CONTACT INFORMATION
Mining Records Curator
Arizona Geological Survey
416 W. Congress St., Suite 100
Tucson, Arizona 85701
602-771-1601
http://www.azgs.az.gov
inquiries@azgs.az.gov

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NAME OF SENDER
E. Wisser

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September 30, 1969

Mr. Malcolm B. Gould
H.W.Gould & Co.
57 Post Street
San Francisco, Calif.94104

Dear Scotty:

Enclosed find the Aetna illustrations;I didn't think the photos vital.

I hope I am right in assuming that the Basin Montana Tunnel Co., 1 East 57th St.,N.Y. is no longer in existence. If it is,and still owns the Aetna,I am violating ethics in sending these illustrations. But since you obtained the report in some way,it seems like leaning over backward not to complete it with the maps.A lapse of 27 years should,I think,be covered by the statute of limitations.

About 1943 I turned over the Aetna consulting job to Frederick; for the next 5 years my work was largely confined to Mexico. Fran wrote a report in 1944,with many detailed maps and cross-sections. Basin Monana paid for this report also;if they no longer exist,I think it would be perfectlly ethical to try to get it from Mary,assuming she has a copy.

Please let me know who now owns the Aetna;maybe H.W.Gould & Co. does,in which case all is O.K. What I suggest you do is,reproduce my illustrations,stock them your copy of my report,return the originals to me,and let every one assume they were in your copy when you acquired it.

Tap 'er light

Edward Wisser

F.F.

FRANCIS FREDERICK

FRANCIS FREDERICK
MINING GEOLOGIST

926 CROCKER BUILDING
SAN FRANCISCO, CALIFORNIA
PHONE SUTTER 0416

August 18, 1944

Mr. Gerald Sherman
Basin Montana Tunnel Company
1 East 57th Street
New York, N. Y.

Dear Mr. Sherman:

Here is my report on the proposed diamond drilling program for the Aetna Mine, Napa County, California. This is not a complete geological report, it is merely a presentation of some of the ore possibilities that might be proved by means of diamond drilling. Most of the geologic background for the conclusions reached is the result of a study of Ed. Wisser's work, plus my own observations at the property. A composite surface and underground plan map is submitted here because there are some additions to the surface geology shown on Wisser's map submitted with his report in May 1942.

The maps and sections are somewhat self-explanatory and present the situation much better than words, so I'll not overdo the description. Lines drawn on the 200 scale plan map and on the 200 scale longitudinal projection show the position of the cross-sections. The cross-sections and 200 scale plan map show the positions of the proposed drill holes.

A 40 scale plan of the No. 9 level shows some of the proposed drill holes. It also shows the position of the large scale cross-section drawings (1"=10') of the No. 9 Level drift. These drawings are numbered 1 to 9, inclusive, and are on 4 sheets of paper attached herewith.

Up-to-date plan and projection maps of the New Pope workings are also attached herewith. The west vein ore shoot probably contains 1,000 to 2,000 tons of 5# to 7# ore between the surface and 25 ft. below the tunnel level. The position of this vein with respect to the other veins on the Aetna property is shown on the 200 scale plan map.

The New Pope and Lower Pope veins are parallel in strike to the Star, Phoenix and Toothache veins, and parallel in strike to the richest and most productive part of the Silver Bow vein.

An analysis of the old maps and new information gained in the No. 9 level shows that the Silver Bow "bonanza" oreshoot is along a very flat dipping zone that is best explained by pre-mineral faulting of the Silver Bow dike. The cross-sections submitted here all show the same condition of sudden flattening.

The recent reopening work in No. 9 level showed considerable shearing and evidence of faulting along the edge of the dike. Cross-section E-E' is a section along the fault itself, and because the strike of the fault and the strike of the dike are not the same, the apparent dip of the footwall contact of the dike as shown on section E-E' is not the true dip. The hanging wall of the dike is the fault-vein zone. Where the Silver Bow vein was flat (in the fault zone), it was wide and rich. So now it appears that the narrow and lower grade ore along the steep part of the dike contact is not on the main ore structure. The main ore structure is apparently the flat fault zone. Proposed diamond drill holes #4, #5 and #6 are designed to explore the fault-vein zone where it could be rich ore. Holes #1, #2 and #3 are designed to explore the dike zone in general and to see what is under the dike directly opposite the places where the main ore shoot was very rich.

Proposed Holes #1, #2 and #3 are to be drilled from underground in No. 9 tunnel near the Silver Bow stopes. They should probably be about 450 ft. each. Holes #1 and #2 will be to test the footwall side of the dike directly opposite the most productive part of the Silver Bow stopes on the hanging wall. The drill will be set up at the old winze station and stope on the No. 9 level. Hole #3 will start from the No. 9 tunnel in the hanging wall of the dike so that it will explore the Silver Bow vein just southeast and below the old stope. This hole should also be extended to the footwall side of the dike.

Proposed Hole #4 should be drilled from the portal of the Upper Silver Bow Tunnel. It will be about 400' long and will cross the footwall side of the dike where it is cut by the same fault that apparently made the bonanza on the hanging wall side of the dike. Cinnabar has been mined well within the dike at this tunnel and has been found on the surface on the footwall side of the dike. If the flat fault hypothesis is the correct one, then Hole #4 is a better bet than Holes #1 and #2.

Proposed Holes #5 and #6 are shown on cross-section B-B'. These should be about 450 ft. each and will test the "bonanza" fault close to a very productive area on the Silver Bow vein. Hole #5 should cross the fault zone within the dike and may reveal some brecciated dike ore. The wedge of dike between the footwall contact and the fault between Holes #5 and #6 could contain considerable ore.

Proposed Holes #7, #8 and #9, shown on cross-section F-F', should not be considered unless the No. 9 level becomes inaccessible, because the same amount of money spent in extending No. 9 level into the area to be explored by these holes would reveal far more valuable information.

Two other holes should be considered in the area between No. 2 Tunnel and cross-section C at the Upper Silver Bow Tunnel, particularly if Holes #4, #5 or #6 find any encouragement. Perhaps a hole on the line of cross-section D, similar to the position of Hole #4 or #6, should be on the program.

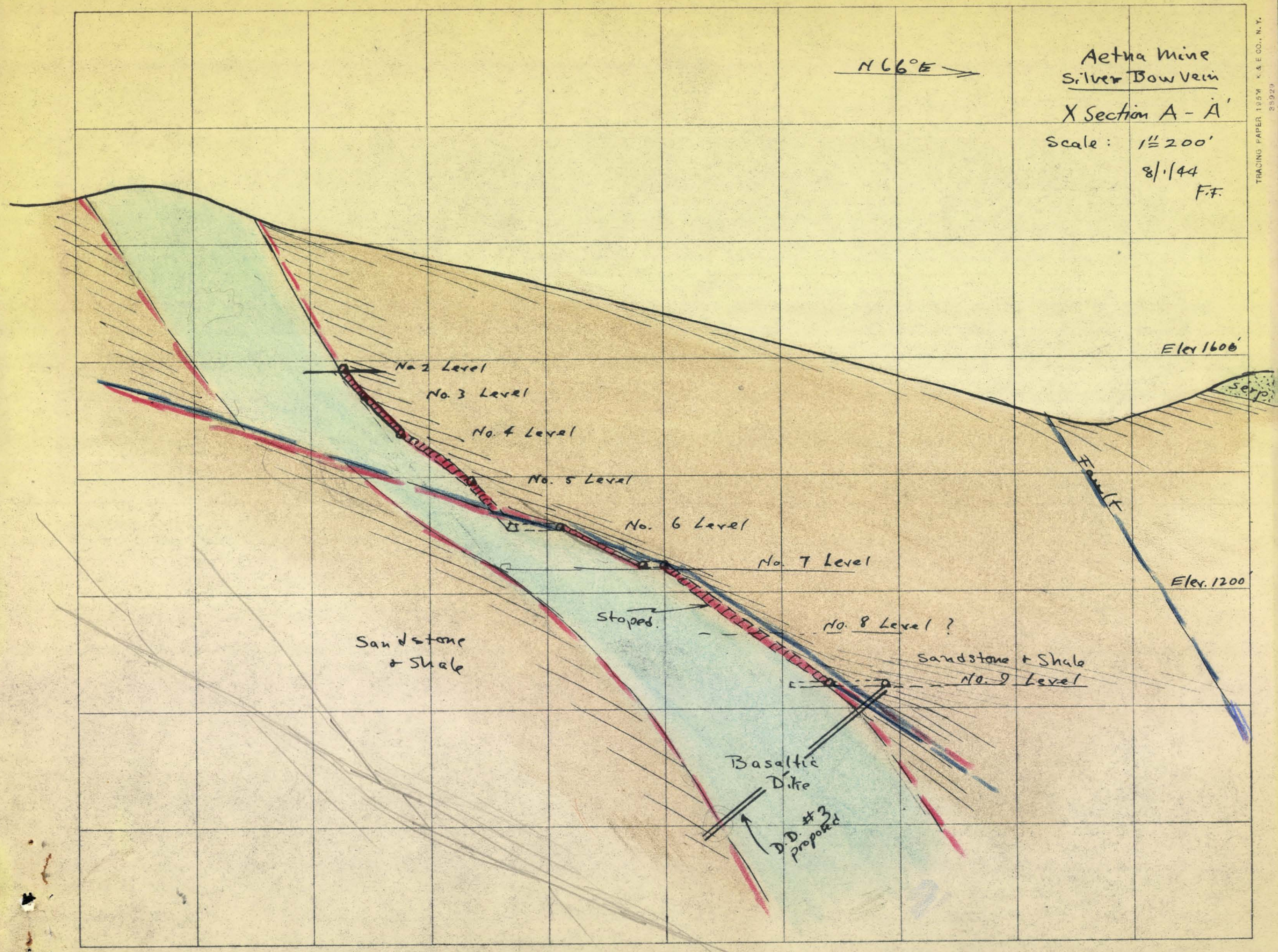
Summary: Excluding Holes #7, #8 and #9, there is a total of 2,650 ft. of specific holes and two other "perhaps" holes of about 400 ft. each. About 1,350 ft. would be drilled from underground stations on the No. 9 level. A mining company would need about $9,000. available for this drilling, and about $7,000. for underground exploration, or a total of about $16,000. to carry out the whole program outlined, including underground exploration in place of Holes #7, #8 and #9.

Yours truly,

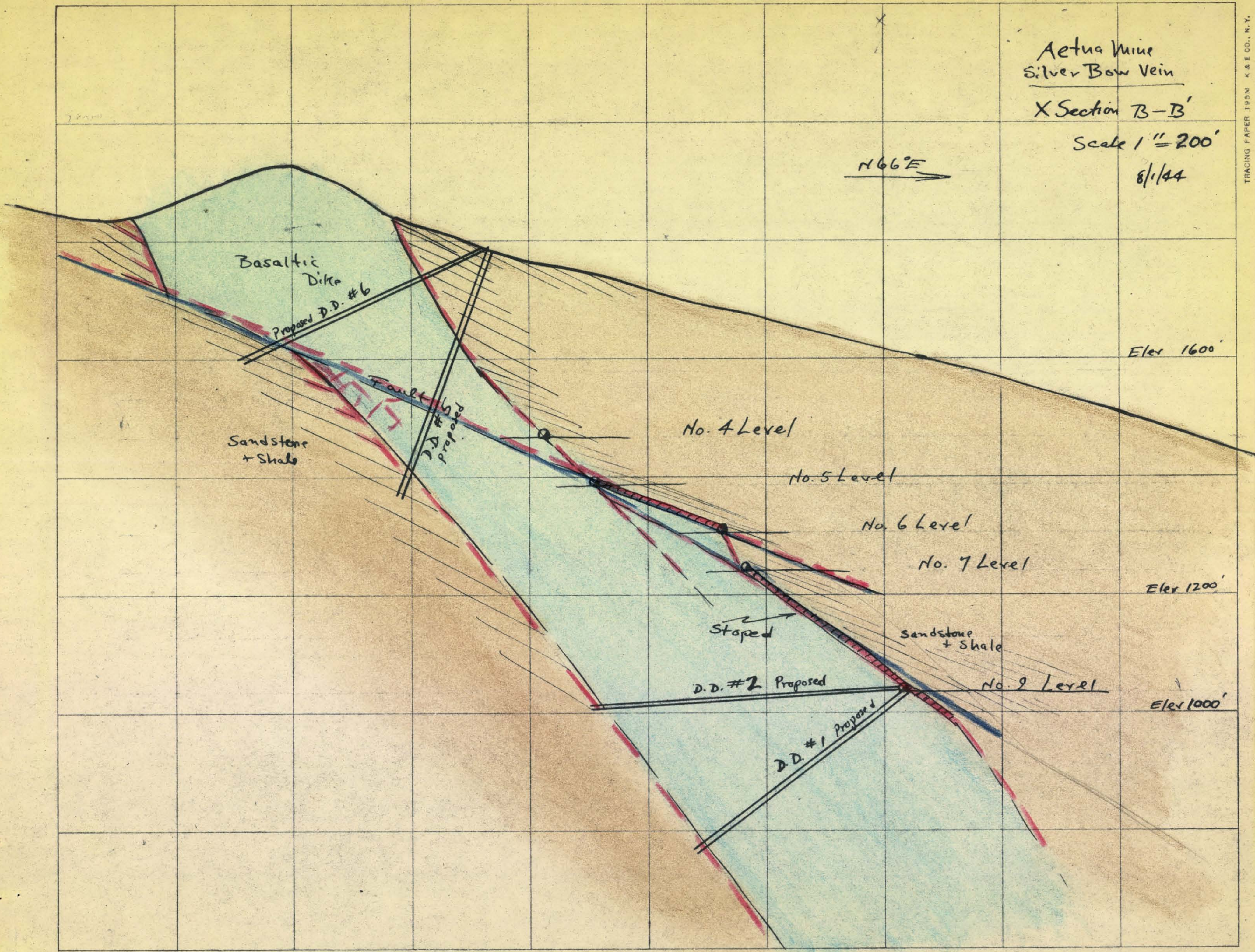
Francis Frederick

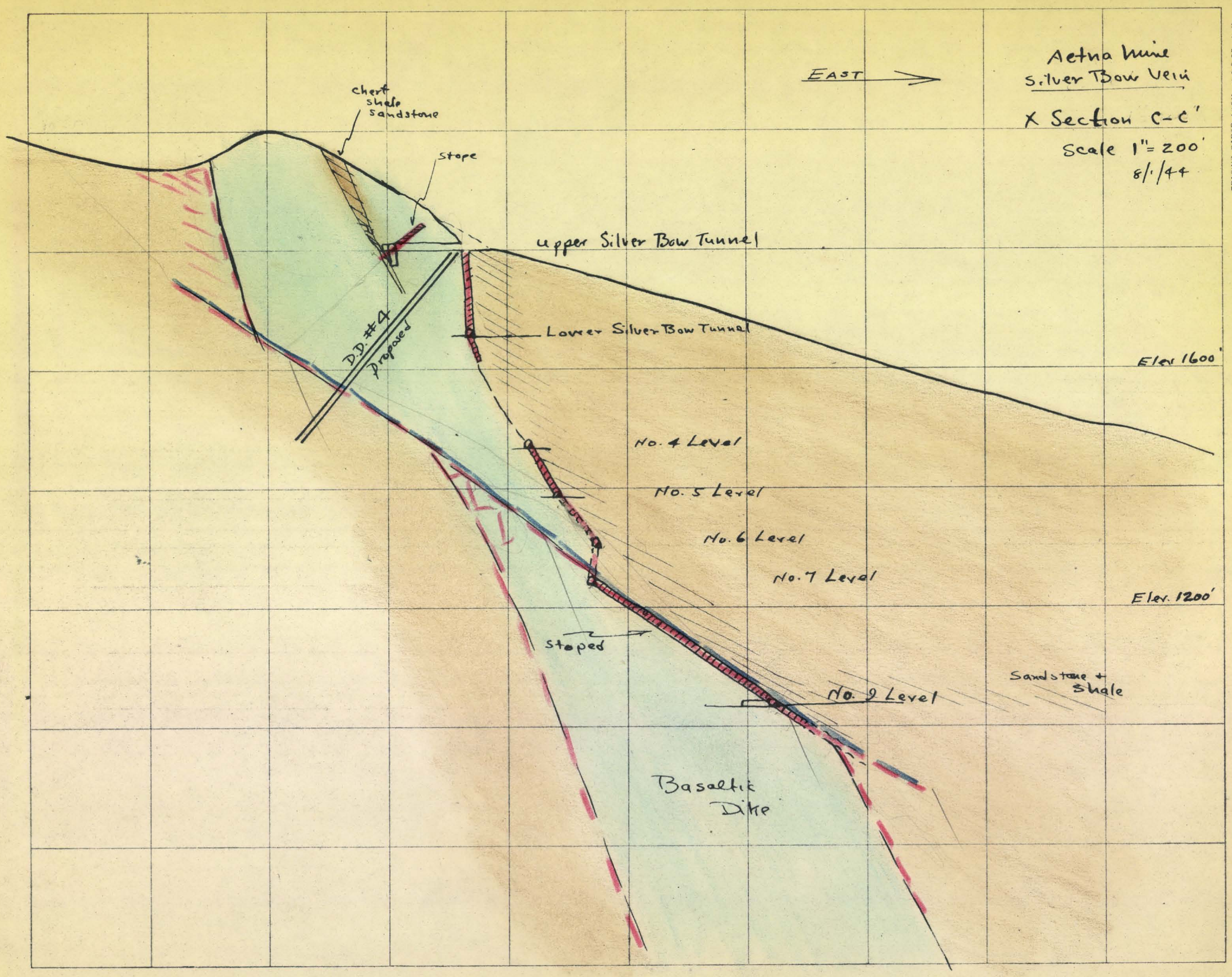
ENCS:

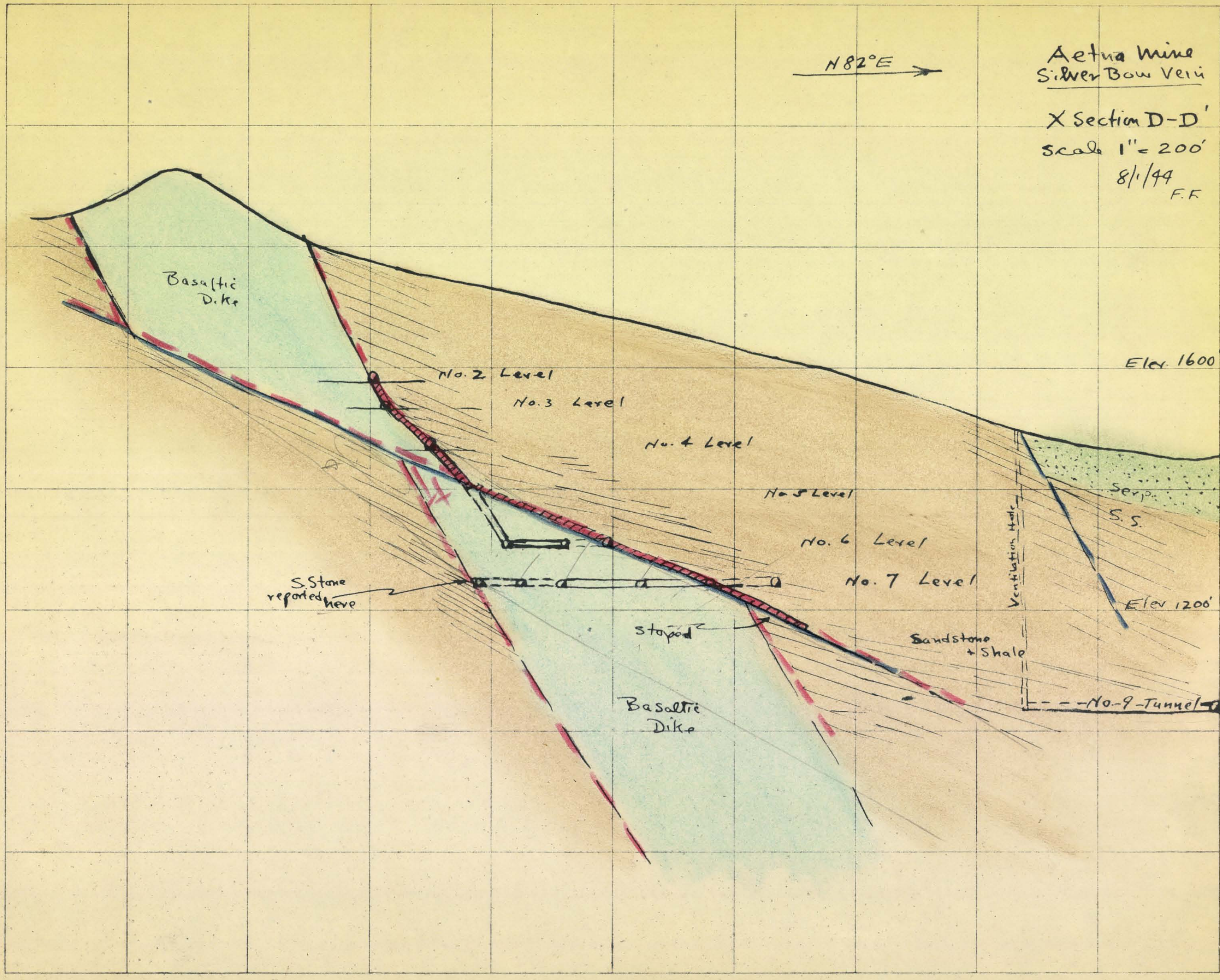
FF:ET



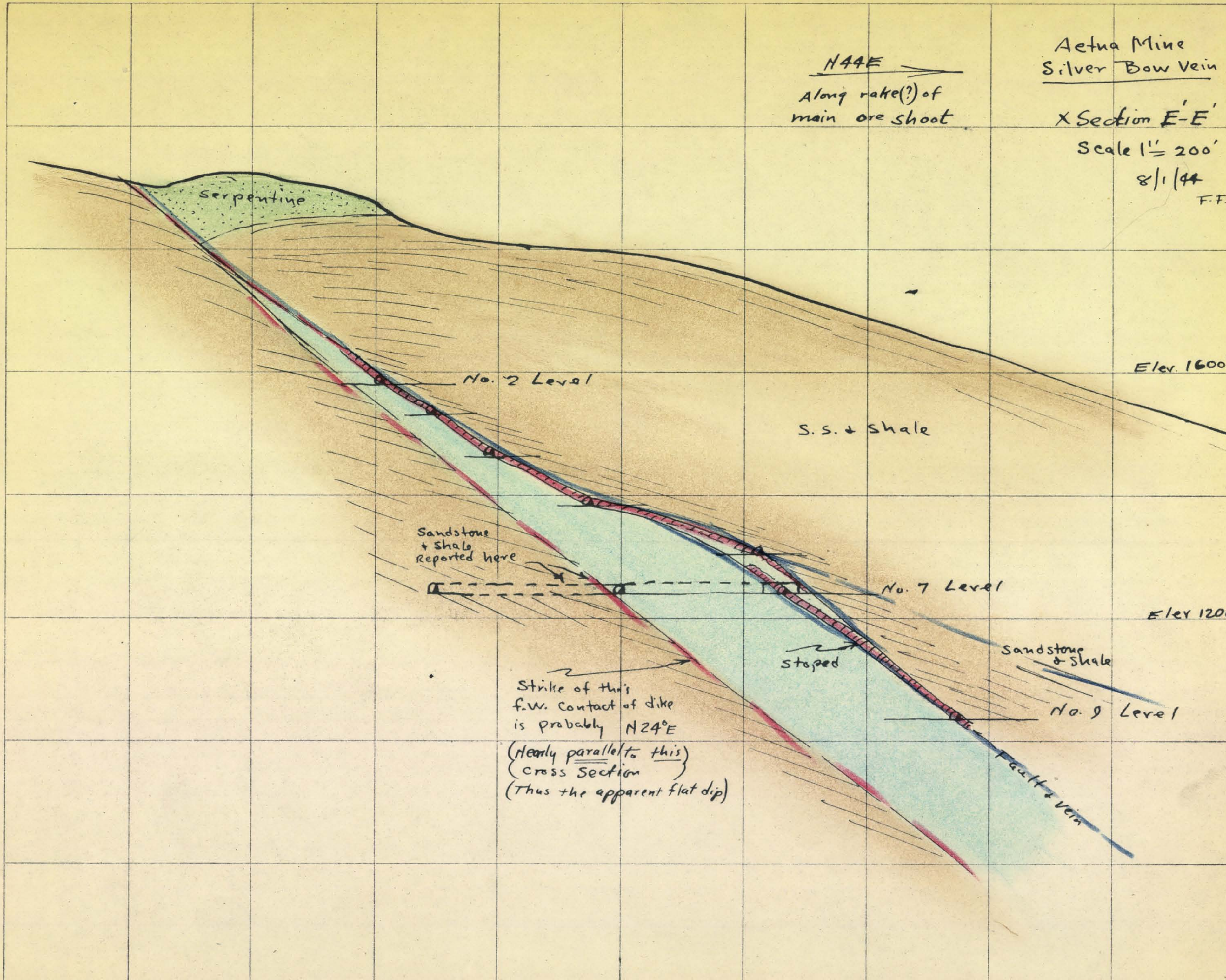
Aetna Mine
Silver Bow Vein
X Section A - A'
Scale: 1" = 200'
8/1/44
F.F.
N 66°E
No 2 Level
No. 3 Level
No. 4 Level
No. 5 Level
No. 6 Level
No. 7 Level
No. 8 Level ?
No. 9 Level
Stoped.
Sandstone & Shale
Sandstone & Shale
Basaltic Dike
D.D. #3 proposed
Fault
Elev 1600'
Elev. 1200'
Serp.
TRACING PAPER 195M K & E CO., N.Y.


Aetna Mine
Silver Bow Vein
X Section B-B'
Scale 1" = 200'
8/1/44
N66°E
Basaltic Dike
Proposed D.D. #6
Fault
D.D. #5 proposed
Sandstone + Shale
No. 4 Level
No. 5 Level
No. 6 Level
No. 7 Level
Stoped
Sandstone + Shale
D.D. #2 Proposed
No. 9 Level
D.D. #1 Proposed
Elev 1600'
Elev 1200'
Elev 1000'


Aetna Mine
Silver Bow Vein
X Section C-C'
Scale 1" = 200'
8/1/44
EAST
chert
shale
sandstone
stope
upper Silver Bow Tunnel
Lower Silver Bow Tunnel
D.D. #4
proposed
Elev 1600'
No. 4 Level
No. 5 Level
No. 6 Level
No. 7 Level
Elev. 1200'
Stoped
Sandstone + Shale
No. 9 Level
Basaltic Dike



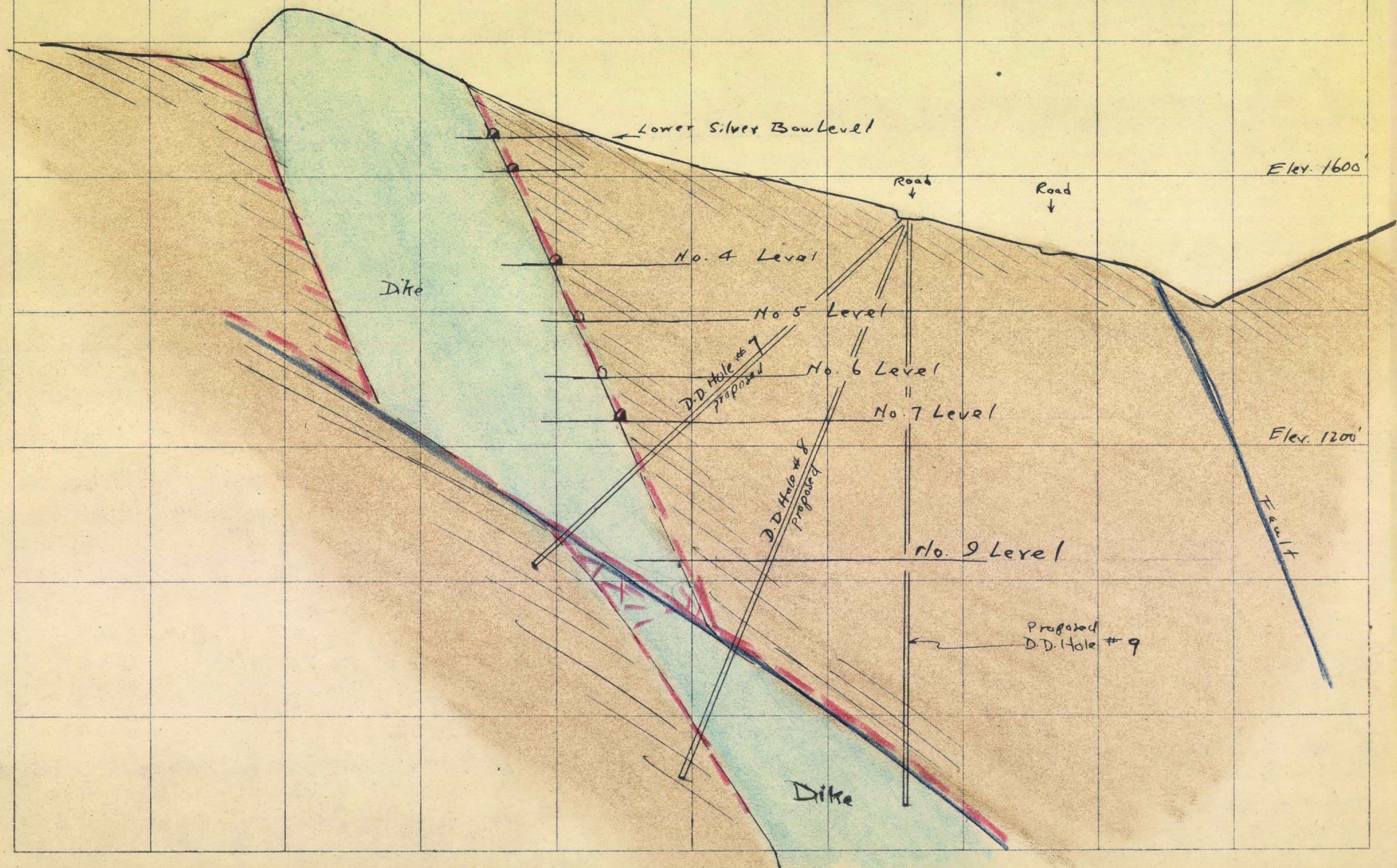
Aetna Mine
Silver Bow Vein
X Section D-D'
Scale 1" = 200'
8/1/44
F.F
N 82°E
Basaltic Dike
No. 2 Level
No. 3 Level
No. 4 Level
No. 5 Level
No. 6 Level
No. 7 Level
Elev. 1600'
Elev 1200'
Serp.
S.S.
Ventilation Hole
S.Stone reported here
Stoped
Sandstone + Shale
No. 9 Tunnel
Basaltic Dike

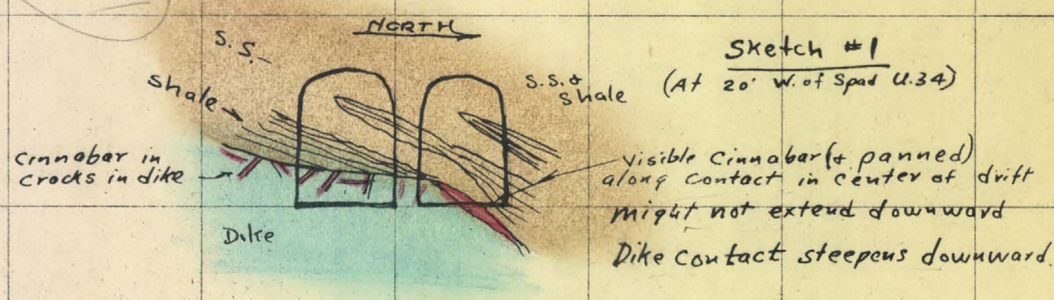

Aetna Mine
Silver Bow Vein
X Section E'-E'
Scale 1" = 200'
8/1/44
F.F.
N44E
Along rake(?) of main ore shoot
Serpentine
No. 2 Level
S.S. & Shale
Elev. 1600'
Sandstone & Shale Reported here
No. 7 Level
Elev 1200'
Stoped
Sandstone & Shale
No. 9 Level
Fault & Vein
Strike of this f.w. contact of dike is probably N24°E
(Nearly parallel to this cross section)
(Thus the apparent flat dip)

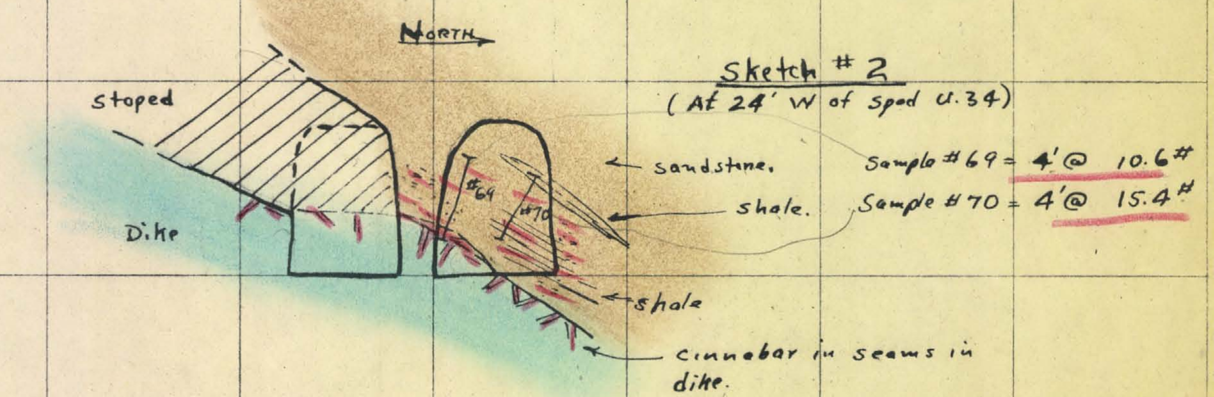
Silver Bow Vein
Aetna Mine
Scale 1" = 200'

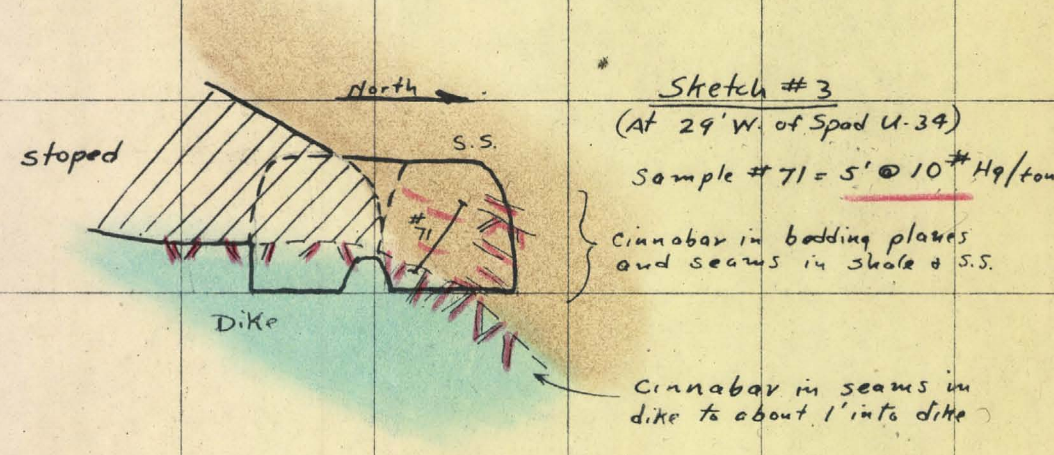
X Section F-F'

8/1/44





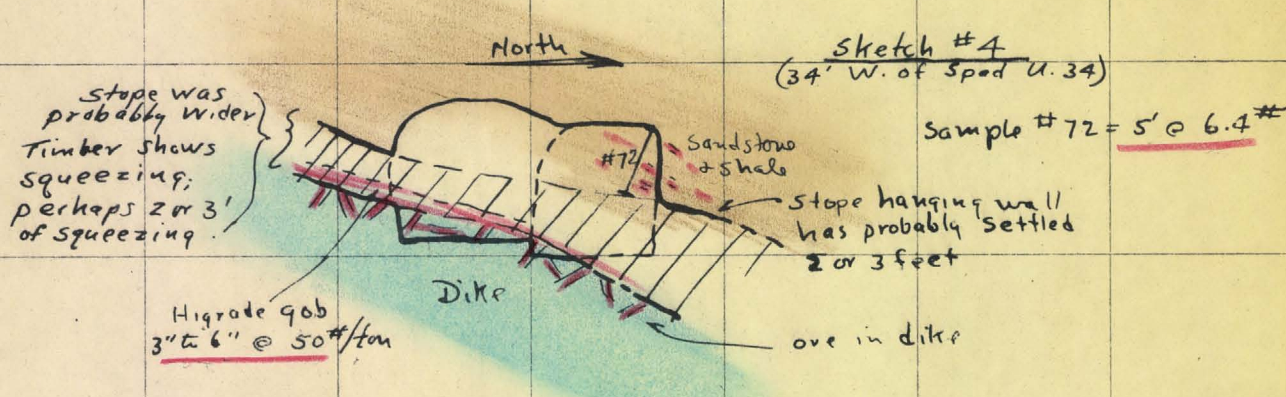


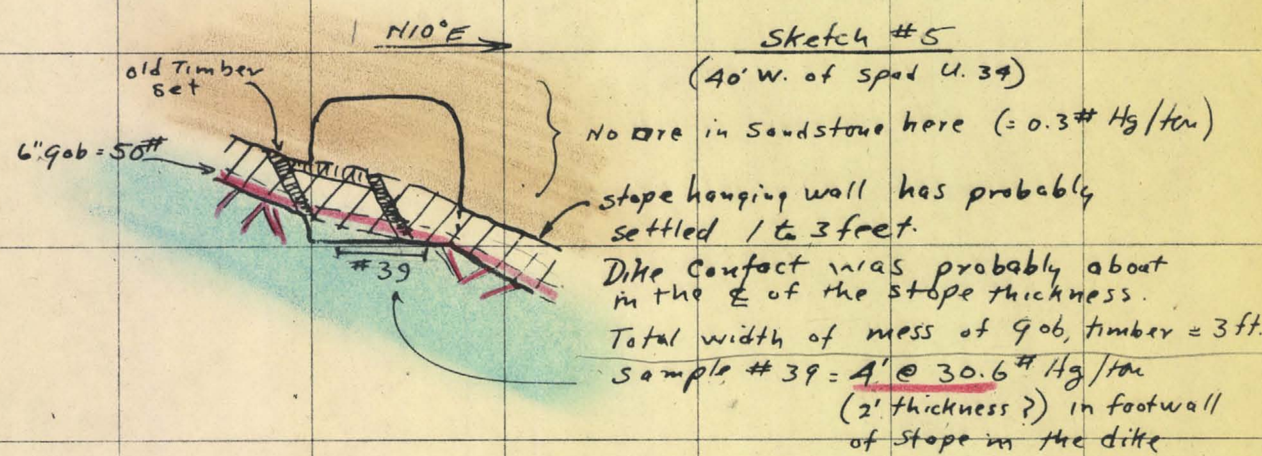


No. 9 Level – Aetna Mine
Cross Section Sketches of Drift Workings
Scale 1" = 10'

5/9/44 F.F.

TRACING PAPER



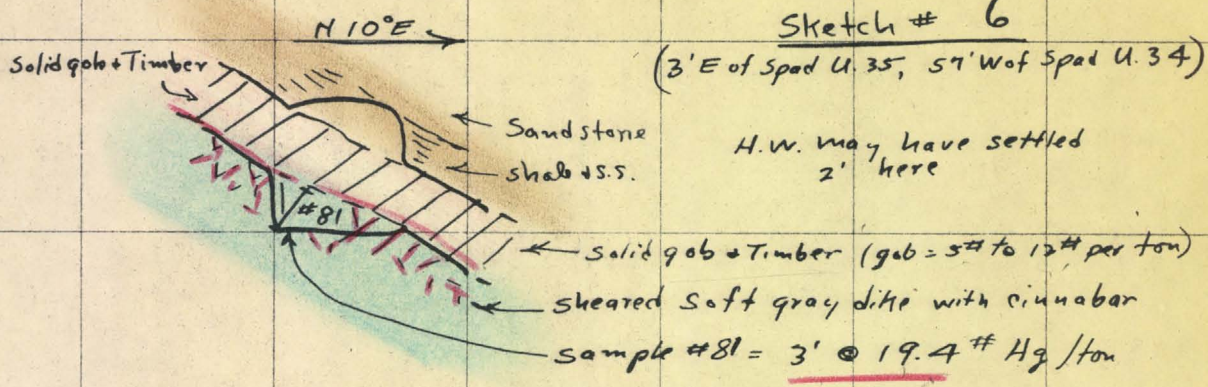


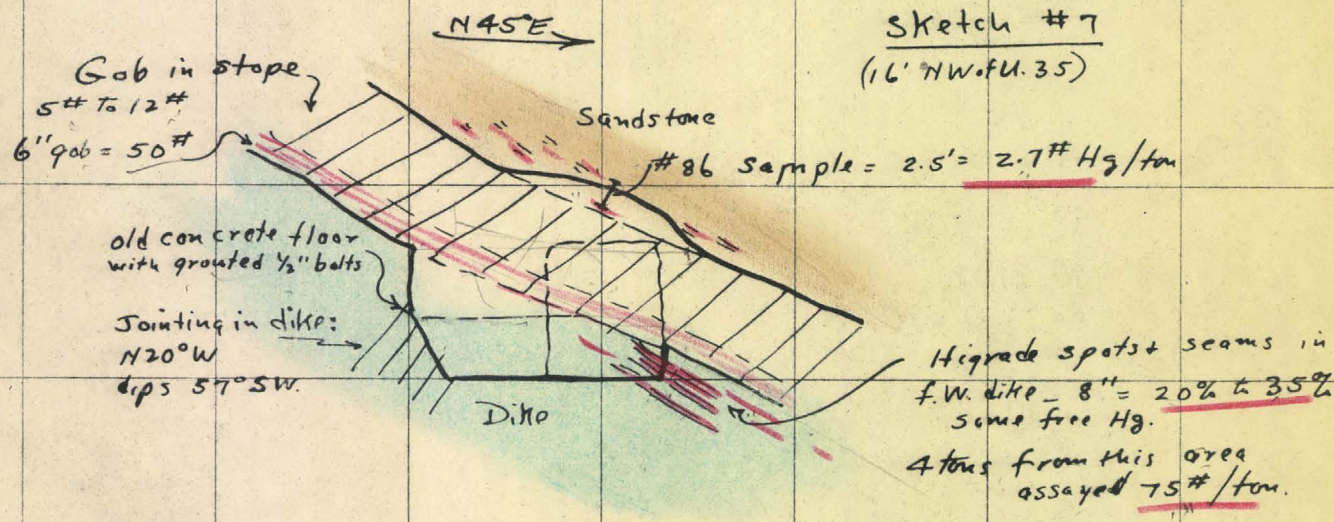
No. 9 Level
Aetna Mine
Cross Section sketches of drift workings

scale 1" = 10'

5/9/44

F.F.





No. 9 Level - Aetna Mine
Cross section sketches
of drift workings.
Scale 1" = 10'

5/9/44 - F.F.

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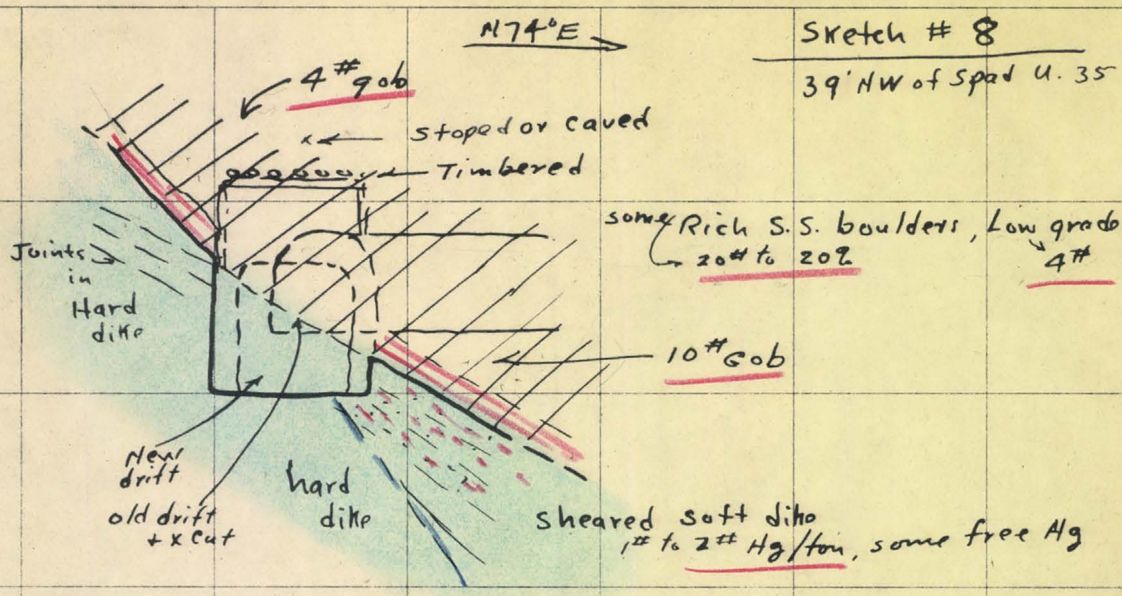
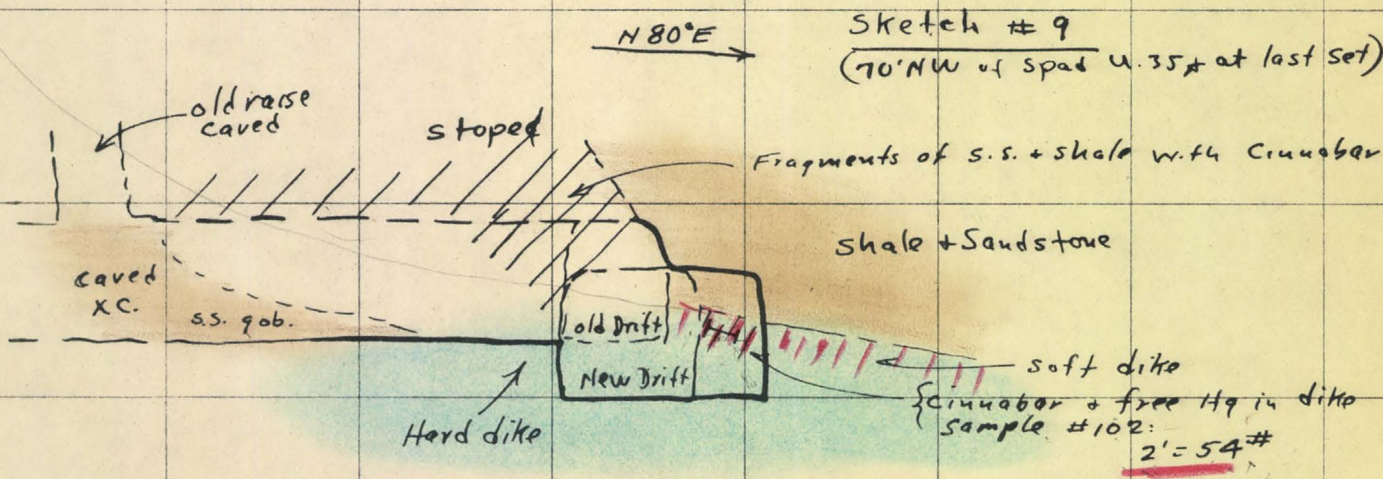
38929





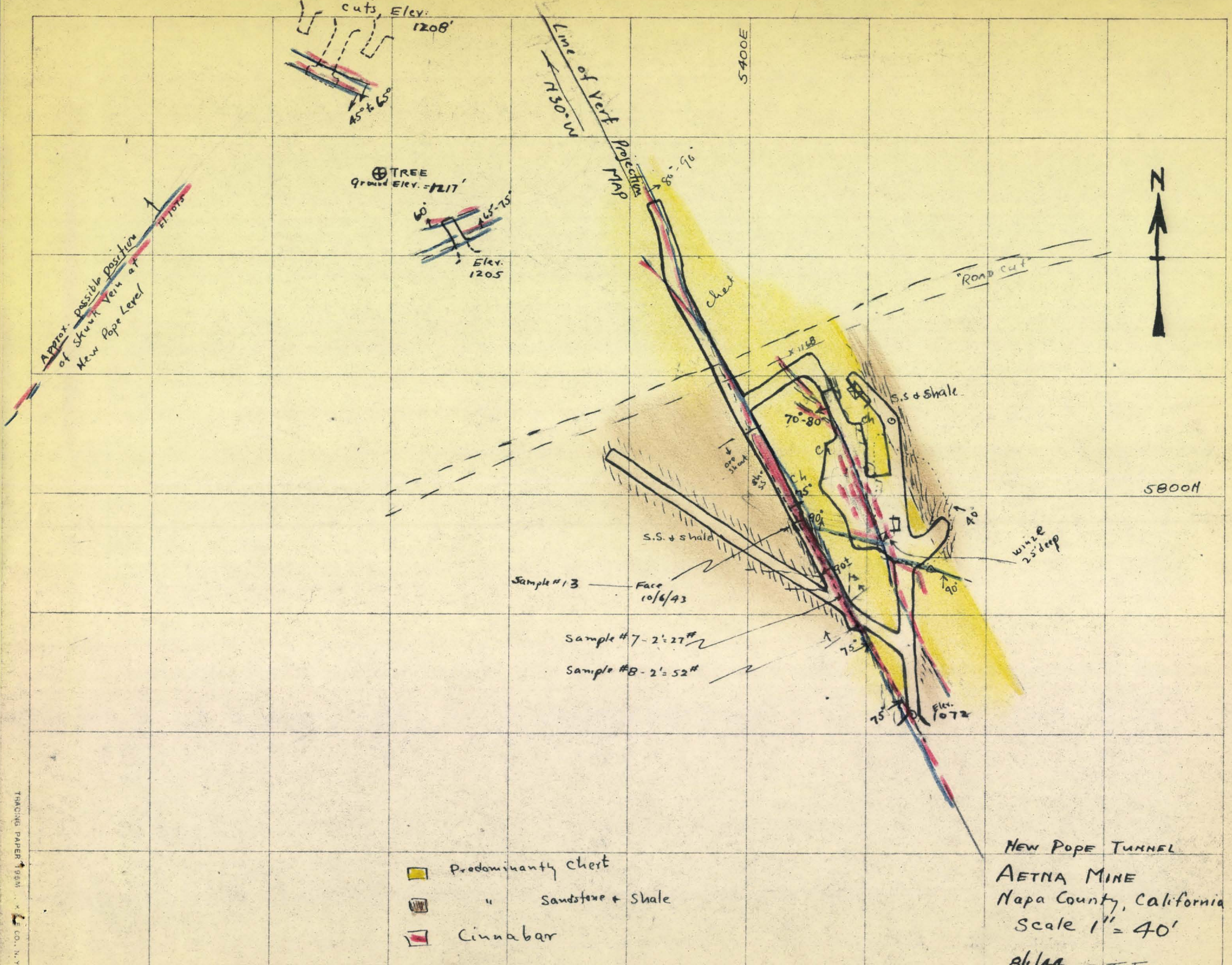
No. 9 Level - Aetna mine
Cross section sketches
of drift workings

Scale 1" = 10'

5/9/44 and 6/1/44

F.F.

TRACING PAPER 195M K & E CO., N.Y.
33929



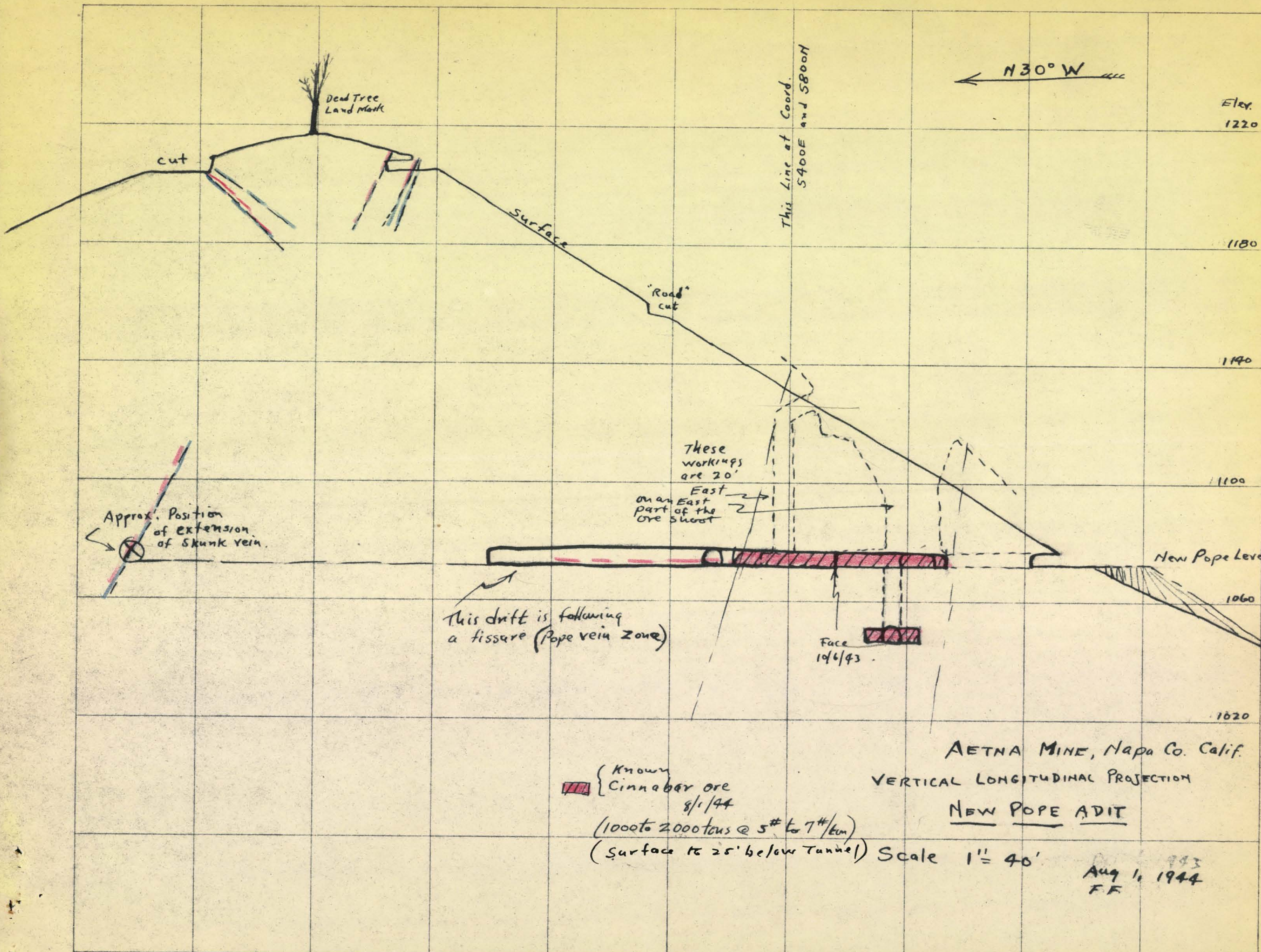
New Pope Tunnel

Aetna Mine

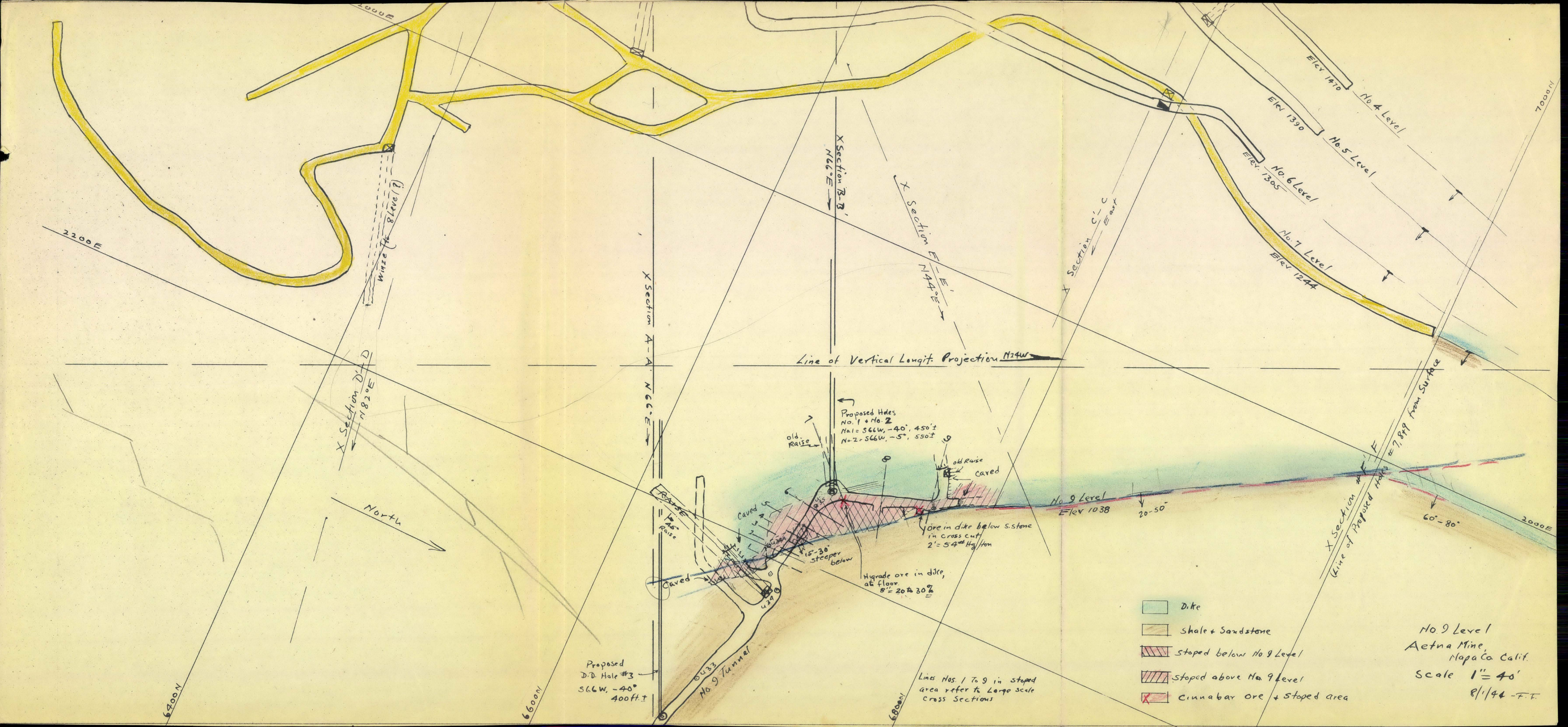
Napa County, California

Scale 1" = 40'

8/1/44 F.F.


N30°W
Elev.
1220
1180
1140
1100
1060
1020
Dead Tree Land Mark
cut
Surface
"Road" cut
This Line at Coord. 5400E and 5800N
These workings are 20' East
on an East part of the ore shoot
Approx. Position of extension of Skunk vein.
New Pope Level
This drift is following a fissure (Pope vein Zone)
Face 10/6/43
Known Cinnabar ore 8/1/44
(1000 to 2000 tons @ 5# to 7#/ton)
(surface to 25' below Tunnel)
AETNA MINE, Napa Co. Calif.
VERTICAL LONGITUDINAL PROJECTION
NEW POPE ADIT
Scale 1" = 40'
Aug 1, 1944
F.F.


N24°W
N24°W
X Section E
X Section A
B
D
X Section C
X Section F
Elev. 2000'
Elev. 1600'
Elev. 1200'
Elev 1200
Elev 800'
Upper Silver Bow Tunnel
Xcut to ore in dike
Serp. h. wall (Silver Bow)
SS. h. wall (Silver Bow)
No. 2 Tunnel
No. 2 Level
No. 3
No. 4
No. 5
No. 6
No. 7 Level
No. 7 Level
No. 8 Level
No. 9 Level
No. 9 Tunnel
Aetna Extension (Kroll)
Aetna
Aetna Extension Tunnel
Rhodes XC Adit
Approx. Boundary of Property along H.W. of Dike
Phoenix Glory Hole
1358 (1310 Tunnel)
Serp. H. Wall
SS H Wall
Drift on Phoenix Vein
Broken Line part of No. 7 Level is X Cut from Phoenix Vein to Silver Bow Vein
Serp hw
Sp. F. W
SS. H. W
Proposed Drilling Station to Drill to footwall of dike
Possible outline of main Silver Bow ore shoot zone
Probably Partly Stoped
Stoped
Production:
Silver Bow Zone: Approx. 40,000 Flasks
Phoenix Vein " 20,000 Flasks
Other Areas on Property " 20,000 Flasks
Total 80,000
Phoenix Vein
Scale 1" = 200'
8/1/44 F Frederick
Silver Bow "Vein"
Aetna Q.S. Mine, Napa Co., Calif.
Vertical Longit. Projection


1000E
2200E
2000E
7000N
6400N
6600N
6800N
Winze to 8 Level (?)
X Section A-A' N66°E
X Section B-B' N66°E
X Section E-E' N44°E
X Section C-C' East
X Section D-D' N82°E
X Section F-F'
Line of Proposed Holes ±7,849 from Surface
Elev 1470
No. 4 Level
Elev 1390
No. 5 Level
Elev. 1305
No. 6 Level
No. 7 Level
Elev 1244
Line of Vertical Longit. Projection N24W
North
Proposed Holes
No. 1 + No. 2
No. 1 = S66W, -40°, 450'±
No. 2 = S66W, -5°, 550'±
old Raise
old Raise
Caved
Caved
Caved
Raise
45° Raise
15°-30° steeper below
Higrade ore in dike, at floor. 8" = 20 to 30%
ore in dike below S. stone in cross cut 2' = 54# Hg/ton
No. 9 Level
Elev 1038
20-50°
60°-80°
Proposed D.D. Hole #3
S66W, -40°
400 ft. ±
No. 9 Tunnel
Lines Nos. 1 to 9 in stoped area refer to Large scale Cross Sections
Dike
Shale + Sandstone
Stoped below No. 9 Level
Stoped above No. 9 Level
Cinnabar ore + Stoped area
No. 9 Level
Aetna Mine,
Napa Co. Calif.
Scale 1" = 40'
8/1/44 - F.F.

DOMES Aetna Hg, Calif.

Thick sill of serpentine intruded in Franciscan ss.,with subordinate shale and chert horizons. The whole folded into short and rather wide anticlines and synclines,trending NW. Probably in Pleistocene,series of domes superimposed on this older folding. Apex of major dome N of mine, latter on S flank. Formations dip SE,S,SW. Major veins radial fissures,which were invaded,1st by basalt dikes(Silver Bow,Phoenix),next by solutions making silica-carbonate rock, finally by Hg solutions. Most ore in silica-carbonate rock, ex-serpentine.Brittleshattered. But brittle ss broke well between soft squeezy shale horizons. Near trunk channel.

Star vein system consists of concentric and radial cracks on a local dome.

Main veins also seats of strong though probably hindered fault movements to crack tough basalt and silica carb.rock. Ss OK if near major channel. Wide veins in silica-carbonate rock pinch to mere slips in serpentine. Silica-carbonate ore: HgS coats fragments of the breccia,fills seams within the fragments.If shattering did not reach stage of fragmentation,irreg. stockwork.

Deformation mainly by vertical uplift. However, seems to be a post-basalt thrust fault which had some control over the mineralization.

Aetna Quicksilver Mine, Napa Co. Calif. CR Franciscan ss, with subordinate shale and chert. Complexly but not very sharply folded into short, wide anticlines, strike NW. Just above these beds are sharing for the most part in their folding is a great sill-like serp. mass, the SE end of a band of serp. extending 9 mi. NW of Aetna along the Mayacmas Hg belt. At the W border of the Aetna district is a large basalt or db. dike cutting the serp. sill and other rocks mentioned. The largest producer, Silver Bow vein, formed in brittle crushed ss. along the E side of this dike. Smaller basalt dikes (premineral) invade some of the main fractures, e.g. Phienix and Star veins.

Probably in the Pleistocene simple uplift effects were imposed on the earlier folding; this later deformation is closely connected with the formation of the Hg ore bodies. The sediments and the sill were uplifted to form a dome or stubby anticline whose apex lies north of Aetna ground so that the S portion only is exposed at the Aetna. The Silver Bow dike intruded a tension fissure formed by the uplift, followed it is thought, closely by the Hg mineralization depositing along the Silver Bow, Pheinix and Morey veins, also tension fissures. The Morey, Star and other fissures formed in connection with the local dome shown, on a nose of the main anticline.

Mineralization in two stages: 1. silica carbonate rock; 2. cinnabar, with sparse pyrite, marcasite.

Extreme epithermal, recent ore type

April 29,1943

Basin Montana Tunnel Co.,
1 East 57th Street,
New York, N.Y.

To Edward Wisser, Dr.,

To professional services, examination of Aetna Mine,	
March 30-April 1st,1943, 3 days @ $50.00................	$150.00
Preparing report and map, 1 day in office @ $25.00....	25.00
Expenses per itemized account enclosed.................	19.27
	$194.27

Expense Account of Edward Wisser with Basin Montana

Tunnel Co.

April 3,1943	Wire to Richardson..........	$0.95
12	" " Sherman.............	11.94
29	White prints...............	1.30
29	Airmailing 2 reports,misc. postage......................	1.03
	Bus tickets to St.Helena, meals.....................	4.05
		$19.27

August 19th, 1942

Mr. Allan A. Ryan, Jr.,
1 East 57th Street,
New York, N.Y.

<u>To Edward Wisser, Dr.</u>

To professional services, examination of Aetna mine, August 15th, 1942	$50.00
Extra gasoline (10 gallons furnished at Aetna)	1.10
Breakfast	0.55
Dinner	1.15
	$52.80

EDWARD WISSER
MINING GEOLOGIST
533 CALL BUILDING
SAN FRANCISCO
TELEPHONE GARFIELD 4676

August 19th,1942

Mr. Allan A. Ryan, Jr.,
1 East 57th Street,
New York, N.Y.

To Edward Wisser, Dr.

To professional services,examination of Aetna mine, August 15th, 1942..	$50.00
Extra gasoline (10 gallons furnished at Aetna)..........	1.10
Breakfast..	0.55
Dinner..	1.15
	$52.80

OK
[illegible]

December 29th, 1942.

Basin Montana Tunnel Co.,
1 East 57th St.,
New York, N.Y.

To Edward Wisser, Dr.,

To professional services, examination of Aetna Mine,
December 17th to 19th,1942, 3 days @ $50.00.............$150.00
Expenses, per itemized account enclosed................ 21.25
$171.25

Note: I expect to be in Mexico through January and possibly February; for this reason I should be obliged if check were made payable directly to my commercial account at

American Trust Company,
Telegraph Avenue Branch,
Telegraph Avenue near Bancroft Way,
Berkeley, Calif.,

sending letter advising me of same to 533 Call Bldg., San Francisco.

EXPENSE ACCOUNT OF EDWARD WISSER WITH BASIN MONTANA TUNNEL CO.

Aetna Trip, Dec.17-19,1942.

Dec.16.	Ticket to St.Helena..........	$1.49
17.	Breakfast.....................	0.57
	Lunch (with Richardson)......	1.47

Misc. phones, wires, postage.

Wire, May 4,1942.....................	1.32
" Aug 11..........................	3.38
" Aug.20 N.Y......................	2.01
" " " Denver re locomotive.....	1.45
" Date not noted, N.Y............	5.44
Paid Postal Telegraph,Sept.28,tracing wire......................................	1.32
Phone Richardson Nov.26...................	1.35
" " Dec.7.....................	1.45
	$21.25

EDWARD WISSER
MINING GEOLOGIST
533 CALL BUILDING
SAN FRANCISCO
TELEPHONE GARFIELD 4676

November 23rd, 1942.

Basin Montana Tunnel Co.,Inc.,
1 East 57th Street,
New York, N.Y.

To Edward Wisser, Dr.,

To professional services, visit to Aetna mine,
November 11th,1942.....................................$50.00

OK
[illegible]

October 1st, 1942.

Mr. Allan A. Ryan Jr.,
1 East 57th Street,
New York, N.Y.

To Edward Wisser, Dr.

To professional services at Aetna Mine, Sept.28th and 29th,1942, two days @ $50..	$100.00
Bus ticket to St. Helena..	2.15
	$102.15

May 14th, 1942.

Mr. Gerald Sherman,
Palace Hotel,
San Francisco.

Dear Mr. Sherman:

Pursuant to your request I submit statement of account for my examination of the Aetna Mine, Napa Co., Calif.

To professional services, fee for examination........	$1000.00
" " " ,trip to mine,May 11-12,1942..	100.00
Expenses as per itemized account.....................	287.53
	$1387.53
Previously received from A.P.Scott...................	250.00
Amount due...	$1137.53

Since I shall be travelling in Mexico for the next several months, out of touch with mail, it would be appreciated if check for above amount could be made in such a form as to permit its deposit to credit of my account, directly, at the

American Trust Co., Telegraph Avenue Branch,
Telegraph Avenue near Bancroft Way,
Berkeley, Calif.

Yours very truly,

Edward Wisser

Enclosure: Itemized expense account, time put in, etc.

Aetna Expense Acc't.

Mileage 580 mi. @ 5¢	29.00
Bridge Tolls	2.45
Supplies, mine	11.28
Repairs to car	5.85
Board at mine	37.50
Films, Photos 2.95 / 1.19 / 4.14	4.14
Prints	4.78
Office supplies	4.50
Phone calls	1.80
Paid J.F. Knapp, labor	7.75
Field assistance, 12 days @ $10.00	120.00
Mailing report to Ryan	0.90
" " " Scott	0.58
Office assistance	57.00
	287.53

7.00

Fee	$1100.00
Previously received	250.00
	850.00
	287.53
Am't due	$ 1137.53

EXPENSE ACCOUNT, AETNA EXAMINATION, MARCH 28-MAY 2nd,1942.

Car mileage, 580 miles @ 5 cents per mile.............	$29.00
Bridge tolls...	2.45
Supplies, mine.......................................	11.28
Repairs to car.......................................	5.85
Board,mine...	37.50
Films, photos..	4.14
White prints...	4.78
Office supplies......................................	4.50
Phone calls..	1.80
Paid J.F.Knapp,labor.................................	7.75
Field assistance, 12 days @ $10......................	120.00
Office assistance:typing,coloring maps etc...........	57.00
Mailing reports to Mr.Ryan and Mr. Scott.............	1.48
	$287.53

Time spent at mine, 14 days; in office, 17 days.

Vouchers accompany more important items. Two transactions are not included: check for $100 sent by A.P.Scott for reppening No.8 tunnel;this was deposited in my account and an equivalant check, herewith submitted,given J.F.Knapp. Second, check for $80 sent me by Scott for wages,surveyor's helper. I deppsited this also in may account, but since the sum of $7.75 was expended by Knapp in his attempt to reopen No.8,over and above the previous $100 given him, I settled accounts with Knapp with a check for $87.75, which accounts for the item of $7.75 on above expense account. Cancelled check for $87.75 has not yet been received from the bank.

Edward Wisser

EDWARD WISSER
MINING GEOLOGIST
533 CALL BUILDING
SAN FRANCISCO
TELEPHONE GARFIELD 4676

May 2nd, 1942

Mr. Allan A. Ryan, Jr.,
1 East 57th Street,
New York, New York.

Dear Sir:

Pursuant to your request, transmitted to me by Mr. A.P. Scott, Chatsworth, California, I have examined the Aetna Quicksilver Mine in Napa County, California, and submit herewith a report covering the results of that examination.

Yours very truly,

Edward Wisser

Edward Wisser

SUMMARY STATEMENT.

The Aetna quicksilver mine, Napa County, California, lies at the southeast end of the highly productive Mayacmas quicksilver belt. The Aetna, discovered in 1854, has produced about 70,000 flasks of quicksilver, which at present prices would have yielded the respectable amount of $13,000,000 gross.

A great serpentine sill lies above sandstone and shale. The country has been faulted in recent geologic times and dikes of basalt have come up along the faults. The principal ore bodies so far found made along two of the major faults, both of which are accompanied by basalt dikes.

The major production took place when quicksilver brought low prices and reduction methods were crude compared to those of today. It is thought likely that considerable ore remains exposed in the mine, not commercial at the time it was found, but capable of yielding a profit at present prices. Further, extensions of known ore bodies should yield ore, and chances exist for finding virgin ore bodies, both close to old mine workings and elsewhere.

Immediate development of the Aetna mine is recommended, provided some $75,000 to$100,000 is set aside for the job. There is a furnace plant and other equipment on the property, and this materially reduces the capital investment required; but owing to the scattered distribution of the areas to be developed, many of them deep in the mountain, the Aetna is not a poor man's mine.

A broad plan for exploration is developed in this report, details to be worked out when the mine workings are again made accessible.

CONTENTS.

ILLUSTRATIONS

REPORT ON THE AETNA QUICKSILVER MINE

NAPA COUNTY, CALIF.

INTRODUCTION.

The following report is based on a stay of 14 days at the property, March 29th to April 12th, 1942. Additional information was kindly furnished the writer by Mr. Francis Frederick, mining geologist, and Mr. G.N. Schuette, mining engineer, both of San Francisco, as well as by several miners who had worked, during past years, in portions of the property now inaccessible. Some data were secured from published and unpublished reports on the Aetna mine. Before and during his stay on the property, the writer had the aid of Mr. George I. Barnett, of Berkeley, California, who resurveyed all accessible mine workings and set a number of surface points which facilitated the geologic mapping.

The object of the work was to decide whether the Aetna, an old and productive mine, was worth reopening; and if so, to select the cheapest and most feasible method of exploration for new ore bodies. Since the Aetna mine appears to offer decided chances for ore, the following report is chiefly concerned with a broad scheme of exploration. The two weeks spent at the mine were sufficient only to block out the main features bearing on possible ore, and few detailed recommendations may be given now. If operations are started, inspection of workings made accessible will guide the detailed exploration.

LOCATION. TOPOGRAPHY. HOLDINGS.

The Aetna quicksilver mine lies in the extreme northwestern portion of Napa County. It is reached via Napa and St. Helena (on State Highway 29) and Pope Valley, a small town 10 miles north of

St. Helena, with which it is connected by a fair mountain road. The mine lies some 6 miles northwest of Pope Valley and adjoins Aetna Springs, a summer resort. Pope Valley is connected to the mine by unsurfaced county road, in fair condition. The total distance by highway from San Francisco is about 90 miles.

The topography is not rough but the relief is considerable: about 1100' difference of elevation between the lowest point on the property, in Aetna Creek, and the highest, on the Silver Bow Ridge (see Photo 6, at end of report, where Aetna Creek lies just to the left of the left foreground and Silver Bow Ridge forms the right background). Brush is heavy and hinders prospecting. There is considerable timber, largely pine, in the higher country in the southwest portion of the property. A spring in this area supplies water, apparently in ample quantities throughout the year, for domestic purposes, furnace plant, etc.

The property consists of 5 patented mining claims: Silver Bow, Phoenix, Red Hill, Pope and Washington. (See Geologic Plan of Surface). These are almost exclusively located in Sections 2 and 3, T 9 N, R 6 W, M. D. B. & M. In addition, 160 acres are owned, apparently patented agricultural land, in Section 11, same Range and Township. This parcel lies south of the Washington Claim, and consists of the following blocks in Section 11: NE 1/4 of NW 1/4; NW 1/4 of NE 1/4; S 1/2 of NW 1/4.

The property is known as Aetna Quicksilver Mines Consolidated; there are 25,000 shares, of which Mrs. Charles A. Gray controls 12,504, Mrs. D. S. Llewellyn, 12,496.

HISTORY. PRODUCTION.

The Aetna mine is said to have been discovered in 1854[1].

1. Walter W. Bradley: Quicksilver Resources of California. California State Mining Bureau Bulletin 78, 1918, 77.

It passed through a number of ownerships, but from 1868 to 1899 maintained a remarkably steady production, usually in excess of 1000 flasks per year; peak production took place between 1893 and 1899, when the average output per year exceeded 3500 flasks. Only 5700 flasks are recorded between 1900 and 1929. A few hundred flasks, probably, have been produced since 1929. The total recorded production 1864-1929, is 63,860 flasks[2], and since production

2. C.N.Schuette: Quicksilver. U.S. Bureau of Mines Bulletin 335, 1931, Table 12, 141-142.

figures are combined with those of the Oathill mine from 1881 to 1883, the total production of the Aetna mine is probably not less than 70,000 flasks.

For our present purpose, it would be of interest to know to what extent each working place contributed to this aggregate production. Unfortunately, the history of the Aetna mine is known in but a fragmentary way. According to Becker[3] the Phoenix vein (see

3. George F. Becker: Geology of the Quicksilver Deposits of the Pacific Slope. U.S. Geological Survey, Monographs XIII, 1888, 371-374.

Geologic Plan of Surface) had been the main producer up to about 1887. The original Phoenix ore body outcropped (site of present Phoenix glory hole) and was followed down from the sufface 150';

it yielded 17,000 flasks of quicksilver which at present prices would be worth three and one quarter million dollars gross. This ore body gave out in depth but at the time of Beckers visit exploration below it was yielding further ore.

In Becker's time the Star or Starr deposit (see Geologic Plan of Surface) had yielded 5,000 flasks. The workings had reached a depth of 400' from the surface and were still in ore. At this period the Silver Bow (see plan referred to) was apparently still in the development stage for Becker gives no production figures for this vein. Later the Silver Bow was to prove the most important producer of the mine.

Exploitation of the Silver Bow ore body must have taken place mainly between the time of Becker's visit (about 1887) and 1901, when the No. 9 Tunnel (see Composite Plan of Underground Working) was allowed to cave. The period 1893 to 1899 was the most productive in the history of the mine (see above) and the bulk of this production seems to have come from the Silver Bow ore body. In 1903, the date of Forstner's, the Aetna mine was idle and had been for several years. Becker barely mentions the Washington area but Forstner mentions a good body of ore taken from the Washington shaft, presumably in the 'nineties.

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4. Wm. Forstner: The Quicksilver Resources of California. State Mining Bureau Bulletin 27, 1903.

There is here a gap in the record. According to Bradley (op. cit.) in 1910-1912 lessees made a small production cleaning up around old furnaces and retorting sorted ore. Between 1913-1915 Bror Soderhjelm, a lessee, attempted concentration of material from the mine and some of the old dumps, the concentrates being retorted. In 1915 D.S.Llewllyn acquired the Aetna. From 1915 to 1917 the concentrating operation was taken over by A.A. Gibson and associates. Other lessees appear to have been associated in a way not clear. During 1917 the 60 ton Scott furnace was rehabilitated and concentration discontinued. Furnacing probably continued through 1918. During this war period at least some of the production was coming from No.7 and No.8 levels on the Phoenix vein according to miners who worked there at the time.

In March, 1918, the present company, The Aetna Quicksilver Mines Consolidated, was formed by Charles A. Gray and David Llewellyn. After 1918 production was negligible until 1926 when operations, presumably a lease, resumed and continued until November, 1927. Another lessee operated the mine from September, 1929 until April 1930. About 1934 Bumstead worked the Star vein finding some new ore in the upper horizons. Shortly before 1938 a lease was obtained by Joe Garcia to run for eight years. In 1938 this lease was assigned to J.F.Knapp and, I understand, it has just been terminated. Knapp worked the Phoenix glory hole, greatly enlarging it, and attempted to concentrate this material. Other than this no serious mining has been done since Bumstead's time.

The history of the Aetna mine is thus long and complicated. No large scale scheme of exploration has been carried through since last century. During the days of such major exploration the mine was a steady and important producer; and even the subsequent smaller scale operations are said to have been for the most part profitable. The later operations were evidently conducted with insufficient capital to explore the Aetna on the scale which the nature of its occurrence requires.

GENERAL GEOLOGY

The principle rocks of the area are sediments of Franciscan (upper Jurassic) age. These consist predominently of sandstone with subordinate shale and chert horizons. These beds are complexly but not very sharply folded into short and rather wide anticlines, the axes of which trend northwest. Lying just above these beds and sharing for the most part in their folding is an enormous sill-like mass of serpentine (probably lower Cretaceous in age). Forstner (op. cit.) on his map of the Mayacmas Quicksilver District, shows the Aetna serpentine to be the southeast end of a great band of serpentine extending far beyond the Great Western Mine nine miles northwest of the Aetna. In the southeastern and southwestern portions of Aetna ground are patches and larger areas of rhyolitic flows,probably Pleistocene in age,and which appear to represent the northeastern margin of a large volcanic field. In and west of the Silver Bow claim (see plan of surface) is a large dike of basalt or diabase which cuts across the serpentine sill in a north-south direction. The Silver Bow vein formed along the eastern contact of this dike. Smaller dikes of basalt intruded along some of the principle fractures of the area, notably the Phoenix and Star vein-zones. The age relations of the rhyolitic flows on the one hand and the basalt dikes on the other have not been worked out, but judging by other similar districts the dikes are probably younger than the flows and represent, together with hot springs (Aetna Springs just south of the mine) the final manifestation of igneous activity in the district. Quicksilver mineralization seems closely linked in time, as will be shown below with this basalt-hot spring phase.

Face p.7

STRUCTURAL MAP
Scale: 1" = 1000'

LEGEND

Structural contours (datum sea-level) on base of serpentine sill: 1200'
Direction of plunge of contoured surface:
Structural trends in sediments:

Fractures are projectected to No. 7 Tun. elev. (1200')

STRUCTURE. MINERALIZATION. QUICKSILVER ORE.

The complex folding of the sediments referred to above took place long before quicksilver mineralization and has no direct connection with the latter. Long after this folding, probably in Pleistocene or recent times a simpler type of deformation took place, and this deformation was very closely connected with the formation of quicksilver ore bodies. This second deformation consisted of simple uplift. The sedimentary beds, the serpentine sill and probably the rhyolitic flows are uplifted to form a dome or short anticline. The apex of the dome lies north of Aetna ground so that the south flank of the dome only is exposed at the Aetna mine. Disregarding minor foldings, the general dip of the beds and of the serpentine sill is toward the southwest, south and southeast in Aetna ground, as shown on the accompanying Structural Map.

The effect of doming is to stretch the rocks domed and to fissure them in stretching. The Silver Bow, Phoenix and Morey veins are believed to represent fissures formed during the doming. As the fissures were opening dikes of basalt came up along them, the most notable being the Silver Bow dike. Faulting also took place along these fissures. The earlier movement was probably in the direction of dip, while the latest movements, as recorded by striations were nearly horizontal.

Mineralization appears to have taken place in two stages. The first stage was marked by the formation of "vein-rock" In the serpentine the vein-rock consists mainly of "silica-carbonate rock", a fine grained, intimate mixture of opal, chalcedony, calcite dolomite, iron oxide and remnants of altered serpentine. While silica-carbonate rock is developed to some extent everywhere along the base of the serpentine sill, and therefore may have formed at any time after intrusion of the sill, its main development is along the Phoenix vein zone which cuts the serpentine sill, and along parallel zones also within the serpentine. The time of origin of these zones of silica-carbonate rock is therefore thought to correspond more or less closely with that of the doming and fissuring described.

The second and the commercially important stage of mineralization consisted in the deposition of cinnabar. The Silver Bow, Phoenix, Star, Morey and other fissures (see Plan of Surface and Underground Working) formed the channels up which the quicksilver solutions rose. The time of entry of these solutions is believed to have been very shortly after intrusion of the basalt dikes. The surface at that time probably differed little from the surface of today. As pointed out to the writer by C.N. Schuette, the basalt dikes, during the period of quicksilver mineralization, had probably cooled near the surface but were still hot at depth. The mineralizing solutions, rising along the trunk channels, carried quicksilver and sulphur with them so long as they were hot; when they cooled they dropped their load and deposited cinnabar in places that provided suitable openings for deposition. Where a basalt dike bordered a trunk channel, as with the Silver Bow and in portions of the Phoenix vein the cinnabar was apt to deposit, near the surface, within the dike itself, because the dike being cold was brittle and tended to shatter under the influence of fault movements that seem to have accompanied the mineralization. The shattering formed openings in which the cinnabar could deposit and the cold dike served to cool the solutions.

Cinnabar occurs along fracture faces in basalt in the upper Silver Bow workings and in the Phoenix workings, which latter are all relatively close to the surface. At greater depth, the thick Silver Bow dike was probably still hot when the quicksilver solutions rose along the Silver Bow fissure, for as Schuette points out, the Silver Bow ore at depth seems to have avoided the dike and made in the sandstone hanging wall at distances from the fissure that increase with increasing depth.

The association of basalt dikes with productive fissures at the Aetna mine is striking, so much so that miners there have used the presence of basalt as an indication of ore near by. The Silver Bow vein borders on the ~~the~~ major basalt dike of the region. The narrow and apparently unconnected basalt dikes along the Phoenix vein outcrop appear to unite to form a wider, continuous dike at depth. One or more basalt dikes intruded in places within the Star vein-zone and appear to have localized some of the ore. Fissures intruded by basalt dikes must have cut deep into the crust since the source of the basalt lay deep; use of the same fissures, almost exclusively, by quicksilver solutions suggests a deep origin of the cinnabar and a source close to that of the basalt.

The openings in which the quicksilver solutions that rose along the trunk channel dropped their load were formed mainly by shattering of brittle rock. Such rock could be basalt where sufficiently cool, i.e. near the surface; or silica-carbonate rock derived from serpentine; or sandstone beds. In general silica-carbonate rock was a more favorable host-rock for ore than sandstone because it was more brittle and shattered better. Thus, the Washington vein at and near the surface (see Geologic Plan of Surface) lies in serpentine (the rhyolite in that area is a mere skin). According to Forstner (op. cit.) the Washington vein carried good ore in the serpentine, but was barren in the underlying sandstone. Again the known productive segment of the Phoenix vein lies in serpentine largely altered to silica-carbonate rock (see Composite Plan of Underground Workings). The Phoenix vein where cut by the No. 9 tunnel lies in shale and sandstone and is barren there because these softer rocks failed to shatter; instead they were squeezed into thick and impervious gouge. Other fissures in sandstone and shale at the Aetna mine are usually unproductive for the same reason.

Under favorable circumstances, however, good ore may occur in the sediments. The Silver Bow ore at the level of No. 9 tunnel appears to lie wholly in the sediments some distance east of the Silver Bow fault, the trunk channel up which the quicksilver solutions rose. The sediments here consist of fairly brittle sandstone beds between intensely squeezed layers of shale, and both shale and sandstone have been deformed, probably by movement on the Silver Bow fault. While the soft shale deformed by squeezing, the brittle sandstone deformed by cracking and the small fissures so formed were filled with cinnabar in sufficient quantity to make the productive Silver Bow lower ore body.

With some veins in sandstone, acute-angle intersections appear to have localized small ore bodies because such places especially favor shattering. The Star vein-zone as exposed in No. 9 tunnel consists of a set of complicated branches, one branch joining the next at an acute-angle (see Composite Plan of Underground Workings). A number of small ore bodies were stoped from the No. 9 tunnel level, and practically without exception they were found at acute-angle vein junctions. The complicated Star fracture system seems closely connected in origin with the local dome shown on the structural map facing page 7. The process of doming appears to have furnished the deformation that shattered the rock at the acute-angle intersections of the fissures.

Areas of intense hydrothermal alteration may have favored ore, both in basalt and sandstone. Both these rocks become to a certain extent porous under such alteration. Ore seen along the outcrop of the Silver Bow vein north of Aetna ground appears to be a dissemination of cinnabar grains in the pore spaces of bleached and altered basalt. Sandstone seen in the Silver Bow workings near the face of No. 9 tunnel is highly altered and the cinnabar is to a certain extent impregnated through it as minute grains. Such highly altered areas are confined to the vicinity of major fissures.

To summarize, the major ore bodies of the Aetna mine occurred in or near the principal fractures of the area and in rock that contained openings for deposition. Those openings were formed mainly by shattering and cracking of rock along the channel-fractures. Only strong faulting could shatter tough and homogeneous rock like basalt and silica-carbonate rock. The Silver Bow and Phoenix veins, where such rocks were shattered, are along the two major faults of the area. Less intense movements could crack sandstone beds, especially where they are not too thick and lie between layers of soft shale, but sandstone so cracked seldom carries ore except in the vicinity of a major fissure. However, acute local doming, more allied to folding than to faulting, seems responsible for the formation of the complex Star fracture zone, for no major fault is known in this area.

Exceptionally even squeezed shale may carry small lenses of ore. In the Pope workings intensely deformed shale next to a fairly strong fault carried several small ore bodies.

Most of the ore mined during the period of major production was undoubtedly high grade. A Scott furnace was used during these years and probably none of the ore furnaced carried less than 10 lbs. quicksilver per ton. The area from which the seventeen thousand flasks were obtained in early operations from the Phoenix vein (page 4) is so small that this ore body must have been very rich. The richness of the Silver Bow ore bodies is common report and the small but rather closely-spaced ore lenses in the Star area are said to have yielded 15 flasks a day at times, when their ore was passed through the rotary furnace, whose capacity probably varied between 50 and 75 tons of ore per day.

The ore carries but sparse sulphides, mainly pyrite and marcasite, so that little difficulty in excess sulphur may be anticipated in furnace operation. Ore found in silica-carbonate rock or fresh basalt may be expected to yield little dust in the plant, but ore in soft, altered sandstone or basalt might dust considerably in treatment.

The principles of ore localization brought out in the above discussion are used in planning the exploratory work described below.

DESCRIPTION OF MINE WORKINGS, KNOWN ORE BODIES AND PROSPECTS.

Refer to Geologic Plan of Surface and Composite Plan of Underground Workings.

Owing to the gentle southeast slope of the Silver Bow ridge (Photo 6, which views this slope nearly at right angles) excessively long cross-cut adits were needed to tap the Silver Bow ore bodies at depth. No.7 was started to exploit the Phoenix vein, and followed that vein for 2,000', at which point it was turned northwest and driven straight to the Silver Bow vein which it followed for about 1,000' northeast. The distance from the portal of No. 7 to where that tunnel cuts the Silver Bow vein is 3,300! This tunnel is now caved at a point 900' in from the portal; in 1930 it was open to the point where it left the Phoenix vein, 2,000' in from the portal. It has been inaccessible beyond that point for many years.

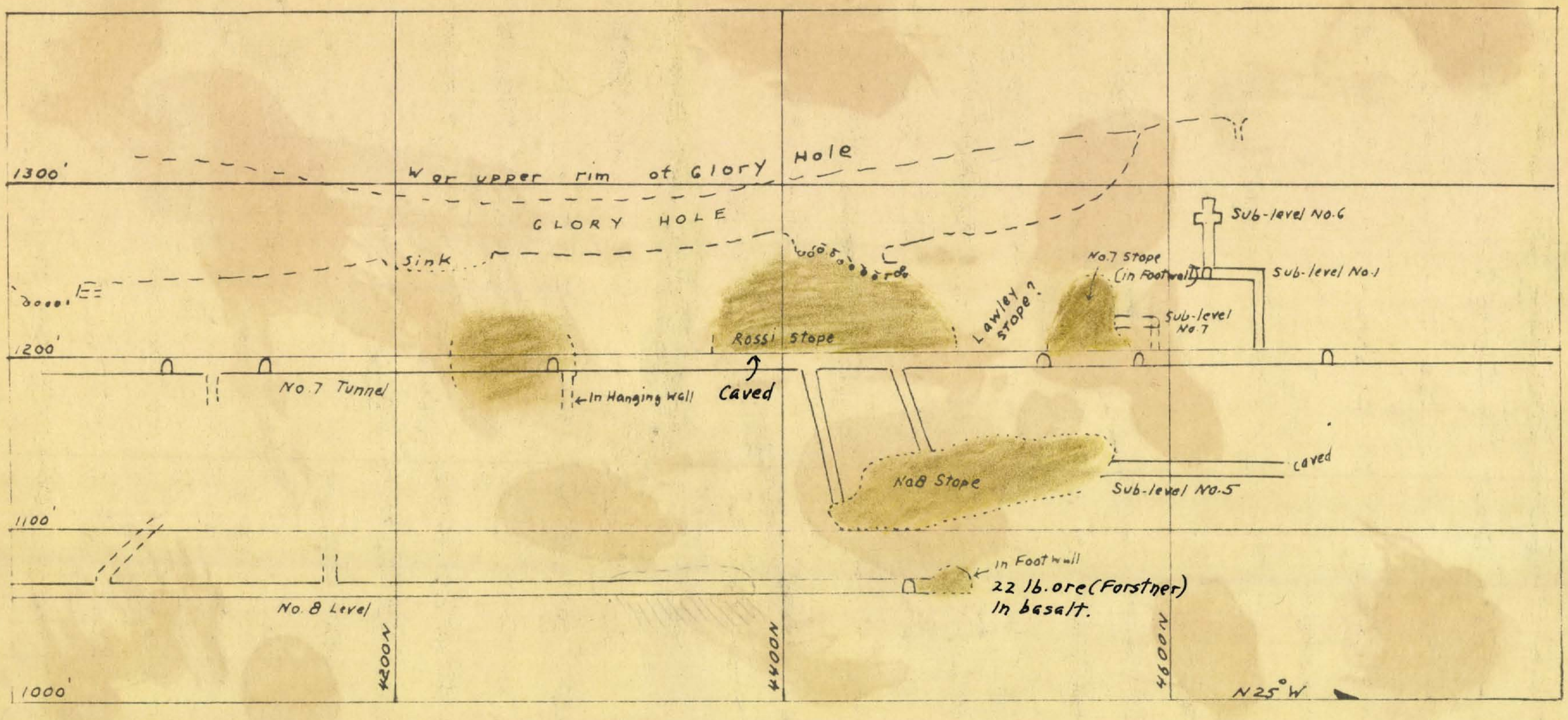
The No. 9 tunnel was started to explore the Star veins at depth, cutting this zone about 1,000' in from the portal; later No. 9 tunnel was extended northwest as a drift along the Morey vein; finally it was extended nearly 2,000' still further northwest to cut the downward extension of the Silver Bow ore bodies developed from No. 7 level 200' above No. 9. No. 9 tunnel is open to the old workings on the Silver Bow vein, which however, are mostly caved.

No.2 tunnel, a 500' cross-cut adit near the south end of the explored segment of the Silver Bow vein, is open to the vein, but both north and south drifts on the vein are caved close to the cross-cut. The north drift was formerly connected with the lower workings on the Silver Bow vein, all of which are now inaccessible. Nearly all of the upper tunnels on that vein (Knapp tunnel etc.) are caved at or near their portals. Most of these could probably be cheaply reopened.

The only surface shaft of importance on the property is the Washington shaft, probably several hundred feet deep. This is now caved at the collar. Thereare several interior shafts, the deepest of which is probably that on the Star vein, No.9 level. This is at present filled with water.

Phoenix Vein.- The Phoenix vein yielded what was probably the first ore body discovered on the property (page 3). The Phoenix fault is composite, a fault zone rather than a single fault plane. The eastern most component of the zone is the Toothache vein. On No.7 level, the Toothache vein is a narrow slip in serpentine only partly altered to silica-carbonate rock. Ore occurred as narrow lenses strung along the slip. Much of the cinnabar is found as "paint." This stuff pans much better than it furnaces.

The main Phoenix fault, as exposed in No.7 tunnel, the only underground working accessible to the writer, is much stronger. Here, too, however, the development of silica-carbonate rock from the serpentine that forms the vein walls is somewhat spotty, far more so than above in the glory hole, which is nearly all silica-carbonate rock. Ore definitely favors areas of silica-carbonate rock. Where the latter is little developed and the rock is mainly soft serpentine, the cinnabar is found in narrow seams, along and parallel to the main slip. Where the walls are silica-carbonate rock, on the contrary, as in the vicinity of the Rossi Stope on



PHOENIX VEIN-ZONE
VERTICAL LONGITUDINAL PROJECTION
Scale: 1" = 100'

Face p. 15

the main Phoenix vein, ore bodies are wider, for the silica-carbonate rock was shattered into fragments throughout a fairly broad zone by movements along the Phoenix fault. Cinnabar coats the fragments and fills seams within fragments; or if shattering did not proceed to the stage of fragmentation, an irregular stockwork was produced.

The Vertical Longitudinal Projection facing this page is quite incomplete;more stopes exist than are shown and doubtless more raises and sublevels. The suggestion, however, is that of moderate sized closely-spaced ore bodies, and a giving out of ore with depth. The latter suggestion may be fallacious. First, the glory hole was not a great body of ore as the projection suggests; a large portion of the present cut was mined by Knapp and the material concentrated. It was too low grade to yield a profit. The much smaller extent of the original surface mining is shown on the Composite Plan of Underground Workings.

Secondly, the ore bodies are separated, one from another, in depth as well as laterally. The No.8 tunnel, most of which seems to have failed to find ore, may have been driven in an early barren horizon. This seems all the more probable because the vein-rock within the Phoenix fracture zone shows a flat dipping structure, and the ore bodies, as judged by the outline of the No.8 stope, tend to be elongated horizontally. With ore bodies elongated vertically almost any level within the vertical limits of ore should hit an ore body; but where the ore bodies lie flat within the vein-zone, a given level may miss one. According to Forstner (private report, 1930) No.8 tunnel, near its face, shows ore averaging about 22 lbs. quicksilver per ton. This showing may be the top of an ore body similar in shape to No.8 ore body; apparently it has never neen explored below No.8 level. There is, therefore, little or no proof that ore along the Phoenix vein-zone is giving out with depth.

The plan of the Phoenix workings (see Composite Plan of Underground Workings) is probably as incomplete as the projection. But cross-cuts are notably scarce in the accessible portion of No.7 tunnel and from the maps appear equally so elsewhere. No.7 ore body occurred some distance in the footwall of the main Phoenix fracture, and there may be others, as yet undiscovered, along the broad Phoenix fracture zone, in the footwall or hanging wall of the fracture drifted on.

The mined section of the Phoenix vein-zone, therefore, may yet yield virgin ore shoots, undiscovered through lack of raising and sinking on the fracture drifted on, or through lack of cross-cutting to explore parallel fractures. In addition, considerable ore may remain that was blocked out by the old-timers but was left by them through inability to treat it at a profit in the Scott furnace then in use. Thus, Forstner, in the report cited suggests that considerable furnace ore remains in and around the Lawley stope, the position of which is roughly indicated on the projection. He mentions also old stopes mined from the long northwest drift on No. 7 level near the point where it turns to the left to reach the Silver Bow vein (see Composite Plan of Underground Workings). Forstner says the ore mined here was high grade; it apparently never was mined below No.7 level, for No.8 level stops far south of this locality.

The projection shows the shallowness of all the Phoenix workings. The Phoenix is one of the major fissures of the region and carries a basalt dike which appears to widen with depth. The Phoenix fracture zone probably passes out of serpentine and enters sandstone at a depth of 100-200 feet below No.8 level. The sandstone might be less favorable for ore, but the basalt dike, probably already cool at this relatively shallow depth during the quicksilver mineralization, might have fractured well and served as a host-rock for ore bodies. Further, while the amount of silica-carbonate rock in the Phoenix mine decreases from the surface down, it may increase again with further depth because the lower contact of the serpentine sill shows a strong development of silica-carbonate rock in most places where this lower contact is exposed. The contact of hard vein rock with the soft sandstone below it should be a locus of intense shattering along the Phoenix fault. For these reasons, exploration of the Phoenix fracture zone below the known ore shoots looks attractive.

<u>The Silver Bow Vein.</u>- The main features of this vein have been described. No stope maps are available, but most of the area north of No.2 tunnel is thought to have been stoped. In the upper levels, as stated above, the ore was mainly within the steep-dipping Silver Bow dike; but at depth the ore made out into the sediments in the hanging wall of the dike. This peculiarity is described by Bradley (op. cit.) page 78) as follows: "It was in the Silver Bow ground tapped by these two tunnels (Nos.7 and 9-E.W.) that the largest and most important ore body of the group was found.........Above the No.7 the vein was not over 3 or 4 feet wide, and with a steep dip". (Evidently along the Silver Bow fissure at the dike contact-

E.W.) "At that depth it flattened out, and widened to 20' between walls, extending to the No.9-- a veritable bonanza".
The present northwest end of No.9 tunnel shows the structure of this ore body. Sandstone beds between layers of shale have been distorted, and dip rather flatly northeast along a zone parallel to the Silver Bow fault. This attitude is contrary to the regional structure of the sediments (see Structural Map facing page 7) and is probably due to drag caused by normal faulting on the Silver Bow fault. The beds show intense movements relative to one another, the soft shale having been squeezed and injected into fractures in the brittle sandstone. Cinnabar occurs as seams filling fractures in the sandstone and as disseminations in that rock, which has been made porous by intense hydrothermal alteration.

A start only has been made in reopening the old Silver Bow workings on the No.9 level. Apparently they were not very extensive and it seems probably that the downward extension of the Silver Bow bonanza was never thoroughly explored on this level. The writer dug several pieces of good ore from the floor of the reopened Silver Bow drift. This looks in place but even if it is old stope fill its presence suggests that there might be considerable ore left here and in the stopes above.

There may be ore outside the explored area also. The north drift on the Silver Bow, No.9 level, probably stopped 400' or 500' short of the north end line of the Silver Bow claim (depending on which survey of the end line is correct). The gap seems worth exploring. No drifting whatever seems to have been done on the Silver Bow vein to the south on the No.9 level. More ore may be found here. Report has it that a winze was put down from No.9

level on the Silver Bow ore to an incline depth of 165' and that the ore maintained its width in this winze to a depth of 120', where it pinched. It is claimed that only a little side-swiping was done on this ore in the winze together with limited underhand stoping of the ore exposed on the No.9 level. Certainly the suggestion is one of very limited testing of the Silver Bow bonanza on and below the No.9 tunnel.

According to Forstner (report cited) some ore remains in that portion of the Silver Bow vein worked by tunnels driven along the outcrop. He says that ore was stoped above the lower Silver Bow tunnel (see Composite Plan of Underground Workings) beginning at a point about 300' in from the portal, and that 13 lb. ore remains in the stope. There seem to have been a number of small ore bodies along the Silver Bow vein close to its outcrop and while the slope is steep to the east here and not very well adapted for shovel operations there do seem to be possibilities for surface mining here.

Washington Vein.- The Washington vein-zone was mapped on the surface (see Geologic Plan of Surface). It strikes northwest and seems in a broad sense to be a member of the Phoenix vein-zone, marking the northeast boundary of that zone. Its northwest continuation appears to be the vein drifted on and stoped near the portal of No. 7 1/2 tunnel. If so, the dip of the Washington vein must turn over in this northwest segment because on the surface near the Washington shaft the dip is southwest, while in the 7 1/2 tunnel the vein dips northeast. No maps are available of the workings from the Washington shaft. Forstner (op.cit.) shows a section of the shaft, without scale. The section shows the shaft in serpentine for about half the depth shown with the lower half of the shaft in sandstone. Serpentine, sandstone and shale are found on the dump, which is of considerable size. Forstner mentions a good body of ore found in the serpentine and says the sandstone was barren. An old furnace formerly existed in the valley southwest of the shaft. The dumps have been repeatedly sorted; piles still remaining of the sorted ore show coarsely crystalline cinnabar in altered serpentine. Report has it that the Washington ore came close to the surface near the shaft. Since the Washington was one of the first mines on the property to be abandoned,and since the gentle topography there discouraged reopening by tunnels so that the Washington has never been reopened, there seems a hope that considerable ore commercially valuable today may have been left. The topography lends itself to the surface operations so that stripping of the vein outcrop seems an attractive prospect.

The Star Vein-Zone.- The Star and Morey veins are respectively northeast and northwest branches of an irregular northsouth vein (see Composite Plan of Underground Workings). The Star produced most of the ore of this system from some horizon below the No.9 tunnel up to the surface. The ore occurred in small but rich lenses not very closely spaced so that considerable dead work was needed to find the next lens after the one being worked was exhausted. At present there seems little incentive for further exploration of the Star vein.

The Morey vein carried one or two small ore bodies just above the No.9 level and does not look attractive there. The drift on the Morey vein on the No.9 level is heading under Red Hill so that the ground rises rapidly above No.9 level. Hence the No.9 drift may be too deep for ore. As shown on the Geologic Plan of Surface the Morey should enter serpentine at a point somewhere near the headwaters of Star Creek. It might be of interest to prospect the outcrop of the Morey vein near where it passes from sandstone to serpentine and if the outcrop there looks favorable to run a tunnel northwest into Red Hill along the vein where the wall rocks would be serpentine vein rock.

Pope Mine.- The Pope tunnel (see Composite Plan of Underground Workings) starts in sandstone but soon enters extremely distorted soft black shale; a vertical northwest fault crosses the shale here and small lenses of ore within the shale and along the fault were mined above and below the tunnel level. These small ore shoots probably represent mineralized sandstone lenses in the shale. The tunnel is caved beneath these stopes, but Forstner in the report cited says that an incline was put down starting 80' in from the portal, at an inclination of 30° and 50' deep and that the incline was sunk along a ledge of sandstone 3' to 4' wide carrying good ore; the dump sample taken by Forstner ran better than 20 lbs. While the Pope may merit later investigation, the smallness of the ore shoots so far found leaves it out of the picture for our present purposes.

Undeveloped Prospects.- While the Aetna mine workings are extensive, the longest tunnels, No.7 and No.9 owe most of their length to the single objective of reaching the Silver Bow ore body. The Silver Bow ore body, probably because of its association with the great Silver Bow dike had a remarkable vertical range. Other fractures exposed in the two deep cross-cut tunnels may well carry ore between those tunnels and the surface. Still other fractures lie to one side of these tunnels and no attempt has been made to explore them on the tunnel levels. Insufficient time was available during this examination for "prospecting"; but a few of the more obvious undeveloped areas of promise are briefly described.

The Surface Geologic Map shows an area of basalt on the western slope of Red Hill at about coordinates 4000E and 6000N. A shaft lies near this outcrop. Forstner, in his report of 1930, speaks of what is probably this shaft as the Red Hill prospect and says that it is 30' deep and shows 12' of ore. A dump sample taken by him ran 10 lbs. The basalt may be a dike intruded along a northwest fracture which quite possibly is the Morey vein. In any case, the presence of basalt combined with that of quicksilver makes this quite a promising prospect. The base of the serpentine lies probably not over 100' beneath the surface here, while the No.9 tunnel lies over 400' below the surface. Since the base of the serpentine may mark the lower limit of any ore found it is plain that a shaft from the surface or a shallow tunnel is indicated when exploring this prospect, rather than the No.9 tunnel.

At least three strong northwest zones of vein rock exist in the Phoenix claim and the southwest portion of the Red Hill claim, west of the Phoenix vein. No cinnabar was observed in these zones but the westernmost one may represent the southern extension of the Silver Bow vein. All three zones lie in serpentine and at least the eastern two do not persist north into the sandstone in the area of the No.2 tunnel. They should therefore, be explored at about the base of the serpentine, since if they do not make strongly in sandstone on their strike, they will probably pinch on entering sandstone on their dip.

Similar zones of vein rock outcrop in the serpentine east of the Phoenix vein. These zones would lie between the No.7 and No.9 tunnels at depth and have never been explored on those levels.

Forstner, in the report cited, mentions a vein exposed in a shallow cut on the ridge between Star Creek and Pope Creek. This locality, as near as I can tie it down, is shown on the Geologic Map of Surface, at coordinates 5200E and 5200N. According to Forstner a cut here shows a vein dipping southwest and carrying 8' of 9 lb. ore. Forstner says that the northeast slope of the ridge pans cinnabar down to Pope Creek. The writer panned a little cinnabar in Pope Creek in the area mentioned.

On the same ridge but about 1500' east of Forstner's prospect is a serpentine sill, which may be part of the main sill (coordinates 6400E and 4800N Geologic Map of Surface). A zone of vein rock trending northwest cuts through this serpentine and lines up roughly with the northwest fault that localized the ore in the Pope workings. The vein rock on the ridge shows traces of cinnabar. There may be an important northwest fissure here, and the basic igneous rock, probably basalt, which lies southwest of the vein rock zone may have come up along this fissure.

There are quite probably other areas of promise on Aetna ground.

CONCLUSIONS

The Aetna mines produced over 70,000 flasks of quicksilver during its long productive life. It lies at the southeast end of the great Mayacmas quicksilver belt, which extends 22 miles northwest and includes such important producers as the Oat Hill (135,000 flasks to 1930) and the Great Western (102,000 flasks to 1930).

The striking point about the Aetna is the wide spread distribution of the ore bodies and the variety of structures that may carry ore. Thus the Silver Bow fissure carried ore in and along the basalt dike it borders, and also far out in the sandstone east of that dike. The Phoenix vein system, including the Washington vein, produced ore in serpentine; the Star, ore in sandstone, in part along a basalt dike; the Pope, ore in shale along a fault. Such a wealth of ore-producing structures, and such an extensive area within which ore is found, must mean that during the period of quicksilver mineralization conditions were favorable for ore formation in the Aetna area, and quicksilver solutions abundant. From the commercial standpoint, it means that chances are good for finding new ore bodies, since so many types of structure in such widely separated places, are capable of bearing ore.

Of course, by very reason of the fact that any ore bodies found may be expected to be widely separated and in many cases far from daylight, exploration of the Aetna mine with a view to restoring it to its former position as a major producer, will cost money. On the other hand, I find it hopeless under present conditions to attempt to estimate how many dollars of profit might reward the enterprise if the exploration proposed below is successful. Extremely high taxes may be balanced to an unknown degree by government subsidies for war metals. For the purpose of this report I can only assume that new ore found will be worth the finding, as it would have been in 1941. With that assumption clearly understood, I recommend the Aetna mine for immediate development, as offering better than average chances for sizable new ore bodies.

RECOMMENDATIONS FOR EXPLORATION.

The reduction plant (see appendix and photos 6 and 7) is in fair condition, and may be put in operation within a short time and at moderate expense. Any plan for resumption of operation at the Aetna mine should have as its primary objective the production of quicksilver at the earliest possible moment, so that the necessarily expensive exploration projects involved may be paid for out of operating profits, not subject to taxation when put back into the ground. For this reason the first and most urgent exploration projects deal with localities thought to offer the best chances for quick production.

1. Reopen No.8 tunnel (caved about 250' from the portal) in order to examine the ore said to be exposed near the face and unmined below No.8, and other possibilities. If information at hand proves correct, further work in No.8 may involve sinking below that level, cross-cutting, etc., and possibly extension of No.8 drift northwest under the stopes above No.7 drift at about 5600N coordinate (see Composite Plan of Underground Workings)

2. Trench by bulldozer and the Washington vein outcrop near the Washington shaft, in the hope of finding readily accessible surface ore.

Projects (1) and (2) are the best bets for quick ore. They may fail, and for that reason other projects needing more time for testing should be under way while (1) and (2) are being carried out.

3. It is impossible at present to explore the Silver Bow vein at the end of No.9 tunnel because of poor ventilation. The cross-section of the tunnel, withits great length, precludes

the use of artificial ventilation. A churn-drill hole, of the greatest practicable size, 10" if possible, should be drilled from the surface, about at the point shown on the Geologic Map of Surface. An attempt should be made to drill this hole directly into the roof of No.9 tunnel, about 500' below the collar of the hole. If the hole fails to enter the tunnel at the depth indicated it should be drilled below the elevation of the tunnel floor; a short cross-cut should pick it up. Once the hole is connected the scheme of ventilation, which will involve use of a small fan, will depend on the natural direction of air currents.

Exploration of the Silver Bow vein from the No.9 tunnel will consist (1) in continuing the reopening of the north drift and the eventual driving of this drift north to the property line. The cross-cut west toward the footwall started by Knapp should probably be continued to the basalt dike. Some drifting south along the hanging wall ore zone will probably be done, as well as an attempt made to raise and connect with the old stopes to see if ore remains there. Whether sinking is done below No.9 will depend upon the amount of ore developed on that level. If enough ore is found a surface shaft will be indicated, which might be driven by raising up along the drill hole.

4. It will probably be desirable to reopen the No.7 tunnel on the Phoenix vein; this should improve ventilation on No.8 level. Eventually No.7 will probably be reopened at least to the old stopes mentioned by Forstner near the turn at 5600N coordinate, and possibly to the Silver Bow vein itself if this looks feasible.

From the turn in No.7 drift at 5600N the Phoenix vein is unexplored for 1100' north to where it is exposed as a barren fault in No. 9 tunnel. The Phoenix vein has a basalt dike along it in the old Phoenix mine, and this dike may persist for some distance into this unexplored segment. Following the Phoenix vein north from the turn at 5600N coordinate may therefore be worthwhile.

The above four recommendations form the heart of the exploration program, and should probably all be started at once. As the operation develops more speculative prospects should be tested as opportunity permits. The remaining recommendations fall in this latter class.

5. The Phoenix fault, north of where the No.7 level drift leaves it at coordinate 5600N has never been prospected except in No.9 tunnel where it appears as a barren fault separating shale from sandstone. Exploration of this segment of the Phoenix vein should be done near the base of the serpentine, which in the area where the fault is cut by No.9 tunnel lies practically at the surface. The logical place to explore the virgin segment of the Phoenix vein would seem to be the deep canyon flowing east just south of No.2 tunnel. The cut shown on the surface map about 500' south of this stream shows cinnabar along the Phoenix vein. As shown on the surface map drive north and south along the Phoenix vein near the bottom of the canyon mentioned

6. As stated on page 21 the Morey vein should enter serpentine on the surface near the headwaters of Star Creek. This outcrop should be trenched and studied, and if the appearance of the vein and the topography prove favorable an adit drift should be

driven on the Morey vein at about the elevation of the base of the serpentine, and northwest into Red Hill.

7. The northwest vein on Red Hill at coordinates 4000E and 6000N has been mentioned on page22. Further study, including trenching should be given this area and if conditions look favorable the vein should be explored, probably by a small incline shaft.

8. The northwest vein of zone-rock at coordinates 6400E, 4800N should be prospected by trenching, probably with a bulldozer, in order to determine whether this is an important structural feature, in which case it would warrant underground exploration.

Doubtless other attractive prospects will appear after more detailed study of the Aetna ground.

PROBABLE COST OF THE VENTURE.

Under present conditions it is utterly impossible to figure the cost of operations. Some items of equipment and supplies cannot be bought new at any price and their cost second hand is entirely a matter of chance. Experienced mine labor is scarce and getting scarcer. About all that can be done is to attempt a reasonable guess at the sum of money that should be made available for developing the Aetna mine.

The furnace plant operated not long ago and could be put back in shape for perhaps $2,000. There are rails in the No.9 tunnel to the face and at least several hundred feet of rails in other tunnels. There are six usable ore cars on the property and five that might be used after repairs (see Appendix I). In addition there are at the Golden Gate mine, and presumably available for use at the Aetna, a compressor, 2 blowers, blacksmith tools, 3 ore cars, a Gardner-Denver drifter, 1000' of ventilating pipe, 2 mine pumps, etc. (see Appendix II). With the furnace plant and so much machinery available, the capital investment to reopen the mine is materially reduced. The chief items that will be needed will be a bulldozer, several trucks and probably a power shovel. Since it may turn out that no ore bodies minable exist, it would be desirable to rent, rather than purchase, the bulldozer and shovel. There is said to be such equipment for rent in some of the nearby towns. The following extremely rough summary of the possible cost of doing the major items of exploration recommended omits therefore, equipment expense except for rehabilitation of the furnace plant. At some time during the exploration campaign operating profits should be able to bear part or all of the cost of exploration. When this time shall come cannot be predicted; this makes the items in the following estimate more uncertain than ever. These estimates simply represent the writers guess as to how much money might need to be expended out of capital before the mine begins to pay for its own exploration.

Estimated Cost to Put Aetna Mine in Production.

Roads	$3000
New bunkhouse and other improvements to camp	6000
Rehabilitating plant	2000
Reopening No.8 tunnel, with some cross-cutting.. raising, etc., possible a winze	10000
Reopening No.7, possibly to turn, with cross-cuts, etc	11000
Churn drill hole to No.9 tunnel level	3000
Exploration of Silver Bow Vein on No.9 level, with raises	12000
Surface exploration, Washington Vein	3000
Total	$50000

Guessing at$10,000 for additional equipment and for supplies brings the amount for which the Aetna mine might be placed in production on a sound basis to$60,000. At least $15,000 additional should be made available if needed, for contingencies, chief of which is the erratic nature of quicksilver mines.

The writer believes that the mine can be put into production for the $75,000 indicated above, but recommends, from past experience, that a total of $100,000 be made available. With luck, perhaps half of this need never be called on; but it is good to have it there.

San Francisco, California

Edward Wisser

May 2nd, 1942.

APPENDIX I.

Equipment on Hand at Aetna Mine.

Furnace Plant.

Upper bunker 20'x20', capacity 150 tons. From here ore feeds through a 15"x 24" Cedar Rapids Jaw crusher, with 25 H.P. motor, to 18" conveyor belt, 5 H.P. motor, and is conveyed by belt to two 12'x 12' storage bins, capacity about 120 tons each. From these to a steel pipe feeder, and into the 4'x 60' Gould rotary furnace. Bins,crusher, belt, feeder and dust chamber were installed new in 1928; furnace is older but was rehabilitated in 1938. Dust ring and upper trunions are defective. Kiln had lower half of lining replaced in 1938; bricks were put in edgewise, choking down cross-section so that capacity is impaired. Kiln turned by 5 H.P. motor.

The cast iron condensors are in fair shape but need a few patches. The fan, which is placed between the kiln and condensors, has a 3 H.P. motor. There are 3 redwood tanks, about 8'x 14', beyond the condensors. These are in fair condition, as are the tile flues. The compressor is a 6"x6" Sullivan stationary with a 7 1/2 H.P. motor. The oil pump is operated with the compressor. All machinery is independent motor-driven, with V belts and pulleys.

There is a D-type retort next to the mill, under a separate roof, built in 1939. It is in poor shape.

Power is from the Pacific Gas and Electric Co. power line, which crosses the Aetna property en route to the Oat Hill mine. I believe it carries 2200 volts. Power used at the plant is at 440 volts.

There is a storage room, shop and assay room at the plant. Most of plant building was built in 1938 and is in good shape.

There are three fuel oil tanks of corrugated galvanized metal, total capacity 10,000 gallons.

Compressor. There is a 9"x 8" Ingersoll-Rand compressor for mining, driven by a Waukesha 5 x 6 1/4 gas motor and mounted on steel wheels. This has been recently overhauled.

Mine Equipment. There are 6 one-ton mine cars, needing only minor repairs, and 5 more car bodies and trucks which need more extensive repairs and reassembly.

There is track for 1800' in No.8 tunnel, and for 3880' in No.9 tunnel. Track is laid for probably about 1700' in No.7 tunnel.

Ford Truck. Model A, with hoist and steel dump bed. Capacity not stated. Motor noisy but still runs.

APPENDIX II.

List of the equipment at the Golden Gate Mine, not including numerous small items:

1	set Blacksmith tools, including anvil, portable blower forge, hammers, tongs, etc.
1	Blower, ventilating, 9" buffalo type.
1	Boiler, heavy water, 24" x 72".
1	Bucket, ore, with steel skids, 36" dia., 48" high.
1	" " " Lugs , 36" " , 30" " .
1	Compressor, Gardner-Denver, Serial No.86277, Type WBH. V, belt-driven from 75 H.P. motor, 440V., 60 Cy., 3 PH. with Receiver 30" x 72" and pipe fittings, and Compensating electric starter.
450	ft. Tyrex electric cable, No.1/0, 3 conductor, 259 strand, with reel.
900	sq. ft. used corrugated iron roofing.
3	Mine ore cars, 18 cu. ft.
1	Machine drill, Gardner-Denver, No.AF89 Drifter (3 1/2" piston) Chuck for 1 1/4 round lugged steel.
1	3 1/2" x 6' Drill column with arm and 2 clamps.
1	3 1/2 " x 4' Drill Column.
6	sets 1" quarter octagon drill steel, straight shank, Timken threads.
36	pieces 1 1/4 round drill steel, Lugged shanks, Timken threads, lengths 18" to 78".
850	resharpened Timkin bits, sizes 15/8" to 2".
1	Oak desk.
No.2	Gelamite blasting powder.
1300	No. 6 Blasting caps.
2	1" air hose, 50' long.
2	1" Oiler- Air hoses, 10' long.
3	1/2" Water hoses, 50' long.
2	One pint line oilers.
1000'	Galv. Iron Ventilating Pipe, 10" diam., 10' lengths, 24. ga.
16	Miscellaneous 10" galv. iron vent pipe fittings.
175'	8" flexible vent tubing.
040'	4" spiral welded, asphalt dipped, 16 ga. pipe, with Dresser couplings.
75	ft. 3" black pipe.
1600	ft. std. black 2" pipe.
1250	" " " 1" "
400	" " " 3/4" "
1	1/3 H.P. centrif. pump, 1" discharge.
1	1 1/2 MRV 20, Ingersoll-Rand Centrifugal pump (Motorpump) with entrance switch and magnetic starter. Pump capacity approx. 130-150 G.P.M., at 350-250 Ft. head.

1 2 MRV 30, Ingersoll-Rand Centrifugal Pump, (Motorpump) with entrance switch and magnetic starter. Pump capacity, 175-325 G.P.M., at 400-200 fr. head.

1 4" suction hose, 15' long, with 5" foot valve and fittings to connect to pump.

1 4" pump discharge hose, 20 ft. long, with fittings to connect to pump.

1 5" suction hose, 10' long.

5 1/2 tons 12No.T rail (1375' of track)

1200' 3/4 plow steel hoisting rope.

1 1/2 ton Ford V8 60 H.P. Pickup truck.

Electric switches (Not including Pump switches)

1	400A,	3 pole,	440V	Entrance	switch	with	fuses.
3	200A	"	"	"	"	"	"
2	30A	"	"	"	"	"	"
2	30A	2 pole,	110V,	"	"	"	"

1 G. E. No. CR7006-D31-B Magnetic switch 75 H.P.

Tools -- Miscel. carpenter and shop. Small quantity.
" " mine, wrenches, etc. " "

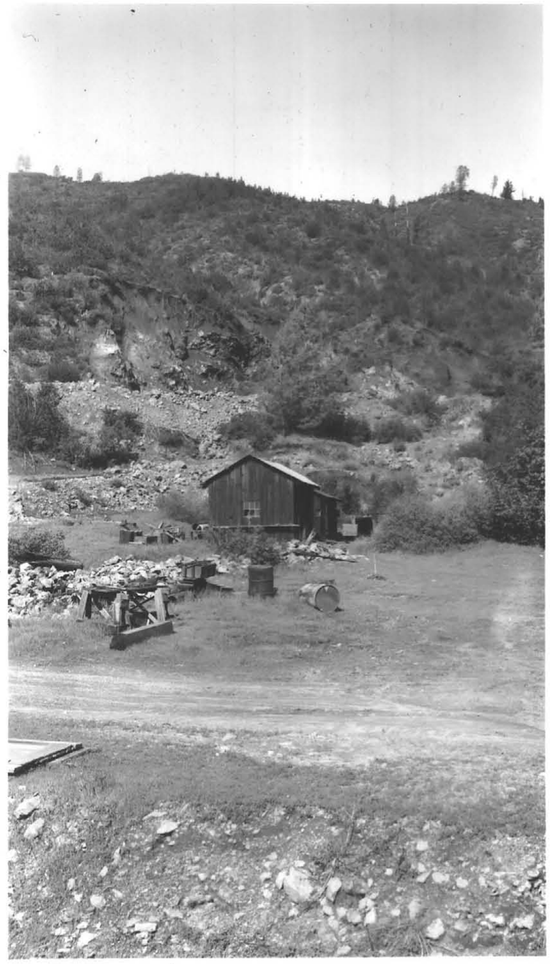


Photo 1: Portal of No. 7 Tunnel, Phoenix vein. Phoenix glory hole in background.

Photo 2: Outcrop of Phoenix vein, road to No. 2 Tunnel.

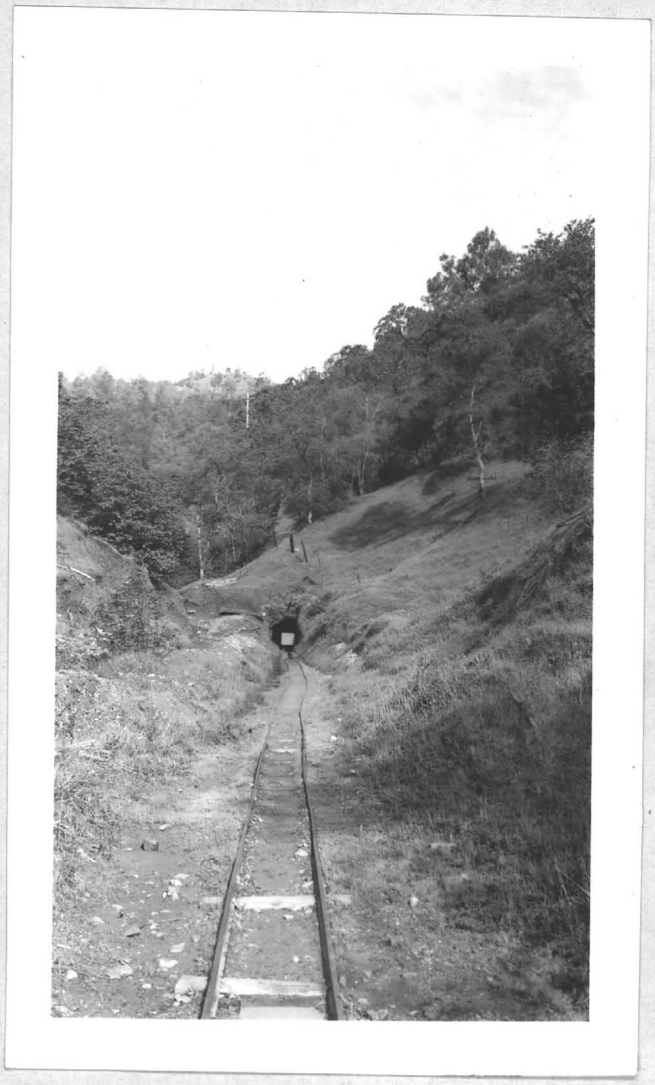


Photo 3: Portal, No. 9 Tunnel

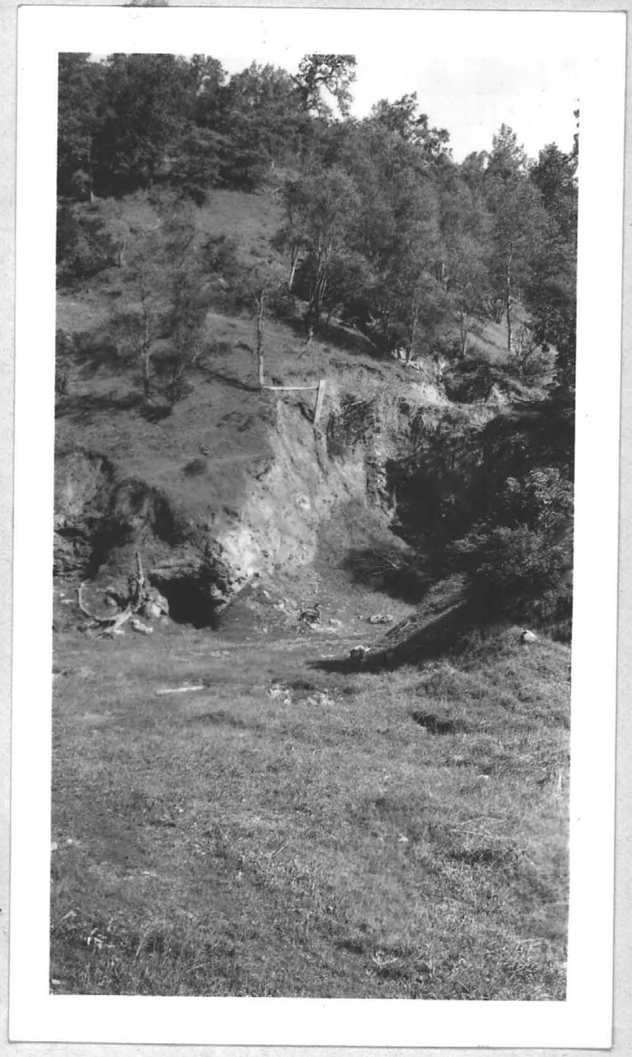


Photo 4: Star Workings

Photo 5: Silver Bow shallow workings

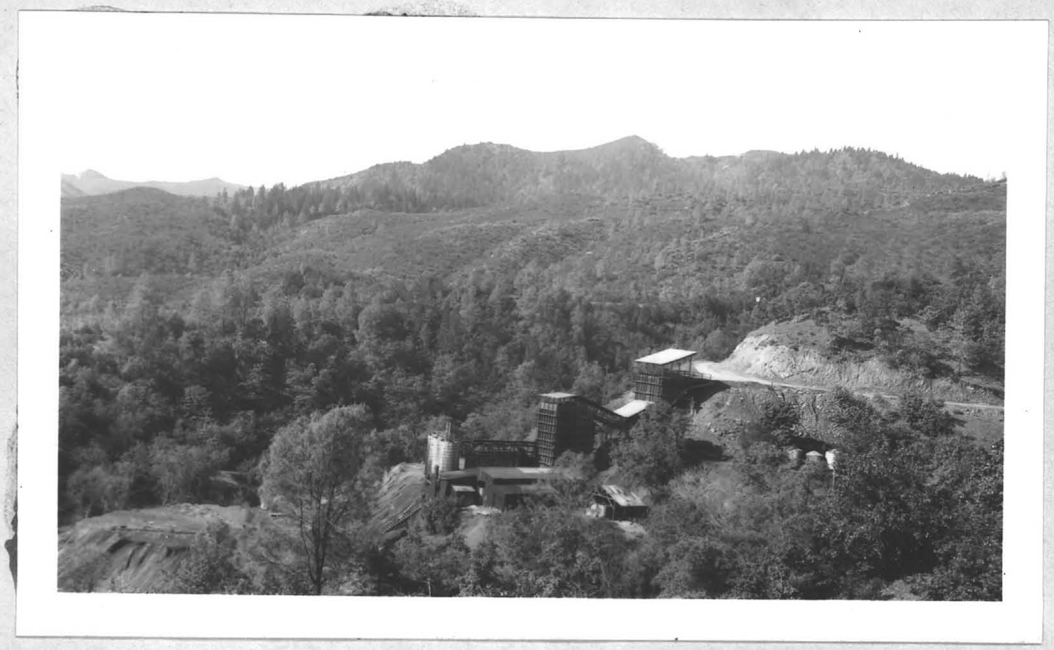


Photo 6: Plant, viewed from the northeast.

Photo 7: Plant, viewed from the south. Star workings in background, above redwood tanks.