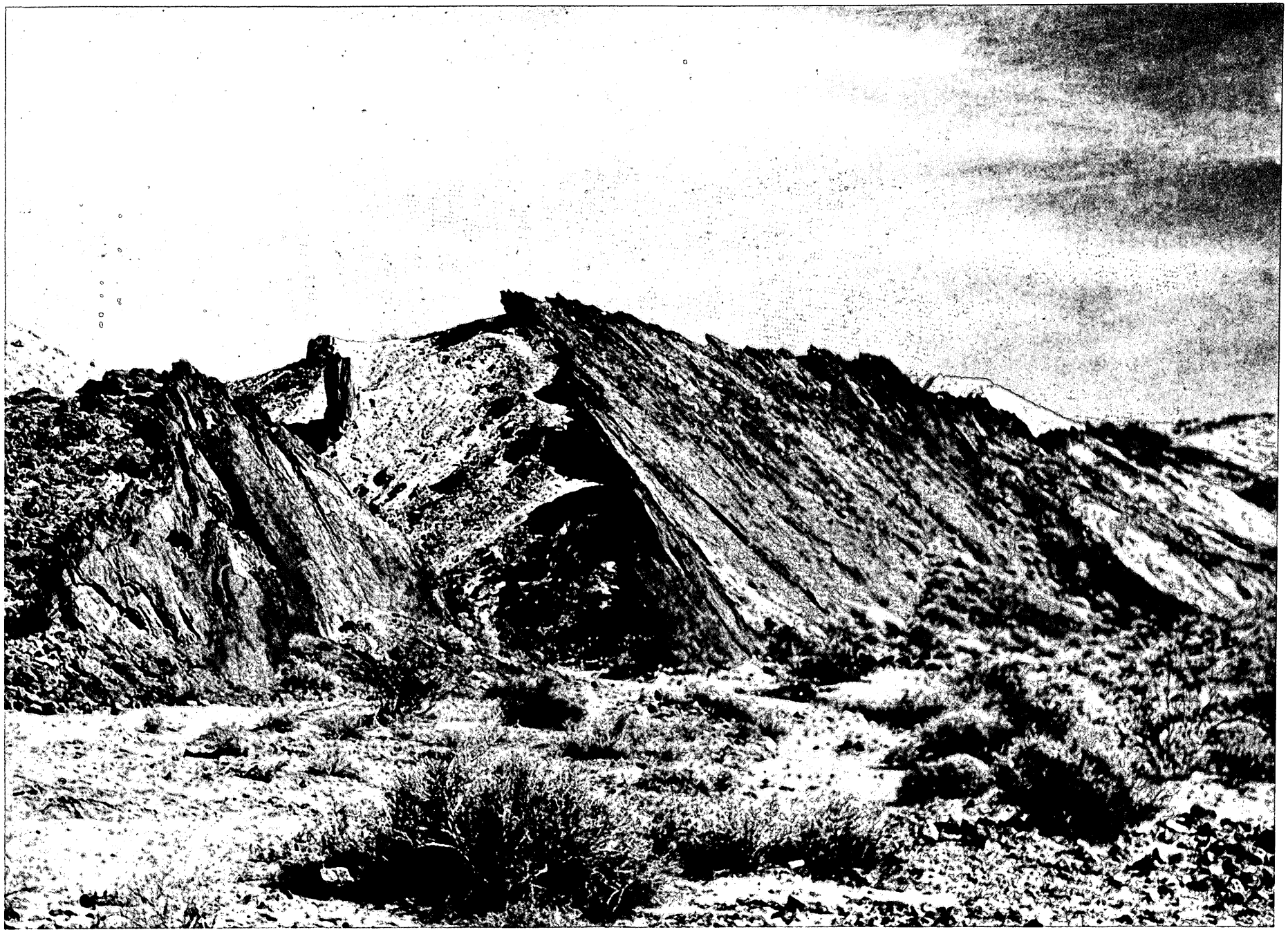
In the following years party after party, most of the earlier ones including one or more of the '49ers, sought in vain for the Lost Gunsight. It was never found – lost mines are seldom found. But the expeditions were not an entire failure. Wrote Henry G. Hanks, first State Mineralogist:

"While these [Lost Gunsight] expeditions generally ended in disappointment they have led to a knowledge of the country, the discovery of mines of antimony, silver, and gold, of unknown value, and now [this was written in 1883] of not less importance, borax fields. The discovery of Coso, Slate Range, Owens' Valley, Panamint, Argus, Telescope, Calico and other mining districts are the result of these expeditions."

Furnace Creek, locale of the "Lost Gunsight" incident, is supposed to take its name from another lost silver (or was it lead? or both?) mine. Tradition says that about 1858 a group of Mormons found silver ore in the Panamint Mountains, and produced some silver bullion from small furnaces at Anvil Springs and Furnace Creek. The church records mention the incidents briefly, but record them as lead mines. A later party, led by Dr. Samuel French, found the smelter at Furnace Creek, so the story goes, and named the creek for it. But even here there are variations. Furnace Creek, said another historian, just as positively, was named because of the climate; not so, said the editor of *Mining and Scientific Press* in 1884, it was called Furniss, spelled Furniss, for a man of that name.

Not all the silver was will-o-wisp. The big strikes in the Comstock lode caused a flurry of excitement in nearby, geologically similar Alpine and Mono counties. In Alpine County, luck was not with the miners. Though the silver production amounted to about $20,000 a year – the Colorado number 2 was the biggest producer – "the product of the bullion," said Mr. Hanks, glumly, "[was] in inverse ratio [to] the labor and capital expended on the mines."

Mono County was more fortunate. The Benton mining district, centered about Benton, the oldest mining town in the county, was rich in silver and gold. In the space of 6 years, some 4 million dollars worth of bullion was shipped from the district, much of it from the famous Blind Spring Hill. South, at Bodie, mining excitement was intense. Eighteen million dollars worth of silver and gold came from her ores in the 12 years of her greatest activity.



Rocks in the Calico Mountains, San Bernardino County. Silver deposits lay in a zone 5 miles long and 3 miles wide in colorful Tertiary beds.

Between Bodie and Benton there were several mining districts, and a great many mines. One of the best known today is the Tioga Mining District, operated entirely on the capital of the Great Sierra Mining Company. In 1882-83, the company built a wagon road, 56 miles long, from Bennetville in Mono County to Crockers in Tuolumne County, by way of Lake Tenaya and Yosemite Creek. Some of that road is now part of State Highway 120, the Tioga Pass road, traversing the heart of Yosemite National Park.

South of Bodie, Cerro Gordo, near Owens Lake in Inyo County, was the site of another silver story. There are conflicting tales as to its discovery; one version says that one Pablo Flores and two other Mexicans found the first ore in 1865; another says that a packer named Savariano, employed by a Comstock mine owner, found Cerro Gordo while absconding with his employer's bullion. At any rate, Cerro Gordo was found, and produced some 17 million dollars worth of ore, mostly silver and lead. The first ore was shipped to the Selby smelter in San Francisco; later a smelter was built on the shore of the lake at Swansea, named for the Welsh town where the first American silver ore was smelted.

Transportation of the bullion was a problem: at times the furnaces were shut down because the backlog of bullion was too great. Hauling was at first done entirely by teams, but this proved inadequate, and some steamers were constructed to transport the bullion across the lake. The most famous of these was the *Bessie Brady,* a vessel 85 feet long and 16 feet in beam. She plied the lake from Swansea at the northeast corner to Cartago, at the southwest. Even so, transport were slow, and it was not uncommon, W.A. Chalfant records in his book, *The Story of Inyo,* for the bullion to be piled up like cordwood at different points along the land route.

Today, Cartago is gone and Swansea can barely be found. What became of the *Bessie Brady* is another of those fascinating but elusive mysteries that bedevil the mining historian. One source says, in phrases that leave no room for doubt, that she was pushed on the shore, and years later her hulk was burned. Still another, just as positive but more romantic, asserts that she sank in the middle of Owens Lake leaving not a trace, and that her bones have yet to be recovered.

About the same time as the Cerro Gordo excitement, silver-bearing tetrahedrite with galena was found far up in Shasta County. The Chicago mine, in the South Fork Mining District, was the chief producer. The district was small, but the county's silver production is not. About 12 million dollars has been realized from the Shasta County silver since 1880, most of it won from other, copper-bearing,ores in the period 1895 to 1919.

The year 1873 was a year of silver strikes in two California localities widely divergent in geography and geology. One of these was the Panamint strike, made high in the Panamint Range above Death Valley. The town, Panamint City, is famous for having contained perhaps the highest concentration of desperados outside prison walls. Its history consists mostly of shootings and robberies, hangings and buryings. So insecure was law and order that Wells Fargo refused to establish an office. In desperation, the mining company moulded its bullion into 750-pound balls, too big for the bandits to steal.

The other silver rush of '73 became famous well beyond its actual importance chiefly because it had a good press agent. On the slopes of Mt. St. Helena in the Coast Ranges, silver was found, and several mines began operations. More than a million dollars worth of silver was recovered from two of them, the Silverado and the Palisade. The mines would be nearly forgotten were it not for a neighbor, there for his health, who gave it an added glamour. He was California's adopted son, Robert Louis Stevenson, and his contribution a book, *The Silverado Squatters.*

The following year, 1874, marked a discovery of considerable importance in California. Inyo County again took the spotlight, this time at Darwin. By 1880, the town had a population of 5000, and several smelters were at work processing the rich, oxidized lead-silver ore. And Darwin has proved its worth; in recent years it has been the chief source of lead in California with a total production of lead, silver and zinc of more than 15 million dollars.

More colorful than the mines of Darwin were the silver mines of the Calico District in San Bernardino County, discovered in 1881. Unlike Darwin, the Calico district ore was valuable, not for its base metals, with silver an incidental but important by-product, but for its silver. The ore consisted of chlorides and chlorobromides of silver in a gangue of barite and jasper. Most of the ore was easily worked, and during the heyday of Calico operations, 1883-85, pockets of cerargyrite and native silver yielded ore worth as much as $2000 a ton. During those years the county produced nearly 6 million dollars worth of silver, mostly from the Calico mines. The peak of activity was reached in 1890, when as many as 700 men were employed in the mines and mills, and the monthly output of bullion was rated at $200,000.

Remains of the Palisade mine, Sonoma County. The mine is celebrated in *The Silverado Squatters*, by Robert Louis Stevenson.

The drop in the price of silver in 1896 to 57 cents an ounce forced most of the mines to close, as they had worked out most of the easily mined and dressed material. Since then, operations have been small and intermittent.

Calico did not recover. The ores, which yielded silver worth more than 65 million dollars, are no longer mined.

But Calico is not empty. At present, the town is being revived by the owners of Knott's Berry Farm near Los Angeles, who have reconditioned it so as to present to the sight-seeing public a commercial replica of Calico of the old days.

California's last big silver strike came at a propitious time. In 1918, near the close of World War I, Congress passed the Pittman Silver Act, which provided that the U.S. Government would buy silver from the miners at a dollar or more an ounce, more than twice its previous price.

In 1919, when purchases on the Pittman Act were barely underway, two prospectors, out looking for red paint pigment in an effort to find something – anything – that would keep the old desert boom camp of Randsburg going, found horn silver. The ore was rich: two samples the prospectors grabbed a few feet off the road on their way home assayed $60 worth of gold, and 436 ounces of silver. The town came to life again, and from the midst of the ground that had already been plowed over for tungsten and gold, came millions of dollars worth of silver. The California Rand, also called the Kelly mine, richest of the Randsburg group, contributed more than half the silver mined in San Bernardino County, leading silver county in California. In the five years after its discovery – 1919 to 1924 – the California Rand produced 10 million dollars worth of silver and gold. The ratio of silver to gold averaged about 350:1, though the ratio was very erratic. In contrast, the nearby Yellow Aster, oldest of Randsburg's mines, was one of the best gold-producers; its ore averaged $1000 worth of gold to $5 worth of silver.

Some of the silver ore, which consisted chiefly of silver, arsenic, antimony, and sulfur compounds together with some of the "horn-silver" or silver chloride found by the original discoverers, was very rich. The richest – from the Treasure Box vein – assayed as high as 13,000 ounces of silver per ton, chiefly in argentite, horn silver. In its early days, the California Rand was literally without a dump. All the rock taken out was high-grade, producing ore worth more than $300,000.

A tour of the streets of Randsburg and her sister towns, Johannesburg and Red Mountain, is reminiscent of the entire history of silver mining: Comstock, Colorado, Couer d'Alene, Ophir, Panamint, Johannesburg, and, of course, Silver.

Perhaps the days of silver bonanzas are over; perhaps the rich, cheaply mined ores are depleted; perhaps not. One is all too well aware of the silver that was overlooked at Randsburg, and of the pitchblende, an irritating contaminant that was thrown on the dumps in Colorado's Idaho Springs, to be too dogmatic concerning any part of the mining industry.

An excellent bibliography on silver in California is in Richard M. Stewart's "Silver" in the Division's Bulletin 176, *Mineral Commodities of California. (In print, $7.50.)*

New books by other publishers

Structure and stratigraphy in the central Toiyabe Range, Nevada. By W.D. Means. 1962. Published in University of California Publications in Geological Sciences, vol. 42, no. 2, pp. 71-110. University of California Press, Berkeley and Los Angeles. Price $2.00. Available from the University of California.

New books by other publishers

Beryllium: Evaluation of deposits during prospecting and exploratory work. By A.A. Beus. Edited by Lincoln R. Page and R.K. Harrison. Translated from the Russian by F. Lachman. 1962. Published by W.H. Freeman and Company, 660 Market Street, San Francisco. 161 pp. Price $5.00.

During the last decade or so, beryllium has become a very important industrial metal, especially for heat resistant alloys used in the manufacture of aircraft, missiles, space vehicles, and nuclear reactors. Unfortunately, the United States is critically short of domestic reserves of beryllium minerals and must import a very large part of its supply. With this in mind, apparently, W.H. Freeman and Company of San Francisco have recently published an English translation of this short Russian book, which was first published in 1956.

Its author, A.A. Beus, is a member of the Academy of Science, Moscow, USSR.

The book is divided into two parts. The first part, which is largely introductory, is called "Occurrence, minerals, geochemistry, and deposits" (pp. 3-97).

The section on "deposits" is a lengthy and well-illustrated technical discussion of the types of beryllium deposits. The second part of the book is its heart: it is named "prospecting for and evaluation of beryllium deposits" (pp. 100-153). This part begins with a chapter on methods of prospecting in both small areas (scale 1:100,000 to 1:200,000) and in areas of pegmatite and non-pegmatite mineralization. The second chapter consists of a description of the methods used to make preliminary evaluations of deposits during prospecting. The next two chapters are on methods of exploration and sampling of deposits; and the book concludes with a chapter on "methods of rating and grading the [beryllium] resources into categories".

The book was written by a geologist principally for geologists, but because no other book attempts to cover its specific field, it should be a part of the library of every beryllium prospector. The only negative aspect to the book is that it is based largely on Russian work done before 1954; since that year a relatively great volume of knowledge has been added to the literature of beryllium. In addition, methods of prospecting for beryllium by nuclear detection have been developed and are very important.

A sampling of the literature published since this work was done follows:

Occurrence of non-pegmatite beryllium in the United States, by L.A. Warner, W.T. Holser, V.R. Wilmarth, and E.N. Cameron. U.S. Geological Survey Prof. Paper 318, 1959, 198 pp. ($2.25, U.S. Govt. Printing office, Wash. D.C.; includes section named "Commercial possibilities and suggestions for prospecting").

Field test for beryllium, by W.M. Dressel and R.A. Ritchey. U.S. Bur. Mines Inf. Circular 7946, 1960, 5 pp. (15¢, U.S. Govt. Printing office, Washington, D.C.)

Field test for beryllium minerals: the Morin fluorescence method, by T.N. McVay. U.S. Bur. Mines Rept. Investigations 5620, 10 pp., 1960. (Free, if still in stock, from Publications Distribution Center, Bureau of Mines, 4800 Forbes Ave., Pittsburgh, Pennsylvania.)

A preferential stain for beryl, by S.G. Ampran. U.S. Bur. Mines Report Investigations 6016, 1962, 4 pp. (Free from U.S. Bur. Mines Publications Distribution Center. Fine particles of beryl can be identified by use of stain test.)

Inyo beryl deposit, Inyo County, California, by W.T. Benson. U.S. Bur. Mines Report Investigations 6013, 1962, 8 pp. (Free from U.S. Bur. Mines Publications Distribution Center.)

The book reviewed above is not available from the Division of Mines and Geology, which distributes only its own publications. A copy is available in the Library, however, for reference.

...F.H.W.

MINERAL MARKETING

The following quotations are taken from *Engineering and Mining Journal Metal and Mineral Markets,* published weekly McGraw – Hill Publishing Company.

Metals – April 22, 1963

Copper, electrolytic, 30.6¢ per pound, domestic refinery, weekly average.

Lead, refined, 10.3¢ per pound, St. Louis; 10.5¢ per pound, New York.

Mercury (Quicksilver), prime virgin, $185 to $188 per flask, New York.

Platinum, $77 to $80 per troy ounce.

Silver, $1.27½ per troy ounce.

Zinc, prime Western, 11.5¢ per pound, East St. Louis.

Metallic Ores – April 22, 1963

Antimony ore, per short ton unit Sb, lump:

50% to 55%	...$3.40 to $3.65
60%	...$4.00 to $4.20
65%	...$4.25 to $4.35

continued on page 16

PRODUCERS OF ROOFING GRANULES IN 1962

Operator	*Address*	*Type of Stone*
Calaveras County		
Altaville Aggregates	P.O. Box 266, Altaville	Rhyolite
Candy Rock Quarry	P.O. Box 295, Avery	Rhyolite (?)
El Dorado County		
El Dorado Limestone Co., Inc.	Shingle Springs	Limestone
Placerville Slate Products Co.	P.O. Box 63, Placerville	Slate
Imperial County		
Don M. Weaver	P.O. Box 536, Jacumba	Basalt
Inyo County		
Premier Marble Products	909 So. Fremont Ave., Alhambra	Marble
Kern County		
W.M. Barnes Co.	980 Orlando Rd., San Marino	Misc. stone
Desert Rock Milling Co.	974 Dale St., Pasadena	Misc. stone
Mojave Rock Products	9452 E. Garvey, El Monte	Sandstone
John W. Nicoll	Weldon	Misc. stone
Otis Turk	27510 Maple St., Taft	Dolomite
Cima-Cinders, Inc.	1392 So. Orange Dr., L.A.	Volcanic cinders
Lake County		
Cinder Products Co.	321 E. 12th St., Oakland	Pumice
Los Angeles County		
Pyramid Rock Co.	113 N. Vineland Ave., City of Industry	Granite and ceramics
Bill and Rudy's Sand and Gravel	P.O. Box 1096, Walteria	Gravel
Chas. G. Hardy, Inc.	7757 E. Alondra Blvd., Paramount	Misc. stone and ceramics
Consolidated Rock Products	2730 So. Alameda, L.A. 54	Granite
Hammer Milled Colored Rock	1850 Woodlyn Rd., Pasadena	Misc. stone
Mariposa County		
John Kingman	Star Route, Mariposa	Slate
Monterey County		
Kaiser Aluminum and Chemical Corp.	1940 Broadway, Oakland	Dolomite
Seaside Sand and Gravel Co., Inc.	P.O. Box 513, Seaside	Sand
Riverside County		
H.T. Lucas Mining Co.	1534 N. Hobart Blvd., L.A.	Limestone
Minnesota Mining and Mfg. Co.	Temescal Canyon, Corona	Volcanic rock
Sno Rock	7000 - 27th St., Riverside	Limestone
Western Rock Prod.	6891 Brockton Ave., Riverside	Limestone
San Bernardino County		
Brubaker - Mann, Inc.	30984 Soapmine Rd., Barstow	Misc. stone
Industrial Mining and Milling Co.	1420 W. Main St., Barstow	Misc. stone
Industrial Rock Prod. Co.	20801 Kendall Drive, San Bernardino	Limestone
Marble - White Dolomite, Inc.	P.O. Box 487, Lucerne Valley	Dolomite
Mineral Wool Insulations	P.O. Box 96, Fontana	Slag
Partin's Limestone Products	20225 Kendall Drive, San Bernardino	Limestone
Rainbow Rock, Inc.	P.O. Box 306, Barstow	Misc. stone
Victorville Lime Rock Co.	P.O. Box 548, Victorville	Limestone
San Diego County		
Don M. Weaver	P.O. Box 174, San Diego	Basalt
Santa Barbara County		
Airox Co.	307 W. 8th St., L.A.	Diatomite
Santa Clara County		
Mirassou Bros.	15630 Harwood Road, Los Gatos	Rhyolite
Siskiyou County		
Siskiyou Stone, Inc.	P.O. Box 187, Yreka	Misc. stone
Tuolumne County		
Norman Tune	Highway 108, Twain Harte	Misc. stone

The January, 1963 issue of *Mineral Information Service* contained an article entitled *Roofing rock: quality and specifications.* It was written by Stuart H. Ingram, consulting mining engineer of Pasadena. The Division has received numerous compliments on Mr. Ingram's article.

We are pleased to present the adjacent table, a list of roofing granule producers, as a supplement to Mr. Ingram's paper.

The Division has in print a guidebook to Yosemite Valley and Merced Canyon. Entitled *Geologic guide to the Merced Canyon and Yosemite Valley, California,* Bulletin 182 is priced at $1.50. Besides discussions on the geology of the general area, the guide contains road logs that one can use to trace the geology across the Coast Ranges and San Joaquin Valley into the Yosemite. Three photographs by Ansel Adams are among the numerous illustrations.

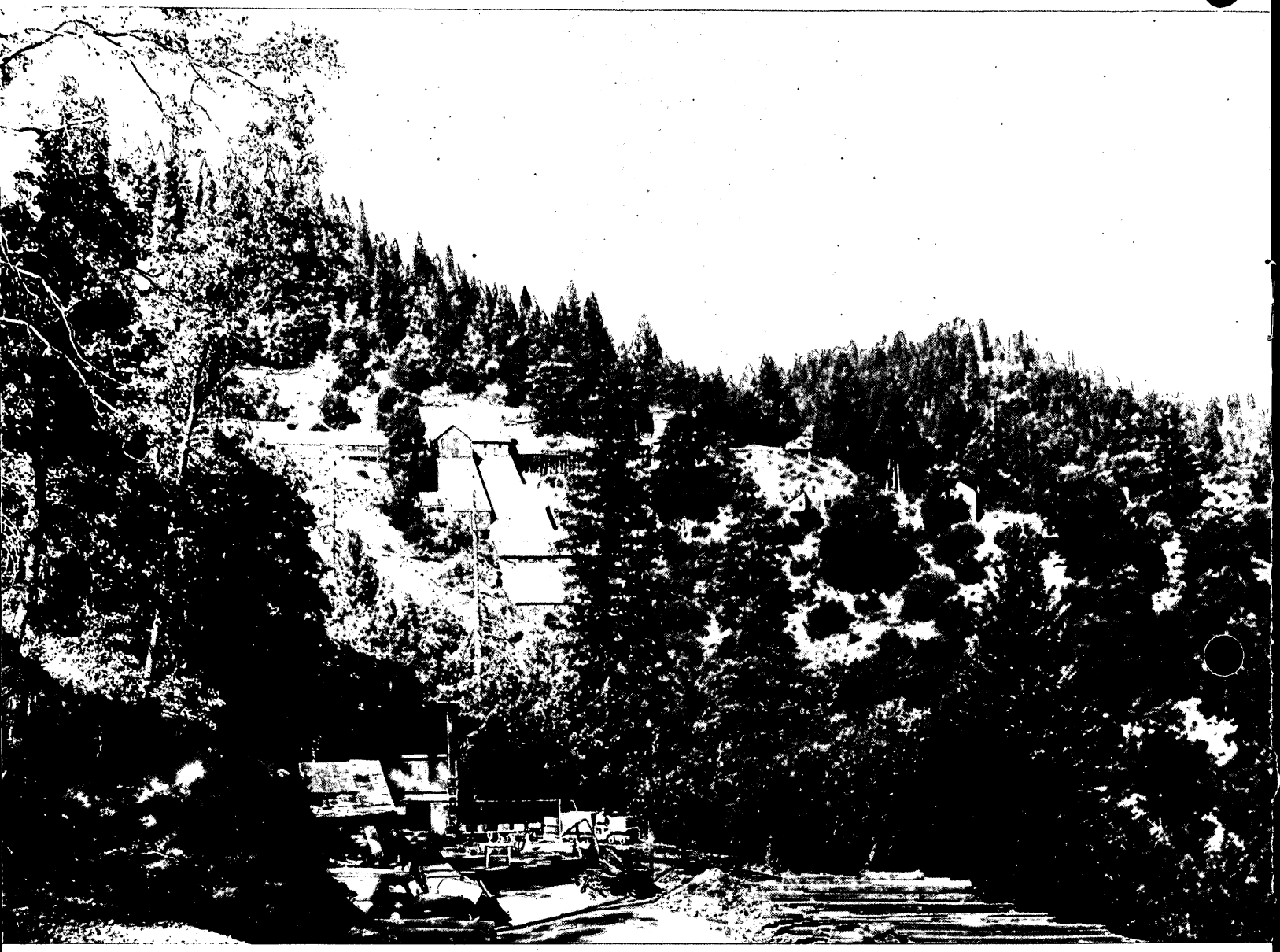
Muir on Yosemite...

Photo by Mary Hill.

The most famous and accessible of the canyon valleys of the Sierra Nevada, and also the one that presents their most striking and sublime features on the grandest scale, is the Yosemite, situated in the basin of the Merced River at an elevation of 4000 feet above the level of the sea. It is about seven miles long, half a mile to a mile wide, and nearly a mile deep in the solid granite flank of the range. The walls are made up of rocks, mountains in size, partly separated from each other by side canyons, and they are so sheer in front, and so compactly and harmoniously arranged on a level floor, that the Valley, comprehensively seen, looks like an immense hall or temple lighted from above.

But no temple made with hands can compare with Yosemite. Every rock in its walls seems to glow with life. Some lean back in majestic repose; others, absolutely sheer or nearly so for thousands of feet, advance beyond their companions in thoughtful attitudes, giving welcome to storms and calms alike, seemingly aware, yet heedless, of everything going on about them. Awful in stern, immovable majesty, how softly these rocks are adorned, and how fine and reassuring the company they keep: their feet among beautiful groves and meadows, their brows in the sky, a thousand flowers leaning confidingly against their feet, bathed in floods of water, floods of light, while the snow and waterfalls, the winds and avalanches and clouds shine and sing and wreathe about them as the years go by, and myriads of small winged creatures – birds, bees, butterflies – give glad animation and help to make all the air into music. Down through the middle of the Valley flows the crystal Merced, River of Mercy, peacefully quiet, reflecting lilies and trees and the onlooking rocks; things frail and fleeting and types of endurance meeting here and blending in countless forms, as if into this one mountain mansion Nature had gathered her choicest treasures, to draw her lovers into close and confiding communion with her.

... John Muir, *The Yosemite.*



View east of the Gold Crown mine (foreground) and Sixteen-to-One mine and mill.

GOLD MINING AT ALLEGHANY

by William B. Clark

The Sixteen-to-One mine at Alleghany in Sierra County, one of the last active underground gold mines in California and also one of the most famous, has recently curtailed mining operations. The property is now being operated on a reduced basis with only a small crew. This mine has been the largest source of gold in the Alleghany district. Although the exact total is unknown, available figures indicate the mine has yielded around $30 million worth of gold during its long history.

The Sixteen-to-One mine is a consolidation of a number of properties, the most important being the Tightner, Twenty One, Rainbow, Red Star, and Osceola. The Tightner vein was first discovered in the early days during placer mining operations, but little attention was paid to it for many years. In 1905 (erroneously given as 1907 in many reports), H.L. Johnson reopened the old adit and discovered high-grade ore in the vein. This led to a revival of lode mining in the district which has continued up until

the present time. Other mines in the Alleghany district which are presently active or which have been worked in recent years include the Brush Creek, Kate Hardy, Mugwump, Gold Crown, El Dorado, Gold Canyon, Irelan, Oriental, Wyoming, Morning Glory, Mariposa, and Yellowjacket.

This district is located in a major belt of gold mineralization that extends from Goodyear's Bar to the south and southeast through Forest, Alleghany, Chip's Flat, and Minnesota in Sierra County and continues into the Moore's Flat and Washington districts in Nevada County. That portion of the belt in Sierra County has yielded more than $50 million worth of gold, much of it from small but extremely rich high-grade ore bodies. Individual ore shoots range from those that contain a few hundred dollars to those that have yielded hundreds of thousands of dollars. At the Sixteen-to-One mine, one ore body about 40 feet long yielded nearly $1,000,000. Another at the Oriental mine, which was 14 by 22 feet as seen in the section of the vein, contained $736,000. Also there were several rich placer deposits in the district, the most notable being at the Bald Mountain and Ruby drift mines. During the late 1930s a number of fist-sized nuggets were recovered in the Ruby mine. These are displayed each year in the Sierra County exhibit at the California State Fair.

This area is underlain by north and northwest-trending beds of metamorphic rocks of the Calaveras group (Carboniferous to Permian?), serpentine, amphibolite, and greenstone. In this portion of the Sierra Nevada, the Calaveras group has been divided into five formations: 1) Blue Canyon slates, 2) Tightner hornblende-chlorite schist, 3) Kanaka conglomerate, chert, and slate, 4) Relief quartzite, and 5) Cape Horn slate. These rocks have been invaded by many basic and ultra-basic intrusions, which have been serpentinized. The gold quartz veins strike in a northerly direction, dip either east or west, and usually range from 2 to 5 feet in thickness. The gold occurs in the free state commonly with arsenopyrite but with only small amounts of other sulfides. The numerous serpentine bodies with associated mariposite or "bluejay" are structurally important in the localization of the ore bodies. The quartz veins tend to bend or fray near serpentine, and it is in these bent or frayed portions where high-grade ore shoots commonly are found. Vein junctions also are important locations for the occurrence of high-grade ore.

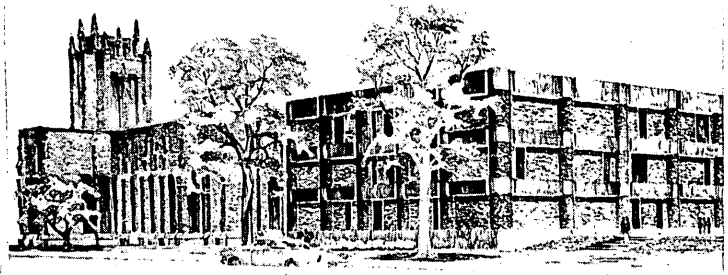
Bibliography

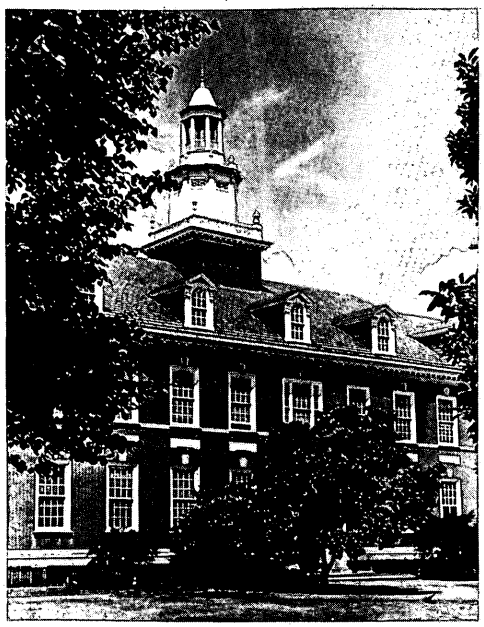
Averill, C.V., 1942, Mines and mineral resources of Sierra County: California Journal of Mines and Geology, vol. 38, pp. 7-67 (price 60¢).

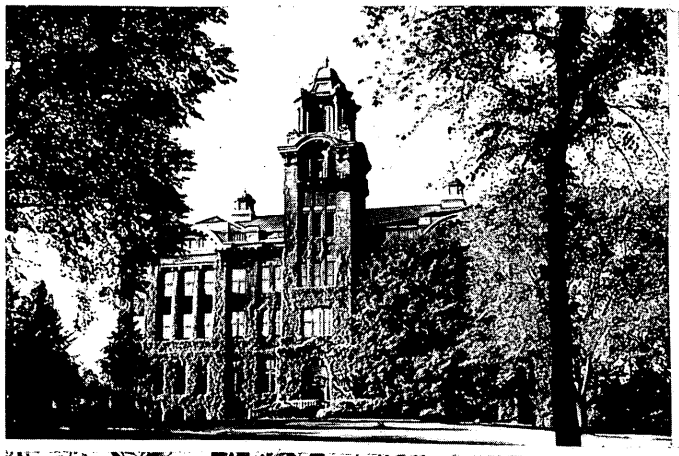
Carlson, D.W., and Clark, W.B., 1956, Lode gold mines of the Alleghany-Downieville area, Sierra County: California Journal of Mines and Geology, vol. 52, 237-272 (price $1.00).

Ferguson, H.G., and Gannett, R.W., 1932, Gold-quartz veins of the Alleghany district, California: U.S. Geol. Survey Prof. Paper 172, 139 pp.

Ore train entering the main adit, Brush Creek mine.







New book

The cover, both inside and out, and the title page of new Special Report 74 are montages of photographs of some portion of the campus (geology building, where possible) of the various institutions whose students contributed to the list of theses on California geology. Some of the photographs were received too late to use on the report itself; they are shown in the montage on the adjacent page. These are, left to right and top to bottom:

Upper left: View through Van Wickle Gates at University Hall, the main administration building of Brown University, Providence, Rhode Island. This is the original college edifice, built in 1770. It is one of the seven college buildings in the United States built before the Revolutionary War that is still standing.

Upper right: Kline Geology Laboratory, now under construction at Yale University, New Haven, Connecticut. This building is the first of a group of four comprising the planned Kline Science Center.

Second row, left: Johns Hopkins University, Baltimore, Maryland.

Second row, right: University of Utah, Salt Lake City. A new geology and earth sciences building is planned for this campus soon.

Third row, left: Lyman Hall, Syracuse University, New York.

Third row, right: Main quadrangle of the River Campus, University of Rochester, New York. The Geology Building is the nearest one on the right hand side.

Bottom left: Geology Building, George Washington University, Washington, D.C.

Special Report 74, *Index to graduate theses on California geology*, compiled by Charles W. Jennings and Rudolph G. Strand, is now being distributed. This index will be of great value to anyone working in California, as it contains a listing of unpublished material that is not available elsewhere.

This index is a systematic compilation of references to geologic theses prepared while compiling the Olaf P. Jenkins edition of the Geologic Map of California, scale 1:250,000. For many areas of the state, unpublished doctor's and master's theses are the only source of available geologic information, hence are essential for preparing a new map. The Division of Mines and Geology frequently refers geologists and engineers who are seeking information on specific areas to the valuable information in theses; the object of this bibliography is to indicate the sources of such information to everyone concerned with the geology of California. It is a companion reference to the Division's Special Reports 52 and 52A *Index to Geologic maps of California*, which are guides to all published geologic mapping in California through 1960.

In order to make this index as complete and accurate as possible, the library catalogues of all institutions in California granting advanced degrees were searched for appropriate theses. These were cross checked by comparing with all available geology department listings of theses. Bachelor theses were not included. Titles of master's and doctor's theses in fields related to geology were considered, and all that appeared to contain information on California geology were included. Consequently, besides titles in geology and paleontology, this index includes most thesis titles from the departments of geophysics, geochemistry, seismology, mining, and oceanography, as well as selected theses in the fields of petroleum engineering, soils science, geography, physics, biology, and botany. In addition, many theses on California geology from out-of-state schools were included. These were obtained primarily from *Bibliography of theses in geology* by John and Halka Chronic and the Petroleum Research Corporation, published in 1958, and *Dissertation abstracts* published by University Microfilms, Inc.

Approximately 1,200 theses are listed in this report, of which about 70 are from schools outside the state. The earliest thesis recorded in this index is dated 1892, and the listings continue through 1961. Thus, references to nearly 70 years of student geologic research are included.

Included with the report is a map of California, on a scale of 1:1,000,000 (or 1 inch equals approximately 16 miles) that uses the outlines of the U.S. Geological Survey topographic quadrangles as a base upon which to plot the thesis locations.

Price of the new report is $1.00, plus tax.

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continued from page 9

Chrome ore, per long ton, dry basis, subject to penalties if guarantees are not met, f.o.b. cars, Atlantic ports: Turkish ore 48% Cr_2O_3, 3 to 1 chromium to iron ratio, $36. to $38., nominal.

Manganese ore, Indian, 46% to 48% Mn, export duty included, nominal at 80¢ to 85¢ per long unit, c.i.f., U.S. ports, import duty extra.

Tungsten ore, U.S. scheelite, f.o.b., mill, $16. to $18. per short ton unit, 65% WO_3.

Industrial Minerals

Prices depend upon chemical analysis, physical properties, color and impurities. Market may be limited.

Barite, per short ton, carload lots, f.o.b. shipping point: drilling mud grade, 83% to 93%, $BaSO_4$, 3% to 12% Fe, gravity 4.25, crude $14 to $16; chemical grade, 95% $BaSO_4$, 1% Fe, hand-picked, $18.50.

Feldspar, per short ton, f.o.b. shipping point, North Carolina, bulk: 20 mesh semi-granular, $7.50; 40 mesh, glass, $13.50.

Fluorspar, per short ton, f.o.b. Illinois and Kentucky, bulk: metallurgical grade, 70% CaF_2, $35 to $37; acid grade, dry, 97% CaF_2, $45, carload lots,

Graphite, per metric ton (2204 pounds), amorphous, f.o.b. mine, bulk, Mexican, $17 to $20.

Magnesite, per short ton, f.o.b. Washington, bulk, carload lots, crude $27.50.

Mica, per short ton, North Carolina district: scrap, depending on grade, $30 to $40.

Phosphate, per long ton, f.o.b. mine, Florida pebble: 70% to 72% tricalcium phosphate, $6.11.

California Market Quotations

The following quotations are from San Francisco area processors and dealers, and were those in effect on May 1, 1963.

Industrial Minerals

Prices depend upon chemical analysis, physical properties, color and impurities. Market is generally limited.

Barite, 90% to 98% $BaSO_4$, crude, $16 per short ton, San Francisco area.

Bentonite, Wyoming type, carload lots, pulverized 200 mesh, $34 per short ton, San Francisco area.

Fire clay, crude, $7 per short ton depending on quality, San Francisco.

Limestone, crude, white, 97% $CaCO_3$, $7.40 per short ton, San Francisco.

Soapstone, crude, $8 per short ton, San Francisco area.

The following quotations are from Los Angeles area processors and dealers, and were those in effect on May 1, 1963.

Barite, crude, 4.20 specific gravity or higher, f.o.b. north-central Nevada railpoints – about $5.50 to $8 per short ton; California ore: delivered to northern California mills – about $12 to $16 per short ton; delivered to southern California mills – about $15 to $18 per short ton. Ground, 95% through 325 mesh, bagged, for use in drilling, wholesale about $25 to $30 per short ton, f.o.b. mill.

Fire clay: crude $5 to $10 per short ton, depending on grade, f.o.b. mine, southern California area.

Perlite, crude, $7 to $8 per short ton, f.o.b. mine; processed, 80¢ per sack of 4 cubic feet, f.o.b. Los Angeles area.

Talc, crude, about $14 to $18 per short ton, f.o.b. railroad, Death Valley talcs; $20 to $25 per short ton for pure crude talc, f.o.b. railroad, Owens Valley talcs; $8 to $14 per short ton, f.o.b. railroad, talc refuse and soapstone from Owens Valley.

Order form

Please send me:

....copies, Special Report 74, *Index to Graduate Theses on California Geology*, at $1.00 each.

....copies, Bulletin 176, *Mineral commodities of California*, at $7.50 each.

....copies, Bulletin 182, *Guide to the Yosemite Valley...*, at $1.50 each.

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CITY.....*ZONE*.....*STATE*.....*AMT. ENCLOSED $*.....

Address orders to the California Division of Mines and Geology, Ferry Building, San Francisco 11, California. Check and money orders should be made payable to the Division. No postage is required; please do not send stamps in payment. California residents please add 4% sales tax.

{Aperη}

MINERAL INFORMATION SERVICE

A PUBLICATION OF THE CALIFORNIA DIVISION OF MINES AND GEOLOGY

VOLUME 20 NUMBER 2

FEBRUARY 1967

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STATE OF CALIFORNIA ▪ THE RESOURCES AGENCY ▪ DEPARTMENT OF CONSERVATION ▪ DIVISION OF MINES AND GEOLOGY

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MINERAL INFORMATION SERVICE is designed to report on the progress of earth science in California, and to inform the public of discoveries in geology and allied earth sciences of interest and concern to their lives and livelihood. It also serves as a news release on mineral discoveries, mining operations, statistics of the minerals industry, and new publications. It is issued monthly by the California Division of Mines and Geology. Subscription price, January through December, is $1.00.

Other publications of the Division include the Annual Report of the State Geologist; the Bulletin, Special Report, Map Sheet, and County Report series; the Geologic Map of California; and other maps and publications. A list of the Division's available publications will be sent upon request. Communications to the Division of Mines and Geology, including orders for publications, should be addressed to the San Francisco office.

MARY R. HILL, *Editor*

MAP PRICES GO UP

The U.S. Geological Survey has announced that, as the result of a recent analysis of costs, map prices will be increased. The new prices and discounts became effective October 1, 1966, and they have been announced by the Survey as follows:

The list price of topographic quadrangle maps at scales 1:24,000, 1:31,680, 1:62,500, 1:63,360, and 1:125,000 is 50 cents each. The list price of topographic maps at scale 1:250,000 is 75 cents each. National Park and other special topographic maps are individually priced. A price list is available from the U.S. Geological Survey, Washington, D.C., upon request.

AWARD TO LYDON

Philip A. Lydon of the Division of Mines and Geology staff has been made the recipient of a Sigma Xi grant-in-aid. The grant, presented by Dr. Harlow Shapley, Chairman of the Sigma Xi Grants-in-Aid of Research Committee, was made in order to assist Mr. Lydon in his study of the geology of the Butt Mountain area, a source of the Tuscan Formation in northern California. Mr. Lydon has been on educational leave for two years, and began study of this area at the University of Oregon in Eugene, Oregon, where he is a candidate for the Ph.D. degree.

FIRST LADY TO RECEIVE MINERAL BROOCH

The American Federation of Mineralogical Societies is directing the preparation of a special jeweled brooch for the First Lady, Mrs. Lyndon B. Johnson. The brooch will contain at least one gem or mineral from each of the fifty states. California will be well represented by three contributions: several ounces of gold were contributed by the San Francisco Gem and Mineral Society; pink tourmaline was donated by Mrs. Goldie E. Wood, of the Los Angeles Lapidary Society, and by Captain John Sinkankas; and rare benitoite was contributed by Glen A. Frost. Among other interesting gems and minerals in the brooch are Arkansas diamonds, a North Carolina ruby, Hawaiian black coral, and petrified wood from West Virginia.

After receiving this unusual piece of jewelry at the National Gem and Mineral Show in Washington (June 29-July 2, 1967), Mrs. Johnson will present it to the Smithsonian Institution for the use of all First Ladies.

FILMS

In this column, which will appear from time to time, we hope to list films concerning the earth sciences. We would like to borrow a review print from film makers or distributors who have films for use by schools, mineral societies, technical organizations, or other groups.

Erosion: leveling the land. Copyright 1964. Encyclopaedia Britannica Films, Earth Science Series, produced in collaboration with the American Geological Institute. 14 min. 16mm. color or b-w. Chief Science Advisor: John S. Shelton. Producer: Stanley Croner; Director: H. William Varney; Photographers: I. Mankofsky, Paul Leimbach. Available by purchase from Encyclopaedia Britannica Films, 1150 Wilmette Avenue, Wilmette, Illinois 60091. Price: color, $150; black-and-white, $75. Suitable for Junior High, High School.

Purpose of the film is to show how erosion, acting through wind and weather, wears the mountains down to dust. As is true of others in the EBF-AGI Series, it succeeds admirably. It is a good film to introduce geology to a naive audience.

Particularly effective are shots of Cleopatra's Needle, taken a century apart; a nail rusting, a milk bottle freezing, artificial rain wearing away limestone—all while one watches, thanks to time-lapse techniques.

Teachers who have attempted to encourage students to see in three dimensions will be very interested in a clay model that is used to reveal structure by means of a table knife. The clay strata are artificial, but a natural sand dune in another shot is just as neatly sliced by a shovel (in the hands of the science advisor), and shows just as tidy banding.

The Airborne magnetometer. n.d. Produced by the U. S. Geological Survey. 34 min. 16 mm., black-and-white. Available on loan from Information Offices, U. S. Geological Survey, 300 North Los Angeles Street, Los Angeles; or 468 Custom House, Denver, Colorado; or Room 2647, Interior Building, Washington, D.C. 20242.

The longer version is detailed presentation of the methods of aerial magnetic surveying. For those wishing to know how to make such a survey (university classes, for example), this is a thorough introduction. It is not suitable for younger or nonprofessional groups. . . . M.R.H.

Genesis of riches

SILVER DEPOSITS OF THE CALICO DISTRICT

By F. Harold Weber, Jr.

Third of three parts *

The principal silver mineral of the Calico district and vicinity has been cerargyrite (naturally occurring silver chloride, colloquially called "horn silver"). It is a soft, waxy-looking mineral, which at Calico has ranged in color from pale gray to pale green. A similar mineral found in the district, but much less commonly, is embolite. These two minerals are called "secondary" minerals, because they have formed near the surface of the earth, generally by dissolution of the original primary silver-bearing minerals of veins, and subsequent redeposition. The primary minerals include tetrahedrite, tennanite, stromeyerite, proustite, argentite, galena, and chalcopyrite. Gangue minerals—in addition to chalcedony (mainly variety jasper) and barite—include hematite, pyrite, and secondary manganese oxides.

Precise data for grade and character of the ore mined at early Calico are not available, as engineering records for those operations apparently no longer exist. The best general idea of grade can be gained from reports of mill returns, keeping in mind two factors: that roughly 75 to 90 percent of the silver generally was recovered from the ore, and that some of the rich ore shipped was carefully hand mined or hand selected from rock mined, thus yielding a higher grade than the rock in place. Generally the earliest reports showed the highest grade not uncommonly to have been 50 to 100 ounces of silver per ton. But a better idea of true grade probably is shown in a report of Goodyear (1888) for the important Silver King mine. This report shows that the mine apparently yielded about 36 ounces per ton from 1883 to 1886, with a maximum of 64 ounces in 1883, diminishing to 20 ounces in 1886. The range of yield for 1885 may have been about 28 to 43 ounces per ton of ore. Another idea can be gained from a report by Lindgren (1887), who said that the grade was "seldom below $20, and often in the hundreds" (price then about $1.00 per ounce). Another old report suggests that the very productive Waterloo mine may have averaged about 25 ounces per ton, though lower grade ore and rich pockets yielding 2,000 ounces per ton also were mined. Additional examples are the Garfield mine: about 36 ounces per ton, during 1886–1887; and the Waterman mine: about 45 ounces during 1883.

More recent data regarding grade are from the activities of the Zenda Company, which in 1930 shipped ore to a smelter from its deep shaft in the Wall Street Canyon area, just before it ceased operations, as the price of silver dropped to less than 35 cents an ounce. Reports indicate that the rock shipped apparently yielded about 50 ounces of silver per ton, though it might have been at least partially hand selected. Another source of data is a consulting report on the Burcham gold mine which shows that the two principal veins, with assay widths of 2 inches to 4 feet, average 0.03 to 0.31 ounces of gold, and 0.1 to 3 ounces of silver. One of the veins also averages 1 to 3 pounds of lead per ton. The average ratio of silver to gold, both veins, is about 5 or 7 to 1.

Unfortunately, not nearly enough is known of the relationship of the areal geology to the mineralization to be able to understand well the genesis of the deposits, and hence, to predict additional occurrences. What follows, therefore, is only a very general guess as to "how the silver got there" and where there might be more.

The earliest mineralization—which formed the belt of primary veins of the Calico district—perhaps took place during early late Miocene time. The belt of northwest-trending fractures that the vein matter filled may have represented an ancestor of the present Calico fault zone, in the same area as even prior ancestral faults, which had been avenues for the upward intrusion of lavas (the probable instigator, if not the basic source, of the silver and barite mineralization). The volcanic rocks had intruded the middle Miocene Pickhandle Formation—sandstone, conglomerate, tuff, and other strata—during perhaps late middle Miocene time. These events, including emplacement of the veins, took place at unknown depths, but deep enough so that the temperatures must have been relatively high and the chemical systems involved at least partially confined.

The primary, silver-bearing deposits must have formed specifically as the result of the interaction of

*The first part of Mr. Weber's series on Calico appeared in the May, 1966 issue of this magazine; the second part in January, 1967.

View north shows part of southwest edge of Calico mountains, at area of Burcham mine. Large, dark-colored mass of rocks in upper left part of photograph constitutes landslide mass, which contains lower-grade silver mineralization. Calico fault zone skirts base of steepest slopes shown, with Barstow Formation in gully areas to left and Pickhandle Formation to right.

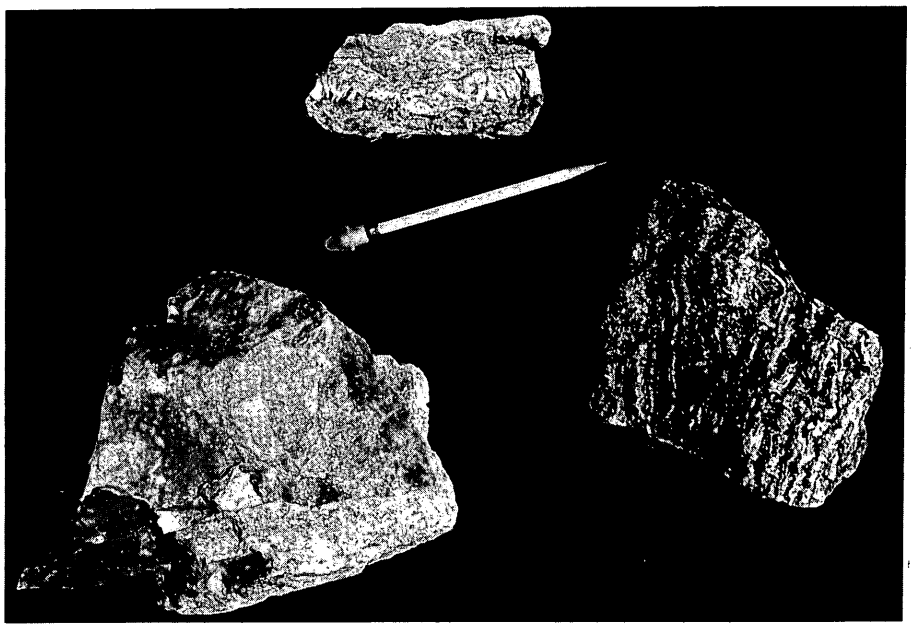
certain fluids (including waters), or the reaction of fluids with certain rocks. These fluids may have been hydrothermal (which rose along faults from deep-seated igneous activity); or they may have been derived from, or associated with, shallow igneous (volcanic) activity; or they may have included connate waters (indigenous waters within the sedimentary rocks) or meteoric (rain) waters circulating through the ground (beneath playa lakes, and within faults, alluvium, and other rocks). Any of these fluids may contain at least minute quantities of practically any element, which may be indigenous or gained by absorption from rocks through which the liquids passed, and with which they may have reacted.

The thin interlayering of chalcedony and barite (along with formation of silver minerals) within many of the primary veins must have been the result of a cyclical change in the character of the fluids entering the fractures, and at least partly precipitating. The change may need not have been extreme, but was distinct. It may have been caused by changes in tectonic conditions (renewed fault movement, for example), changes in deep volcanic activity, or changes in climate (changing the volume of downward circulating waters). But the exact process by which silver and other metals are gained by solutions, then phenomenally concentrated by precipitation into rich deposits, is not understood completely.

After essentially vertical emplacement of the veins, perhaps also during early late Miocene time, the rocks that make up the present day Calico Mountains were uplifted along the present Calico fault zone. With this uplift, the rocks in the west and northwest parts of the mountains seemingly were raised higher than rocks to the east and southeast. Thus, lower parts of the veins in the west and northwest parts apparently were raised higher than veins to the east and southeast, as shown in the accompanying diagram. Consequently, with this uplift, tilting, and subsequent bevelling by erosion, deeper parts of veins were exposed at the surface to the northwest than to the south and southeast.

During this period also, as the faulting and uplift continued during early late Miocene, the upper parts of the veins or zones were being removed by intense erosion. Consequently, the rich secondary silver deposits were being formed by downward and lateral drainage just beneath the surface of the eroding terrain. These deposits formed within zones (the Silver King mine for example) and as areas of stockworks away from veins (as at the Bismarck mine, for example). This process involved the dissolution of the primary silver minerals, as weathering and erosion continued, with the solutions then being carried directly downward into fractures in the zones and redeposited, or out into the surrounding rocks and redeposited (especially in easily mineralized tuff and tuff breccia). These deposits were formed, dissolved, and reformed in a continuing process as the rocks were eroded, with the presentday deposits finally formed perhaps as the period of uplift ended.

Slightly later, during late Miocene time, the lake and other beds of the Barstow and Burcham Formations were deposited against and onto the rising block of the Calico Mountains. As faulting and uplift con-



Specimens of vein material from Calico district. *Lower left:* Pale gray vein barite at bottom is in contact with grayish red andesite wallrock. Barite is broken away at lower left, to show smooth surface of vein wall. *Upper center:* Specimen of cross section of thin vein, with coarse-grained barite in middle, and banded barite-jasper rock in outer portions. Specimen is liberally sprinkled with very fine-grained silver-bearing sulfide minerals. *Right:* Specimen across thin vein; similar to upper specimen, but jasper more abundant, and more concentrated toward middle.

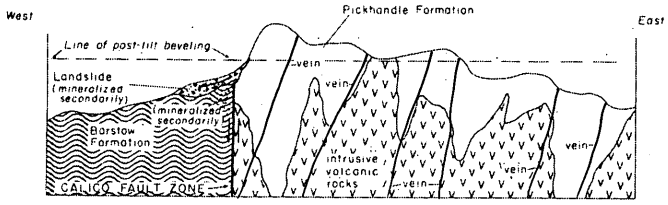
tinued into the Pliocene, the appearance of the terrain was much different than today, though the general position of ranges and valleys probably was similar. But the climate was much more humid than now, with vegetation relatively abundant, hot springs along the active Calico fault zone, and perhaps small lakes. Silver minerals were being deposited by hot waters circulating in the Calico fault zone and adjacent rocks, with the silver gained perhaps from primary or secondary deposits being eroded nearby. Weathering and erosion were intense, cutting the present gorge-like canyons into the range as it was being uplifted; and great masses of broken-up material were being carried out from the range and deposited as alluvium. Mass wasting was common, with the occurrence of the landslide * that led to the mineralized breccia. This slide, which headed down the steep southwest slope of the range, over the Calico fault zone, probably was derived from bedrock now mostly eroded away. After sliding it was mineralized by the previously noted silver-bearing solutions percolating upward in the Calico fault zone.

Barely enough is known of the mineral deposits and geology of the Calico district and vicinity to guess as to the possible location of additional ore deposits. Especially unknown are the rocks which lie beneath the broad stretch of alluvium west and south of the Calico Mountains, beyond the Calico fault zone. For example, the northwest end of the primary belt of veins and zones extends to the Calico fault zone, west of which lies alluvium. Presumably the mineralization is dying out to the northwest, but possibly it might increase in intensity at some point beyond where the belt renews on the other side of the fault, probably to the northwest, beneath alluvium.

Also offset by the Calico fault zone is the mineralized landslide breccia; portions of this faulted mass may be buried nearby, beneath alluvium.

Additional silver deposits may lie somewhere beneath the broad stretch of alluvium that extends westward from the Calico Mountains to the hills which contain the Waterman and Lead Mountain mines. Even the Calico Mountains themselves contain alluvium, with unknown rocks beneath. Silver mineralization also may have enriched rocks that lie below the Barstow-Burcham Formations, provided that these formations are younger than the belt of primary veins and zones and the deposits of stockworks. Especially, such mineralization might occur beneath the lobe of the Barstow Formation which lies just south of East Calico.

* Also interpreted by others as being of tectonic origin.



Hypothetical and exaggerated cross section across ancestral Calico Mountains, showing possible tilting of rocks along Calico fault zone, which raised deeper parts of veins to west and northwest higher. Subsequent bevelling by erosion exposed deeper parts in the west and northwest than in the east and southeast.

Silver-bearing deposits may also be associated with the volcanic rocks which are nearly surrounded by alluvium or younger rocks west of Calico, in the vicinity of the Waterman and Lead Mountain mines. In these areas, prospecting might be aided by an understanding of why silver and barite occur together at the Waterman and Lead Mountain mines and barite occurs alone at the Barium Queen and Penny deposits.

Within the Calico Mountains themselves, very low silver enrichment with economic potential may exist in rocks other than the landslide breccia.* For example, certain tuffs within the Pickhandle Formation of East Calico, which were mined for rich pockets at the surface, might contain additional deposits of voluminous though extremely low grade mineralization (tuff is known as an absorber of minerals from solution). Fractured volcanic rocks, filled partly with barite, occur especially at several localities in the northwest part of the range, but a possible link with silver is not known.

Another factor concerning exploration for silver at Calico is the relationship of known deposits to depth. Though the grade of the deposits is known to diminish downward in mines, nothing is known about these deposits at much greater depths (thousands of feet).

In conclusion, though California never has been a great silver producing state, the metal has been mined at many localities, which suggests a variety of possibilities for renewed exploration and mining if the price continues to rise. Perhaps presently uneconomic deposits can be developed whereby silver and other metals or minerals are recovered together from very large tonnages of low grade rock considered previously to be noneconomic. In this respect, the Mojave desert, and the region to its north and east, contain many districts in many types of terranes, along with complex regional geology and great stretches of alluvium which cover possible deposits. Unfortunately, very few geological workers in the region today are studying the academic geology of metal deposits. However, more and more regional geologic data are being accumulated and perhaps such data will be utilized by economic geologists of the future to uncover additional deposits. Who knows, there may be another Comstock Lode somewhere out on the desert in some least suspected locality, buried beneath just a few hundred feet of alluvium—possibly even near the Calico Mountains.

* This subject was discussed in several papers by F. B. Weeks.

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A limited supply of a more extensive bibliography on the Calico district has been prepared by Mr. Weber and is available at no charge upon request.

THE HISTORY BOOKSHELF

Walker's R.R. Routes—1853, by Pat Adler and Walt Wheelock. La Siesta Press. 61 pages, maps, photos, drawings. 1965. Price $4.50.

Orders should be addressed to La Siesta Press, Box 406, Glendale, CA 91209.

The role played by Joseph R. Walker in the history of California is significant as he was, perhaps, one of the first guides who led mapping and exploratory companies through the territory. His discovery of the pass at the southern tip of the Sierra Nevada which now bears his name became the topic for heated debate when the choice of routes was being discussed. The pass was easily accessible, and was travelled by many coming into California in search of gold or land. The practicality of this route having been demonstrated, it is difficult to comprehend why it was not selected. One reason may be found in the conditions that existed in Congress. As the authors summarize, "It would not be exaggerating to say that this [the] Benton-Fremont alliance was the most powerful single force in the development of the western routes. . . ." Their influence, exerted against a southern route, was too great and expediency was substituted for practicality.

—*Albert D. Ortiz.*

The Songs of the Gold Rush. Edited with Introduction by Richard A. Dwyer and Richard E. Lingenfelter; music edited with guitar arrangements by David Cohen. University of California Press, Berkeley and Los Angeles, 2d printing, 1965. 200 pages, illustrated. Price $3.50.

A collection of 88 gold-rush songs, drawn chiefly from such contemporary song-books as *Put's Original California Songster* (1855), *California Songster* (1855), *The Gold Diggers' Song Book* (1856), and *Johnson's Original Comic Songs* (1858). The songs are grouped by subject under various headings— "Ho! for California!", "Seeing the Elephant", "An Honest Miner", "Life in California", etc.—and each group is introduced by a short commentary on the sundry gems that it contains.

The songs, say the authors in their introduction, "exhibit . . . every facet and mood of the great rush—the voyage around the Horn or by the Panamanian isthmus, the trek across the plains, the humor and drudgery of mining, the hopes and the disillusionment of the miners, the hardships and humbugs of life in California, and the last reminiscences of the days of '49": this for the "buff" of gold rush history or romance. He who would like actually to *sing* the songs will find this collection has an advantage over many others: he is not left—in most instances, at least—to scour his memory for some tune a hundred years dead ("Air: I Get in a Weaving Way"; "Air: Lucy Long"; "Air: Rosin the Bow"). Words, guitar chording, *and music* appear together on the page.

To order, address University of California Press, Berkeley, CA 94720; the book is not distributed by the Division of Mines and Geology. E.L.E.

Inyo 1866–1966. Sponsored by Inyo County Board of Supervisors. 95 pages, many illus. 1966. Price $3.27, paperback; $6.39, hardback; price includes tax and handling charges. Address orders to Miss Mary Cavitt, County Librarian, Courthouse, Independence, CA 93526.

Marking the centennial of the formation of Inyo County in 1866, this book, with its beautifully reproduced illustrations and interesting text, recounts the history of Inyo, from the first attempts at settlement to the County's current productions and activities. The many short articles that make up the book cover a multitude of subjects—pioneer resident Samuel Bishop, who drove cattle from Fort Tejon to Owens Valley in 1861; Camp Independence, the Civil War fort of adobe, which stood until the earthquake of 1872; mining; agriculture; forestry; the interdependence of Inyo and that old water pirate, Los Angeles; tourism and recreation; and many others. E. L. E.

THE GEORGE A. GROTEFEND MINERAL COLLECTION

By Irene Kitchell

During his lifetime, George A. Grotefend acquired an extensive mineral collection, including many excellent specimens from the mines in Shasta and Trinity counties. In 1950 he loaned this collection to the California Division of Mines for display at the Redding office. When the provisions of his will were revealed after his death in 1951, it was learned that he had bequeathed his mineral collection to the Division of Mines with the stipulation that it be kept on exhibit and displayed at the local office. Visitors are welcome to see the display at our Redding office, which is located at 2135 Akard Avenue, Room 10. Office hours are 8:00 to 12:00 and 1:00 to 5:00 daily, Monday through Friday.

Dr. Grotefend came from pioneer stock in Shasta County. His father, August Grotefend, was born in Germany in 1824 and came to St. Louis with his family in the same year. Lured by the stories of gold discoveries, he came to California to seek his fortune, settling in Shasta County in 1849. After several unsuccessful mining attempts he discovered a rich pocket of gold ore in Schaeffer Gulch, from which he removed about $18,000. In 1853 or 1854 he married Emilie Zumdahl and engaged in the mercantile business in the town of Shasta, where he was very successful. The remains of his store are still preserved as a part of the Shasta State Historical Monument.

George Adolph Grotefend was born in 1869, the next to the youngest son of August and Emilie Grotefend. He was educated in the local schools and the Methodist College in Napa. He then attended the University of Pennsylvania, graduating in dentistry in 1889. He returned to Redding where he opened an office in 1890, which he maintained for 20 years, in the Odd Fellows Building. He was considered Redding's leading dentist, keeping abreast of all modern techniques and equipping his office with the finest fixtures available.

About 1909, together with Bill Foster, Dr. Grotefend organized the Trinity Farm and Cattle Company. The firm had headquarters near Trinity Center and grazing land in the Bald Hills. Actually the doctor made his money in his mining ventures and invested the proceeds in the land and cattle company. He held the controlling interest in this company at the time of his death.

George Grotefend had considerable mining interests throughout his lifetime. Probably his most outstanding mining venture was the purchase, about 1930, of the Washington mine in the French Gulch mining district. Lode gold was first mined in Shasta County in 1852 at the Washington mine; thus it ranks among the earliest lode locations in California. By 1890, total production was estimated at $500,000 to $600,000. The mine was continuously active until 1865, after which it was operated only intermittently by lessees. He bought all the stock of the mine "for a song" and put several men to work driving what is known as the H level, sometimes called the 350 level. The level was driven ahead about 150 feet, where it encountered a nice showing of ore. About 100 tons of ore was mined and stockpiled on the dump, as the old Washington mill had deteriorated to a point where it would have to be rebuilt before the ore could be milled. About that time J. H. Scott came to the French Gulch district, having so far been unsuccessfully engaged in mining ventures. Dr. Grotefend agreed to sell him the Washington mine for $10,000 down and 25 percent royalty to apply on the purchase price of $70,000 for the mine. Scott paid the $10,000 down. He shipped the ore on the dump to the smelter and recovered over $13,000 from the 100 tons. Another $800,000 worth was mined from the shoot of ore before he was forced to shut down the mine during World War II.

George A. Grotefend. Photo courtesy *Redding Record-Searchlight.*

Dr. Grotefend had once married, but the marriage ended in divorce, and there were no children. From

the seven children born to his mother and father, only one grandchild grew to adulthood. This niece, Bessie Prehn, was never married and died in 1957, leaving the Grotefend family with no descendants. Dr. Grotefend retired from active practice in the early 1940's and spent the last twenty-five years of his life living at the Golden Eagle Hotel. [This old landmark, built in 1888, burned to the ground in 1962.] He died there in 1951 at the age of eighty-two. His will, made only two months before he died, contained some unusual and surprising provisions. After bequests to several friends, he bequeathed his extensive mineral collection to the California Division of Mines and set up three trust funds.

The third fund, an amount of about $261,000 was set up as a scholarship fund for students who spend four years in Shasta County high schools and who desire to go to college. There are very few restrictions and the students are able to choose their own schools. They must be worthy and in need of help other than can be afforded by their parents but it is not necessary that they be of the current graduating class, so that students already in college are eligible.

The scholarship fund is administered by three trustees: the principal of Shasta Union High School, the county superintendent of schools, and a third member to be selected by them. This third member currently is Superior Court Judge Richard B. Eaton. As much as $20,000 has been given in a single year. Beneficiaries of this program who have graduated include doctors, nurses, dentists, ministers, and teachers.

The Grotefend story is in a sense the story of America—thrift, energy, wise investment, and charity. The Division's Grotefend Mineral Collection symbolizes the physical aspect of that story and the George A. Grotefend Scholarship Fund symbolizes its more human aspects. It is hardly possible that the doctor could have left his fortune for a more worthy cause, or a more fitting memorial to perpetuate the name of Grotefend.

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Henry Carter, personal communication, 1956.

Judge Richard B. Eaton, personal communication, 1965.

Wanda Grooms, personal communication, 1965.

Raymond V. Darby, personal communication, 1966.

The mean velocity of a sound wave in a crystal of quartz is 9,811 miles per hour.

GOWER LEGAL SERVICE ADDED TO LIBRARY

Through the generosity of Mr. Philip R. Bradley, Chairman of the Mining and Geology Board, the Division of Mines and Geology Library in San Francisco is proud to announce that we now have a subscription to the Gower Federal Service in Mining. This publication is specifically devoted to legal decisions concerning mining, and it appears in three sections. Selected decisions of the Bureau of Land Management and Hearing Examiners are printed on white sheets. All opinions of the Solicitor on mining are printed on green sheets. And, from time to time, significant judicial decisions are reported or abstracted; they appear on yellow sheets. A full year's index appears at the end of each year.

A binder containing the 1966 issues will be placed on the DMG Library shelves for public use and study. As new decisions appear, they will be added to those already shelved.

Another set of the decisions, which are published by the Rocky Mountain Mineral Law Foundation at the University of Colorado, will be placed in the Division's Library in Los Angeles. This set is being provided by courtesy of the California Mine Operators Association.

NEW INVENTIONS USE AUTO SCRAP TO OPEN NEW SOURCES OF IRON, ZINC

Two processes that promise increased use of the metal in millions of old autos discarded each year are among new U.S. Bureau of Mines inventions patented by the Department of the Interior.

A less costly method for reclaiming zinc from die-cast zinc-aluminum alloys used for carburetors, trim, and other parts of automobiles is the objective of one invention. Bureau researchers found that an iron compound can be used to convert the aluminum in such alloys to easily separated forms at lower temperatures than are required by the distillation method used conventionally.

Besides reducing the amount of fuel required to reclaim the zinc in relatively pure form, the process yields aluminum chloride as a marketable byproduct.

Also aimed at wider use of scrap automobiles is the process invented by the Bureau for using the metal in them to beneficiate off-grade iron ores which, though abundant domestically, have so far remained unused. These ores, a form of taconite, lack the magnetic property possessed by other taconites now being developed commercially.

In the Bureau's process, scheduled for demonstration-scale tests in the near future, auto scrap conveys magnetic properties to the off-grade ores when mixed with them and roasted in a rotary kiln.

MINERAL RESOURCES OF LIBERIA

By A. E. NYEMA JONES

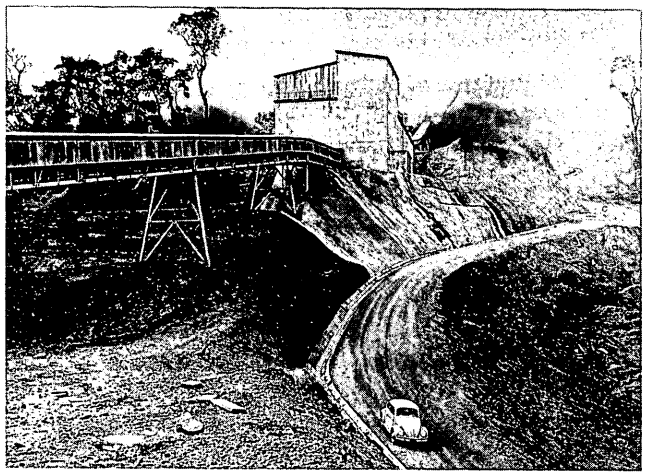
The following article was written especially for this magazine by one of its readers, Dr. Nyema Jones, now Chief of the Liberian Geological Survey, a branch of the Bureau of Natural Resources and Surveys. We thought our other readers would enjoy a brief view of the geology and resources of another country half a globe away.

... M. R. H.

Liberia is Africa's first and oldest republic. It lies in the western bulge of the continent, four to eight degrees north of the equator, with an area of 43,000 square miles and a continuous coastline of 350 miles along the Atlantic Ocean.

The Republic of Liberia had its origin in the efforts of several American philanthropic societies to provide an asylum on the west coast of Africa for freed American Negroes. In 1822 a settlement was established at the site where the city of Monrovia now stands, and on July 26, 1847, Liberia was declared an independent state. Its capital city, Monrovia, was named after James Monroe, fifth president of the United States of America.

The Constitution of Liberia provides for a democratic republican form of Government, and is modelled after that of the United States of America. The Government consists of three separate coordinate branches —Legislative, Executive, and Judicial. The country is divided into nine counties and five territories, each administered by a Superintendent appointed by the President of the Nation.



Conveyor belt from mine to railroad loading station at Seca Valley, Nimba, Liberia.

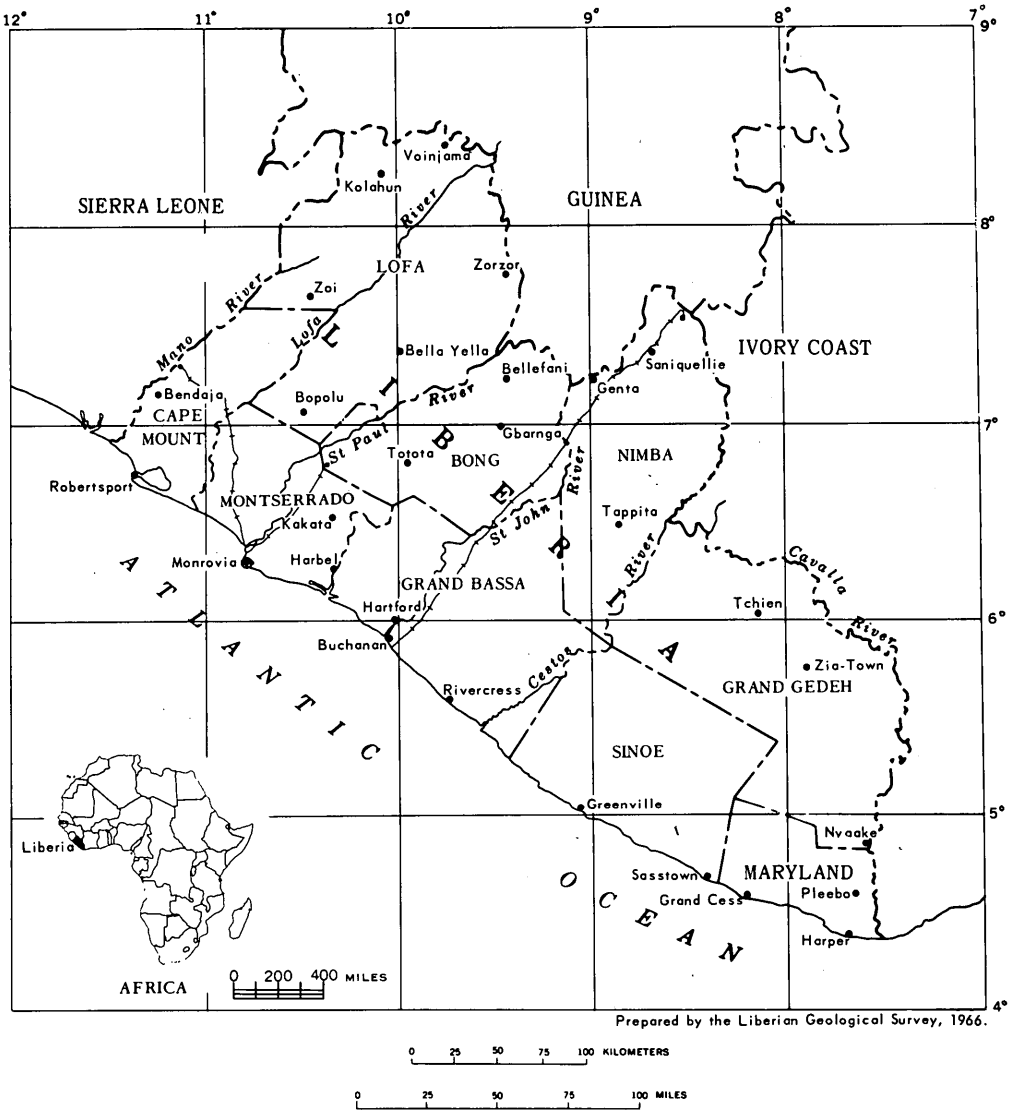
Liberia has a population of approximately one and a half million people. These people are descendants of the early settlers, and of indigenes who lived in that area several centuries ago, some of whom migrated from the north and east. Although relatively small in area, Liberia is occupied by 28 tribes of hospitable and friendly people. Each tribe has its own language, customs, and traditions, but English is the official language and is widely spoken and taught throughout the country.

Geography

Since Liberia is situated in the equatorial rain forest belt of West Africa, its climate is tropical and humid, with alternating dry and rainy seasons of almost equal duration—the former from November to April and the latter from May to October, approximately. The duration of the dry season increases northward with distance from the equator. The average yearly rainfall varies from 80 inches in some parts of the interior to as much as 200 inches at elevated areas on the Atlantic Coast, such as Cape Mount. In the coastal areas there are two weeks of steady sunshine in the middle of the rainy season, known as the "middle dries".

Although Liberia is close to the equator, it does not have the extremely hot and unhealthy climate usually associated with the tropics. On the coast, the climate is tempered by the almost constant seabreeze, while most parts of the interior are cool and comfortable because of the higher altitudes, particularly in the mountainous regions. The relative humidity varies from 60 to 100 percent. Average daily temperatures are 75 to 80 degrees Fahrenheit, with extremes of about 50 degrees and 95 degrees Fahrenheit. The lower temperatures occur during the night. Because the constancy of temperature and the accompanying humidity is favorable to luxuriant plant growth, there is an abundance of evergreen vegetation.

The physiography of Liberia is characterized by coastal plains, rolling hills, dissected plateaus and mountain ranges. Three promontories are in the coastal region, forming capes on the Atlantic Coast. Cape Mount near the Sierra Leone border is 1068 feet above sea level; Cape Mesurado at Monrovia rises to approximately 300 feet, and Cape Palmas near the Ivory Coast border is about 100 feet above sea level. There are several mountain ranges in the country, with the



Index map of Liberia.

highest elevations almost 5000 feet above sea level. The highest mountains are the Wologisi, Nimba, and Bong.

The country is drained by six principal rivers and several smaller rivers which flow from north to south into the Atlantic Ocean. The largest lakes are the Fisherman's Lake in Grand Cape Mount County, and the Shepherd Lake in Maryland County.

Geologic structure

Liberia forms a part of the West African Shield, which is a large Precambrian region consisting predominantly of ancient crystalline rocks. The rocks forming this crystalline shield are a series of granite, gneiss, and schist beds which have been subjected to intense folding and faulting.

With the exception of sandstone beds along the Liberian coast, the rocks comprising the basement complex are of Precambrian age. Iron-bearing formations (itabirites) are interspersed in this basement complex and appear to be a part of the Precambrian formation. The original sediments of the iron-bearing formation have undergone great physical and chemical changes resulting in metamorphosed and migmatized rocks.

Volcanic rocks occur along the coast, forming promontories at Cape Mount, Cape Mesurado, and Cape Palmas. The capital city, Monrovia, is built on a ridge of diabase about four to six miles long by a mile or two wide. Diabase and gabbro occur as basic rock intrusions in the interior of Liberia, forming numerous dikes. Bands of amphibolite which follow the trend of foliation in the gneisses are also common.

The igneous and metamorphic rocks of Liberia have been intensely deformed and metamorphosed by tectonic and metamorphic forces acting on a regional

scale. Some structural features in these rocks are uniform over relatively large areas. Gneissic structure and schistosity dip at high angles in most places and are often vertical. The predominant strike is NE-SW.

More knowledge about the geology of Liberia will be obtained during the course of the joint mapping activities of the Liberian Geological Survey and the United States Geological Survey which are now in progress. It is anticipated that, after 1966, geological maps of sections of the country will be published, and, by 1972, a complete geological map of Liberia will be available.

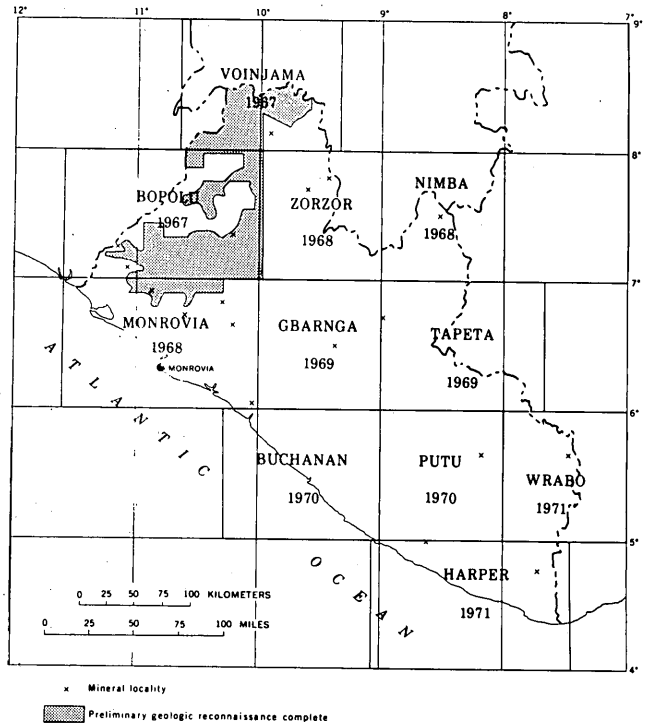
Mineral resources

Liberia is now the largest producer of iron ore on the continent of Africa, and the third largest exporter of iron ore in the world. Gold and diamonds are other minerals which are found in economic quantities and are being extracted for local use and for export. In addition, many other minerals are known to occur in Liberia, but their economic potentials have not yet been determined. These minerals are presently being investigated by geologists of the Liberian Geological Survey and the United States Geological Survey, under a joint geologic mapping and mineral appraisal program.

The following are known mineral occurrences in Liberia:

Asbestos	Kyanite
Barite	Lead
Bauxite	Manganese
Chromite	Mica
Clay	Monazite
Columbite-tantalite	Platinum
Copper	Quartz
Corundum	Rutile
Diamond	Talc
Gold	Tin
Graphite	Tungsten
Ilmenite	Uranium
Iron	Zircon

The Liberian iron ores consist mainly of hematite, magnetite, and itabirite. The Bomi Hills deposit, located about 50 miles northwest of Monrovia, was the first iron ore deposit to be discovered and developed. It contains proven reserves of 50 million tons of high grade magnetite ore yielding 68 to 70 percent pure iron, and 150 million tons yielding 35 to 50 percent. This deposit is being developed by the Liberia Mining Company, which is the pioneer mining company in Liberia. Total exports in 1965 reached two and half million tons.

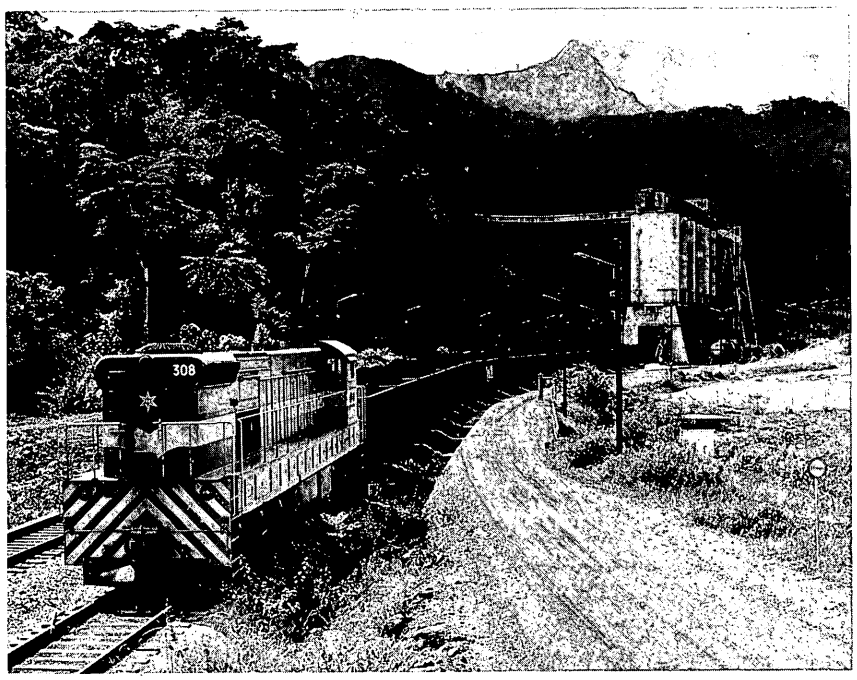


Index map showing areas of coverage of scale 1:250,000 geologic map series and scheduled completion dates of reconnaissance mapping

The largest iron ore deposit in Liberia is located at Mount Nimba near the Guinea and Ivory Coast border. Total reserves are estimated to be 250 million tons of high grade hematite ore yielding 65 to 69 percent pure iron. In addition, there is a considerable amount of low grade ore. The Nimba deposit is being mined by LAMCO (Liberian American-Swedish Minerals Company). The first iron ore shipment by LAMCO was made in April, 1963. In the year 1964 this company exported six and half million tons of iron ore, and eight million tons in 1965.

Other iron ore deposits of lower grade occur in the Mano River area near the Sierra Leone border, and in the Bong Range, 50 miles northeast of Monrovia. The estimated reserves of iron ore are 50 million tons in the Mano River Mine, and about 250 million tons in the Bong Mine yielding 35 to 45 percent pure iron. The National Iron Ore Company is developing the Mano River deposit. Two and half million tons of iron ore were exported in 1964, and three and half million tons in 1965. The Bong Range deposit, which went into production in April 1965, is being developed by DELIMCO (German Liberian Mining Company). Its export of iron reached three million tons in 1965.

Extensive iron deposits are also known to occur in the Bie Mountains of Grand Cape Mount County and the Wologisi Range in Lofa County. Detailed appraisal of these deposits has been undertaken by the



Railroad loading station at Seca Valley, Nimba, Liberia.

Liberia Mining Company and the Liberian Iron and Steel Corporation, respectively, to determine their economic potential.

Gold and diamonds occur in stream and river beds in various parts of the country. Individual miners are engaged in placer mining by hand methods. Several diamond concessions are engaged in more systematic and productive methods of alluvial mining by mechanical means. Kimberlite, an ultrabasic rock which is believed to be the source rock of most diamonds, has been found in three different areas in Western Liberia. One of these areas is at Weasua, near the Lofa River, where there is much activity in prospecting and mining for diamonds.

Joint mapping project

Under the terms of a project agreement between the Government of Liberia and the United States Agency for International Development, a geologic mapping and mineral appraisal program was initiated in 1964. This program is being implemented jointly by geologists of the Liberian Geological Survey and the U.S. Geological Survey.

The primary objectives of the program are twofold:

(1) To prepare a geological map of Liberia at a scale of 1:250,000 and establish a systematic geological mapping program at larger scales to support detailed mineral exploration.

(2) To evaluate the mineral resources of Liberia and prepare recommendations for future mineral exploration and development.

Aerial photographs and mosaics are utilized in the field as base maps for accomplishing reconnaissance geologic mapping along rivers, foot trails, and motor roads. Traverse lines are cut in areas not accessible by trails and roads. Heavy mineral concentrates, stream sediments, and soil samples are collected systematically for laboratory studies.

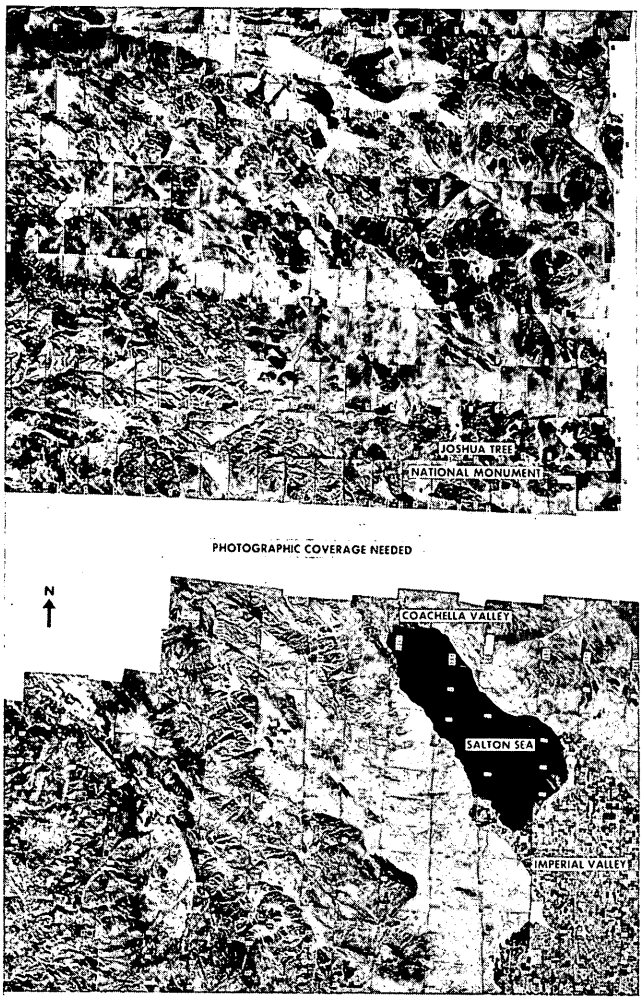
Field methods employed for mineral exploration include conventional prospecting and detailed geologic mapping, as well as geochemical and geophysical exploration. The appropriate techniques are applied if areas of economic mineral interest are found as a result of geologic reconnaissance mapping.

In equatorial rainforest regions such as Liberia, relatively few bedrock exposures are visible due to the dense, luxuriant vegetation and the thick overburden caused by lateritic weathering. The application of geochemical exploration methods under these conditions could result in new mineral discoveries through systematic sampling and analyses of soils, rocks, sediments, and stream water. Geophysical surveys are also applicable, since they serve to detect discontinuities or changes in character of concealed geological formations, and to outline certain mineral bodies which differ in physical properties from their surrounding country rock.

It is anticipated that the implementation of this geological exploration and resources appraisal program will ultimately result in significant new mineral production and mineral industries in Liberia.

Monrovia, Liberia
November 10, 1966

MAPPING BY U. S. SPACECRAFT



Photos courtesy U. S. Geological Survey.

Some of the practical results of the Gemini mission are shown in the two photographs above. To the left is a mosaic of the more than 500 aerial photographs needed to show the area around the Salton Sea and Joshua Tree National Monument. Some of the photographs are missing; the area has not yet been covered by conventional aerial mapping methods.

To the right is the same area, shown in one photograph taken by Gemini. It is not necessary to spend many laborious hours to compile a mosaic; in addition, there are no missing areas.

REVIEWS

VISIBLE GEOLOGY

Geology illustrated. By John S. Shelton. Drawings by Hal Shelton. Published by W. H. Freeman and Company, available at bookstores. 1966. 434 pp. Price $10.00.

An interestingly organized book on "visible" geology. The Shelton brothers, here in concert, have together produced a book that is a new look at old subjects; in addition, it will serve many an author as a good source book for illustrative material, particularly for Dr. John Shelton's air photos.

SOUTHERN CALIFORNIA STUDIED

Engineering geology in southern California was released in October 1966 by the Association of Engineering Geologists. This publication, edited by R. Lung and R. Proctor from 39 contributors, contains a wealth of information pertaining to geologic hazards and problems of interest to engineering geologists working in southern California, including landslides, flood control, earthquakes, faults, nuclear reactor sites, and many more. Numerous case histories of failures due to geologic hazards are detailed in the 389-page volume. Extensive bibliographies are presented at the end of each chapter. Chapter titles are:

1. Earthquakes and faults; 2. Aqueducts, dams and tunnels; 3. Highways and freeways; 4. Landslides and urban development; 5. Legal aspects of engineering geology; 6. Grading Codes; 7. Ground water; 8. Subsidence; 9. Flood control; 10. Marine geology and beach erosion; 11. Foundations, soil mechanics and rock mechanics; 12. Nuclear reactor siting.

Three maps have been prepared to show the major geologic and engineering features, landslides, and soil and bedrock distribution.

Engineering geology in southern California may be purchased from the Association of Engineering Geologists, P.O. Box 21-4164, Sacramento, California 95821. The price is $12.00 plus tax.

The Division of Mines and Geology has copies for reference, but none for sale.

TWO NEW EXPANDED SHALE PLANTS

Stimulation provided by geologists of the Division of Mines and Geology has resulted in the enlargement of the expansible shale industry in the San Francisco Bay Area. Following a comprehensive study of expansible shale deposits in the southern San Francisco Bay area, private prospectors and scientists intensified their search for suitable raw materials to sustain the lightweight aggregate industry in the area.

The result is the establishment of two new expanded shale plants, one to be operated by Kaiser Industries, the other by Port Costa Clay Products Company.

The Kaiser plant is located on a 170-acre site north of State Highway 84 between Fremont and Sunol. A deposit of shale will be quarried on the site and processed through a 4.5 million dollar facility centered around a rotary kiln 11 feet in diameter and 170 feet long. The crude shale is crushed and heated to 2100°F. where it expands to form lightweight aggregate. The Sand and Gravel Division of Kaiser Industries hopes to produce 230,000 yards of aggregate per year which will be marketed under the trade name KI-LITE.

The other new plant has been opened near Port Costa on Carquinez Strait by Port Costa Clay Products Co., a subsidiary of the Homestake Mining Co. The raw material is quarried at the plant site from a thick section of marine shale and sandstone of Cretaceous age which lies between Crockett and Martinez. The plant is fully integrated to produce brick as well as lightweight aggregate for concrete.

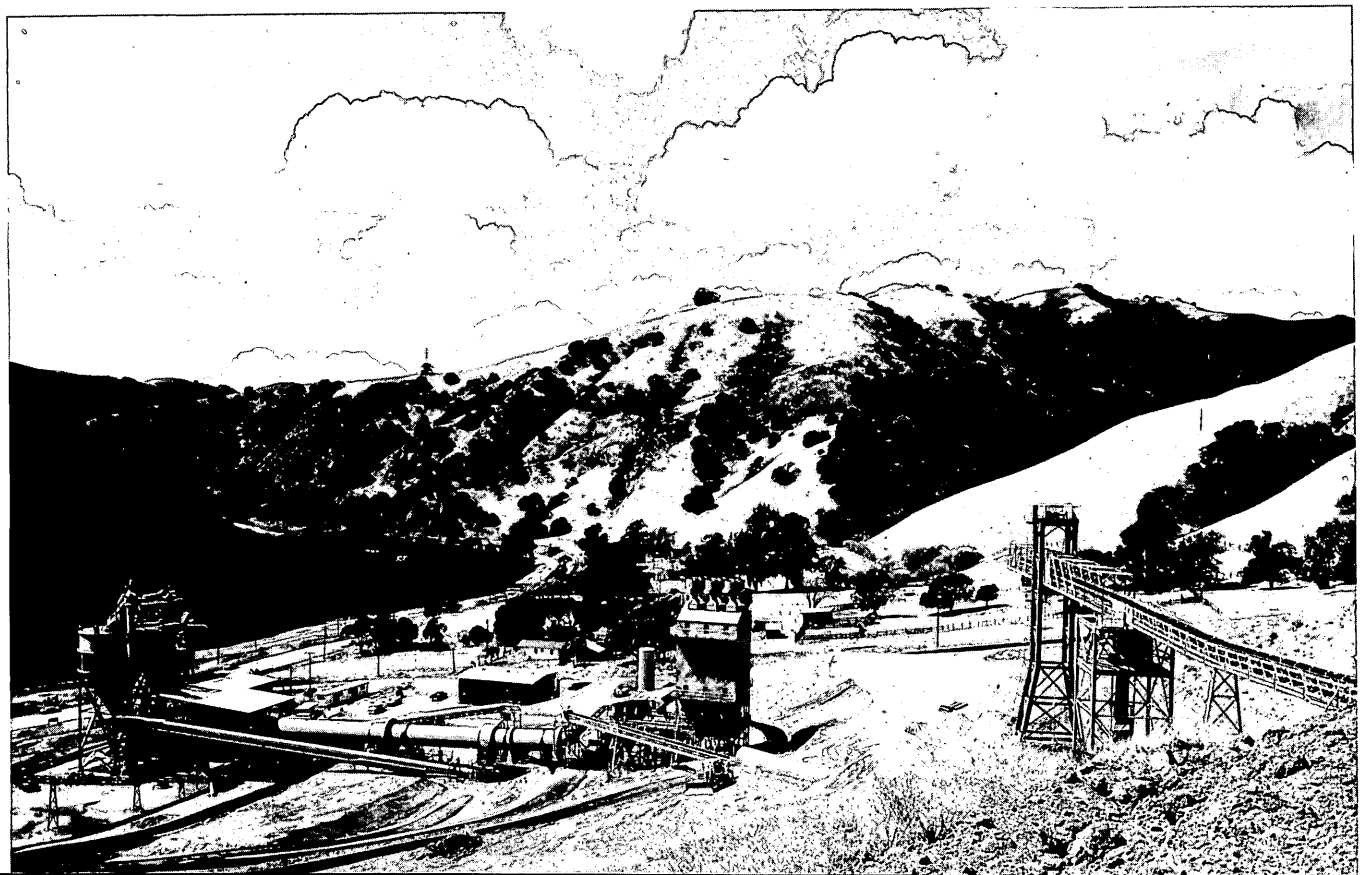
Two other plants have been producing expanded shale aggregate for the Northern California market for many years—the Basalt Rock Company near Napa and the McNear Company at San Rafael.

The results of the intensive study of expansible shale deposits of the area were published in late 1965 by the California Division of Mines and Geology as Special Report 87, written by the principal investigator, staff geologist John L. Burnett.

Special report 87, entitled *Expansible shale resources of the San Jose-Gilroy area, California*, presents an analysis of the marketing economics and raw materials available for the manufacture of lightweight concrete aggregate as well as the field and laboratory methods developed by the Division for appraising deposits of expansible shale.

Copies of the report are still available, and may be ordered by mail from the Division's main office in the Ferry Building, San Francisco 94111, or over-the-counter from any of the branch offices in Sacramento, Redding, or Los Angeles. Its price is $1.50, plus tax.

Kaiser Industries expanded shale plant, Sunol. *Photo courtesy Ki-lite Division, by Kaiser Graphic Arts.*



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WORLD CLIMATE CHANGES RESULTED FROM CONTINENTAL DRIFT

Much of the variation in climate during the geologic past has been caused primarily by the movement of continents across the face of the earth, rather than by worldwide changes in climatic zones, reports Warren Hamilton of the Department of the Interior's Geological Survey.

Dr. Hamilton, who recently completed a study of the earth's ancient climates, supports the theory that continents "drift" about the surface of the earth.

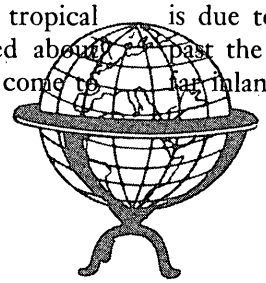
"Each continent," Dr. Hamilton notes, "has its own pattern of climatic variations, rather than a pattern shared with all other continents. Thus, it is likely that climatic zones remain relatively unchanged in width and position, and that the continents have drifted through these zones throughout geologic time."

Past climates are recorded in rock strata by fossils of land plants and marine shells, and by such rocks as the deposits of ancient glaciers and of tropical coral reefs. Tropical climates today are limited to a belt centered on the equator, and the tropical deposits of the past 15 million years show a similar distribution. Farther back in the geologic record, however, tropical deposits become progressively more scattered about the earth, indicating that the continents have come to their present positions gradually and irregularly.

Two hundred and seventy million years ago, tropical coral reefs grew in a warm shallow sea in what are now arctic Canada, Greenland, and Spitzbergen, and at the same time great glacial ice caps covered now-tropical parts of India, Australia, and Africa. Neither reefs nor glaciers could possibly have formed where these lands are now, so the continents must have moved to their present positions.

Dr. Hamilton regards the data now available as proving that continental drift has occurred throughout at least the past half-billion years.

"Early concepts of continental drift such as the development of the Atlantic Ocean by the separation of the Americas from Europe and Africa, and the northward migration of the island continent of India until it collided with Asia, are substantiated by abundant new data," he stated. "In addition, however, we can now define complex bending, breaking, and sliding within continents. The San Andreas fault, whose movement caused the 1906 San Francisco earthquake, is due to the northward sliding of coastal California past the interior, and related motion is distributed as far inland as the Rocky Mountains."



Please send me:

. . . .copies, Special Report 87 (Expansible shale resources of the San Jose-Gilroy area), at $1.50 each, plus tax.

. . . .copies, Bulletin 170 (Geology of southern California), in two cloth-bound volumes, at $13.00 per set.

Please note: Orders for all books and maps to be sent to a California address must include 4% sales tax. There is no tax on subscriptions to *Mineral Information Service*.

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MINERAL INFORMATION SERVICE

A PUBLICATION OF THE CALIFORNIA DIVISION OF MINES AND GEOLOGY

VOLUME 20 NUMBER 1

JANUARY 1967

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STATE OF CALIFORNIA ▪ THE RESOURCES AGENCY ▪ DEPARTMENT OF CONSERVATION ▪ DIVISION OF MINES AND GEOLOGY

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MINERAL INFORMATION SERVICE is designed to report on the progress of earth science in California, and to inform the public of discoveries in geology and allied earth sciences of interest and concern to their lives and livelihood. It also serves as a news release on mineral discoveries, mining operations, statistics of the minerals industry, and new publications. It is issued monthly by the California Division of Mines and Geology. Subscription price, January through December, is $1.00.

Other publications of the Division include the Annual Report of the State Geologist; the Bulletin, Special Report, Map Sheet, and County Report series; the Geologic Map of California; and other maps and publications. A list of the Division's available publications will be sent upon request. Communications to the Division of Mines and Geology, including orders for publications, should be addressed to the San Francisco office.

MARY R. HILL, *Editor*

FILMS

In this column, which will appear from time to time, we hope to list films concerning the earth sciences. We would like to borrow a review print from film makers or distributors who have films for use by schools, mineral societies, technical organizations, or other groups. Please indicate the audience for which the film was prepared (i.e., primary, secondary, college, general, professional groups), how and where prints may be obtained, and the price of purchase or rental. The title, maker, and date of copyright would also be helpful. Please send film to:

Mary R. Hill, Editor
Mineral Information Service
California Division of Mines and Geology
Ferry Building
San Francisco, California 94111

The Beach: A river of sand. 1965. Encyclopaedia Britannica Films, Earth Science Series, produced in collaboration with the American Geological Institute. 17 min. 16mm. color, or b-w. Science Advisors: Douglas Inman and John S. Shelton. (Dr. Inman is a specialist in beaches at Scripps Institute of Oceanography; Dr. Shelton is Chief Science Advisor for the AGI-EBF Earth Science Program.) Producer: Stanley Croner; Director-Editor: Warren Brown; Cameramen: I. Mankofsky, Frederic Goodich. Available by purchase from Encyclopaedia Britannica Films, 1150 Wilmette Avenue, Wilmette, Illinois 60091. Price: color, $240; black-and-white, $120.

By means of time-lapse, animation, and fast-motion techniques, *The Beach* explores the environment of the shore, with special attention to the sand that makes up the beach. The film shows where sand along the California coast comes from (rivers on shore), how it is moved (by the waves and longshore currents), and where it goes (into submarine canyons).

By concentrating on the sand and its movement, and by using numerous methods of illustrating the behavior of the sand and the waves that move it, including underwater, aerial, and wave-tank sequences, the film maintains a high pace and achieves a unity, both uncommon in earlier educational films. It has been the unfortunate fate of many films in the earth science field to have contained errors that made earth scientists squirm. This reviewer detected none in *The Beach*. Other films, although technically correct, have been cinematographically bad or exceedingly dull, or both. *The Beach* is neither.

The EBF-AGI Earth Science Series was especially designed for junior high school students. They, or anyone interested in beaches (including the many mineral societies), should find it interesting and informative. . . . M.R.H.

Wilderness quest. Promotional Films, Inc., sponsored by The Red Wing Shoe Company. 29 min. Color. Consultants and actors: Montana Department of Fish and Game; Charles L. Sommers Wilderness Canoe Base, Region 10, Boy Scouts of America; U.S. Park and Forest Services; University of Minnesota Museum of Natural History. Producer: Alfred Peterson; Written by: Cliff Sakry; Production: George Daugherty. Available from: Boyd Film Company, 1569 Shelby Avenue, Saint Paul, Minnesota. 16mm.

The out-of-doors is colorfully displayed in this film, with an emphasis on "scenery." There is not much coherence—the film is rather like a slide show—but the mountains, valleys, and water are of sufficient interest in themselves to make this a good film for the general audience. Clubs and organizations should find it excellent program material.

The Red Wing Shoe Company, sponsors of the film, are to be congratulated on their desire to present the wilderness as a conservation topic. There is no advertising.

It is to be wished that the film makers had as much knowledge of the subject as the sponsor had good will. At no point is the fabric of the out-of-doors seen closely; almost all the shots are "postcard views" with obtrusive people and a never-ceasing narration that drowns out even the sounds of the nature it intends to portray. Moreover, several scenes showing doubtful outdoor manners will not gladden the heart of conservationists (including this one): a woman picks a wild flower (a merciful cut almost saves the scene); a man carries a pistol in a side holster; and, worst of all, while the narration talks about "water pure enough to drink," man, woman, and child wash in a running stream. . . . M.R.H.

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Bonanza in the lonely desert

SILVER DEPOSITS OF THE CALICO DISTRICT

By F. Harold Weber, Jr.

Second of three parts *

Silver was first discovered in the east-central Mojave Desert of southern California during the mid- or late-1870's, when the desert still was very remote. In the region near the discoveries a small community grew and was named Calico, probably by prospectors. The bright, splotchy patterns of parts of the nearby terrane probably made these men away from home think of Calico cloth, so popular in those days for ladies' dresses. They probably realized too that the Calico-like areas were the best to prospect, for they comprised the Tertiary sequences of continentally deposited sedimentary rocks, intruded by volcanic rocks, which even then were known to be the hosts for "bonanza" deposits of silver and gold. The "small community" shortly was renamed Daggett, in favor of a Lieutenant Governor of the state, and the name "Calico" moved 6 miles north to a mining camp and mountain range, where the major silver discoveries were made in 1881, and where the rock patterns of the region are the brightest and the splotchiest.

Important mining operations began in the Calico district in 1882, and continued until 1896. Since that time, little silver has been mined, because of the generally lower price of the metal, and because ore rock that remains is generally deeper and lower in grade. The total value of silver produced is estimated at between $13 and $20 million. Also obtained from the deposits in more recent years have been much smaller-valued amounts of barite, lead, copper, and gold. Borax also was once mined in the region, and crushed and broken stone for a variety of roofing granules is produced today from the multi-colored rocks. But most significant to the region in early 1966 was the fact that the price of silver had risen during the past few years from about 92 cents to $1.29 per troy ounce, and, with other factors, had created renewed interest by the mining industry in the Calico district.

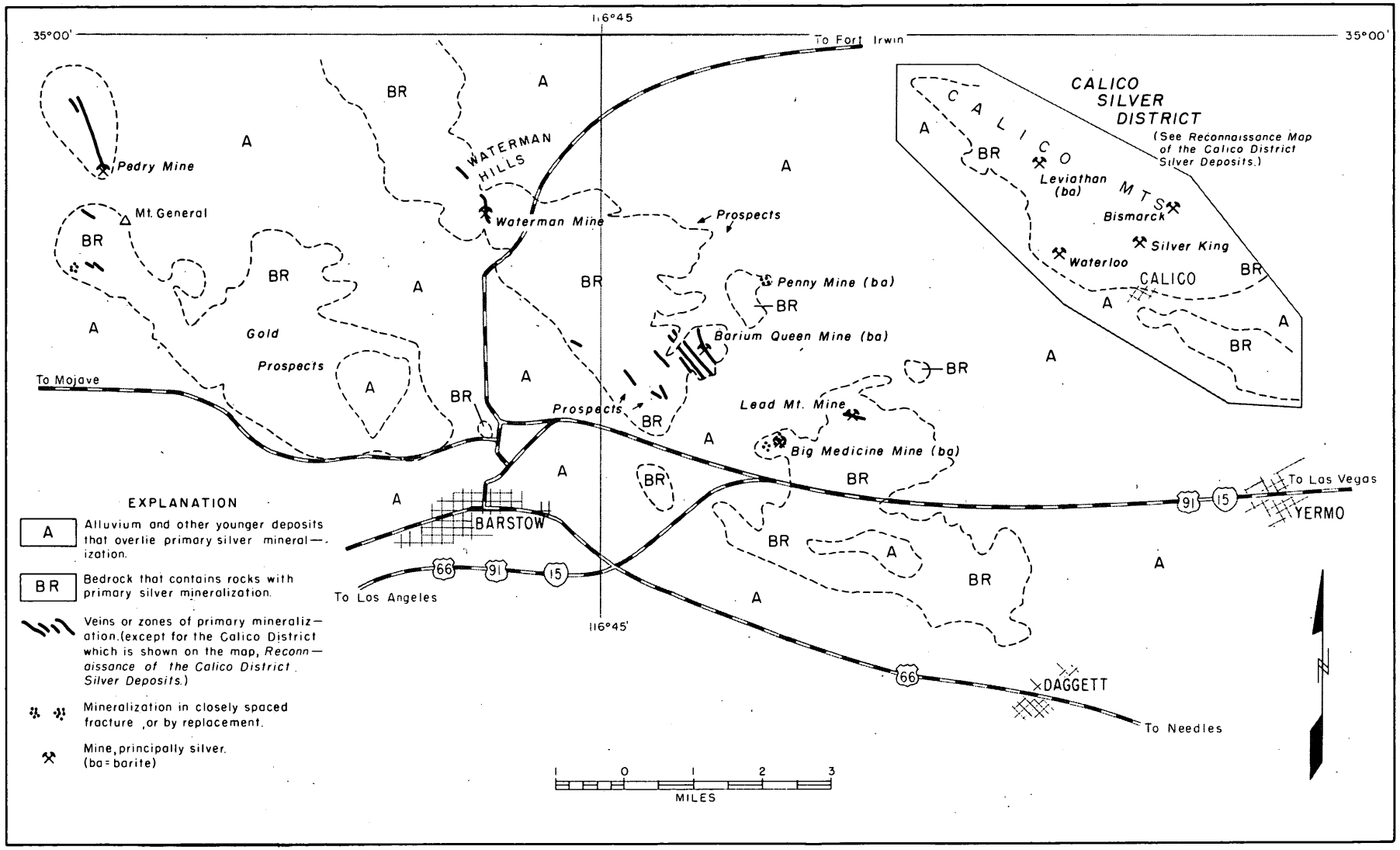
The central Mojave Desert comprises small to moderate ranges and groups of hills separated by small to broad valleys which commonly contain playa lake beds. The ranges and hills generally are blocks of rock that have been faulted relatively upward, and the valleys blocks that have been faulted relatively downward. Most of the blocks have been faulted along lines that trend northwest, generally parallel to the San Andreas fault, whose nearest point lies about 50 miles southwest of Calico. This fault, which dominates the structural geology of southern California, is believed by most geologists to have moderate to very large right lateral movement, whereby the rocks on the northeast side of the fault have moved southeastward relative to the rocks on the southwest side. Similar movement along faults of the central Mojave Desert has been shown by Dibblee (1963) and others.

The Calico Mountains themselves constitute a range which trends generally northwest but is irregular in plan. Silver deposits are mainly in the southwest portion, known as the Calico mining district, which has peak elevations of about 3,000 to 4,000 feet. The range is bounded mostly by nearly flat alluvial areas, as low as 1,900 feet, and is separated from the lowlands to the west and south by a steep northwest-trending front, along the base of which is the Calico fault zone —the predominant structural feature of the region.

To many people, the most spectacular sights in the Calico Mountains are steep-sloped hills, commonly capped with resistant volcanic rocks (which are dark shades of gray, red, or green) and underlain by much softer sedimentary rocks (such as sandstone or tuff, which are pale green, pale yellow, or buff). The resistant volcanic caps have shed trains of bouldery fragments down the steep slopes, giving the overall appearance perhaps of chocolate syrup dribbling down scoops of ice-cream. Such sights can be seen at the steep southwest edge of the mountains, even from a car, while travelling along Interstate Highway 15 near Yermo. At other localities, colorful sedimentary strata are steeply tilted or spectacularly folded, and penetrated by deep canyons, especially Wall Street Canyon, which extends northward from the reconstructed "ghost" of Calico town, at the southwest edge of the mountains.

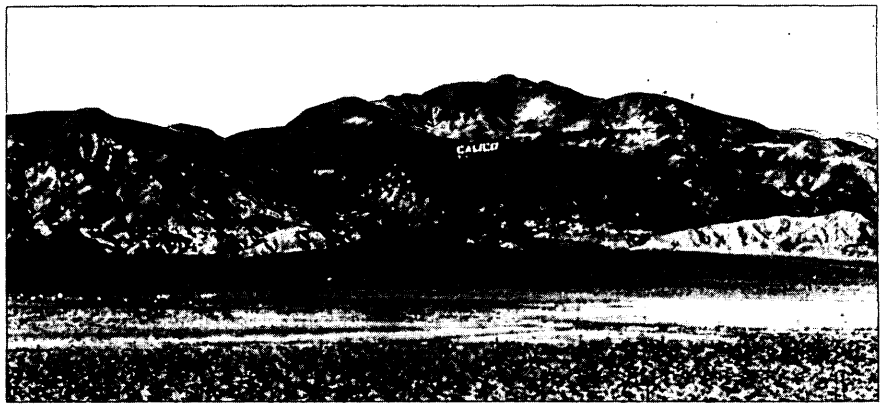
Geologic terrain somewhat similar to that of Calico also underlies other mining districts in the Mojave Desert, including Mojave, Randsburg, Stedman, and Lava Beds. But the classic illustration of a "bonanza" deposit is the Comstock lode, at Virginia City, Nevada.

* The first part of Mr. Weber's series on Calico appeared in the May, 1966 issue of this magazine.



CALICO SILVER DISTRICT AND VICINITY

View north-northeast shows portion of southwest Calico mountains. The word "Calico" lies at the crest of King Mountain, with the Silver King and Oriental mines just below, and the town of Calico at the base of the mountain. Wall Street Canyon lies to the left of King Mountain, and Odessa Canyon lies to the right. The Burcham mine is shown near the left edge of the photo, which was taken in 1959.



The ore deposits of the Calico region have been studied briefly by many geologists and engineers. The most eminent is Waldemar Lindgren (1887), who formulated the "hydrothermal" classification for the origin of certain ore deposits. The areal geology of the mountains has been mapped in detail by T. H. McCulloh (1965), as part of a regional study.

The oldest rocks in the Calico Mountains region consist principally of the Waterman Gneiss, which may be as old as Precambrian. Next younger are metasedimentary rocks of Paleozoic age, and granitic intrusive rocks of probable Jurassic or Cretaceous age. Together, these older rocks compose the "basement," rocks formerly at great depth but uplifted irregularly along faults during late Cretaceous or early Tertiary times, creating mountain ranges and valleys. Material eroding from the ranges into the valleys during the Tertiary period created the sedimentary rocks, into which the volcanic rocks were intruded. Such a cycle of sedimentation and subsequent volcanism, stimulated by faulting and uplift, has been repeated at least several times since the beginning of the Miocene epoch of the Tertiary period, about 25 million years ago.

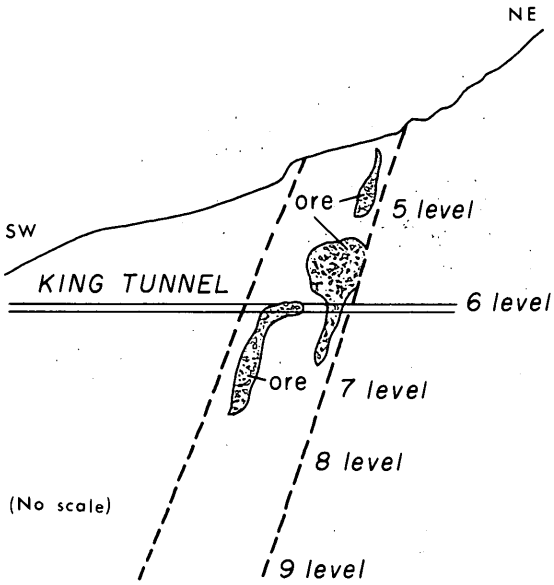
In the Calico district, the principal sequence of rocks consists of faulted and gently tilted tuff, tuff breccia, granite breccia, and sandstone, which was named the Pickhandle Formation by McCulloh (1965). It is probably middle Miocene in age. This sequence has been faulted, gently tilted, and intruded by volcanic rocks which range in composition from rhyolite to andesite. The earliest silver-bearing deposits occur within veins that cut the Pickhandle Formation and intrusive volcanic rocks (as shown on the accompanying map of the district). Related to the veins in the Pickhandle Formation are silicification, baritization, and other forms of alteration.

Composing the remainder of the bedrock, but apparently not containing veins, are the younger Barstow Formation and the Burcham Formation of McCulloh (1965), both probably of late Miocene age. These rocks mainly border the Calico fault zone on the southwest, and also lie within an embayment into the Calico Mountains, where they are mostly surrounded by the older, middle Miocene rocks. The Barstow and Burcham Formations consist mostly of sandstone, mudstone, and conglomerate, along with limestone and other rocks. These rocks appear fresh and unaltered, except in the Waterloo mine area, where probably they were altered as mineralization of the Calico fault zone occurred. They appear to be younger than the primary veins, but do not seem to contain clasts of the vein matter.

Lying above the Tertiary rocks are deposits of uplifted, unconsolidated terrace gravels, probably as old as early Pleistocene or possibly even Pliocene. The youngest deposits consist of Recent alluvium.

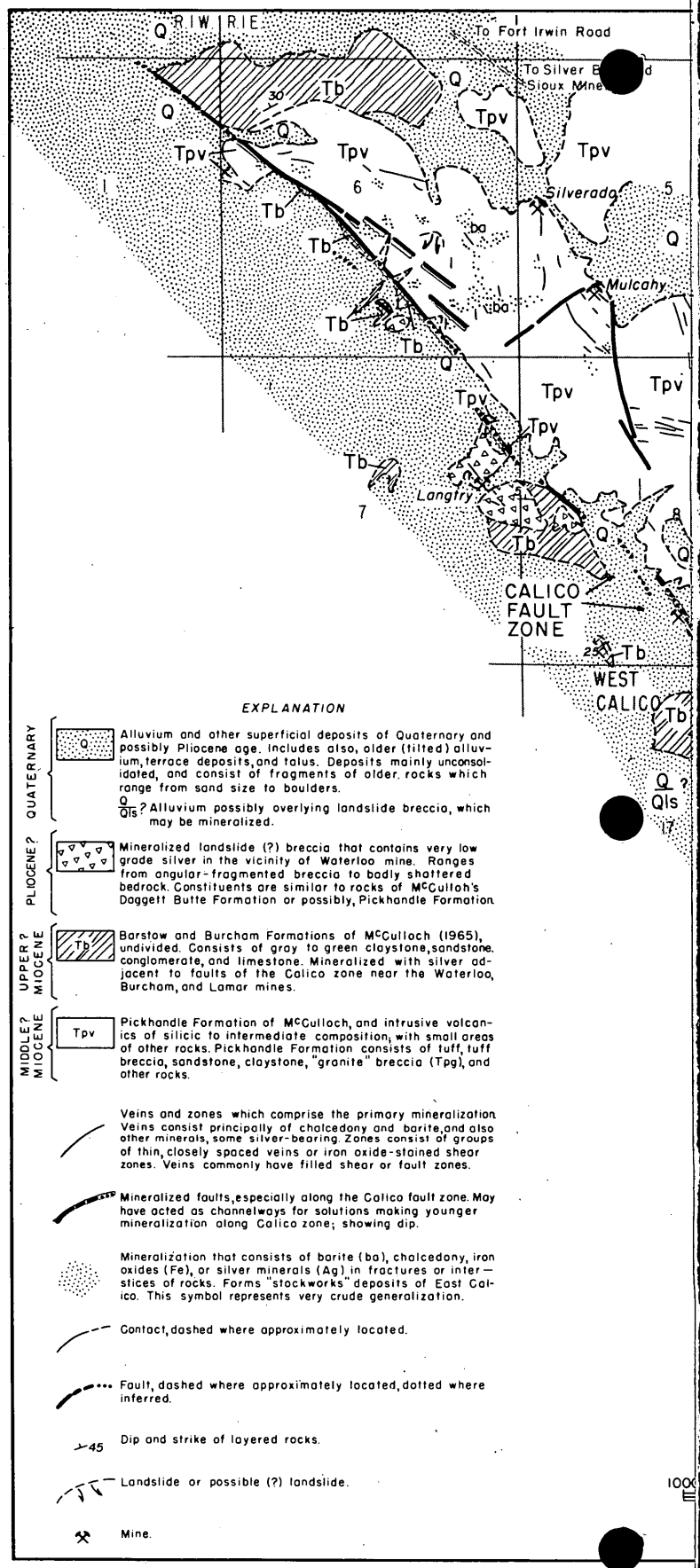
Silver has been sought in the Calico district from three closely related types of deposits: most obvious are veins or vein-like zones which lie north and northwest of Calico and include the Silver King mine ; less obvious, and southeast of the principal veins ("East Calico"), are areas of near-surface stockworks; and west and northwest of Calico lie deposits (including the Waterloo mine) that are associated with the Calico fault zone.

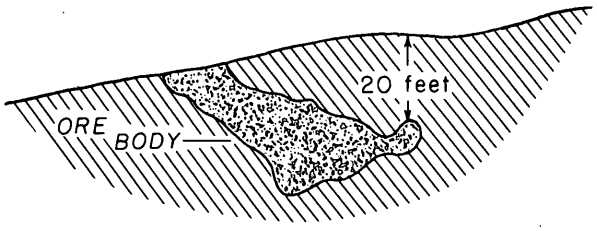
The vein and zone deposits are the basic (primary), oldest, and most widespread silver-bearing occurrences of the district. Veins consist of elongate, tabular bodies which generally consist principally of red jasper and white barite, commonly thinly interlayered parallel to the sides of the veins, with much smaller proportions of manganese, iron, silver, and other minerals. Zones consist of closely spaced thin veins or vein-like features which contain principally stains of iron oxide minerals. The veins trend mostly northwest to north-northwest, and make up a northwest-trending belt roughly 4 miles long and a quarter of a mile to a mile wide. This belt extends from the northwest corner of the Calico Mountains, with a bend near its middle, to points north and east of the town of Calico, where it seems to evolve into the area of stockworks.



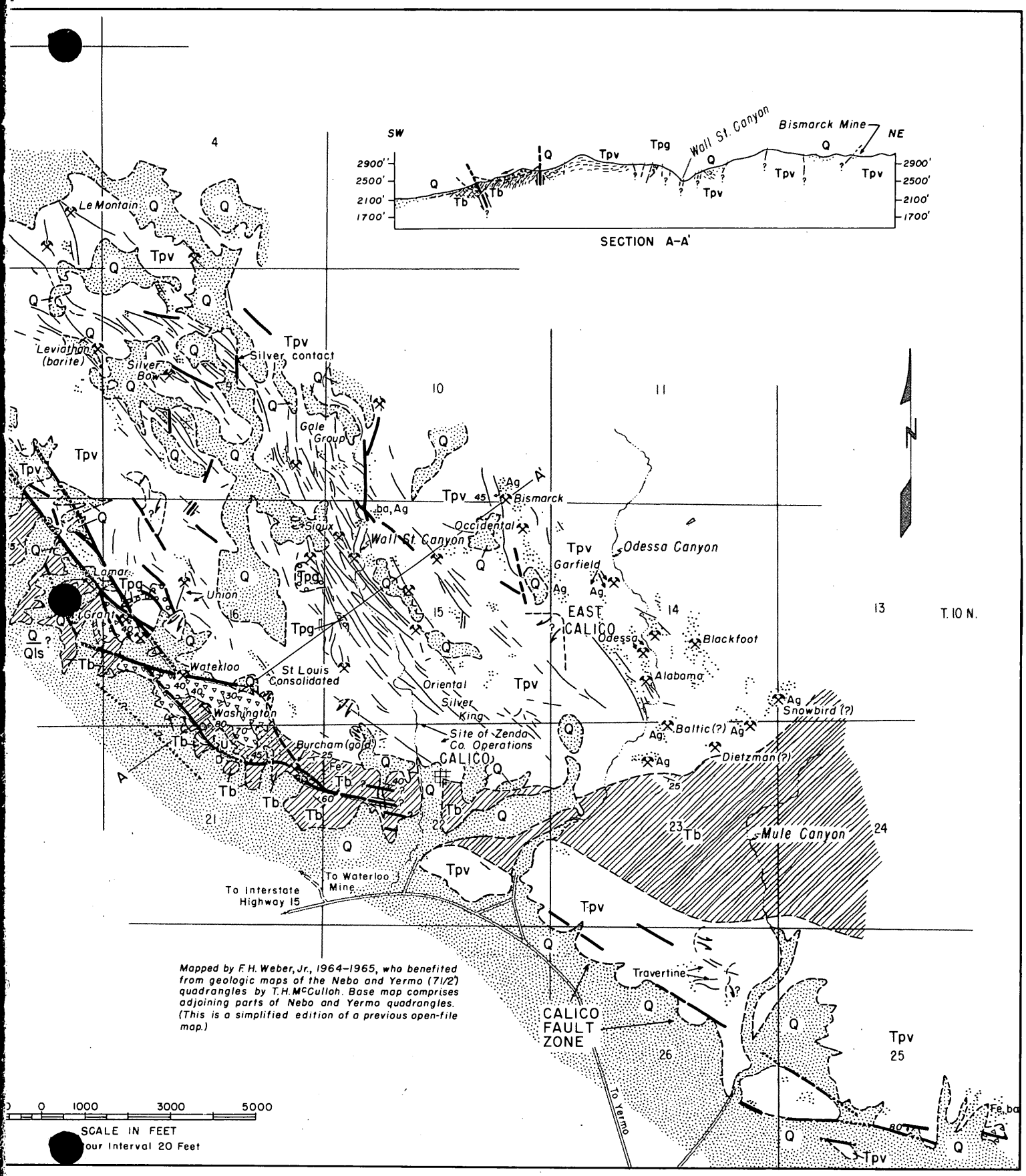
Silver King mine; cross section showing ore bodies of secondary minerals in upper part of steeply dipping zone, which cuts layered and intrusive volcanic rock. Sketch was drawn in the late 1880s for court trial (Storms, 1893).

RECONNAISSANCE MAP OF THE CALICO DISTRICT SILVER DEPOSITS





Blackfoot mine showing in cross section one of the shallow ore bodies as seen in active mine by W. Lindgren (1887). Silver minerals fill fractures in tuff (called "tufa" by Lindgren) with body of minerals following layering of tuff.



Mapped by F.H. Weber, Jr., 1964–1965, who benefited from geologic maps of the Nebo and Yermo (7 1/2') quadrangles by T.H. McCulloh. Base map comprises adjoining parts of Nebo and Yermo quadrangles. (This is a simplified edition of a previous open-file map.)

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The veins and zones range in length from less than 50 feet to about 4,500 feet. The veins range in width from less than a quarter of an inch to perhaps 50 feet (at the Leviathan mine, where barite has been recovered), and most commonly from about half a foot to several feet. Most of the veins dip steeply, commonly 75 to 85 degrees west. Parts of some veins that are very thin (less than 2 or 3 inches) can be traced remarkably continuously for many hundreds of feet along the surface. One vein, for example, which is as much as 7 to 8 feet thick, where exposed in the Silver Bow mine shaft, can be traced southeast along the surface from the shaft, though less than one inch wide, for nearly 500 feet. This continuity helps to suggest that the vein may widen at some point beneath the surface, southeast of the shaft, below possible constrictions, which may have acted as traps to the mineralizing solutions. Possibly the constrictions were caused by a change in lithology. In other areas, a rock unit that seems to have a constrictive cap-like effect on vein deposits is pale-yellow weathering lithic tuff of the Pickhandle Formation. An example of this effect is at the St. Louis Consolidated deposit.

The richest vein deposits, near the southeast end of the belt, consist of zones that once contained rich bodies of so-called secondary silver minerals in their upper parts. Examples were the ore bodies for the Silver King, Oriental, and nearby mines (see accompanying illustration). Deeper parts of these veins are composed nearly wholly of primary minerals; and primary ore minerals are common near the surface in the north-central part of the vein system, at the Silver Bow, Le Montain, and other deposits. The primary deposits generally have been lower in grade than the secondary ones.

The most economically important variation apparently in the character of the principal veins, in the southeast part of the belt, is that with depth they decrease in grade. The best example of this economically unfortunate phenomenon is exposed by the Silver King mine, where ore yielded less silver as mining proceeded—mostly downward. Another variation is that the veins of the central and northwest part of the belt contain principally primary sulfide minerals in their upper parts, and no rich secondary deposits, as do the veins to the southeast. Thus these deposits have been infinitely less important economically than the ones to the southeast. For example, the thick Leviathan deposit is reported to be very low in silver.

Southeast of the belt of veins lie the areas of stockworks, where veins or zones also occur, some in conjunction with the stockworks. The Bismarck and Garfield deposits comprise a combination of veins and stockworks. The stockworks consist of shallow networks of multitudinous fractures in tuff, sandstone, and other rocks which are filled with silver minerals. The Blackfoot mine is characteristic (as shown in the accompanying diagram). At least some of these deposits are restricted to a single layer, or to adjacent layers (such as perhaps the Occidental mine).

The third type of deposit includes those that are associated with the Calico fault zone, which extends along the southwest edge of the range. Silver minerals occur in vein-like deposits in faults of the zone, and as deposits of stockworks in sandstone and shale of the Burcham and Barstow Formations, which are adjacent to the zone. Potentially important, very low grade deposits, explored during 1965–66, constitute disseminated silver minerals in bodies of a landslide breccia, which is associated with the Calico fault zone. In addition, the only gold deposits of the district (the Burcham mine, particularly) occur in the zone.

West of the Calico Mountains, in the hills beyond the broad lowlands, lie additional deposits, including the rich Waterman mine, the Lead Mountain mine, and the Penny, Big Medicine, and Barium Queen barite deposits (as shown on the accompanying map). Most of these deposits seem to be primary veins, with the Waterman mine having contained rich secondary deposits.

A bibliography on the Calico district will accompany the third part of this series.

Order form on page 2

MINERAL INFORMATION SERVICE

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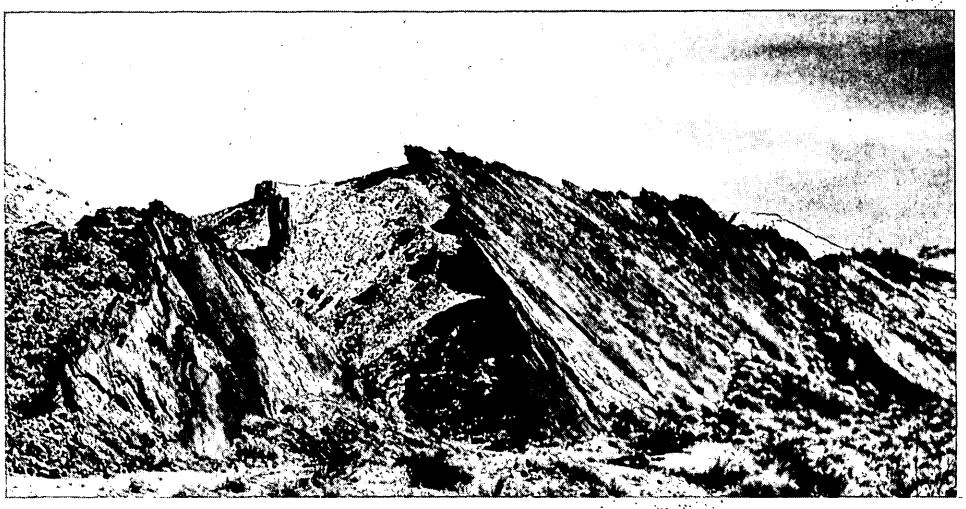

Calico Mountains

STATE OF CALIFORNIA ▪ THE RESOURCES AGENCY ▪ DEPARTMENT OF CONSERVATION ▪ DIVISION OF MINES AND GEOLOGY

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MINERAL INFORMATION SERVICE is designed to report on the progress of earth science in California, and to inform the public of discoveries in geology and allied earth sciences of interest and concern to their lives and livelihood. It also serves as a news release on mineral discoveries, mining operations, statistics of the minerals industry, and new publications. It is issued monthly by the California Division of Mines and Geology. Subscription price, January through December, is $1.00.

Other publications of the Division include the Annual Report of the State Geologist; the Bulletin, Special Report, Map Sheet, and County Report series; the Geologic Map of California; and other maps and publications. A list of the Division's available publications will be sent upon request. Communications to the Division of Mines and Geology, including orders for publications, should be addressed to the San Francisco office.

MARY R. HILL, *Editor*

THE HISTORY TRAIL

From Mr. Braeme E. Gigas comes good news concerning the name Mount Mary Austin. Writes he, "Happily, we need no longer put that phrase in quotes, because I have just received a letter from the Board of Geographic Names that the name has been approved." An enclosed letter from the Board adds, "This decision will be published in Decision List 6601 and the entry will read as follows:

> Mary Austin, Mount: mountain, elevation over 13,040 ft., 1 mi. NE of Black Mountain and 8.5 mi. W of Independence; named for Mrs. Mary Austin, a prominent writer, natural historian, and long-time resident of the area; Inyo Co., Calif.; 36° 48′ 57″ N., 118° 21′ 43″ W."

THE HISTORY BOOKSHELF

Mines of the High Desert, by Ronald Dean Miller. 63 pages, 20 photos, maps, index, references. Price $1.95.

History of the Dale mining district, in and about Joshua Tree-Twentynine Palms National Monument, is recounted by Mr. Miller, who was for years a naturalist at the Monument. The two dozen mines of the area—among them the Virginia Dale, Old Dale, New Dale, Supply, OK, Zulu Queen, Gold Coin, Snowcloud, Lost Horse, Hexie, Anaconda, and Desert Queen—were "small, almost do-it-yourself" turn-of-the-century ventures, but their story contributes an interesting and picturesque page to desert lore.

Mines of the High Desert is the fifth booklet in Walt Wheelock's La Siesta Press desert series . . . its predecessors *Freeman's, A Stage Stop on the Mojave*, by E. I. Edwards (price $1.95); *Exploring Joshua Tree*, by Roger Mitchell (price $1.00); *Baja California Overland*, by L. Burr Belden (price $1.95); and *Desert Peaks Guide, Part I*, by Walt Wheelock (price $1.00). They may be obtained from La Siesta Press, Box 406, Glendale, California, 91209.

Dedicated to keeping the gold mining industry from becoming an irrevocable page from history is the monthly paper *American Gold News*, the official publication of the American Gold Association and the Mineral Association of Northern California. Those who wish to keep a finger on the pulse of the ailing industry can do so with a subscription, price $3.00 per year (foreign $4.00 per year) or $5.00 for two years. Address P.O. Box 427, San Andreas, CA 95249.

The Rock Paintings of the Chumash, by Campbell Grant. 163 pp., 120 figs., 30 colored plates and frontis. University of California Press, Berkeley and Los Angeles. 1965. Price $10.00.

Our thanks to reader "C.S.", Librarian at Santa Barbara Museum of Natural History, for his complaint that we had not reviewed *Rock Paintings of the Chumash*. We are much in his debt for calling to attention this unusually beautiful volume, typified by a clear, understandable text and some of the most finely reproduced Indian paintings it has been our pleasure to view. Campbell Grant, author and artist, has copied many of the original paintings, on the spot; his copies are printed in color, along with a few color photos of the originals for comparison.

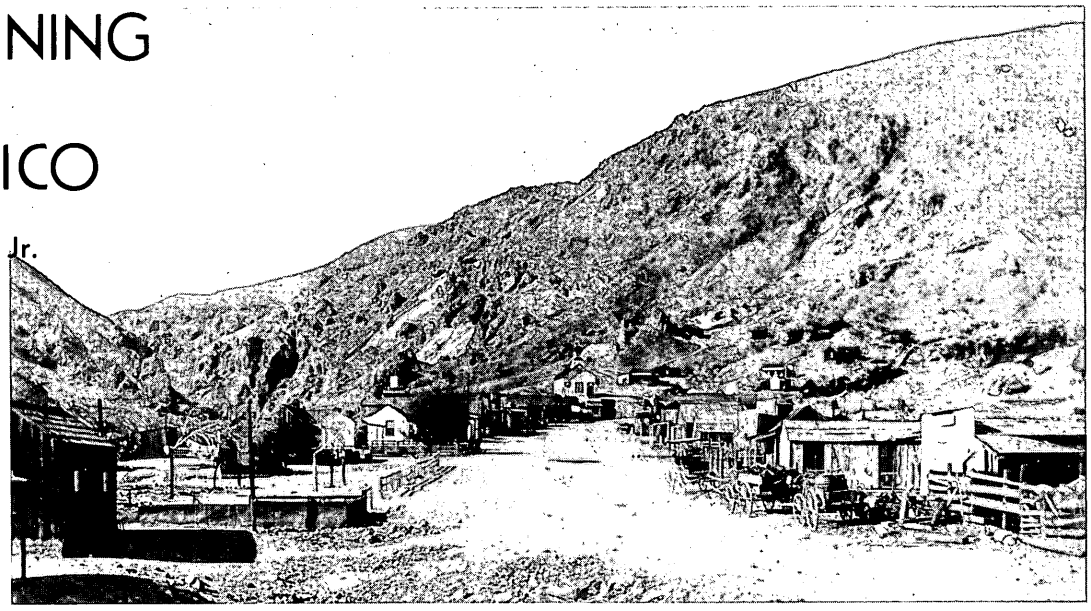
The book explores the territory of the Chumash, their history, and their culture, and the text is supplemented by numerous black and white illustrations. The material presented is authentic, yet its rendition is not hampered—for the layman—by the language barrier common to many scientific works.

Mr. Grant has included a short section entitled "Erosion and Vandalism" in which he concludes that "Damage through vandalism is a far greater threat to the existence of these pictographs than erosion". Fortunately their locations are not too well known, nor are they too accessible (what a sad comment to have to make!); but even so, many of them have been seriously damaged by vandals.

Rock Paintings may be ordered from University of California Press, Berkeley, California 94720. It is not distributed by the Division of Mines and Geology.

SILVER MINING IN OLD CALICO

By F. Harold Weber, Jr.



Early Calico, view north; in background are mine workings of Wall Street Canyon area to left and King Mountain area to right. Mine dumps on King Mountain are principally from Silver King and Oriental mines. Date of photograph not determined, perhaps about 1890. *Collection of The Huntington Library, San Marino.*

> Seven miles north of Daggett is the much talked of city of Calico. One narrow and serpentine street is the only thoroughfare. The place is built on a narrow ridge; the back end of lots on each side of the street end on or over a bluff. Small, hastily-built houses are the order of buildings, only a few two-story houses gracing the camp. Saloons are more than numerous. Business generally is overdone, and the number of black-legs and tin-horn gamblers that infest the place is remarked by a newcomer. The only water supply is that hauled two miles from Evans' well, and costs from 3 to 5 cents per gallon. Wood is $10 per cord. Board, $7 to $8 a week. The Occidental and Whitfield House are the only hotels, and they are pushed to their utmost capacity to accommodate the travel that is arriving daily. The camp is a good one, but at present is overestimated and overcrowded by men out of money and work. Capital, development and a chance is all this camp needs to be a second edition to the Comstock at no great distant date.

These words, written by a correspondent of the *Mining and Scientific Press*, were published in the issue of March 14, 1885. The "bonanza" Calico district then was in its fourth year of productivity, and near its zenith; within a few years it would begin to wane, becoming a near "ghost" by the very early 1900's. During this period of roughly 20 years, the 50-odd mines of the Calico district and surrounding region—the Silver King, Oriental, Waterloo, Bismarck, Garfield, Odessa, Occidental, Waterman, and others—yielded an estimated $13 to $20 million in silver. This production is small in comparison with $225 million taken from the great Comstock Lode at Virginia City, Nevada, but very significant in terms of metal mining in southern California. Since 1900, silver mining operations in the Calico district have been mostly small and intermittent; but great interest shown in the district by the mining industry since 1963 suggests that once again it may become the site of important silver mining operations.

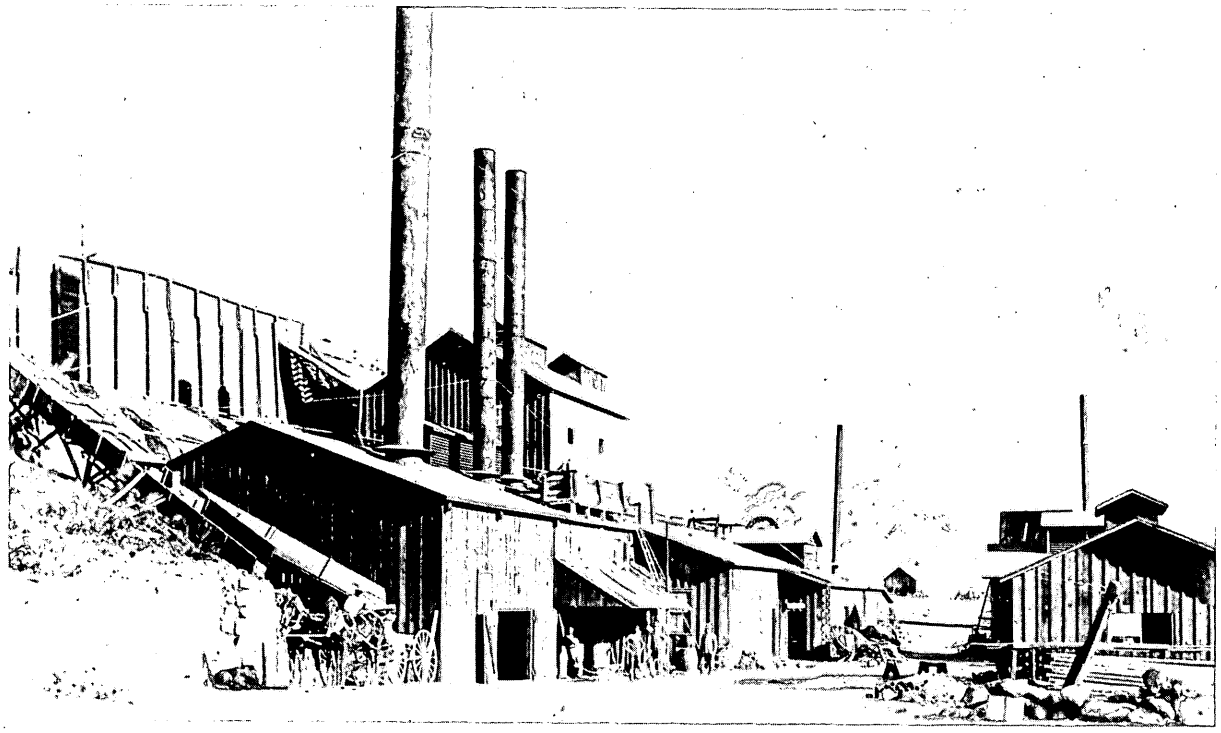
The little "ghost" town of Calico lies at the southern edge of the Calico Mountains, about 10 miles northeast of Barstow in the central part of the Mojave Desert of southern California, and about 100 miles northeast of Los Angeles. It is commercialized now, and hardly a ghost: parking lots often are filled with modern automobiles, whose brash, shiny colors seem out of place in an old mining camp. Genteel tourists poke curiously along the town street, perusing relics of former mining days, and wander among the dusty graves of the cemetery. Loudspeakers blare inducements to concessions, and the whistle from a sightseeing train echos hauntingly back into the mountains, to the north, where lie the old mine workings of the district. These workings consist both of extensive, professionally engineered adits and shafts, and of widespread, crude gopher-like surface diggings. Altogether, the mine workings have yielded perhaps 15 to 20 million ounces of silver, plus small amounts of barite, gold, lead, and copper. In addition, the region has yielded $9 million worth of borax minerals, mined from 1884 to 1907.

Prospecting for silver in the Calico Mountains and surrounding region apparently was begun seriously during 1880–81, although the first discoveries may

have been made earlier, perhaps in 1875. Some prospectors must have searched the Mojave Desert soon after development began of the gold mines in the Mother Lode region, but because the desert region was desolate, poorly accessible, and largely unexplored, mineral discoveries were few. The real spark to prospecting in the eastern mountain and desert region of California, and in Nevada, probably was ignited by discovery of the Comstock Lode at Virginia City in 1859, about 300 miles north-northwest of Calico, and its spectacular development during the 1860's. From this focal point, prospectors spread out widely over the west, and began to discover other great districts, including Eureka, Tintic, and Pioche. Prospecting also was sparked by completion of the transcontinental railroads, beginning with the Central Pacific in 1869, which enabled more men to come west to seek their wealth. In eastern California, during the 1860's and 1870's, Blind Spring Hill, Cerro Gordo, Panamint City, and Darwin were discovered; then Calico; following it, during the late 1890's and early 1900's, were developed the gold districts of Mojave and Randsburg, which eventually also yielded large amounts of silver.

The demand for silver that was the basis for prospecting was natural, as long through history silver had been considered a precious metal, and had been used in coins and as a backing for wealth. The United States had adopted the silver dollar as its unit of monetary value in 1776; and ultimately adopted bimetallism for monetary purposes, whereby the dollar eventually became (in 1837) worth 23.22 grains of gold or 371.24 grains of silver (hence the expression "16 to 1"). But until the Comstock Lode was discovered, the country imported nearly all of its silver. Since that discovery, the U.S. has been a major producer of silver, and during most years from 1871 to 1915 was the world's leading producer. In 1964 the United States ranked third in world output, following Mexico and Peru, and ahead of Canada and USSR. In that year, the United States produced about 36 million ounces of silver, worth about $47 million, principally as a by-product of base-metal mining operations, but partly from ore mined for gold or primarily for silver itself. About 52 million ounces of silver was imported during 1964.

One very important event that was gradually to blight the nation's young but growing silver mining industry occurred in 1873, when the United States went off bimetallism and onto the gold standard (though without basic change to the monetary policy). Soon afterward, the price of silver began to fall

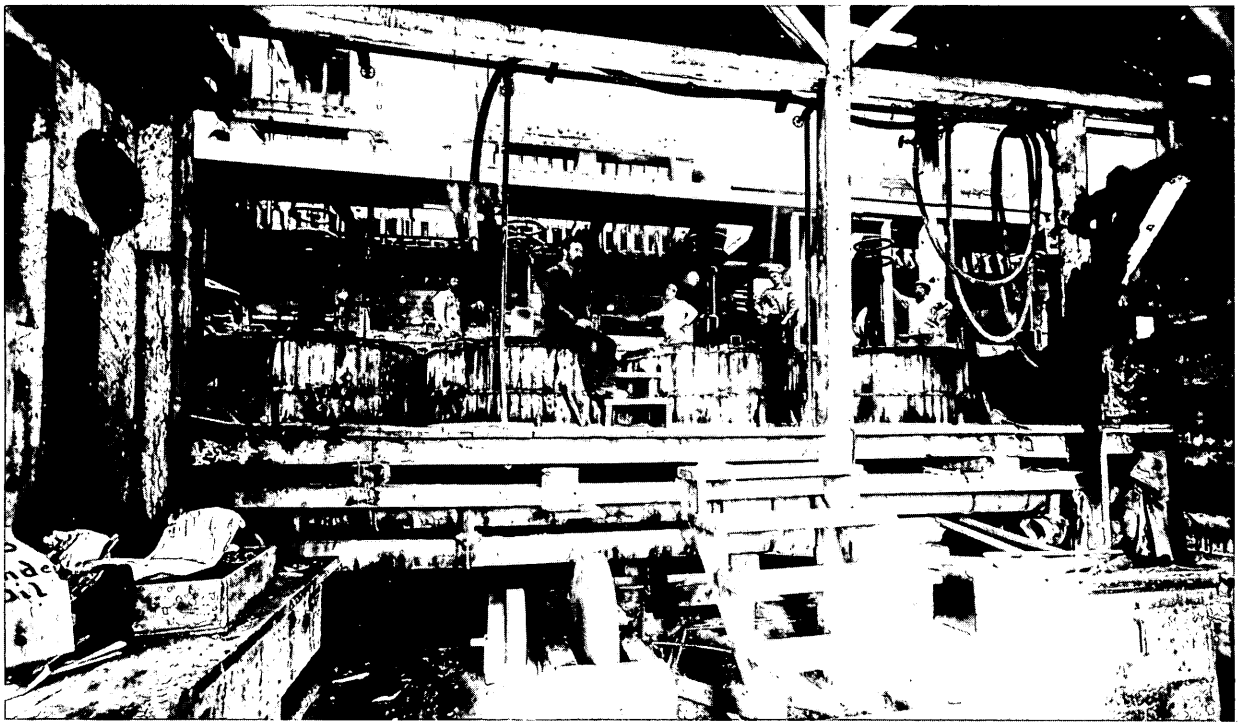


Mill of the Silver King Mining Company (also called Garfield mill). Photo taken perhaps about 1890. At that time ore from Occidental (including Garfield mine), Odessa, and Oriental groups was being processed here. Site of mill is on south side of hill between mouths of Wall Street and Odessa Canyons. *Collection of The Huntington Library, San Marino.*

irregularly from an average high during 1865–73 of about $1.33 per troy ounce to roughly $1.13 in 1881, when Calico was discovered, and to about 64¢ by 1894, when most of the larger operations in the Calico district had ceased or nearly ceased. The price continued to fall, though with fluctuations, to 51 cents in 1915, and to its ultimate low, about 25 cents, in 1932; even during this last period, however, developers and promoters were actively attempting to reopen and redevelop the mines of Calico.

In some respects it is ironic that the Calico district should lie so close to the new freeway of Interstate Highway 15, which links Los Angeles and Las Vegas, Nevada. For Los Angeles epitomizes the unbridled growth in population of the nation, which is reflected in the growth of the Nevada gambling industry that has evolved from the early days of silver mining. This growth in population has led basically, if indirectly, to the renewed demand for silver, and to the increase in its price from about 91 cents in 1961 to $1.29 by 1963. This relatively high present price has stimulated hope in the mining industry for an even higher price, which, in effect, evokes a rebirth in interest in all inactive silver-bearing deposits and districts. Especially of interest are "bonanza" districts such as Calico, which have yielded relatively large amounts of silver from near-surface workings in rich, shallow deposits, mined almost wholly for precious metals, because many such deposits in California commonly have not been thoroughly explored or studied either at depth or on the surface.

Development of the Calico district might be said to have begun earnestly on April 6, 1881 when S. C. Warden, Hues Thomas and John C. King and others located claims which they began to develop as the Silver King mine. Calico did not then grow with a great "rush", but by the spring of 1882 about 100 people were reported to be living in the town, and mining was underway. Activity was slowed during the summer, partly because of illness in the camp, and perhaps also because of the intense desert heat. But in the fall of 1882 mining in the region seemed to gather momentum: consolidation of smaller properties into larger ones led to more efficient development and mining, and more professional miners had arrived. In July, for example, the Silver King mine had been sold for $300,000 to San Francisco interests. In addition, the Atlantic and Pacific Railroad was being constructed eastward from Mojave. By October 22, 1883 track had reached Waterman's, near present-day Barstow, and by the end of the year it had reached Ludlow, 130



Inside mill of Silver King Mining Company. Tanks shown were part of system of Boss (multiple pan) process which utilized chlorination and amalgamation to recover silver. *Collection of The Huntington Library, San Marino.*

miles to the east beyond Calico. The railroad, obviously, became a vital link for the district, essential to growth.

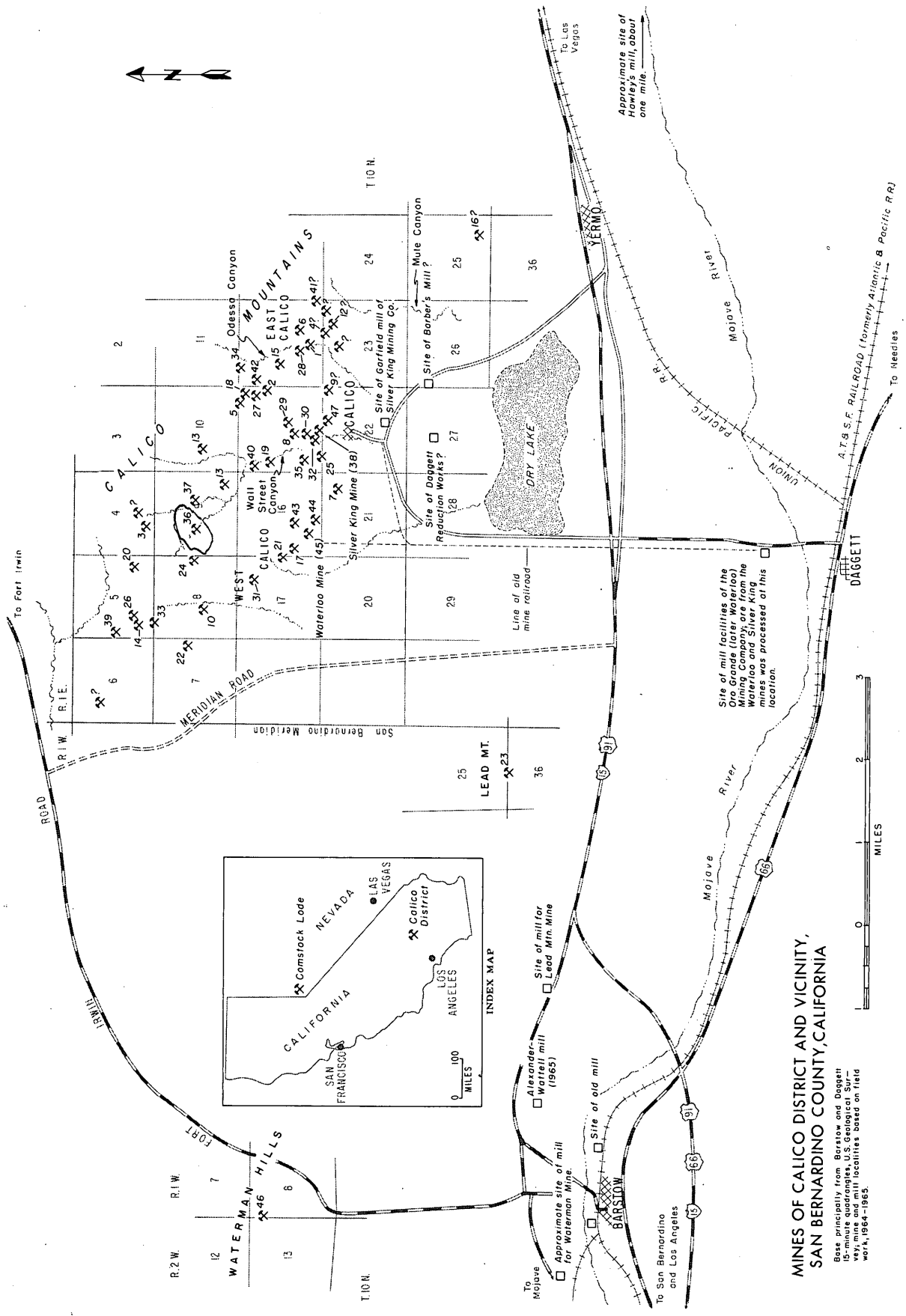
By the end of 1882, the district had taken shape geographically: immediately north of Calico camp, on the steep sides of Wall Street Canyon and on King Mountain were the Silver King, Oriental, Burning Moscow, Red Cloud, and other mines. To the northeast, in the vicinity of presentday-named Odessa Canyon, were the mines of "East Calico", including the Garfield (opened December 1882), Odessa, Bismarck, Blackfoot, and others; and to the west and northwest lay "West Calico," with ultimate development of the Waterloo, Langtry, and other mines. About 5 miles west of Calico, in low hills beyond a broad valley, was developed the Lead Mountain mine; and about 10 miles to the west the Waterman mine had been developed (perhaps even before the first mines at Calico).

Along with development of the mines, mills for processing the ore and recovering the silver were constructed near Calico and along the Mojave River, several miles to the south, where water was plentiful. The ore was hauled to the mills in horsedrawn wagons, and the earliest ore from the Silver King mine was hauled 40 miles to a mill along the Mojave River at Oro Grande. The general silver recovery process used in the region was the so-called "continuous pan" (or Boss) process, in which ore pulverized in stamp mills flowed as pulp through a series of pans in which it first was chlorinated, then amalgamated for recovery of the silver. Such a process apparently handled the free-milling oxide ores of the Calico mines relatively efficiently, for it recovered as much as 95 percent of the silver from the purest chloride ores, and about 75 to 80 percent of the silver from deeper, sulfide-bearing ores. Salt for the chlorination came from south of Danby (100 miles east of Calico) and coal for fuel came from New Mexico.

The Silver King was the most prominent mine in the district, according to a report of the Director of the Mint for 1882; by the end of the year it had been developed to a depth of 250 feet, with about 500 feet of drifts and crosscuts. These developments were reported to have exposed "a ledge 20 feet wide, between well-developed walls, with rich streaks of from 2 to 3 feet on each wall. . . . Many car loads of partially selected ore from the mine have been sold in San Francisco, averaging $300 per ton. . . ." The next in importance was the Oriental mine, under management of Judge James Walsh, a veteran miner, who said that Calico was "another Comstock". The 1882 mint report went on to say that "the Burning Moscow, Red Jacket, and Sue and Fay, and several others have been sufficiently developed to be called mines. In all these mines the ore contains scarcely anything but silver in spar, and in the shape of chloride, bromide, verda plate (green silver), and horn silver." The report also stated that "The Cuba mine is another valuable location in East Calico, and is being developed with promising results. On looking over the Cuba location, almost the entire surface of the claim appears covered with a conglomerated mass of calcareous tufa and porphyry carrying chlorides and horn silver. Wherever the surface has been broken, ore is visible to the eye. . . . All the first class ore from the mine will work $300 per ton, and the owners make it a point not to sack any that will not assay that much." (Silver was then worth about $1.14 per ounce). No minable gold had been found.

MINES OF THE CALICO DISTRICT

1. Alabama
2. Argentum
3. Backdoor No. 1 prospect
4. Baltic
5. Bismarck
6. Blackfoot
7. Burcham (Total Wreck) (Gold-lead)
8. Burning Moscow
9. Carbonate group
10. Cisco
11. Cuba (location undetermined)
12. Dietzman
13. Gale Group
14. Galena King
15. Garfield
16. Grandview
17. Grant
18. Humbug
19. Falls
20. Le Montain (Sliver-lead-barite)
21. Lamar
22. Langtry
23. Lead Mt. (Silver-barite)
24. Leviathan
25. Lone Star group
26. Mulcahy group
27. Occidental
28. Odessa
29. Old Oriental
30. Oriental
31. Possibility group
32. Red Cloud
33. Revier
34. Runover
35. St. Louis Consolidated
36. Silver Bow (Silver-lead-barite)
37. Silver Tip (Silver-lead-barite)
38. Silver King
39. Silverado
40. Sioux
41. Snowbird
42. Thunderer
43. Union (Gold)
44. Voca (Washington)
45. Waterloo
46. Waterman
47. Zenda



MINES OF CALICO DISTRICT AND VICINITY, SAN BERNARDINO COUNTY, CALIFORNIA

Base principally from Barstow and Daggett 15-minute quadrangles, U.S. Geological Survey; mine and mill localities based on field work, 1964–1965.

By the light of a candle and metal reflector, a Calico miner fills an ore car from a chute. Unidentified mine and date. O. A. *Russell Collection.*

As an example of how mining developed, the Garfield mine is reported to have been worked from December 1882 until April 1883 by only 2 men, who shipped 11 tons of selected, high grade ore which yielded $5,885 in silver; but from November 1883 to January 1, 1885, 2,400 tons of ore was shipped from the mine, which yielded $290,400 in silver (and a "large amount" of "unassorted" ore was worked locally at Barber's mill). By January 1883, the Waterman mine had yielded 9,000 tons of ore which yielded $39.30 per ton, with the resultant tailings yielding about $10 per ton (making a total of about $440,000); and during 1883, the Silver King mine was reported to have yielded about $426,000 in silver.

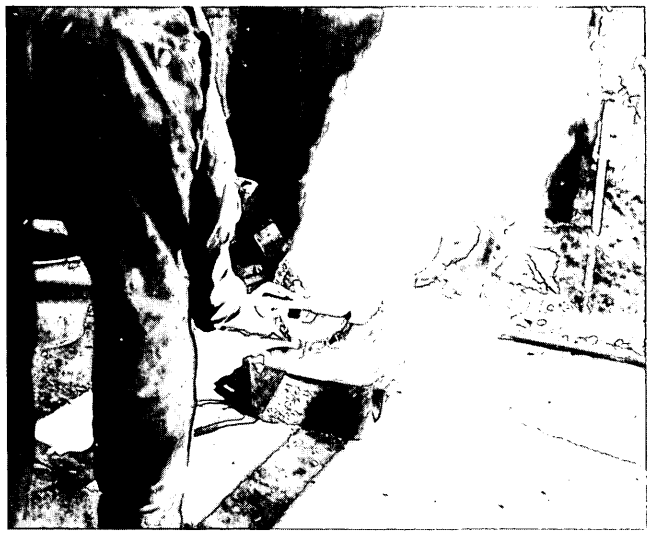
Smaller properties often were worked by so-called "chloriding" methods, whereby lessees operated mines individually or in small groups, paying one-quarter to one-fifth of the mill proceeds to the owners. This procedure was very inefficient, and hindered or prevented maximum possible development of the mines. For most such lessees cared only to mine expediently the richest possible ore, which was commonly composed of thin stringers and veinlets of silver chloride and associated minerals. Compounding the problem were the expensive charges to miners for hauling and milling: the charge for hauling from Calico mines to mills along the Mojave River was $2.50 per ton; and the charge for custom-milling was $11 to $14 per ton, even though the actual milling cost was only $3 to $5.

Productivity in the district reached its peak during 1884–1885, when perhaps as many as 2,500 people lived in the district. By this time, the Silver King mine had been purchased by the Oro Grande Mining Company, owned principally by C. M. Sanger of Milwaukee. (Ultimately the Oro Grande Mining Company also was to gain control of the Waterloo mine, after settlement of a law suit.)

At the beginning of 1884 the Silver King mine had been worked to a depth of 500 feet, and was reported to "still show well at the bottom." From January 1884 to March 1885, the mine yielded about $1 million worth of silver bullion, with the company mill at Daggett reportedly averaging $40,000 to $50,000 per month. Each ton of ore was reported to yield about $30 to $45 in silver (at about $1.11 to $1.06 per ounce), and to cost about $18 total to mine, haul, and mill. Miners were paid about $3.50 per day.

The Sue mine,* northwest of the Silver King, also was prominent; and Barber's mill, just south of Calico, was operating. In East Calico, 10 tons of ore mined daily at the Bismarck mine yielded $100 per ton; and ore from the Cuba mine was processed at Hawley's mill. The Snowbird mine also was active, and the main adit of the Garfield mine had reached a length of 1,000 feet. In West Calico, the Waterloo mine was worked extensively underground, though it is said mostly for rich pockets.

Activity in the district began to decrease after 1884–1885, as the price of silver began to fluctuate downward more sharply from about $1.10 in 1884 to 93



Molten silver is being poured from a melting pot into a bullion mold by J. Bert Osborne, 1924. Silver probably was recovered from ore taken from the Sioux mine, which was worked by Osborne at that time. O. A. *Russell Collection.*

* Probably same as mine later spelled "Sioux".

Early day miners at Occidental mine. Gopher-like workings, typical of most of East Calico, are in background. O. A. *Russell Collection.*

cents by 1889; in addition, once the richer deposits near the surface had been mined, operators were forced to mine deeper, leaner ore, which cost more to mine, as well as providing less revenue. Thus the Waterman mine ceased operations in 1886; and activity in the region probably became very light by the end of 1888, although the Oro Grande Company accelerated its operations (constructing a new 60-stamp mill in 1888). An event of note was the visit to the district in December 1886 of Waldemar Lindgren, a young mining engineer and geologist, later to become perhaps the most eminent in his field.

Two events then served to stimulate mining in the Calico district briefly: the first, late in 1888, was construction by the Waterloo Mining Company (successor to the Oro Grande Company) of a small railroad which extended from the Silver King and Waterloo mines to the company milling facilities at Daggett. This railroad reduced the cost of ore haul from about $2.50 to 12 cents per ton. The second event was passage of two Congressional Acts: the Bland-Allison Act and the Sherman Purchase Act of 1890, which enabled the Government to purchase silver for monetary use. The consequent administration of these laws drove the price of silver upward significantly, even though the Acts were soon defeated by their opponents (as was William Jennings Bryan, the famous proponent of "16 to 1" bimetallism.) Thus, during the period from 1889 to 1892, mining was revived: in September 1889 about 100 tons of ore from the Silver King mine and 50 tons from the Waterloo mine were reported being mined daily; in addition, it was reported that in December 1891 the Garfield mill was taking ore from the Odessa, Oriental, and Occidental groups. At one point during the period, it was reported that 700 men were employed in the district, 150 stamps were operating in mills, and about $200,000 per month in bullion was being produced.

Soon, though, the price of silver dropped again, from about $1.05 in 1890 to about 64 cents by 1894. The Waterloo was forced to close down in March 1892, with 130 men losing their jobs. In 1896 the Silver King Company apparently ceased hoping that the price would somehow rise again, for it shut down operations at its Occidental and Oriental groups. The Odessa mine also was closed.

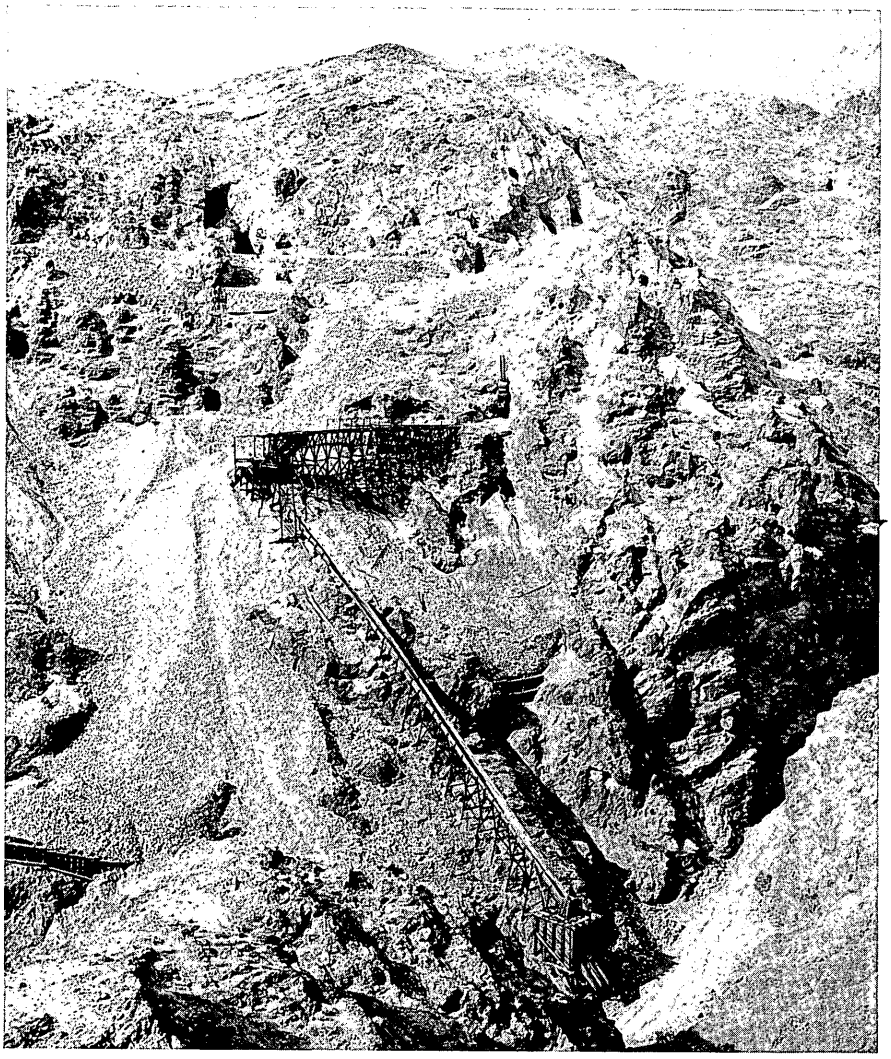
The district remained nearly dormant from about 1900 to 1915, when the price of silver again began to rise. From a low of about 48 cents in 1915, the price rose briefly to about $1.38 late in 1919, before it began to decrease. The rise was caused principally by industrial demand and international monetary needs (re-

sulting in the Pittman Act) caused by World War I. With this rise in price, the district became very active again, but the activity was not reflected in significant production of silver.

The period from 1915 to the mid-1920's did contain several relatively important events though: The Calico-Odessa Company was organized in 1915 by J. R. Lane, and subsequently explored and mined on a small scale in a wide area east of Wall Street Canyon; the Daggett Reduction Company and others treated some of the old mill tailings by cyanidation; and some ore mined in the district was sent to smelters.

In 1926 the total output of the district was reported as 157 tons of ore, which yielded 35 ounces of gold, 582 ounces of silver, 115 pounds of copper, and 190 pounds of lead. Also in 1926, the Zenda Company acquired the assets of the Waterloo Mining Company, and began an exploration and development program on the Silver King property, though the price of silver had dropped to about 62 cents. The company core-drilled 2 holes, and subsequently sank 2 shafts, of 550 and 350 feet, to explore deeper parts of veins whose upper parts formerly had been so productive. A 50-ton shipment of ore from these workings to a smelter in 1930 is said to have averaged 67 ounces of silver and no gold per ton. But the price of silver continued to fall (to about 32 cents by late 1930), and operations ceased in November 1930, when 47 men were laid off.

From that time until the present (early 1966) the only metal mining operations in any of the Calico mines have been very small and intermittent. Mill tailings, discarded after treatment of earlier mined Calico ores, continued to be processed by cyanidation through the 1930's, even though recovery apparently averaged only about 1 ounce to 2 ounces of silver per ton (with the range of recovery about 1 ounce to 9 ounces per ton). These tailings could be processed economically by cyanidation mainly because less efficient processing methods had been used at Calico dur-



View west-northwest in 1951 shows old workings of Odessa silver mine, on west side of Odessa Canyon, East Calico, mined principally from 1882 to 1896. Rugged topography is cut in andesite. Ubiquitous, gopher-like workings resulted from expedient mining of near-surface, "bonanza" deposits. *Photo by O. A. Russell, Yermo.*

ing the early mining years (cyanidation was developed in the late 1880's, and not used in California until 1891). Through the 1930's and 1940's small mining operations continued at such mines as the Sioux (by J. B. Osborne), the Waterloo (by Morris Mulcahy), the Burcham (Gold-Lead, also by Mulcahy), and the Zenda (by Lawrence Coke).

During the 1950's ore mined from several properties was processed for recovery of silver, lead and barite: such operations took place at the Le Montain and Silverado mines (by R. C. Buch and associates) and at the Silver Bow mine (by W. S. Hubbard). From 1957 to 1961, Oil Base, Inc. mined and processed relatively large tonnages of low grade barite ore at the Leviathan silver mine. Barite recovered in the district has been used as a weighting material in oil well drilling fluids. During 1964–65, the Alexander-Wattell mill was constructed near Barstow for recovery principally of silver and gold.

Perhaps because there have been no large, significant silver mining operations in the Calico district since the 1890's, and no mining operations at all from 1962 to 1965, the Calico district might be considered to have very little or no potential as a future source of silver. A pamphlet, issued in August 1965 by the United States Bureau of Land Management, which describes the recently established "Calico resource conservation area," states that

> "The Calico Mountain area, once rich in silver, which spawned the brawling, lusty mining town of Calico, now a County recreation facility, is still an attraction to campers, hikers, and rock hounds."

Such a statement sounds almost like an epitaph for mining.

Actually, as the year of 1966 began, chances for renewed and significant silver mining in the Calico district seemed better than at any time since the 1890's, when the larger early day operations were closed down. These chances were in the form of very significant interest shown in the district by the mining industry since about 1963. This interest stemmed from an increase in the price of silver from about 91 cents an ounce in November 1961 to $1.293 per ounce in June 1963. (In November 1961 the U.S. Treasury stopped sales of its silver at the price of 91 cents, and the free market price gradually rose to $1.293 per ounce, the United States monetary value of silver). Because of the higher price, and the possibility for an even higher price accompanying anticipated increased United States and world industrial and monetary demand, interest in older districts with significant silver production, such as Calico, became very logical.

Especially of interest to large mining companies in the Calico and other districts are very large, very low grade deposits, measured in tens and possibly many scores of millions of tons of potential ore, and scores and possibly a hundred million ounces or more of silver. Such deposits can be mined by simple, low cost

Red Cloud mine, part of Oriental group. Early day work in west end of Mammoth stope, which was reported to be 60 feet wide. Highest of four miners seems to be carefully working part of steeply dipping vein that consists of highgrade ore. Middle of three lower miners may have handcobbed and sorted ore before carrying it from stope in wheelbarrow. O. A. *Russell Collection.*

methods (such as open pit), taking advantage of modern techniques and equipment (such as giant earth-moving equipment); and the ores processed with the most modern of metallurgical techniques: with barite, lead, copper, or gold also recovered as byproducts.

Indeed, the Calico district still remains an "attraction" to the mining industry, as well as "campers, hikers, and rock hounds". If the district could speak out, it might use Mark Twain's famous words:

"The reports of my death are greatly exaggerated."

A list of references will accompany the last article on the subject of Calico, to be published in a future issue of this magazine.

CALICO

— Highlights of its history —

1881: April 6, claims are located for future Silver King mine.

1882: Spring; mining is underway; about 100 people live in Calico camp. Fall, mining gathers momentum, as smaller properties consolidated, and the part of Atlantic and Pacific Railroad nearby is completed. Price of silver, about $1.14 per ounce.

1883: At beginning of year, active mines include Silver King, Oriental, Burning Moscow, Garfield, Odessa, Bismarck, Blackfoot and others; also Waterman mine, to west.

1884–1885: Productivity is at peak, with perhaps 2,500 people living in district. Beginning of 1884, Silver King mine is developed to a depth of 500 feet; January 1884 to March 1885, Silver King yields $1 million in bullion. Price of silver about $1.09.

1886–1889: Productivity decreases, as price of silver drops to 93 cents by 1889. In addition, deeper, more expensive mining is mostly in leaner ore. Many mines are shut down.

1889–1892: Mining stimulated briefly by (1) short-lived Congressional Acts which briefly raise silver price to $1.05 in 1890, and (2) completion of narrow gauge railroad from Waterloo and Silver King mines to mill at Daggett.

1892–1896: In 1892, Waterloo mine is closed; by 1896 most other mines are inactive.

1915–1919: Activity in district is stimulated as price of silver rises from 48 cents in 1915 to $1.38 in 1919, before beginning to fall. But the activity is not accompanied by important production of silver.

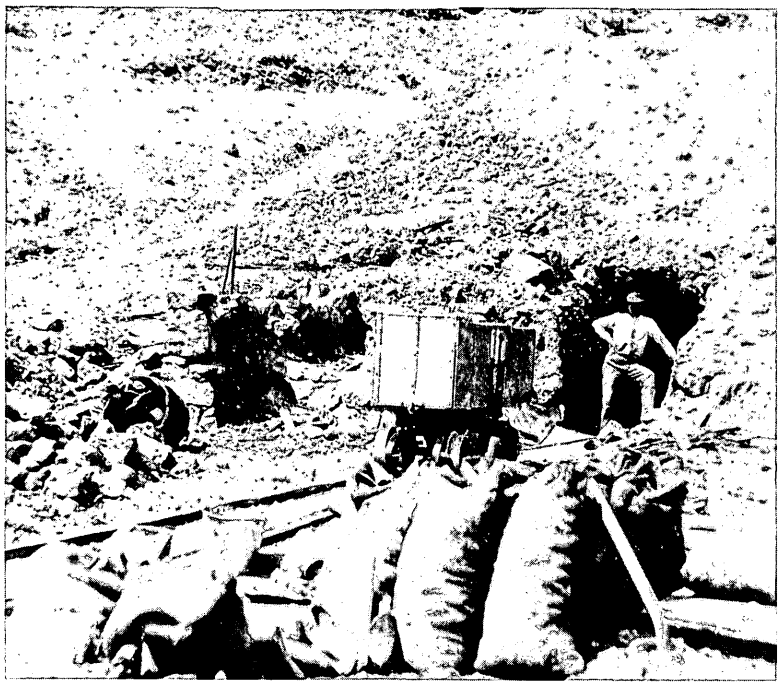
1926–1930: Zenda Company begins deep exploration program at Silver King mine in 1926 when price of silver is 62 cents an ounce. Program ceases in late 1930, as price falls to about 32 cents.

1930–1950: Small and intermittent mining operations for recovery of silver, as well as gold, lead and copper, take place. In addition, old mill tailings are processed for silver.

1957–1961: Oil Base, Inc. recovers barite from barite-jasper vein material.

1963–1966: As price of silver rises to $1.29 per ounce, interest in district is greatly accelerated. Ironically, as "ghost" town tourist operation grows, chances also grow for important future silver mining operations.

Total production of silver: Estimated roughly at between $13 and $20 million; mined mostly between 1882 and 1896.



Portal of unidentified mine, showing sacks of handcobbed, presumably highgrade ore ready for shipment to mill. O. A. Russell Collection.

GEOLOGIC GUIDEBOOKS REPRINTED

GEOLOGIC GUIDEBOOK OF THE SAN FRANCISCO BAY COUNTIES

The book, issued as *Bulletin 154,* is now in its fourth printing in fifteen years. It deals with a region that has contributed greatly to the color and character of the West: not only to its tales and legends, its swashbuckling history, and its fabulous wealth, but also to its steady economic and cultural evolution to its present position as one of the nation's important centers.

The natural features and factors that helped the area attain its eminence are the subjects of the guidebook. Of the twelve counties treated, nine (Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, Solano and Sonoma) border on the shores of San Francisco Bay, and three (Sacramento, San Joaquin, Yolo) are in the delta region of the San Joaquin and Sacramento Rivers, yet all twelve unite to form one large unit, naturally, historically, and industrially. Although a diversity of scenic beauty is found in the twelve counties, from the rugged relief of mountain ranges to the wide expanse of ocean waters, or the flat monotony of fertile delta lands, the story of each is bound to the other, and the complete story of the landscape not only tells the story of the background against which the human history of the San Francisco Bay area took place but also shows the natural reasons for the course of that history.

The perceptive reader and the earnest student will derive much enjoyment from the 32 authoritative articles that comprise the book. Each was prepared by a technical expert, yet they are written in an easily understood manner, and are grouped into seven logical parts, including, "Historical background," "History of the landscape," "Geologic history," "Prehistoric life," "Mineral industry," "Water," and "Places to go and routes to travel." The casual reader, too, will find the 28 authors have prepared for him a tale in words and pictures – nearly 300 illustrate the text – that will stir his interest and enthusiasm. Because the 392 text pages cannot present an exhaustive study of the natural history and resources, nearly all of the articles append a bibliography that will serve as a useful beginning for further research. Those who like to roam will find Part VII, "Places to go and routes to travel," an invaluable collection of motorlogs for short trips in the San Francisco Bay area; this section, together with the seven colored strip maps of the 12 counties showing the geology and roads forms a handbook that will enhance their driving pleasure. Because it is necessary to introduce in the text some unfamiliar technical words, a convenient glossary has been included.

The book, containing 392 pages and more than 300 photographs, drawings, and maps, is bound in sturdy tan cloth. It may be purchased for $2.50 plus tax.

GEOLOGIC GUIDE TO YOSEMITE VALLEY

Originally prepared for the annual meeting of the American Association of Petroleum Geologists held in California in 1962, *Geologic guide to the Merced Canyon and Yosemite Valley, California,* has been out of print recently, but is again available.

Issued as Bulletin 182, the book contains "Summary of the pre-Tertiary geology of the western Sierra Nevada metamorphic belt, California," by Lorin D. Clark; "Granitic rocks of the Yosemite Valley area, California," by Frank C. Calkins and Dallas L. Peck; "The geology, geomorphology, and soils of the San Joaquin Valley in the vicinity of the Merced River, California," by Rodney J. Arkley; "Geomorphology of the Yosemite Valley region, California," by Clyde Wahrhaftig. Included also are road logs for "do-it-yourself" geologic guiding.

Price of the bulletin, bound in paper, is $1.50, plus 6¢ tax for California residents.

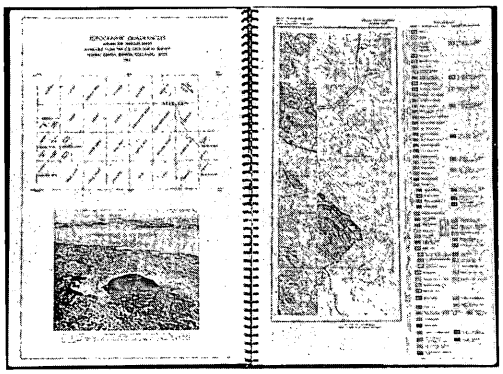
Half Dome from Glacier Point. *Photo by U. S. National Park Service.*

NOW AVAILABLE....

GEOLOGIC ATLAS

The geologic atlas of the State of California was prepared by the California Division of Mines and Geology to present an integrated summary of current knowledge of California geology. Preparation of these maps began in 1952, after the popular 1938 edition of the 1:500,000 scale state geologic map went out of print. This atlas, the first sheet of which was published in 1958, has been designated the "Olaf P. Jenkins Edition" in recognition of the stimulus Dr. Jenkins provided to geologic mapping in California during the 29 years he served as Chief Geologist and later as Chief of the Division of Mines, and in recognition of his personal direction of the atlas program at its inception.

The atlas consists of 27 map sheets which show the regional distribution and interrelationships of the various rock units and the major geologic structures that are present in California. One hundred and twenty-four cartographic units representing plutonic, volcanic, marine sedimentary, and non-marine sedimentary rock types of different geologic ages are delineated in the atlas. The many hundreds of formational units recognized in California preclude the possibility of depicting each of these separately on the map sheets; therefore, the formational units have been grouped in "time-rock units" according to their generally accepted age assignments. Contact lines of two different weights are used on the maps, the lighter weight being used to represent depositional or intrusive contacts, and the heavier weight being used to represent faults.



ATLAS BINDER. A loose-leaf, library size binder (16-½ inches by 22-½ inches) in green cloth with gold lettering. Included with the binder are enough adhesive strips to accommodate all of the sheets of the geologic map and all of the data sheets, as well as a title page and instruction sheet. Price $7.00, plus 28¢ tax.

OF CALIFORNIA

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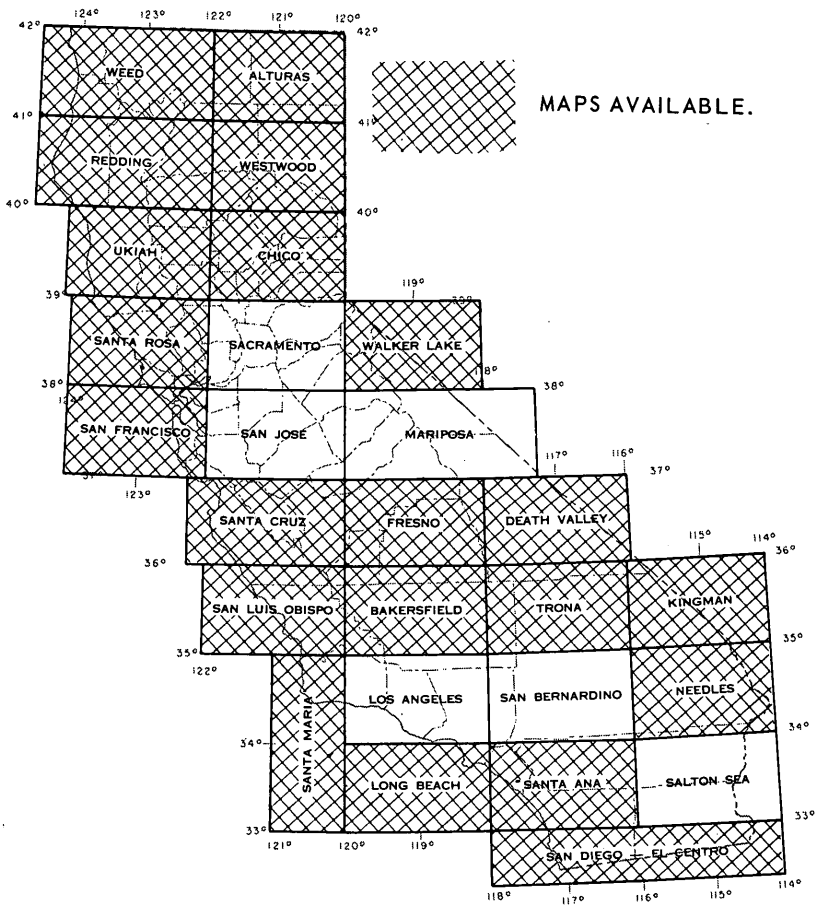

Individual sheets of the geologic map may be purchased from the Division of Mines and Geology, Ferry Building, San Francisco, California, 94111. Each sheet is accompanied by a data sheet which explains more fully the map units, and also lists the sources of information used in preparation of the map. The price of each map and data sheet set is $1.50, plus tax. Map sheets on which the geologic units are not colored are available for 50 cents.

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THESES

The following theses and dissertations have been completed and are on file at the colleges and universities indicated:

The Dumont dune system of the northern Mojave Desert, California. By Angus Andrew MacDonald. 1966. 106 pp., 8 maps, 28 figures, 1 graph. M. A. Thesis. On file at San Fernando Valley State College, Northridge, California. Includes dune terminology and mechanics, migration of the dune system.

Geohydrochemistry of the San Gabriel Valley area, Los Angeles County, California. By Sanford L. Werner. Copyright, 1965. M. S. Thesis. On file at University of Southern California, Los Angeles. Abstract on file in Division of Mines and Geology Library, San Francisco. Emphasizes the use of chemical analyses of various types of water as a basic tool to show geohydrochemistry.

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MINERAL INFORMATION SERVICE

STATE OF CALIFORNIA DIVISION OF MINES AND GEOLOGY

VOLUME 16 NUMBER 10
OCTOBER 1963

Barite in California...

by F. Harold Weber jr.

Barite (or "barytes") is naturally occurring barium sulfate, the most common mineral of barium, and the most dense of the nonmetallic minerals used industrially. With a specific gravity of 4.5, barite is slightly more than twice as dense as common salt. Two principal products are manufactured in California from crude barite rock: crushed and ground barite for use principally as a weighting agent in oil and gas well drilling fluids, and barium chemicals.

Slightly more than 115,000 short tons of crude and processed barite is estimated by the writer to have been consumed annually by California industry from 1959 to 1962. Of this amount, only about 18,000 tons, valued at about $234,000, has been mined annually in California itself; all of the rest apparently has been mined in Nevada. The total domestic consumption of crude barite during this period has averaged about 1,370,000 tons annually, of which about 45 percent has been imported; Arkansas and Missouri have led in output of crude barite, while Georgia, Nevada, and California have followed in recent years. The total recorded production of crude barite mined in California from 1910 to 1962 is 729,386 tons valued at $5,363,352.

Geology of California Deposits

Barite is a relatively common mineral, as evidenced by its occurrence at more than 140 known localities in California. At most of these localities the mineral is a constituent of veins or other bodies of hydrothermal origin which have formed at low to moderate temperatures, and which also may consist of quartz, chalcedony, calcite, or metallic ore minerals. Barite of these bodies ranges from very sparse to very abundant, but most of the barite rock that has been mined for commerce in California has been obtained from a relatively small number of deposits which consist almost wholly of barite; about 90 percent of the state output has been obtained from six deposits in a belt which includes the Sierra Nevada and the Klamath Mountains. Relatively small tonnages have been obtained from

Below. Barite vein at north end of Bald Mountain deposit, Tulare County. Where seen, vein ranges in thickness from about 4 to 8 feet.

MINERAL INFORMATION SERVICE

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The Resources Agency — Hugo Fisher, *Administrator*
Department of Conservation — DeWitt Nelson, *Director*
Division of Mines and Geology — Ian Campbell, *Chief*
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MINERAL INFORMATION SERVICE is designed to inform the public on the geology and mineral resources of California and on the usefulness of minerals and rocks, and to serve as a news release on mineral discoveries, mining operations, markets, and statistics, and activities and publications of the Division. It is issued monthly by the California Division of Mines and Geology. Subscription price, January through December, is $1.00.

Other publications of the Division include the Annual Report of the State Geologist; the Bulletin, Special Report, Map Sheet, and County Report series; the Geologic Map of California; and other maps and publications. A list of the Division's available publications will be sent upon request. Communications to the Division of Mines and Geology, including orders for publications, should be addressed to the San Francisco office.

MARY R. HILL, *Editor*

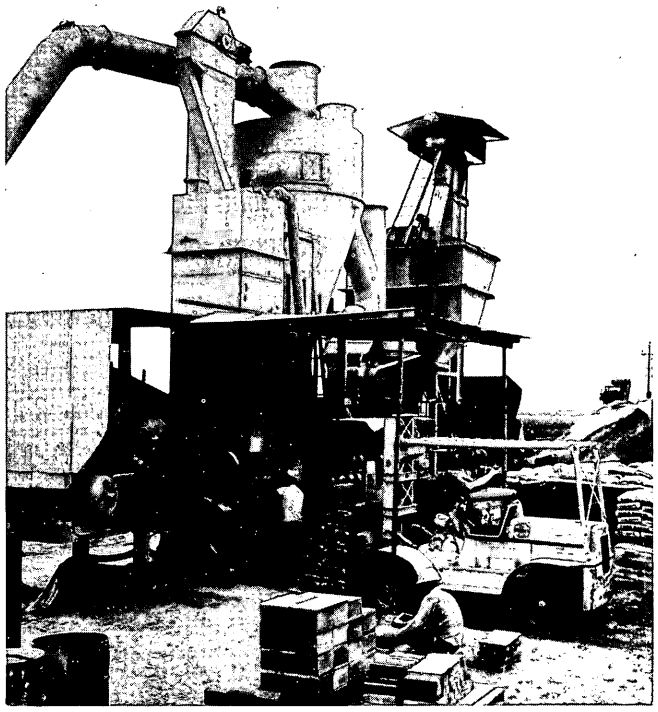
deposits in other areas which also consist almost wholly of barite: the White Mountains, Inyo and Mono Counties; the Fremont Peak area, Monterey County; and the Labrea Canyon area, Santa Barbara County. Barite rock also has been mined from the silver-gold bearing veins of the Calico Mountains and vicinity, San Bernardino County; and it has been recovered as a by-product from the Mountain Pass rare earth deposits, San Bernardino County. It is a rare to common gangue mineral of the copper-zinc deposits of the Shasta region and the Foothill belt; and it is abundant in at least several of the manganese deposits of the Blythe region of southeastern California.

Barite rock of California deposits typically is white or pale gray, but ranges from these colors through shades of buff and pinkish gray, to very dark gray (almost black); banding is common, and the color and texture may vary considerably within a single deposit.

Deposits of the Sierra Nevada and Klamath Mountains: The principal deposits of barite in California lie within a discontinuous belt which extends north-northwestward to northwestward from the south part of the Sierra Nevada to the Klamath Mountains, a distance of about 450 miles. These deposits consist of north to northwest-trending linear zones, at least as long as several miles, which contain veins or layers of barite rock. The zones lie almost exclusively within terranes of the Calaveras Group and similar units of late Paleozoic age.

These deposits probably were formed by hydrothermal solutions which were precipitated as veins in shear zones and which also may have replaced layers of limestone. The linear zones of the central and southern parts of the belt appear to lie nearly parallel to similar zones to the west and southwest which contain the gold deposits of the Mother Lode region and the barite-bearing copper-zinc deposits of the Foothill belt. Both the metal and the barite deposits are believed to have been formed by solutions which were genetically related to the formation of the batholith of the Sierra Nevada. The barium of these solutions may have been derived directly from the batholith, or may have been sapped from barium-rich rocks through which the solutions ascended: thus it may have been derived from possible underlying units of clay shale or clay associated with limestone, which generally are relatively rich in barium. No broad stratigraphic controls to the mineralization are known.

Below. Portable mill of Yuba Milling Unit, Metals Disintegrating Corp., at Sutter, Sutter County, February 1963. Crushed and ground barite produced here is consumed principally in gas fields of the region.



California Barite Deposits

Province	Geologic setting	Nature of occurrence	Economic factors: Development and production	Economic factors: Problems and miscellaneous factors	References*
Sierra Nevada and Klamath Mountains region	NW- to N-trending belts of phyllite, schist, quartzite, and marble of Calaveras Group and similar units of late Paleozoic age.	N- to NW-trending zones that range in length from several hundred feet to several miles contain veins of barite, and barite and quartz. Zones may contain one to many veins, which have about the same attitude: N to NW strike and moderate to steep dip; parts of zones may contain two to four veins that are parallel, within a maximum width of 100 feet or slightly more. Average length of the veins is several hundred feet, with the maximum at least 3,000 feet; average width is about 3 to 8 feet, with the maximum range from less than 1 foot to perhaps 40 feet. Veins commonly pinch and swell and are faulted. Largest and most extensive known deposits are the El Portal, Ninemile, Bald Mountain, and Devils Gulch: these deposits average about 75 to 85 percent white to gray barite, 10 to 20 percent quartz, plus additional calcite, witherite, pyrite and perhaps other minerals. Less extensive deposits (north of El Portal), such as the Democrat and Glidden Company, may contain as much as 90-95 percent barite, which commonly is very dark gray.	90 percent of state production from 6 of these deposits: El Portal, (about 4/7 of total), Spanish, Ninemile, Almanor, Democrat, and Glidden Co. All mining from surface in recent years. Principal unmined deposits known are Bald Mountain and Devils Gulch.	Most of the barite ore mined from the more extensive deposits (El Portal, Ninemile) has been upgraded to 4.2 in specific gravity from about 3.9 to 4.1. Outer parts of veins of more extensive deposits commonly contain less barite than inner parts. Richest deposits (north of El Portal) are largely mined out at surface. Most deposits cannot be mined during the inclement months of winter and spring.	a, b, c, d
Calico Mountains and Vicinity, San Bernardino County	Volcanic and related pyroclastic and sedimentary rocks of Tertiary age.	Steeply dipping veins of barite and barite-jasper also contain minerals of manganese and iron, and deposits of silver and gold. Composite veins consist of interlayered barite and jasper, or barite, jasper and country rock. Veins range from solitary short veinlets to deposits as much as 1,500 feet or more in length and as much as 25 to 50 feet in width. Total composition of barite of deposits ranges from less than 25 percent to perhaps 80 percent or more; average of deposits mined or seriously prospected for barite is about 50 or 60 to 80 percent.	Only one sustained operation: Leviathan deposit. Total production from district slightly less than 20,000 tons. Principal undeveloped deposit is Burcham-Waterloo.	Ore had to be upgraded to 4.2 specific gravity at Leviathan operation from about 3.6 to 3.9(?). Barite recovered at Waterman was recovered with silver by beneficiation from tailings. Iron content of most deposits is relatively high. Area is close to Los Angeles market.	a, b, c, d 4.0 – 4.2 @ Silver Bow
White Mountains, Inyo and Mono Counties	Diabase, shale, sandstone, and marble of Cambrian and Precambrian age.	Discontinuous veins of barite, and barite and quartz range in thickness from less than 1 foot to 6 feet. Veins pinch and swell abruptly, and may be irregular in composition.	Total output, principally from Gunter Canyon deposit, is less than 5,000 tons. Both underground and surface mining used at Gunter Canyon.	Very rugged terrain; far from markets. Deposits are rather thin and too irregular for easy mining. Quality of ore varies; parts of Gunter Canyon deposit are very high grade.	a, b, c, d
Mountain Pass area, San Bernardino County	Metamorphic rocks of Precambrian age.	Carbonate-rich veins developed for rare-earth bearing fluorocarbonate minerals also contain barite. Largest body is 2,400 feet long and 400 feet in average width. Deposits contain 20-25 percent barite.	Small tonnage of barite recovered as byproduct one year.	Difficult to produce barite economically as byproduct in today's market.	c, d
Southern Coastal region	Franciscan and Tertiary rocks typical of coastal region.	Irregular vein deposits which range from groups of veinlets which fill fractures (Palos Verdes Hills) to deposits which contain relatively large bodies of nearly pure barite (Labrea Canyon). Red Hill deposit consisted of barite associated with quicksilver minerals. Fremont Peak deposit may be related to this group.	Total production between 5,000 and 10,000 tons is almost wholly from Labrea Canyon deposit. Small tonnage recovered one year as byproduct of quicksilver mining operation at Red Hill deposit.	Additional ore bodies may lie below surface at Labrea Canyon deposit. Other deposits are too irregular to be mined in today's market.	a, b, d
Blythe region, Riverside and Imperial Counties	Various rocks of Tertiary age and older.	Barite occurs sparingly to abundantly with manganese and other minerals in veins. White Swan deposit consists of zones which contain veins of nearly pure barite with sparse manganese minerals and jasper; veins range in width from 2 to 4 feet.	Small output from White Swan deposit.	Rather thin deposits; difficult to mine large tonnages of clean high grade ore.	a, b, c
Death Valley region, Inyo and San Bernardino Counties	Principally Precambrian metamorphic rocks, plus others.	Thin veins of barite.	Many deposits prospected, none mined.	Deposits apparently too thin to be mined for today's market.	b, c, d
Foothill Belt and Shasta region	Metavolcanic rocks of pre-Cretaceous age.	Barite occurs with copper, zinc and other minerals in sulfide replacement bodies associated with shear zones. Shasta No. 1 ore body was reported to contain 7.4 percent barite.	No production of barite recorded.		b, c, d

* Explanation for references
a. Personal observations of writer.
b. Published and unpublished Division of Mines and Geology reports.
c. Information from property owners and operators, mill operators, and others.
d. Reports by Brobst or Kundert in bibliography herein.

*Principal known barite deposits of California.**

Sierra Nevada and Klamath Mountains region

1. Afterthought (d): sec. 2, T34N, R4W, and secs. 34,35, T35N, R4W, MDM.
2. Almanor
   a. Cameron (Synthetic Iron Color) mine (b; 1932-36, 62): sec. 5, T26N, R8E, and sec. 32, T27N, R8E, MDM.
   b. Savercool (Kansas Extension) mine (b; 1945-47, 49-53): sec. 5, T26N, R8E, MDM.
3. Alwood (c;1962): sec. 33, T7N, R7E, HM(proj.).
4. Austin quarry (c; 1921-22,24): sec. 29, T34N, R3W, MDM.
5. Bald Mountain
   a. Baro group (d): secs. 10, 15, T22S, R34E, MDM.
   b. Barite Star group (d): secs. 4,9,10, T22S, R34E, MDM.
6. Camp Nelson (c;1955): sec. 33, T20S, R31E, and sec. 3, T21S, R31E, MDM.
7. Clavey River (d): sec. 3, T1N, R17E, MDM.
8. Democrat (Maguire) (b; 1919-22,24,26-27,29-30,60): sec. 24, T16N, R10E, MDM.
9. Devils Gulch (Egenhoff) (c; 1937?, 1961): secs. 17,20, T4S, R20E, MDM.
10. El Portal (a; 1910-1948, except 1918-19,23,25): secs. 18,19, T3S, R20E, MDM.
11. Glidden Company (Loftus) (b; 1919, 1931, 1962-63): sec. 18, T38N, R3W, MDM.
12. Ninemile Canyon (Paso Baryta)
    a. Barite King group (b; 1950, 1955-62: secs. 26, 34,35, T23S, R36E, and sec. 2, T24S, R36E, MDM.
    b. Finn property (c; 1960-61): sec. 34, T23S, R36E, MDM.
    c. Undetermined (d): sec. 3, T24S, R36E, MDM.
13. Noble (d): sec. 21 or 28, T29N, R9W, MDM.
14. Ritter Ranch (d; 1960): sec. 4, T31S, R33E, MDM.
15. Spanish (b; 1938-45, 55-61): secs. 19,30, T18N, R11E, MDM.

Calico Mountains and Vicinity

16. Barium Queen (c; 1929-1930?): secs. 22,27, T10N, R1W, SBM.
17. Burcham-Waterloo
    a. Burcham property (d): sec. 16, T10N, R1E, SBM.
    b. Waterloo property (d): sec. 16, T10N, R1E, SBM.
18. Hansen (c; 1929): sec. 36, T8N, R7E, SBM.
19. La Montane (c?; 1910-1913?): sec. 5, T10N, R1E, SBM.
20. Lead Mountain (c; 1930-31, 37): secs. 25,36, T10N, R1W, SBM.
21. Leviathan (b; 1957-61: secs. 8,9, T10N, R1E, SBM.
22. Silver Bow (c; 1961): sec. 8, T10N, R1E, SBM.
23. Silverado (d): sec. 5, T10N, R1E, SBM.
24. Waterman (c; 1931): sec. 14, T1N, R2W, and sec. 18, T1N, R1W, SBM.

White Mountains

25. Gunter Canyon (c; 1917, 30-31, 58?, 62-63): secs. 5,6,8, T6S, R34E, MDM.
26. Ritch (d): T6 or 7S, R34E, MDM.
27. Starr (d): T6S?, R34E, MDM.
28. White Mountains (d; 1962): sec. 33, T5S, R34E, MDM.

Mountain Pass area

29. Sulphide Queen (c; 1953): secs. 12,13, T16N, R13E, SBM.

Southern Coastal region

30. Labrea Canyon (c; 1928-32): sec. 8, T10N, R30W, SBM.
31. Red Hill (d; 1927): 2 miles east of Tustin.

Blythe region

32. White Swan (d; 1961): sec. 24, T9S, R19E, and sec. 19, T9S, R20E, SBM.

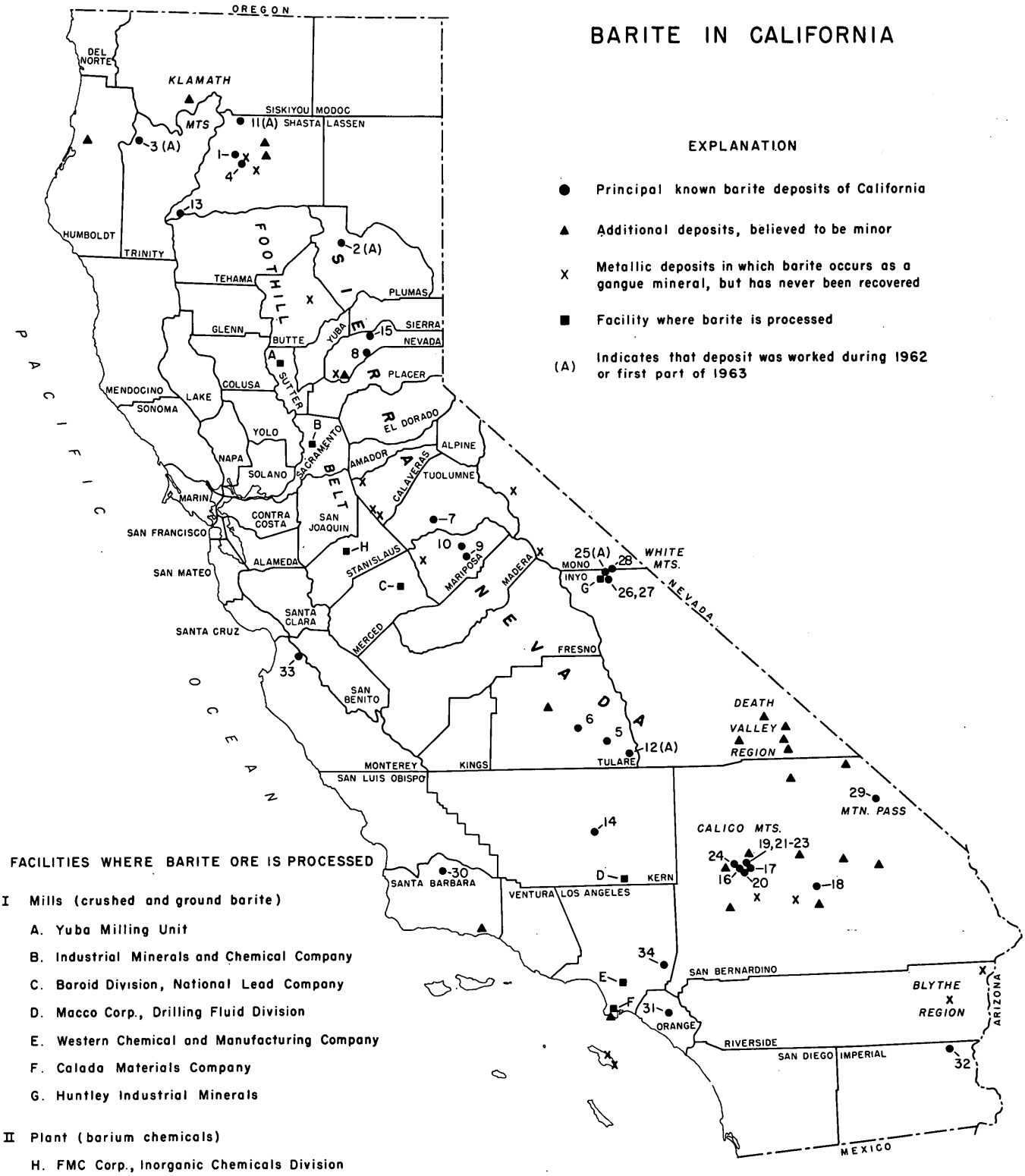
Other areas

33. Fremont Peak (Gabilan Peak; Bardin Ranch) (c; 1916-20): secs. 34,35, T13S, R4E, MDM.
34. San Dimas (d; 1915): sec. 23, T1N, R9W, SBM.

**Explanation for data within parentheses:* letter indicates range of total recorded production of barite in short tons, and numbers indicate years for which this output is recorded or otherwise known.

(a) Production between 100,000 and 500,000 tons (El Portal).
(b) Production between 10,000 and 100,000 tons (Almanor, Democrat, Glidden, Ninemile, Spanish, Leviathan).
(c) Production between 100 and 10,000 tons.
(d) Production less than 100 tons, or deposit is undeveloped or only partly developed.

BARITE IN CALIFORNIA



EXPLANATION

- ● Principal known barite deposits of California
- ▲ Additional deposits, believed to be minor
- X Metallic deposits in which barite occurs as a gangue mineral, but has never been recovered
- ■ Facility where barite is processed
- (A) Indicates that deposit was worked during 1962 or first part of 1963

FACILITIES WHERE BARITE ORE IS PROCESSED

I Mills (crushed and ground barite)

- A. Yuba Milling Unit
- B. Industrial Minerals and Chemical Company
- C. Baroid Division, National Lead Company
- D. Macco Corp., Drilling Fluid Division
- E. Western Chemical and Manufacturing Company
- F. Calada Materials Company
- G. Huntley Industrial Minerals

II Plant (barium chemicals)

- H. FMC Corp., Inorganic Chemicals Division

Companies that produce barite or barite products in California, or that may have an additional interest in barite in the state.

Company	Location of plant and products*	Additional interest in barite†	Company	Location of plant and products*	Additional interest in barite†
Baroid Division National Lead Co. P.O. Box 1675 Houston 1, Texas	Merced (a)	(1,2,3)	Los Angeles Chemical Company 4545 Ardine Street South Gate	No mill	(2)
Calada Materials Co. 3501 Dock Street Terminal Island San Pedro	Harbor City (a)	(1,2,3)	Macco Corporation Drilling Fluid Div. 7844 E. Rosecrans Paramount	Rosamond (a,b)	(1,2,3)
FMC Corporation Inorganic Chemicals Division Box 3808 Modesto	Modesto (c,b)	(3)	Magnet Cove Barium Corporation P.O. Box 6504 Houston 5, Texas	Battle Mt., Nevada (a)***	(3)
Fresno Agricultural Chemical Co. P.O. Box 1286 Fresno	Fresno	(1)	Organic Mineral Sales Ltd. 5464 W. Washington Blvd. Los Angeles		(2,3)
Huntley Industrial Minerals Bishop	Laws	(1)	Western Chemical & Manufacturing Co. 3270 E. Washington Blvd. Los Angeles 23	Los Angeles	(1)
Industrial Minerals and Chemical Co. 6th and Gilman Streets Berkeley 10	Florin (a,b)	(1,2,3)	Yuba Milling Unit Metals Disintegrating 1069 Second Street Berkeley 10	Sutter (a,b)	(1,2,3)

*
(a) Principal product is crushed and ground barite for use in drilling fluids.
(b) Very minor amounts of crushed and ground barite for one or more of following uses: glass, paint, rubber, tractor tires.
(c) Principal products are barium chemicals.

†
(1) Custom miller of ore.
(2) Buyer of crude ore (generally of 4.2 specific gravity or higher).
(3) Buyer or leasor of barite properties.

Economics*

Products, processing and marketing: The two most important products of crude barite in California are crushed and ground barite and barium chemicals. More than 70 percent of the crude barite consumed in the state in 1961 was crushed and ground, for use as a weighting agent in oil and gas well drilling fluids.

Crushed and ground barite: During 1961, 84,336 short tons of crushed and ground barite, valued at $2,040,080 was produced in California mills; about 98 percent was used in drilling fluids, and the remainder as filler in paints and rubber, and in the manufacture of glass. Crushed barite has been used in recent years in the state as aggregate in high density concrete for shielding against radiation in nuclear reactors and other nuclear installations, and as ballast for large ships. Crushed and ground barite rock of about 3.8 specific gravity, or slightly higher, is used as a weighting material in tractor tires and to compact pipes laid in water; crushed and ground barite also has been used with asphalt as an emulsion.

Barite rock for use in drilling, and for several other products first is crushed, then ground in Raymond ring roller mills (see p. 2). To meet specifications for drilling fluids, the final product must be at least 4.20 in specific gravity and 90 to 95 percent of it must pass through a 325-mesh screen. The average cost for crushing and grinding barite rock is about $6 to $7 per ton, plus $2 to $2.50 for bagging. Rock of less than 4.20 specific gravity that has been mined in California in the past has been upgraded to that figure by at least three methods: (1) jigging (Macco operation, Ninemile Canyon, Tulare County); (2) a combination of jigging and sink-float (Baroid operation, El Portal, Mariposa County); and (3) air separation (Oil Base

*Statistical data compiled during February-May, 1963.

operation, Calico Mountains, San Bernardino County).

Crushed and ground barite for drilling purposes generally is marketed in 100-pound bags under such trade names as Baroid, Calwate and Yuba barite. Some such barite is marketed in bulk, especially for very large offshore drilling jobs. Wholesale prices in northern California for crushed and ground barite for drilling range from about $25 to $27 per short ton, bagged (plus delivery); in southern California the price range generally is several dollars higher. Retail prices for the state are in the range of $41 to $43 or slightly higher per ton, including delivery and technical service at the well.

Barite for use in drilling fluids is an extremely competitive commodity in California, chiefly because the industry furnishing the material for drilling is developed to perhaps its maximum; and at this time of maximum development, fewer wells are being drilled than was anticipated a decade ago, thus decreasing the projected need for barite.

Enterprises concerned with ground barite for drilling in California range from efforts of individuals who only mine the mineral, to small to large companies and corporations which provide the mineral as part of their well-servicing activities (such as Baroid Division, National Lead Company; Calada Materials Company; and Macco Corporation, Drilling Fluid Division) (table p. 6). These organizations purchase or mine barite, process it, deliver it to wells, and provide technical engineering service at the wells. Within the broad range of enterprises are smaller companies, such as Industrial Minerals and Chemical Company and Yuba Milling Unit of Metals Disintegrating, which purchase barite, process it, and sell it to so-called "mud" companies, whose business may be solely to service wells with drilling fluids. The success of a company dealing in barite for the drilling industry may depend more on the quality of the technical service that it provides at wells, rather than on the quality of its barite and other products, or on its sales ability.

Barium chemicals: Barium chemicals are produced from crude barite in California by Inorganic Chemicals Division of FMC Corporation at Modesto. The principal products are barium oxide and barium hydroxides; also sold are barium carbonate and barium sulfate (blanc fixe). These and other chemicals are manufactured by the following general process: ground barite is mixed with coke and heated in a rotary kiln to give barium sulfide; this product is placed into solution, soda ash is added, and barium carbonate is precipitated; barium carbonate is mixed with carbon and fired in an electric furnace to give barium oxide; and barium oxide is added to water to give barium hydroxides. The plant has been an important supplier of the barium oxide and barium hydroxides used in the United States.

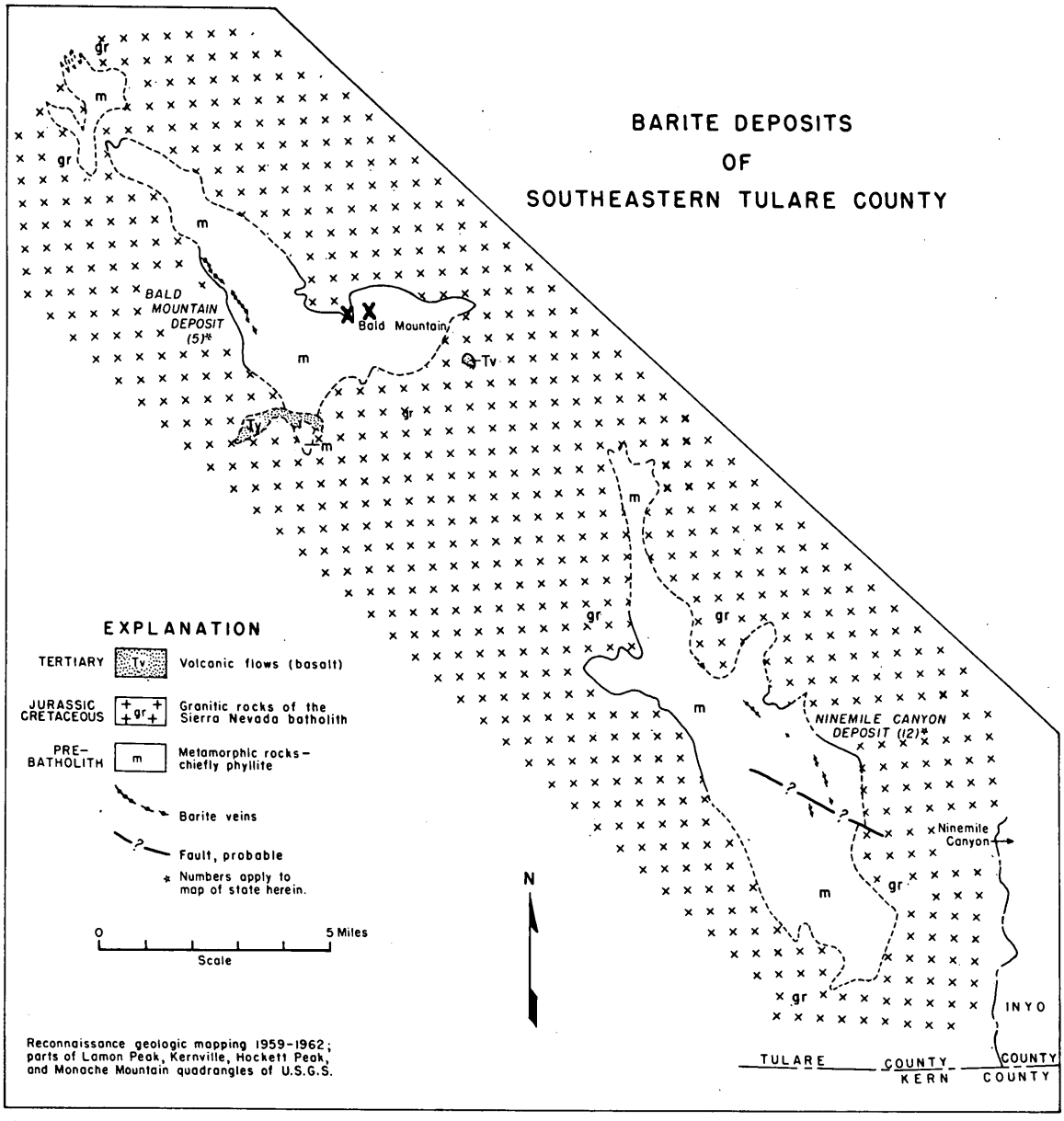
Specifications and price of ore:* The principal specification of barite ore to be crushed and ground for use in drilling fluids in California is that it has a specific gravity of at least 4.20; it should also be clean and relatively free of iron. The only possible exceptions to these specifications are for barite rock of less than 4.20 specific gravity which (1) is to be upgraded mechanically to that figure, or (2) is to be mixed with very high grade ore to balance the specific gravity of the final product at 4.20 or slightly higher. Barite rock that has been mined in the state has ranged in specific gravity from 3.5 or 3.6 to about 4.4; recently the average has been about 4.2 to 4.3.

The specifications for barite ore used to produce crushed and ground barite for rubber and dark paints are about the same as for barite ore for drilling; for light-colored paint, white barite is required; and for glass, a relatively pure barite is needed. Manufacturers of barium chemicals generally require ore that contains at least 90 percent barium sulfate, and no more than about 0.5 percent iron oxide.

Only barite rock to be crushed and ground has been purchased from independent miners for use in California in recent years. The prices paid for such ore depend on the buyers and sellers involved, on the grade, and on the ability of the seller to sustain an ore supply. Prices paid for ore mined in Nevada, f.o.b. north-central Nevada railpoints, range from about $5.50 to $8.00 per short ton (with the actual millhead cost ranging from $14 to $18 per ton including transport to northern California processing facilities, and about $18 to $22 including transport to southern California facilities). Prices paid for ore mined in California range from about $12 to $15 per ton delivered to northern California processing facilities, and $15 to $18 delivered to southern California facilities.

Mining and transport of ore: Deposits of barite that have been mined in California during the last decade generally have been worked by the most simple of surface methods. These methods have been necessitated by the low price of the commodity. Such operations have been carried on by two- or three-man enterprises which are independent or on contract to mill operators.

* "Ore" may be defined informally as rock that can be taken from the earth and sold or used by its taker to earn a living.



In former years, barite was mined by underground methods at El Portal and other areas, but to profitably mine barite deposits today in California by such methods is very difficult.

The average costs of barite mining operations in the state are estimated to be about as follows:

(A) Property: Leasing arrangements for barite properties generally stipulate a royalty of about 50¢ to $1.00 per ton for crude ore which is transported from the property. Within this range, royalties for ore mined in northern California have been lower than those for ore mined in southern California, principally because of the slightly lesser value of crude ore in northern California. A royalty that is commonly considered fair is one which consists of ten percent of the value of the crude ore at the mine.

(B) Mining: The average actual mining cost has been about $3 to $5 per ton, depending on the size of operations and the degree of difficulty of mining.

(C) Transport: The average cost of transporting barite ore to mills by truck is roughly $5 per ton for the first 100 miles, which generally includes about 5 to 20 miles of good hilly or mountainous dirt road, and about $5 per ton for an additional 200 miles. The cost of rail transport of Nevada ore from north-central Nevada points ranges from about $8 to $11 per ton for shipment to northern California facilities, and about $15 to $16 per ton for shipment to southern California points.

Outlook: The outlook in the barite industry of California is relatively good for larger companies that can

Mining operation at Glidden Company deposit, Shasta County, October 1962. Castle Crags are in background.

absorb temporary losses or take only very small profits during periods in which fewer oil and gas wells are drilled. During such periods, smaller companies must maintain very high standards of product and customer service to remain competitive. In the long run, what is needed are more uses, and therefore additional markets, for both crushed and ground barite and barium chemicals.

Resources

Resources of barite rock in California that constitute ore are small: deposits that consist nearly wholly of barite (rock of 4.20 specific gravity or higher) generally have been mined out at the surface, or are nearly mined out. Several such deposits contain large reserves of high grade barite rock which would have to be worked by underground methods, but probably could not be mined profitably by these methods.

Several deposits of marginal grade (including those at Devils Gulch, Mariposa County, and Bald Mountain, Tulare County) contain relatively large reserves of barite ore at the surface which probably would average slightly less than 4.20 in specific gravity if mined non-selectively. Other large deposits (such as the Burcham and others of the Calico Mountains, San Bernardino County) average between 3.5 and 4.0 in specific gravity. These deposits could be worked relatively easily for barite rock that would have to be upgraded for use in drilling muds; or perhaps some of them could be mined selectively for ore of 4.20 specific gravity.

In addition, the Mountain Pass rare earth and several other types of deposits contain moderate proportions of barite which might be recovered profitably in the future as a byproduct of metal mining operations.

Recommendations for prospecting

The most logical areas in California to prospect for additional deposits of barite are in the Sierra Nevada and in the Klamath Mountains. Such areas lie within, between, and outward from linear zones known already to contain barite deposits (such as the Ninemile Canyon-Bald Mountain zone, Tulare County), and in regions that are suspected to contain these zones (for example the El Portal-Devils Gulch region, Mariposa County). Of special interest should be such areas that may have been overlooked by previous prospectors: areas of very rugged and nearly inaccessible terrain, or terrain that is covered by thick vegetation or veneers of talus or alluvium.

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Attorney Gilmore Dies

Charles L. Gilmore, well-known mining attorney of of Sacramento, died in August. He was 80.

Counsellor Gilmore was precisely that to the Division for many years. He was an unfailing source of information on the legal technicalities of mining and oil, which were the specialties of Gilmore and Gilmore, a firm consisting of Mr. Gilmore and his wife.

Mr. Gilmore, as a public service, revised the Division's *Legal Guide for California Prospectors and Miners* in 1960. It is one of the most popular of the Division's publications, and one of the most useful.

New Division Publications

Walker Lake Sheet

We have received a supply of the Walker Lake sheet of the Geologic Map of California. Priced at $1.50 for the colored lithographed edition, 50¢ for the black-and-white edition, the sheets are now on sale.

Bulletin 181 Map

Purchasers of Bulletin 181, *Geologic guide to the gas and oil fields of northern California,* will be glad to know that they may have, free, upon request, a copy of plate 20, "Geologic map of the northern Santa Cruz Mountains." An uncolored plate 20, using a planimetric base, was included in the volume.

The new plate, which has been added to remaining copies of the book still in stock, is in three colors with a topographic base. Those who request this new map need not send back their original plate 20.

Those who missed the guidebook altogether may still obtain it, hardbound, in a case with maps, priced at $8.00, plus tax. The new plate 20 will be included.

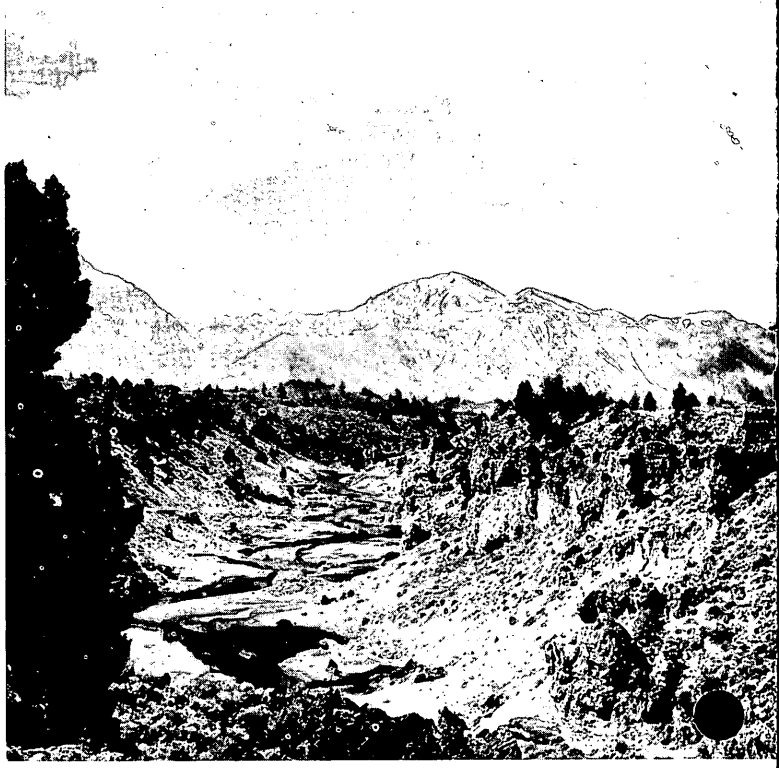
New Report on Clay

A new report on clay deposits in the Little Antelope Valley region, in Mono County, on the east side of the Sierra Nevada, may now be purchased from Division offices.

Entitled, *Geology of the Little Antelope Valley Clay Deposits, Mono County, California,*" the new information was issued as Special Report 72. It was written by George B. Cleveland, staff geologist with the Division of Mines and Geology in the Los Angeles office.

Price of Special Report 72 is $1.00 plus tax. Besides a 28-page text, the booklet contains 17 figures and two plates. The plates consist of a geologic map in three colors on a scale of approximately 1 inch = ½ mile and a tabulated summary of the general geology of the area, including a columnar section. Both plates are folded in a pocket in the back of the volume.

Below. View of Hot Creek area, Mono County. One of the illustrations from Special Report 72. Clay deposits in the area, although discovered only in recent years, have yielded nearly $100,000 worth of clay. Hot springs in the area attest to continuing hydrothermal alteration, a process that has been responsible for the clay now being mined.



A page from history - The Quake of '65

by Elisabeth L. Egenhoff

On Sunday afternoon, October 8, 1865, at approximately fifteen minutes of one, San Francisco suffered two shocks — "the most severe earthquake visitation" in 30 years. Though not so vicious as the notorious 1906 quake, it did its share of damage. Also, it demonstrated — to the observant reporter for the Daily Alta Californian, *at least — a thesis which is still being iterated by geologists and engineers: "The 'made land' part of the city, east of Montgomery street, and the flats of Market, seem to have felt the effects most severely. Many slightly-built, thin walled buildings, or buildings erected on unsubstantial foundations, were more or less injured, some very badly; it is a noticeable fact that the substantially constructed buildings, even those of five and six stories in height, almost without exception escaped uninjured."*

Most of the populace also escaped uninjured. One man, who panicked, jumped from a window through a skylight, and a Chinese man and woman were struck by falling brick. They were the most serious casualties; but the fact that not all of San Francisco's quakes were — as the Alta *reporter remarked — "more a subject for joking and quizzing among friends and acquaintances than of serious anxiety to anybody," was thoroughly impressed upon all.*

Other things happened, too. Said the Daily Morning Call, *"The vicinity of Howard street, from Fifth to Eighth, exhibited lively signs of caving in. In some spots the streets and lots adjoining, sunk, and in others rose. A lot at the southwest corner of Seventh and Howard streets, sunk fourteen feet, leaving a sewer bare and broken; and where Saturday was a dry bank of sand, to-day a flock of ducks are disporting themselves in a pond of water.... At Sixth and Howard, Mission and Beale, and divers other places, the ground opened, while great volumes of water were forced up into the air, in some instances as high as fifty feet. On Tehama, Howard, and Moss streets, the ground has become slightly undulating, where it was perfectly level. No. 548 Tehama street sunk a foot or so below its former level. A fissure opened west of Fillmore [?] street, extending transversely with and crossing the Bay-shore Road. This effect was also produced in other localities. In many buildings the window-glass, particularly in the walls running east and west, was involved in a general crash. Large show-windows and plate-glass were shivered to atoms and the sash twisted and sprung into utter ruin. In the stores, goods were thrown into a promiscuous heap about the floors; and in dwelling houses, mantels were wrenched from their places and transferred to another part of the room. Lamps, bottles, dishes, furniture, and ornaments, rolled about, breaking whatever was frangible, and bruising what wouldn't break.... The horses in the stalls at Mr. Collier's stables, numbering some sixteen or eighteen at the time of the shock, fell prostrate in their stalls simultaneously, as if struck by lightning, and when made to rise they exhibited every symptom of terror; trembling and uneasy.... Those who observed the shot-tower [probably the Thomas H. Selby Company tower on the southeast corner of First and Howard streets] and tall flag-poles, say their tops swayed through an arc, east and west; the former, to use the expression of one who was looking at it at the time, bending like a bamboo rod, but resuming its perfect perpendicular when the earth became quiet. The tall flag-poles whipped the air for a short space of time, working from a direct into a circling motion, and gradually lessening, until they, too, were once more quiet. The water in a tumbler sitting on the sill of a window looking north, was spilled over to the east and west sides of it, while none went over to the north or south. A gentleman had left a quantity of money, in half dollars, placed in piles of ten pieces each; yesterday morning he found them uniformly thrown over toward the east wall of the house. Clocks were stopped on walls running both ways. It is a significant fact that nearly all the walls that were thrown down faced the east or west, and that in the former instances the detached masses were generally thrown a number of feet clear of the building, while the walls facing the north and south present the ugly fissures, as if operated upon by a movement parallel with them.... One man says the shock seemed to strike upward in a line from the centre of the earth, and to bump, as it were, against the surface from below. Another, who was passing along the street in another portion of the town, says he was suddenly brought to a stand by the first shock as if struck by an opposing gust of wind; and the second threw him laterally against a wall, his feet seeming to slide out from under him. Others, again, described it as a swaying or undulating motion, the waves running from southeast to northwest — the second motion following more nearly parallel with the lines of latitude. Two persons, who were in a boat on the Bay, say that their first impression was that a porpoise or some other large fish was striking and rubbing against the bottom of the boat, as if trying to turn it over. The Bay, in*

places, seemed to effervesce, and became covered with foam."

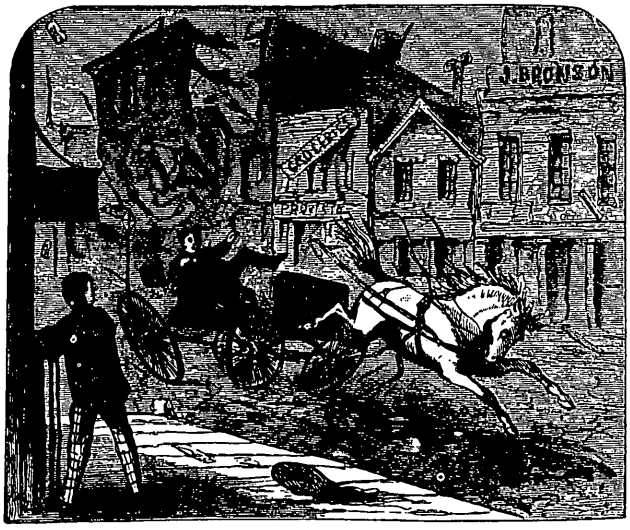
Nor was the excitement confined to San Francisco. Reporters from towns throughout the Bay area – San Jose, Santa Clara, Santa Cruz, Watsonville, Corralitos, Petaluma – and even as far away as Stockton telegraphed messages of damage or shock.

One reporter was almost a decade late with his story. Samuel L. Clemens – or Mark Twain, as he is now better known – in Roughing It, *published in 1872, recalled the earthquake in these words:*

[In early October] I enjoyed my first earthquake. It was one which was long called the "great" earthquake, and is doubtless so distinguished till this day. It was just after noon, on a bright October day. I was coming down Third street. The only objects in motion anywhere in sight in that thickly built and populous quarter, were a man in a buggy behind me, and a street car wending slowly up the cross street. Otherwise, all was solitude and a Sabbath stillness. As I turned the corner, around a frame house, there was a great rattle and jar, and it occurred to me that here was an item! – no doubt a fight in that house. Before I could turn and seek the door, there came a really terrific shock; the ground seemed to roll under me in waves, interrupted by a violent joggling up and down, and there was a heavy grinding noise as of brick houses rubbing together. I fell up against the frame house and hurt my elbow. I knew what it was, how, and from mere reportial instinct, nothing else, took out my watch and noted the time of day; at that moment a third and still severer shock came, and as I reeled about on the pavement trying to keep my footing, I saw a sight! The entire front of a tall four-story brick building in Third street sprung outward like a door and fell sprawling across the street, raising a dust like a great volume of smoke! And here came the buggy – overboard went the man, and in less time than I can tell it the vehicle was distributed in small fragments along three hundred yards of street. One could have fancied that somebody had fired a charge of chair-rounds and rags down the thoroughfare. The street car had stopped, the horses were rearing and plunging, the passengers were pouring out at both ends, and one fat man had crushed half way through a glass window on one side of the car, got wedged fast and was squirming and screaming like an impaled madman. Every door, of every house, as far as as the eye could reach, was vomiting a stream of human beings; and almost before one could execute a wink and begin another, there was a massed multitude of people stretching in endless procession down every street my position commanded. Never was solemn solitude turned into teeming life quicker.

Of the wonders wrought by "the great earthquake," these were all that came under my eye; but the tricks it did, elsewhere, and far and wide over the town, made toothsome gossip for nine days. The destruction of property was trifling – the injury to it was wide-spread and somewhat serious.

The "curiosities" of the earthquake were simply endless. Gentlemen and ladies who were sick, or were taking siesta, or had dissipated till a late hour and were making up lost sleep, thronged into the public



The "One-Horse Shay" out-done.

streets in all sorts of queer apparel, and some without any at all. One woman who had been washing a naked child, ran down the street holding it by the ankles as if it were a dressed turkey. Prominent citizens who were supposed to keep the Sabbath strictly, rushed out of saloons in their shirt-sleeves, with billiard cues in their hands. Dozens of men with necks swathed in napkins, rushed from barber-shops, lathered to the eyes or with one cheek clean shaved and the other still bearing a hairy stubble. Horses broke from stables,

Hard on the innocents.

and a frightened dog rushed up a short attic ladder and out on to a roof, and when his scare was over had not the nerve to go down again the same way he had gone up. A prominent editor flew down stairs, in the principal hotel, with nothing on but one brief undergarment – met a chambermaid, and exclaimed:

"Oh, what *shall* I do! Where shall I go!"

She responded with naive serenity:

"If you have no choice, you might try a clothing-store!"

A certain foreign consul's lady was the acknowledged leader of fashion, and every time she appeared in anything new or extraordinary, the ladies in the vicinity made a raid on their husbands' purses and arrayed themselves similarly. One man who had suffered consider-

Dry bones shaken.

ably and growled accordingly, was standing at the window when the shocks came, and the next instant the consul's wife, just out of the bath, fled by with no other apology for clothing than – a bath-towel! The sufferer rose superior to the terrors of the earthquake, and said to his wife:

"Now *that* is something *like*! Get out your towel my dear!"

The plastering that fell from ceilings in San Francisco that day, would have covered several acres of ground. For some days afterward, groups of eyeing and pointing men stood about many a building, looking at long zig-zag cracks that extended from the eaves to

"Oh, what shall I do?"

"Get out your towel, my dear."

the ground. Four feet of the tops of three chimneys on one house were broken square off and turned around in such a way as to completely stop the draft. A crack a hundred feet long gaped open six inches wide in the middle of one street and then shut together again with such force, as to ridge up the meeting earth like a slender grave. A lady sitting in her rocking and quaking parlor, saw the wall part at the ceiling, open and shut twice, like a mouth, and then – drop the end of a brick on the floor like a tooth. She was a woman easily disgusted with foolishness, and she arose and went out of there. One lady who was coming down stairs was astonished to see a bronze Hercules lean forward on its pedestal as if to strike her with its club. They both reached the bottom of the flight at the same time, – the woman insensible from the fright. Her child, born some little time afterward, was club-footed. However – on second thought, – if the reader sees any coincidence in this, he must do it at his own risk....

Such another destruction of mantel ornaments and toilet bottles as the earthquake created, San Francisco never saw before. There was hardly a girl or a matron in the city but suffered losses of this kind. Suspended pictures were thrown down, but oftener still, by a curious freak of the earthquake's humor, they were whirled completely around with their faces to the wall! There was great difference of opinion, at first, as to the course or direction the earthquake traveled, but water that splashed out of various tanks and buckets settled that. Thousands of people were made so sea-sick by the rolling and pitching of floors and streets that they were weak and bed-ridden for hours, and some few for even days afterward. – Hardly an individual escaped nausea entirely.

The queer earthquake - episodes that formed the staple of San Francisco gossip for the next week would fill a much larger book than this, and so I will diverge from the subject.

LONG BEACH SHEET ISSUED

We have received from the printer the Long Beach Sheet, the 13th in the series of 27 geologic map sheets comprising the new Geologic Map of California. The map, printed in full color, and at a scale of 1:250,000 (1 inch equals approximately 4 miles) was compiled by Charles W. Jennings from the newest available sources of geologic mapping and is plotted on the newly revised Army Map Service topographic base map.

The area encompassing this map lies largely offshore from the southwestern part of the Los Angeles Basin (Palos Verdes Hills, Inglewood, Long Beach and Whittier Hills area) and includes the following islands: Santa Catalina, San Clemente, San Nicolas, Santa Barbara, the southern half of Santa Cruz Island and the eastern end of Santa Rosa Island.

Thirty separate references are listed in the index to geologic mapping used in compilation of this sheet, nine of which were heretofore unpublished. The map depicts 17 different geologic units, including five Quaternary sedimentary units, nine Tertiary sedimentary and volcanic units, four Mesozoic sedimentary, granitic, and ultrabasic units and one pre-Cretaceous metamorphic unit.

This sheet should be of particular interest to oceanographers and others interested in offshore geology, for in addition to the areal geology portrayed for the individual islands, some 110 offshore stations are indicated showing the location of submarine dredgings where rock in place has been recovered. At each of these offshore stations, the type and age of the rock is indicated, and the depth is noted. Submarine topography is clearly portrayed by contours utilizing a 300 foot interval. Several well defined submarine canyons are shown, as well as a number of spectacular escarpments and seamounts. A number of oceanographers contributed offshore data for this map sheet, and special thanks go to Professors K.O. Emery and Francis P. Shepard and to Dr. Elazar Uchupi.

The geology depicted for the "onshore" part of this map sheet consists largely of marine Miocene and Pliocene rocks. These are at least 20,000 feet thick in the Los Angeles Basin and contain several ma-

View northward of Palos Verdes Hills with Los Angeles City in background. At least five of the 13 major Pleistocene terraces are displayed in this view. *Photo by John S. Shelton, 1958.*

View of Little Harbor embayment on the west side of Santa Catalina Island, site of many "south sea island" movies. The rocks in this view consist largely of glaucophane-bearing metasandstone. *Photo courtesy Santa Catalina Island Company.*

jor oil producing zones. A prominent display of late Pleistocene marine terraces representing at least 13 levels, is a major feature in the uplifted block composing the Palos Verdes Hills. The curious occurrence of glaucophane and related schists in these hills is also noteworthy. Miocene basaltic sills and irregular intrusive basalts also occur in this locality. Structurally, this part of the Los Angeles Basin is dominated by the Newport-Inglewood Fault, made famous in 1933 by the disastrous Long Beach earthquake.

Of all the offshore islands shown on this sheet, Santa Catalina Island is the best known. Lying some 25 miles off San Pedro Harbor, it serves as a popular resort and marine playground. The geology of the island is equally attractive and contains both a variety and complexity of rock units to whet the appetite of geologists. Here higher grade metamorphic rocks overlie lower grade metamorphic rocks, probably in thrust contact. The glaucophane-bearing rocks have been compared with the Franciscan Formation in the Coast Ranges. Serpentine, dacite porphyry intrusive rocks, and Miocene volcanic and sedimentary rocks all occur on the island.

San Clemente Island, lying southwest of Santa Catalina, is comprised almost entirely of Miocene volcanic rocks, although there exist a few small patches of middle Miocene marine sedimentary rocks. The island is a very remarkable fault block with the active San Clemente Island Fault, marked by a great submarine escarpment, lying off the island's eastern coast.

San Nicolas Island, the most remote island in the group shown on the Long Beach sheet, is made up of marine Eocene strata, overlain by surficial Quaternary terrace deposits and sand dunes. A considerable amount of submarine geologic investigation has been carried out to the northwest and northeast of the island, and a a number of offshore stations have been plotted on the

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map sheet in this vicinity.

Tiny Santa Barbara Island, approximately one square mile in area, lies in the central part of the map and is composed almost entirely of volcanic rocks. It is thought to represent part of a volcano which erupted in Miocene time. The age of these volcanic rocks has been determined by study of foraminiferal fossils found in a thin interbedded shale unit.

Only the southern half of Santa Cruz Island falls on this sheet; however, the area contains a number and variety of interesting geologic features. The island, of course, is noted for the well-defined Santa Cruz Island Fault which essentially cuts the island in two along a northwesterly trending rift valley. Pre-Cretaceous phyllite, schist, and greenstone, and Mesozoic quartz diorite make up the basement rocks on the island. Miocene pyroclastic and flow rocks are widespread and Tertiary marine sedimentary rocks have been the site of several exploratory oil wells.

The Long Beach map sheet, together with an explanatory data sheet (containing detailed information on the stratigraphic nomenclature, a source data index and four striking aerial oblique photographs) is available from the Division offices in San Francisco or any of the branch offices. Both folded and unfolded copies are available and also colored and uncolored editions. Mail orders should be sent to the Division of Mines and Geology, Ferry Building, San Francisco 11, California. The price of the map with data sheet is $1.50 and the uncolored map (sold without data sheet) is 50¢. California residents please add 4 percent tax. ...*C.W.J.*

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5/5	Kupp	

AIRMAIL

Mr. William S. Hubbard
Civic Center Building
175 West Fifth Street
San Bernardino, California 92401

MAY 8 1967

Re: OME-6607 (Silver)
William S. Hubbard
Silver Bow Mine
San Bernardino County, California

Dear Mr. Hubbard:

Careful study of your application for financial assistance in exploring the referenced property indicates that the probability of disclosing significant silver ore reserves is not sufficiently promising to justify Government participation in the proposed exploration. Accordingly, we regret to inform you that the application is denied.

We regret the necessity of taking this action, but it is taken without prejudice to the property and is based on the OME regulations that pertain to the eligibility of a project in relation to the mineral sought. Three criteria for an eligible mineral govern our decision:

1. The principal dollar value of the ore is in minerals on the current OME list of eligible minerals (see booklet "Exploration Assistance," page 4).

2. The ore could be mined for the eligible minerals alone, regardless of the other values.

3. An exceptionally large quantity of eligible minerals is expected to be found by the proposed work.

Unless at least one of these criteria can be met, we have no alternative but to deny the application. We wish to thank you for your interest in the minerals exploration program and for bringing your property to our attention.

Sincerely yours,

FRANK E. JOHNSON

Frank E. Johnson
Chief, Office of
Minerals Exploration

Enclosure

cc: Director's Reading File
Division File
Econ. Geol. File
Region II
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Date	Surname	Code
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5/3/67	Kirkemo	
	Johnson	

May 3, 1967

Memorandum

To: The File

From: R. M. Smith, Office of Minerals Exploration

Subject: OME-6607 (Silver)
William S. Hubbard
Silver Bow Mine
San Bernardino County, California

Justification for denial of application

Very little work has been done on the property since an earlier application (OME-6339) for virtually the same proposed exploration was denied (May 27, 1964) because the project did not qualify under OME criteria for an eligible mineral.

The principal mineral in the Silver Bow veins is barite which constitutes about 95 percent of the veins and contains a lesser amount of jasper and minor quantities of argentiferous galena, sphalerite, chalcopyrite, and traces of gold. In the oxide zone near the surface small amounts of cerargyrite, embolite, and native silver are found, but sulfide minerals are also found in the outcrops.

Although the mine is explored to the 275-foot level, production of silver ore is about 200 tons from above the 50-foot level produced shortly after discovery in 1890. About 3,000 tons of barite has been mined and sold since 1958. Eight tons of lead-silver ore sorted from the barite and sold in 1961 averaged 25% lead, 2.3 oz. silver per ton, and a trace of gold. Another 2 tons of sorted ore containing argentiferous galena was sold to tourists. Average grade of the 3,000 tons computes to be about 0.08% lead and 0.01 oz. silver per ton. On this basis the 265,000 tons of barite ore reserves estimated by the Applicant would contain 2,650 ounces of silver worth $3,400.

The Applicant proposed a $67,000 project to explore by drifting and crosscutting on the 200-foot level and raising to the surface on four veins. All but the upper 50 feet of the raises is below the zone where silver ore might be expected, and even in the upper 50 feet no minable reserves of silver ore are inferred.

Facilities for recovering the minor amounts of argentiferous galena are neither available nor planned, and the lead-silver content is too low to justify mining or separation from the barite gangue.

The proposed project does not qualify for OME assistance as the deposit meets none of the three criteria for an eligible mineral. The principal mineral is barite, the only eligible mineral is silver, the ore could not be mined for its silver content alone, and the silver content is so low that discovery of large quantities cannot be expected. I concur in the Field Officer's recommendation to deny the application.

The Applicant is evidently aware of the tenor of the ores but has nevertheless gone to the trouble of preparing two applications, and writing his Congressman. This indicates that he is unaware of the OME criteria for eligible minerals. I suggest he be so informed in the denial letter.

R. M. Smith

R. M. Smith

cc: Director's Reading File
Division File
Econ. Geol. File
OME Docket
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RMSmith/mm (5/3/67)

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Memorandum April 28, 1967

To: Chief, Office of Minerals Exploration
Washington, D. C.

From: Field Officer
Region II

Subject: OME-6607 (Silver)
William S. Hubbard
Silver Bow Mine
San Bernardino County, California

Enclosed is my application report on the subject property recommending that the application be denied.

As pointed out in your referral memorandum of March 31, 1967, the silver ore bodies for which the Calico district is famous consisted of rich secondary ores of cerargyrite and were of minable grade to depths of only about 75 feet. Below these bodies the silver content in the primary minerals was too low to constitute ore. In the northwestern part of the district, where the Silver Bow Mine is located, primary minerals are exposed at the outcrop and only very small ore shoots have been found.

The Silver Bow veins have been, and can be, mined for their barite content alone, but the lead and silver content is too low to justify mining or separation from the barite gangue. Inasmuch as barite and lead are not eligible for OME assistance and the ore is not minable for its silver content alone the application does not qualify for assistance as a silver exploration project and should be denied on that basis.

H. K. Stager

Enclosure

UNITED STATES

DEPARTMENT OF THE INTERIOR

STEWART L. UDALL, SECRETARY

OFFICE OF MINERALS EXPLORATION

REPORT OF EXAMINATION

REGION II

APPLICATION REPORT

OME-6607 (Silver)
William S. Hubbard
Silver Bow Mine
San Bernardino County, California

By

H. K. Stager
Field Officer
OME, Region II

April 28, 1967

FIELD
EXAM REPT

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ILLUSTRATIONS

Figure 1. Index map of San Bernardino County, California.

INTRODUCTION

Mr. William S. Hubbard, Civic Center Bldg., 175 W. Fifth Street, San Bernardino, California 92401, applied to the Office of Minerals Exploration for Government assistance in an exploration project, Docket OME-6607, to explore for silver at the Silver Bow Mine, Belleville (Calico) Mining District, San Bernardino County, California. The applicant infers the presence of silver- and lead-bearing ore bodies in barite veins that occur on the property and wishes to explore these veins by drifting and crosscutting on the 200 level of the Silver Bow Mine.

A field examination was requested by the Office of Minerals Exploration and made by H. K. Stager, Field Officer, on April 20, 1967, accompanied by the applicant. The applicant's maps, cross sections, and assay data were carefully studied and compared with surface and underground exposures at the Silver Bow Mine.

A previous application by the applicant for essentially the same proposed exploration at the Silver Bow Mine (Docket OME-6339), dated January 28, 1964, was denied on May 27, 1964, on the basis that the probability of disclosing significant ore reserves was not sufficiently promising to justify Government participation. Very little additional work has been done since the previous application.

SUMMARY

The Silver Bow Mine contains several veins that have yielded about 3,000 tons of barite vein material (sold for high-density drilling media) and several hundred tons of lead-silver ore. The results of the examination indicate that the barite veins do not contain ore shoots minable for their silver content alone.

The applicant proposed to explore the Silver Bow vein and other nearby veins by 700 feet of drifting, 500 feet of crosscutting, and 1,550 feet of raising, at an estimated cost of $67,000. Although the work would probably develop a large tonnage of salable barite ore containing minor amounts of lead and silver, it does not qualify as a silver exploration project.

RECOMMENDATIONS

It is recommended that the application for Government assistance to explore for silver ore shoots at the Silver Bow Mine be denied. The probability of discovering ore bodies minable for their silver content alone is too low to justify the cost of the work.

If, at some future date, barite and/or lead are added to the list of commodities eligible for OME assistance, an exploration project similar to the one proposed by the applicant could be justified.

LOCATION, ACCESSIBILITY, AND LOCAL FACILITIES

The Silver Bow Mine is in sec. 9, T. 10 N., R. 1 E., SBBM, in the western part of the Calico Mountains at an altitude of about 3,000 feet, Belleville (Calico) Mining District, San Bernardino County, Calif. (Fig. 1).

To reach the Silver Bow Mine, that is about 15 miles north of Barstow, the nearest town, travel 11.5 miles north on the paved Fort Irwin Road, then turn right (east) on a good gravel road about 4.5 miles to the property. The road to the mine is readily passable to ordinary passenger vehicles and the trip requires about 30 minutes.

Labor, mail, telephone, railroad and trucking service, lumber, and mining supplies are available in Barstow. There is no timber on the property and water must be hauled from Barstow. Assay services are available in Los Angeles (145 miles) at $3 per sample for gold and silver. The nearest silver and lead smelter is at Selby, Calif. (500 miles). Mine labor is available locally at about $2.50 per hour.

PROPERTY

History and Production

The Calico district was discovered in 1881 and most of the larger deposits were opened the following year. In 1890, at the peak of activity, mills totaling 150 stamps were treating the ores and about 700 men were employed in the mines and mills. The exhaustion of the known high-grade ores and a drop in the price of silver from $1.13 to 57¢ per ounce, in 1896, led to virtual cessation of mining. During the period 1882-1896 the district yielded silver ore with a total value estimated from 13 to 20 million dollars.

The Silver Bow Mine was probably discovered about 1890 and a small amount of ore was produced from the 50 level. No record is known of this production, but from the size of the stopes it probably did not exceed 200 tons of ore. The applicant acquired the property in 1958 and has produced and sold about 3,000 tons of barite vein material. About 2 tons of argentiferous galena was hand-sorted from this material for sale to tourists in the nearby ghost town of Calico, and about 8 tons of ore was sorted and sold to the A.S.&R. smelter at Selby, California in 1961. The smelter return indicates the ore assayed 25 percent lead, 2.3 ounces of silver and a trace of gold per ton.

Ownership

The property, included in the application, consists of two unpatented claims owned by the applicant. These claims are the Silver Bow, Book 270, page 457, and the Silver Bow Annex, Book 308, page 264, both recorded in San Bernardino, California.

The applicant owns or leases a large number of claims in the district, including the adjoining Leviathan and Silver Contact Mines.

Financial Eligibility

The applicant submitted copies of letters to a bank and a mortgage company requesting loans for the proposed work and also copies of letters denying the loans. The applicant proposed to finance his share of exploration costs by use of his equipment and mine personnel plus cash derived from the sale of barite.

Development

The Silver Bow Mine is developed by an inclined shaft 325 feet in depth with levels at 50, 100, 150, 200, and 275 feet. The principal workings are between the 100 and 200 levels. Workings below the 200 level are not accessible. The surface installations include a head frame and hoist house equipped with gasoline powered hoist, generators, and compressor; small skip bucket on wooden rails; and a front-end loader. There are two house trailers for living quarters and a large amount of miscellaneous mine equipment and machinery, mostly in poor condition.

There are numerous shallow prospect pits, shafts, and trenches on the property along the surface outcrop of the Silver Bow and nearby veins. The watchman who lives at the property spends his spare time prospecting and digging trenches on the nearby outcrops. The mine is not operating at the present time.

GEOLOGY

Geologic Setting

The Calico district is an area of relatively high relief and exposures are good. The rocks exposed in the district are volcanic rocks and lake deposits of Tertiary age that rest upon an unexposed pre-Tertiary crystalline basement. These Tertiary rocks are about 5,000 feet thick and consist of a thick (3,000-4,000 ft) lower unit of tuff, tuff breccia, agglomerate, rhyolite, dacite, and andesite overlain by about 1,000 feet of lake beds and a thin (200-500 ft) upper unit of andesite. Bedding in the sedimentary rocks, in general, strikes northwest or north and dips moderately west.

The Tertiary rocks are cut by a prominent set of faults and fractures that strike northwest and dip moderately to steeply east. Veins, commonly composed of barite and jasper, occur along the faults and fractures and locally contain lead and/or silver ore shoots.

Ore Deposits

The silver ore deposits that have been mined in the Calico district are of two types: those occurring in faults or fractures and those occurring in shallow pockety disseminations. Both types are characteristically shallow, few mines exceeding 200 feet in depth, although the veins commonly do continue to considerable depths below the minable silver mineralization.

The veins consist chiefly of barite and jasper. Barite commonly comprises as much as 95 percent of the vein material. Ore minerals are cerargyrite, embolite, and native silver. Also present in the deeper parts of the veins are argentiferous galena, sphalerite, chalcopyrite, and traces of gold. The average silver content of the Calico ores was 10 to 20 ounces per ton, but high-grade pockets yielded as much as 2,000 ounces per ton. The veins are from a few inches to more than 10 feet thick and average 3 to 4 feet. Ore shoots have been mined down dip for several hundred feet and along strike for as much as 1,000 feet but most shoots are much smaller and yield only a few hundreds or thousands of tons of ore.

The veins at the Silver Bow Mine are a few inches to 12 feet thick, averaging about 3 feet thick, and can be traced on the surface for about 1,000 feet. The deepest exploration has been about 300 feet. Sulfide minerals, galena and sphalerite, occur in the outcrop material in a gangue of barite, calcite, and jasper. Secondary silver minerals are relatively uncommon and the small amount of ore that has been produced consisted of argentiferous galena containing about 0.5 ounce of silver per percent of lead. 0.1 ?

Sampling

There were no new exposures in the mine since Mr. Fillo's examination in 1964, and no additional samples were taken. Results of the assaying of the five samples taken by Mr. Fillo are repeated for information here:

Sample No.	Description	Silver (ounces per ton)	Barite (percent)
15393	30-inch chipped sample in east drift on 50-foot level	0.80	44.5
15394	22-inch chipped sample in stope east drift of 150-foot level	0.70	27.0
15395	32-inch chipped sample at east end of drift face on 150-foot level	0.20	32.0
15396	36-inch chipped sample in northwest drift of 200-foot level	9.3	39.6
15397	Character sample near a 20-foot shaft on Silver Bow Annex Claim	4.5	50.3

arith ave. 5) 15.5 / 3.1

Ore Reserves

There are no known reserves of minable silver ore on the Silver Bow claims and none are inferred.

The applicant estimates reserves of 265,000 tons of barite ore in the mine. This barite locally contains some lead and silver but not in minable quantities. The vein material that has been mined by the applicant has been sold for its barite content alone with no attempt to separate the minor amounts of argentiferous galena.

265,000
.01 ave.
2,650 oz. Ag.

EXPLORATION

Applicant's Proposal

The applicant proposed to explore the deposit by drifting 700 feet to the west on the 200 level, with about 800 feet of raising to explore the Silver Bow vein. He also proposed to crosscut 500 feet to the south on the 200 level, in the footwall of the Silver Bow vein, to explore several parallel veins that crop out to the south of the main shaft. An additional 750 feet of raising was proposed on these veins.

The applicant's proposal would probably be successful in developing a large tonnage of barite, with minor amounts of lead and silver, but would not find minable silver-rich ore shoots of the type mined in the early days of the district. At the 200 level horizon all of the silver appears to be present in the form of sulfides or argentiferous galena. High-grade secondary-type silver ore bodies, if present, would occur much nearer the surface, probably above the 100 level as elsewhere in

the district. The applicant did not appear to be interested in exploration at this shallower horizon. The presence of considerable sulfide minerals in the surface outcrops of the veins in the mine area probably preclude the presence of minable secondary ore shoots of silver.

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

OME-6607
(Silver)

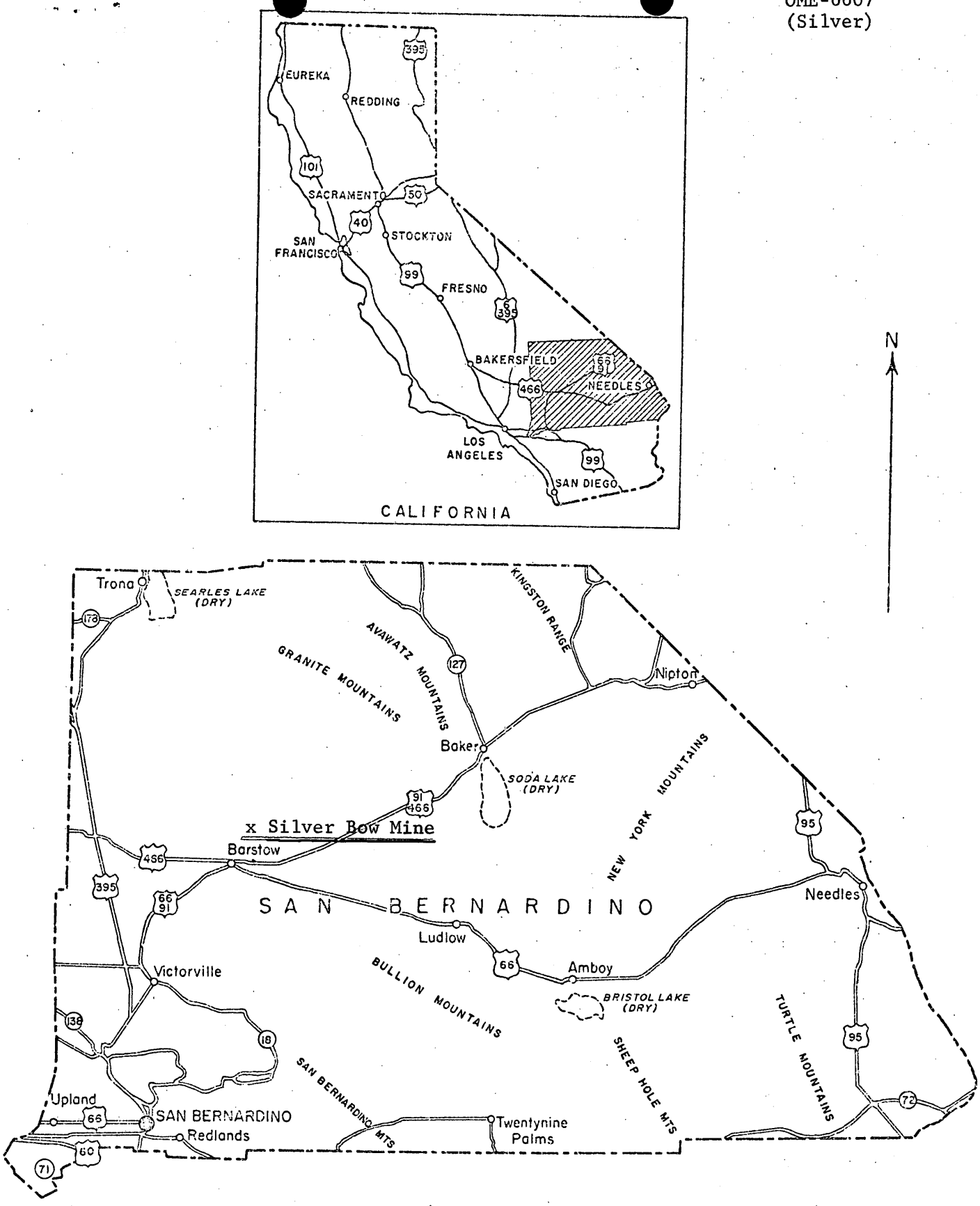

Figure I. INDEX MAP OF SAN BERNARDINO COUNTY, CALIFORNIA

0 30 60 90 Miles

MME Form 7
(2/63)

OFFICIAL FILE COPY

Date	Surname	Code
3/29/67	R M Smith	120
3/31/67	Kirkemo	120
		110
3/31	cal	220
		120M

AIRMAIL

MAR 31 1967

Memorandum

To: Field Officer, Region II

From: Chief, Office of Minerals Exploration

Subject: OME-6607 (Silver)
William S. Hubbard
Silver Bow Mine
San Bernardino County, California

The application is referred to Region II for review, a field examination, and recommendations.

Normally we would ask the Applicant to establish his eligibility before requesting a field examination, but as you plan to be in the area on OME business, and as it appears that eligibility is probable, we are referring it immediately to save time.

The Calico district is famous as an old-time silver camp but, ridiculous as it may seem, the deposit may not be eligible as a silver project. The explanation is both geologic and economic. The primary deposits are barite-jasper veins containing a high proportion of lead and smaller amounts of silver and gold. Although partly oxidized to depths of 100 feet or more, they are lower in silver content than the secondary deposits that were mined in the 1880's. The rich secondary ores are irregular deposits of nearly pure cerargyrite along joint planes and fractures near the veins and were of ore grade to depths of about 75 feet (AIME. Trans. 15, p. 717-734). During erosion the vein materials were evidently transported, and more barite-free silver than lead was redeposited near the surface short distances from the veins. Silver, but not lead or barite, was economic, so only the secondary deposits were extensively mined.

The purpose of the proposed project is to explore on the 200-foot level of the Silver Bow Mine by drifting along the Silver Bow vein, by cross-cutting in the foot wall in search of other parallel veins, and by raising to the surface on each vein. In the veins the combined values of lead and barite exceed those of silver and gold. According to data in the application, the ratios are about as follows:

23263

	Av. grade	Price, 1967	Value/ton
Silver	19 oz./ton	$ 1.29	$24.51
Gold	0.7 oz./ton ?	35.00	2.45 - ?, 24.50
Lead	35%	0.14	98.00
Barite	50%	9.25	4.62

If the absolute grade of the targets is expected to exceed these figures, then the ore might be mined for its silver-gold content alone, in which case it would be eligible. Otherwise, it would not.

The Applicant's reasons for expecting to find barite along the Silver Bow vein are documented, but his reasons for expecting to find silver are not clear. No justification is given for the proposed crosscutting; it is not clear whether the foot wall veins are known or postulated, or why they are expected to contain silver.

If you recommend a contract, please inform the Applicant that his correspondence with the Bank of California is acceptable, but the letter from the Standard Mortgage Company is not because a brokerage firm is not a normal source of credit for exploration. We would require additional correspondence with one other bank or, if he prefers, a financial statement.

As you point out, the proposed raises appear to be development. Their value for this purpose should be weighed against their exploratory value since they penetrate the near-surface zone of secondary enrichment. The estimated costs are lower than usual but may be realistic since the proposed crosscut is in tuff and presumably no pumping is required.

An earlier application (OME-6339) on the same property was denied because it appears that the only ore produced from the Silver Bow Mine was barite from which a small amount of silver was obtained. Additional information submitted through the office of Hon. Ken W. Dyal was not sufficient to reverse the denial. The Applicant was informed that the only way the decision might be altered would be to perform additional work on the property and submit information on the geology and mineral occurrences exposed by such work.

cc: Director's Reading File
Division File
Economic Geology File
OME Docket
OME Reading File
Mr. Smith

FRANK E. JOHNSON

Frank E. Johnson

RMSmith/gla 3-29-67

MME Form 7
(2/63)

OFFICIAL FILE COPY

Date	Surname	Code
3/29/67	RM Smith	120
3/31/67	Heirhemo	120
		110
		220
		120M

MAR 31 1967

AIRMAIL

Mr. William S. Hubbard
Civic Center Building
175 West Fifth Street
San Bernardino, California 92401

Re: OME-6607 (Silver)
William S. Hubbard
Silver Bow Mine
San Bernardino County, California

Dear Mr. Hubbard:

The application for assistance in exploring the subject property has been reviewed by the Washington Office and referred to Mr. Harold K. Stager, Field Officer, Region II, Office of Minerals Exploration, U. S. Geological Survey, Building 2, 345 Middlefield Road, Menlo Park, California 94025.

The Regional Office will notify you if additional information concerning the application is needed.

Sincerely yours,

FRANK E. JOHNSON

Frank E. Johnson
Chief, Office of
Minerals Exploration

cc: Director's Reading File
Division File
Economic Geology File
OME Docket
OME Reading File
OME Region II
Mr. Smith

GLAult/a 3-29-67

23263

March 24, 1967

Mr. William S. Hubbard
Civic Center Building
175 West Fifth Street
San Bernardino, California 92401

Subject: OME-6607

Dear Mr. Hubbard:

Your application for exploration assistance, dated March 15, 1967, submitted to our office at Menlo Park, California, has been assigned Docket No. OME-6607.

Please identify all future correspondence relating to your application by this docket number.

Sincerely yours,

Frank E. Johnson
Chief, Office of
Minerals Exploration

Copy to Region II