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NAME AND ADDRESS OF AGENCY *(Include street address, building, room no. and ZIP Code)*

Thor Kiilsgaard
U.S. Geological Survey - Western Minerals Branch
656 U.S. Courthouse
Spokane, WA 99201

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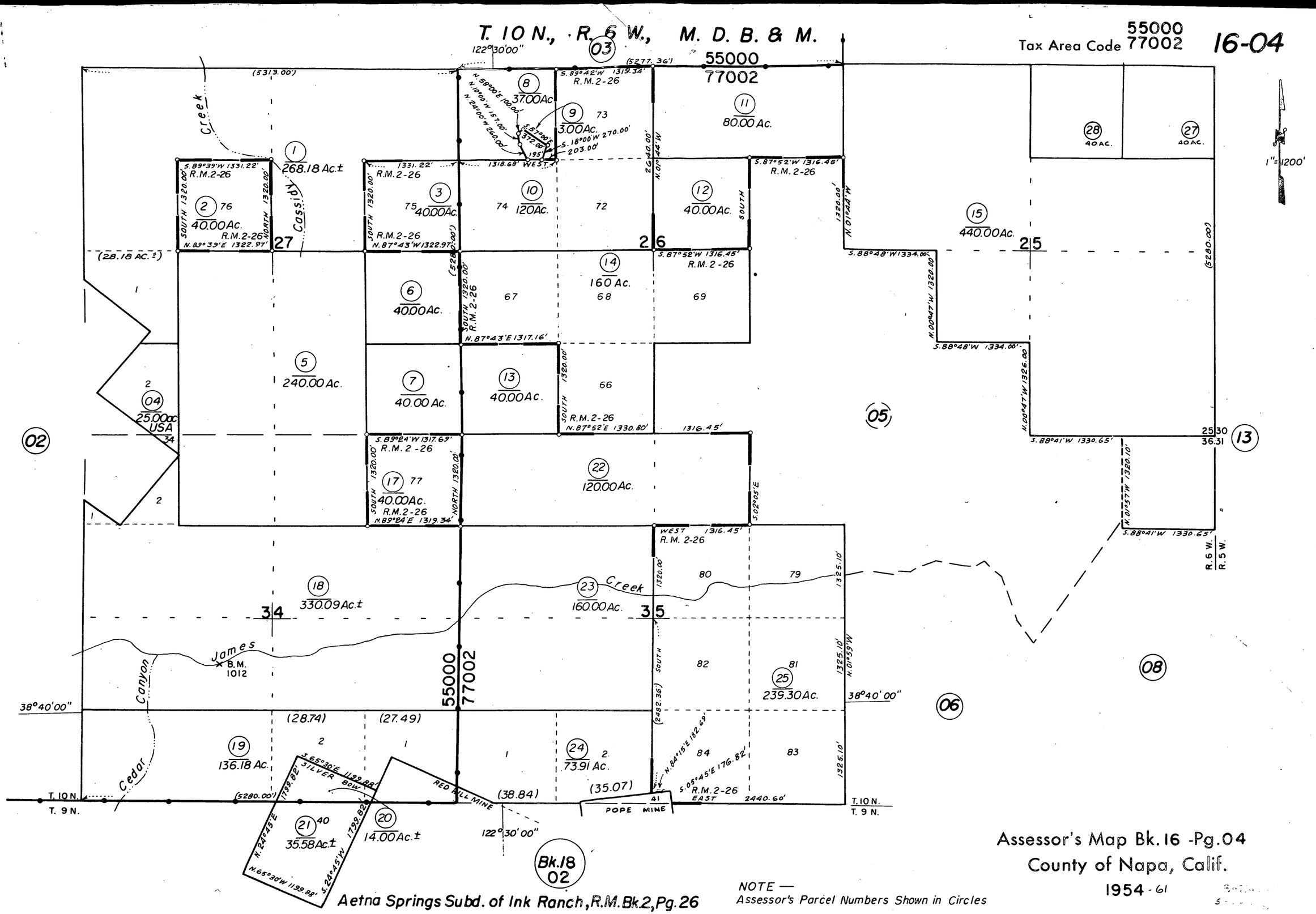
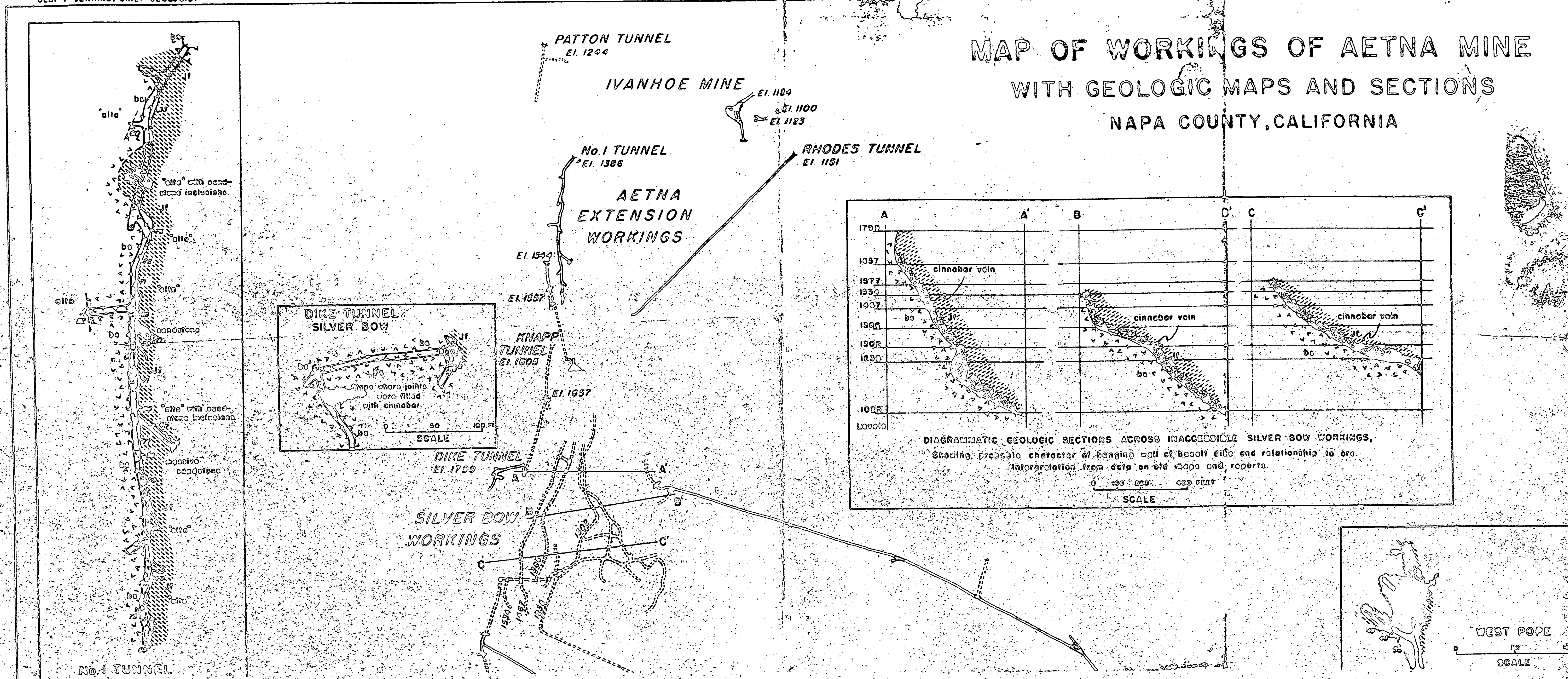

T. 10 N., R. 6 W., M. D. B. & M.
Tax Area Code 55000 77002
16-04
1" = 1200'
55000
77002
(5313.00')
(5277.36')
122°30'00"
38°40'00"
Cass Creek
James Creek
Cedar Canyon
B.M. 1012
1 268.18 Ac.±
2 76 40.00 Ac. R.M.2-26
3 75 40.00 Ac. R.M.2-26
4 25.00 ac USA
5 240.00 Ac.
6 40.00 Ac.
7 40.00 Ac.
8 37.00 Ac.
9 3.00 Ac.
10 120 Ac.
11 80.00 Ac.
12 40.00 Ac.
13 40.00 Ac.
14 160 Ac.
15 440.00 Ac.
17 77 40.00 Ac. R.M.2-26
18 330.09 Ac.±
19 136.18 Ac.
20 14.00 Ac.±
21 40 35.58 Ac.±
22 120.00 Ac.
23 160.00 Ac.
24 73.91 Ac.
25 239.30 Ac.
27 40 AC.
28 40 AC.
S.89°39'W 1331.22' R.M.2-26
N.89°39'E 1322.97'
S.89°42'W 1319.34' R.M.2-26
S.87°52'W 1316.46' R.M.2-26
S.87°52'W 1316.45' R.M.2-26
N.87°43'W 1322.97'
N.87°43'E 1317.16'
N.87°52'E 1330.80'
S.89°24'W 1317.69' R.M.2-26
N.89°24'E 1319.34'
S.88°48'W 1334.00'
S.88°41'W 1330.65'
N.00°47'W 1326.00'
N.01°57'W 1320.10'
N.01°24'W 1320.00'
N.00°47'W 1320.00'
S.02°05'E
N.01°59'W
S.65°30'E 1199.88' SILVER BOW
N.65°30'W 1199.88'
N.24°45'E 1799.82'
S.24°45'W 1799.82'
RED HILL MINE
POPE MINE
S.05°45'E 176.82' R.M.2-26 EAST
N.84°15'E 182.69'
2440.60'
R.6 W.
R.5 W.
T. 10 N.
T. 9 N.
Bk.18 02
Aetna Springs Subd. of Ink Ranch, R.M. Bk.2, Pg.26
NOTE — Assessor's Parcel Numbers Shown in Circles
Assessor's Map Bk. 16 - Pg. 04
County of Napa, Calif.
1954 - 61

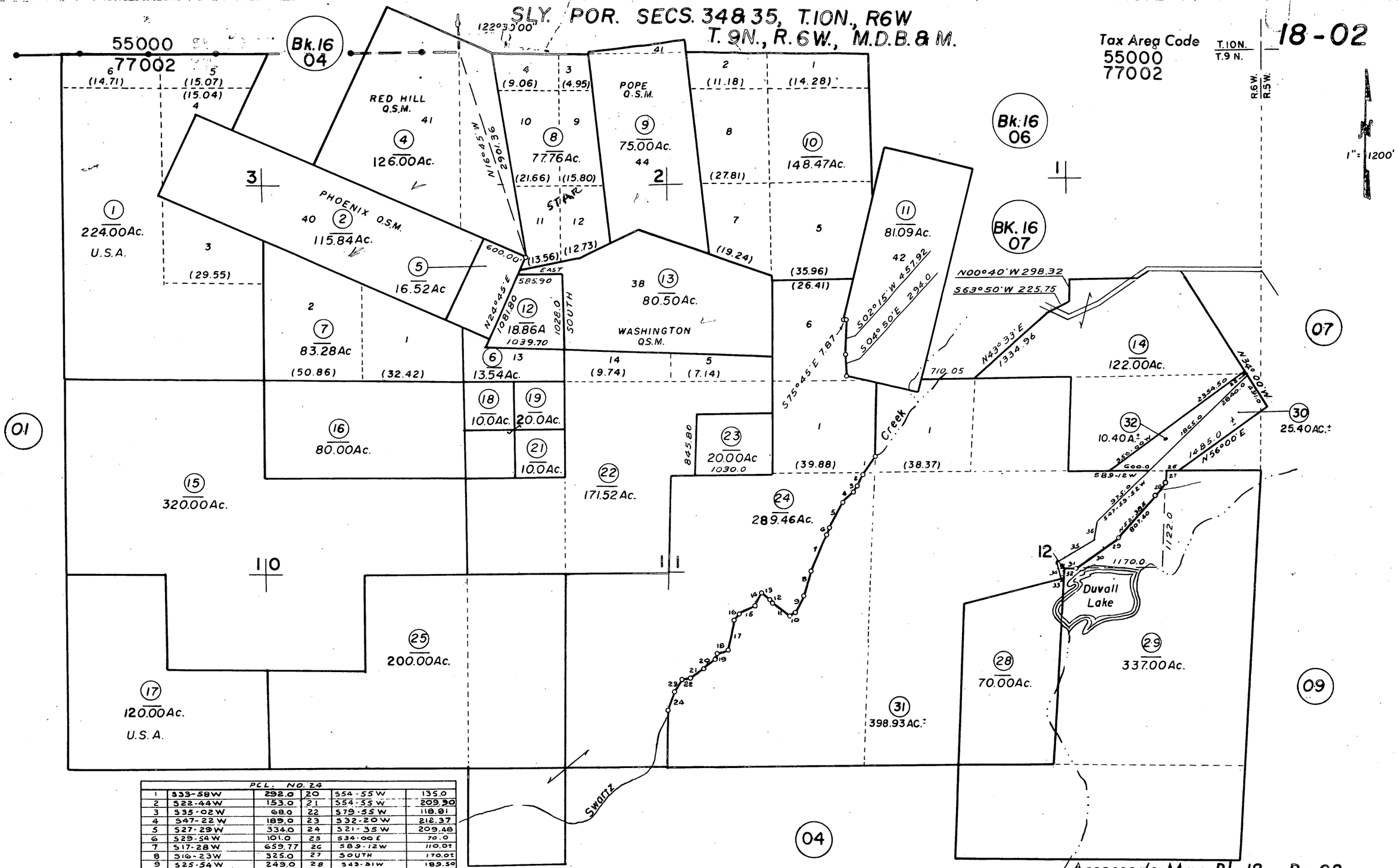
DIVISION OF MINES
WALTER W. BRADLEY, STATE MINERALOGIST
OLAF P. JENKINS, CHIEF GEOLOGIST

STATE OF CALIFORNIA
DEPARTMENT OF NATURAL RESOURCES

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

PLATE





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2	S22-44W	153.0	21	S54-55W	209.90
3	S35-02W	68.0	22	S79-55W	118.81
4	S47-22W	189.0	23	S32-20W	212.37
5	S27-29W	334.0	24	S21-35W	209.48
6	S29-54W	101.0	25	S34-00E	70.0
7	S17-28W	659.77	26	S89-12W	110.02
8	S16-23W	325.0	27	SOUTH	170.02
9	S25-54W	249.0	28	S43-51W	189.50
10	S69-54W	63.10	29	S35-46W	247.77
11	N54-33W	293.38	30	S36-34W	387.60
12	N60-00W	60.85	31	WEST	180.0
13	N49-49W	121.0	32	SOUTH	258.0
14	S33-05W	180.83	33	S84-30W	48.02
15	S61-50W	238.17	34	N10-53-04W	281.74
16	S44-20W	113.75	35	N45-09-42E	S32.42
17	S13-25W	410.95	36	N11-48-22E	267.71
18	S69-10W	151.43			
19	S16-00W	90.90			

NOTE—Assessor's Block Numbers Shown in Ellipses.
Assessor's Parcel Numbers Shown in Circles.

Assessor's Map Bk. 18, —Pg. 02
County of Napa, Calif.
1956-62

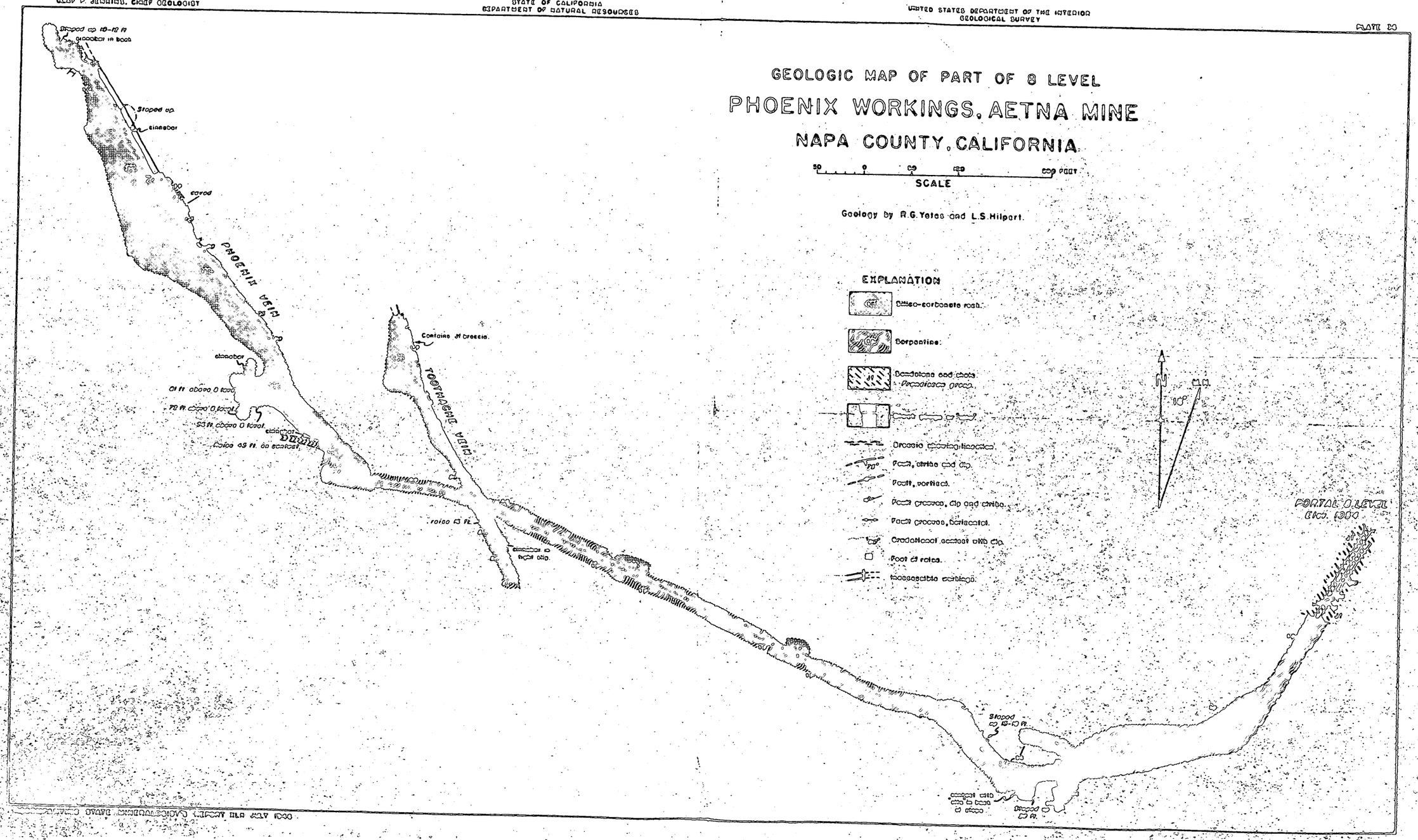
DIVISION OF MINES
WALTER W. MACALLEY, STATE MINERALOGIST
CLAY P. BEDFORD, CHIEF GEOLOGIST

STATE OF CALIFORNIA
DEPARTMENT OF NATURAL RESOURCES

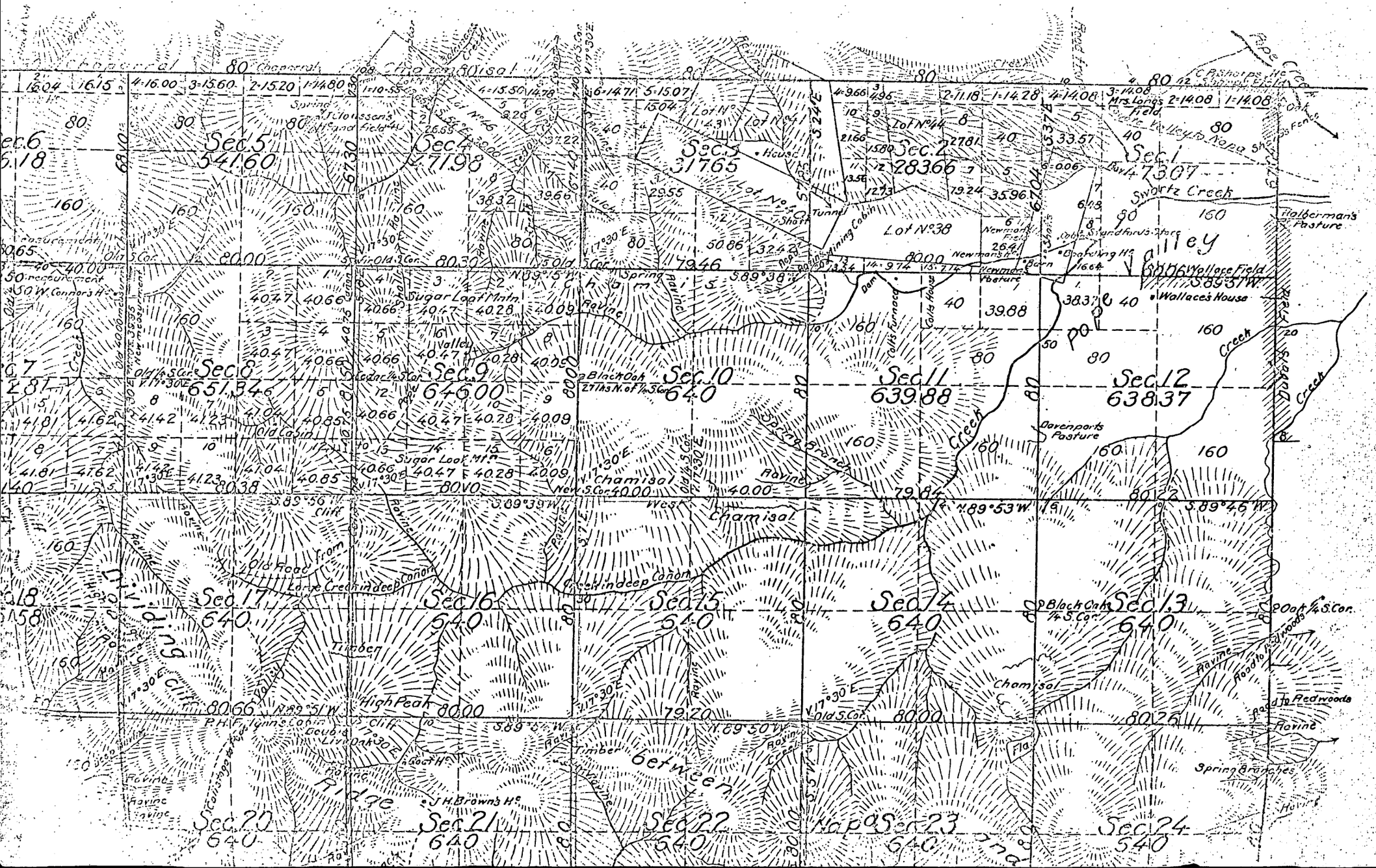
UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

PLATE 20

GEOLOGIC MAP OF PART OF 8 LEVEL
PHOENIX WORKINGS, AETNA MINE
NAPA COUNTY, CALIFORNIA



ship No. 9 North, Range No. 6 West, Mount Diablo Meridian.



Mining c

Lot No. 38 Washington
" " 40 Phoenix
" " 41 Red Hill
" " 42 Valley
" " 43 Silver Bo
" " 44 Pope
" " 45 Azogue
" " 46 Eclipse
" " 47 Old Disco
" " 48 B. Grigsby
" " 49 Ida Eos

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 about sandstone and shale. The country has been faulted in recent geologic times and dikes of basalt have come up along the faults. The principal orebodies 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.

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. C. 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

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Photographs	At end of Report
Geologic Plan of Surface	In pocket
Composite Plan of Underground Workings	" "

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 Box 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 amble 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 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.

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

For our present purpose, it would be of interest to know to what extent each working place contributed to this aggregate production. Unfortunately, the histroy of the Aetna mine is known in but a fragmentary war. 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 surface 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 where 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 Bulletin,[4] the Aetna mine was idle and

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

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.

There is here a gap in the record. According to Bradley (op. cit.) in 1910-1912 lessees made a small prpduction 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. Llewellyn acquired the Aetna. From 1915 to 1917 the concentrating operations 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 chart 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.

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 domes 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 solution.

Cinnabar occurs along fracture faces in basalt inthe 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 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-car-

bonate 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 ndeded 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. There are 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

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 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 been 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 on 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.

The Silver Bow Vein.-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 topes 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.

Washing 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 5800N coordinate (see Composition 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, with its 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 of 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 of 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 out-crop 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 page 22. 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 now 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 of 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	$ 3,000
New bubkhouse and other improvements to camp	6,000
Rehabilitating plant	2,000
Reopening No. 8 tunnel, with some cross-cutting, raising, etc., possible a winze	10,000
Reopening No. 7, possibly to turn, with cross-outs, etc.	11,000
Churn drill hole to No. 9 tunnel level	3,000
Exploration of Silver Bow Vein on No. 9 level with raises	12,000
Surface exploration, Washington Vein	3,000
Total	$50,000

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
May 2nd, 1942.

Edward Wisser

9. Water Supply:

The water supoly is now ample for all purposes. If necessary, some of the water from the lower tunnel can be pumped to a service tank during the dry season.

Spring water is piped down for camp purposes.

The water originates on the property with no external rights.

COMPARED

Other copy

xxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

Harry B. Lawley, et al, :
to :
Aetna Quicksilver Mines Consolidated(a corporation) :

xxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

This Indenture made on the 11th day of March, in the year of our Lord, One thousand nine hundred and eighteen, between Harry B. Lawley and Hattie A.Lawley (his wife), Charles A. Lawley and Rosemary Lawley(his wife), all of the county of Napa, State of California, the parties of the first part, and "Aetna Quicksilver Mines, Consolidated", (a corporation), the party of the second part,

Witnesseth: that the said parties of the first part, for and in consideration of the sum of ten ($10.00) dollars, in gold coin of the United States of America, to them in hand paid by the said party of the second part, at or before the ensealing and delivery of these presents, the receipt whereof is hereby acknowledged, have granted, bargained, sold and conveyed and by these presents do grant, bargain, sell and convey unto the said party of the second part, and unto its successors and assigns forever, all those certain lots, pieces or parcels of land situate, lying and being in the county of Napa, State of California, bounded and particularly described as follows, to-wit:

Phoenix Mining Claim, part of sections 2 and 3, in township 9 north, range 6 west, M.D.M.; Washington Mining Claim, part of section 2, in said township and range; The northwest quarter (¼) of the northeast quarter (¼), and the northeast quarter (¼) of the northwest quarter (¼), and the south half (½) of the northwest quarter (¼), of section eleven (11), in said township and range; Red Hill Mining Claim, part of sections 2 and 3, in said township and range, and sections 34 and 35, in township 10 north, range 6 west, M.D.M.; Silver Bow Mining Claim, being lots 40 and 43, in townships 9 and 10 north, range 6 west, M.D.M.; Pope Mining Claims, being lots 41 and 44, embracing a portion of townships 9 and 10, north, range 6 west,M.D.M.

Lots 3,4,9,10, 11, and 12, in section 2, township 9 north, range 6 west, M.D.M.; the west half (½) of the southeast quarter (¼) of section 13, and the west half (½) of the northeast quarter (¼) of section 24, in township 9 north, range 6 west, M.D.M.; lots 13,14, and 15, in section 2, township 9 north, range 6 west, M.D.M.

Together with all and singular the tenements, hereditaments, and appurtenances, thereunto belonging or in anywise appertaining, and the reversion and reversions, remainder and remainders, rents, issues and profits thereof.

To have and to hold all and singular, the above mentioned and described premises, together with the appurtenances, unto the said party of the second part, its successors and assigns forever.

In Witness Whereof, the said parties of the first part have hereunto set their hands and seals, the day and year first hereinabove written.

Harry B. Lawley, (seal)
Hattie A. Lawley, (seal)
Charles A. Lawley, (seal)
Rosemary Lawley, (seal)

State of California)
county of Napa.) ss.

On this 11th day of March, 1918, before me, D.L. Beard, a Notary Public in and for the county of Napa, State of California, personally appeared, Harry B. Lawley and Hattie A. Lawley, his wife, and Charles A. Lawley and Rosemary Lawley, his wife, known to me to be the same persons whose names are subscribed to the within instrument, and they duly acknowledged to me that they executed the same.

In Witness Whereof, I have hereunto set my hand and affixed my official seal at my office in the county of Napa, the day and year in this certificate first above written.

Rec. Stamps $30.00
H.B.A. 3/11/18

SEAL

D. L. Beard
Notary Public in and for the county of Napa
State of California.

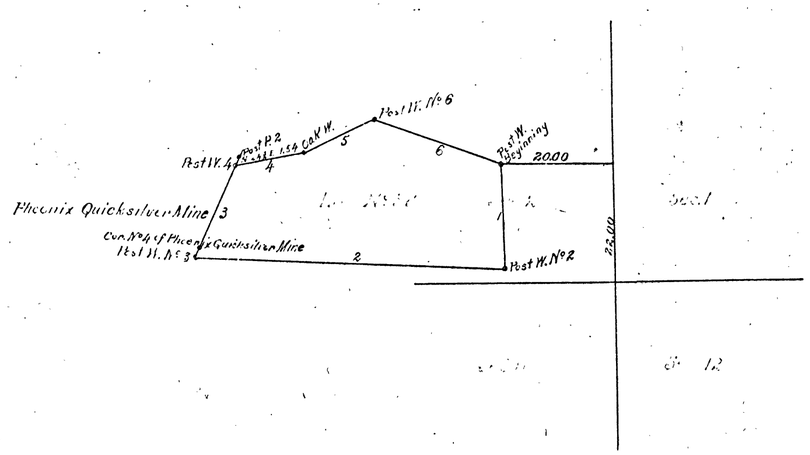
My commission expires
May 15, 1918.

A true copy of an original recorded at the request of Charles A. Gray, Mar. 12, 1918, A.D., at 5 mins. past 11 o'clock A.M.

H. S. Gunn
County Recorder.

Survey No 39
Mineral District No 11

PLAT
of the
WASHINGTON QUICKSILVER MINE
POPE VALLEY MINING DISTRICT, NAPA Co. CAL.
Claimed by the WASHINGTON QUICKSILVER MINING COMPANY
Surveyed by T. J. Dewoody U.S. Dep. Surv.
April 1869
Containing 114 $\frac{79}{100}$ Acres
Scale 20 chs to 1 inch
Magnetic Variation 16¼ East.



T. 9 N., R. 6 W. Mt. Diablo Meridian

Boundaries		
No	Course	Dist.
1	South	19.08
2	N. 87½ W.	57.02
3	" 24¾ E.	18.64
4	" 78 "	12.53
5	" 65¼ "	14.08
6	S. 70¼ "	25.30

DEPARTMENT OF THE INTERIOR,
GENERAL LAND OFFICE,
Washington, D. C. August 6, 1909.
I hereby certify that this is a true copy of the plat of official survey of the lands to which it relates, on file in this office.

Recorder, General Land Office.

The field notes of the Survey of the Washington Quicksilver Mine, from which this Plat has been made, have been examined and approved, and are on file in this Office; and I hereby certify that the lode claimed is of quicksilver, and the value of the labor and improvements is not less than one thousand dollars; and I further certify, that no portion of this Claim is embraced within the boundaries of any other Claim, nor does this Claim include within its boundaries any portion of another Claim so far as I am informed.
U. S. Surveyor General's Office,
San Francisco, California.
October 20th 1869

Sherman Day,
U.S. Surveyor General for California and Arizona

Filed in the U. S. Land Office, San Francisco this 20th day of October, 1869.
H. G. Rollins, Register.

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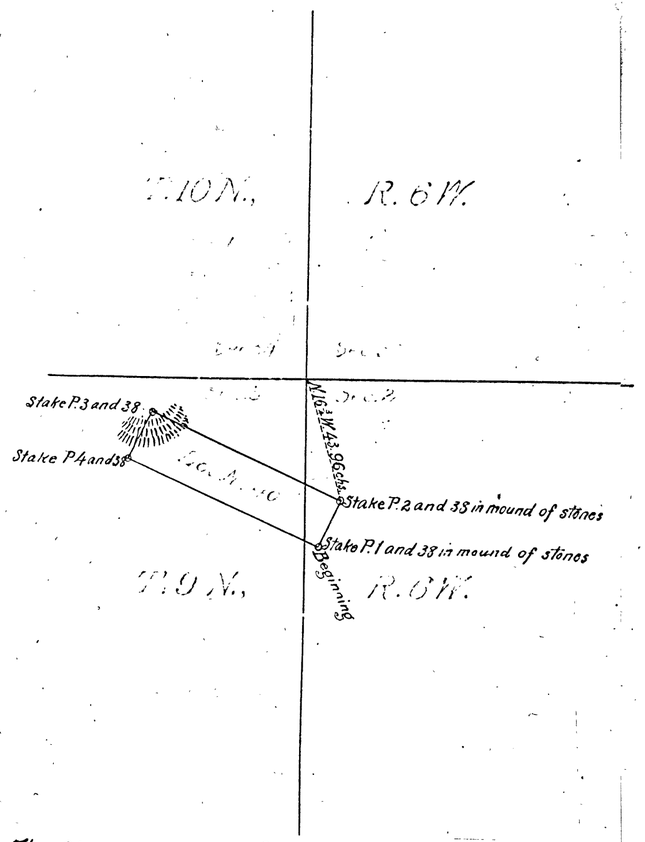
VOL 89-3

1

PATENTED FEBRUARY 15, 1871



Mineral District No. 11

PLAT

of the

PHOENIX QUICKSILVER MINE

NAPA Co., CAL.

Claimed by the Phoenix Mining Company

Surveyed by T. J. Dewoody, Dep. Sur.

May, 1868.

Containing 132 20/100 Acres

Scale 40 Chs. to 1 inch

Variation 16¼ East

Boundaries

No.	Course	Dist
1.	N. 24¾ E.	18.18
2.	N. 65¼ W.	72.72
3.	S. 24¾ W.	18.18
4.	S. 65¼ E.	72.72

The field notes of the Survey of the Phoenix Quicksilver Mine from which this plat has been made, have been examined and approved and are on file in this Office, and I hereby certify that the lode claimed is cinnabar, containing a working percentage of Quicksilver, and the value of the labor and improvements thereon is not less than one thousand dollars; and I further certify that no portion of this Claim is embraced within the boundaries of any other Claim, nor does this Claim include within its boundaries any portion of another Claim.

U. S. Surveyor Generals Office,
San Francisco, California
May 28th 1870.

Sherman Day,
U. S. Surv. Gen. Cal.

Filed in U. S. Land Office, San Francisco, this 12th day of Sept. 1870.

H. G. Rollins, Register.

DEPARTMENT OF THE INTERIOR
GENERAL LAND OFFICE,
Washington, D. C., Aug. 16 1902.
I hereby certify that this is a true copy of the plat of official survey of the lands to which it relates, on file in this office.

Recorder, General Land Office.

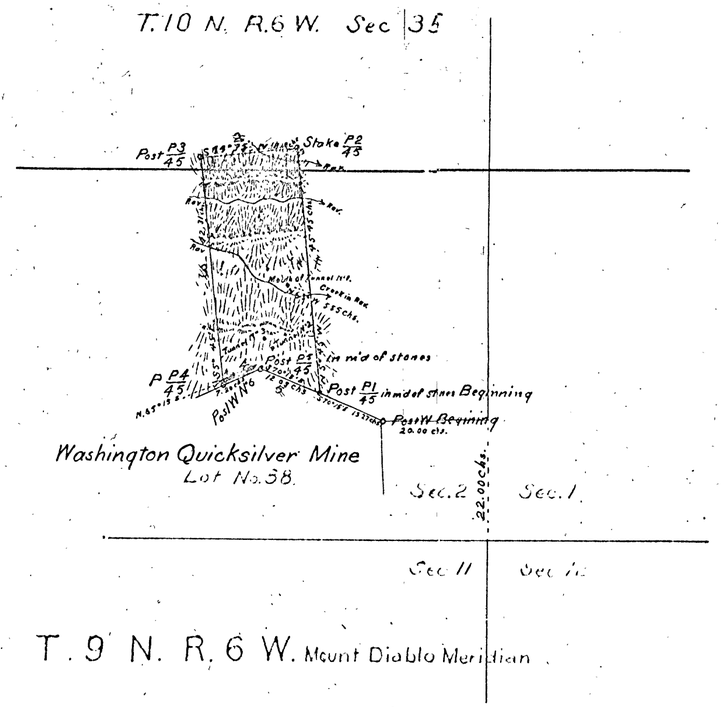
125-21

70 013

13

E. H. H.
E. M. P.

PATENTED AUG 11-1877



PLAT

of the Claim of the Pope Mining Company
upon the POPE QUICKSILVER MINE
situated in Pope Valley Mining District
Napa County California
claimed by the
Pope Mining Company
surveyed by
T. J. Dewoody Deputy Surveyor.
August 1872.
Containing 75 69/100 Acres
Scale 20 chs to 1 inch
Var 16 20' E.

Boundaries		
N°	Course	Distance
1	N 5¾° W	45.45
2	S. 84¼ W.	18.18
3	S. 5¾° E.	42.31
4	N. 65¼ E	7.20
5	S. 70¼ E	12.03

DEPARTMENT OF THE INTERIOR,
GENERAL LAND OFFICE,
Washington, D. C., Oct. 2, 1909.
I hereby certify that this is a true copy of the plat of official survey of the land to which it relates, on file in this office.

Acting Commissioner.

The original fieldnotes of the survey of the Pope Quicksilver Mining Claim from which this plat has been made, have been examined and approved and are on file in this Office and I hereby certify that this claim is quicksilver bearing and that the value of labor and improvements thereon is not less than one thousand dollars, as shown by the report of the Deputy Surveyor and the testimony of two witnesses, and I further certify that this claim is not embraced within the boundaries of any other claim nor does this claim include within its boundaries any portion of an other claim.

U. S. Surveyor General's Office
San Francisco California
November 14th 1872

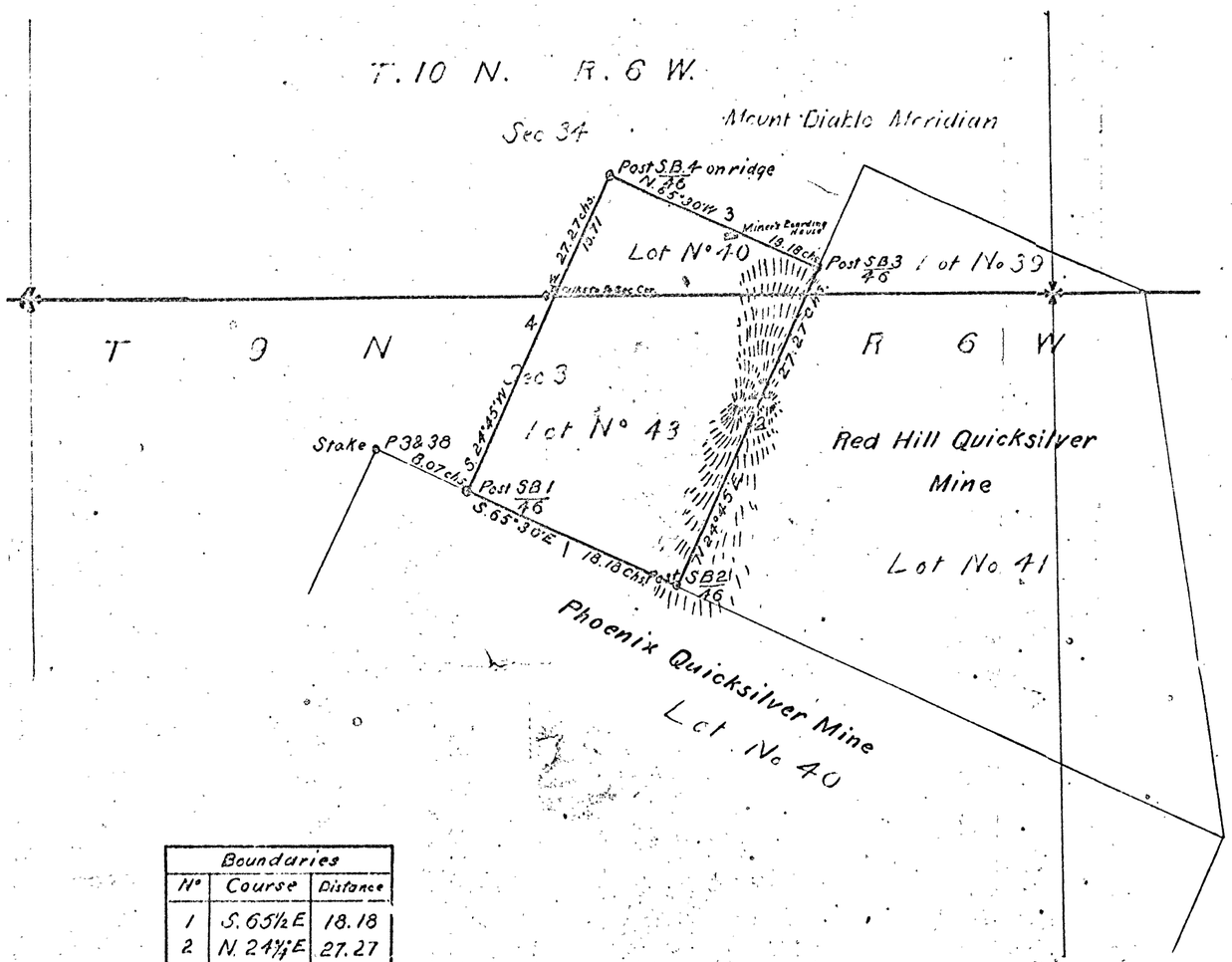
119-12

70 488

L. R. Hardenbergh
U. S. Surv Gen'l Cal.

PATENTED AUG 11-1877

E.H.H.
EMP



Boundaries		
N°	Course	Distance
1	S. 65½ E	18.18
2	N. 24¾ E	27.27
3	N. 65½ W.	18.18
4	S. 24¾ W.	27.27

PLAT

of The claim of the SILVER BOW MINING COMPANY

upon the SILVER BOW QUICKSILVER MINE

Situated in Pope Valley Mining District

Napa County, California

claimed by

the

Silver Bow Mining Company

Surveyed by

T.J. Dewoody Dep. Surv.r

August 1872

Containing 49 50/100 Acres

Scale 10 Chs to 1 inch

Var 16°30' ~~East~~

DEPARTMENT OF THE INTERIOR,
GENERAL LAND OFFICE,
Washington, D. C., Oct. 12, 1904.
I hereby certify that this is a true copy of the plat of official survey of the lands to which it relates, on file in this office.

Acting Commissioner General Land Office.

The field notes of the survey of the Silver Bow Quicksilver Mining Claim from which this Plat has been made have been examined and approved and are on file in this Office and I hereby certify that this claim is Quicksilver bearing and that the value of labor and improvements thereon is not less than one thousand dollars, as shown by the report of the Deputy Surveyor and the testimony of two witnesses, and I further Certify that this claim is not embraced within the boundaries of any other claim, nor does this claim include within its boundaries any portion of another claim.

U.S. Surveyor General's Office
San Francisco, California.
November 4th 1872.

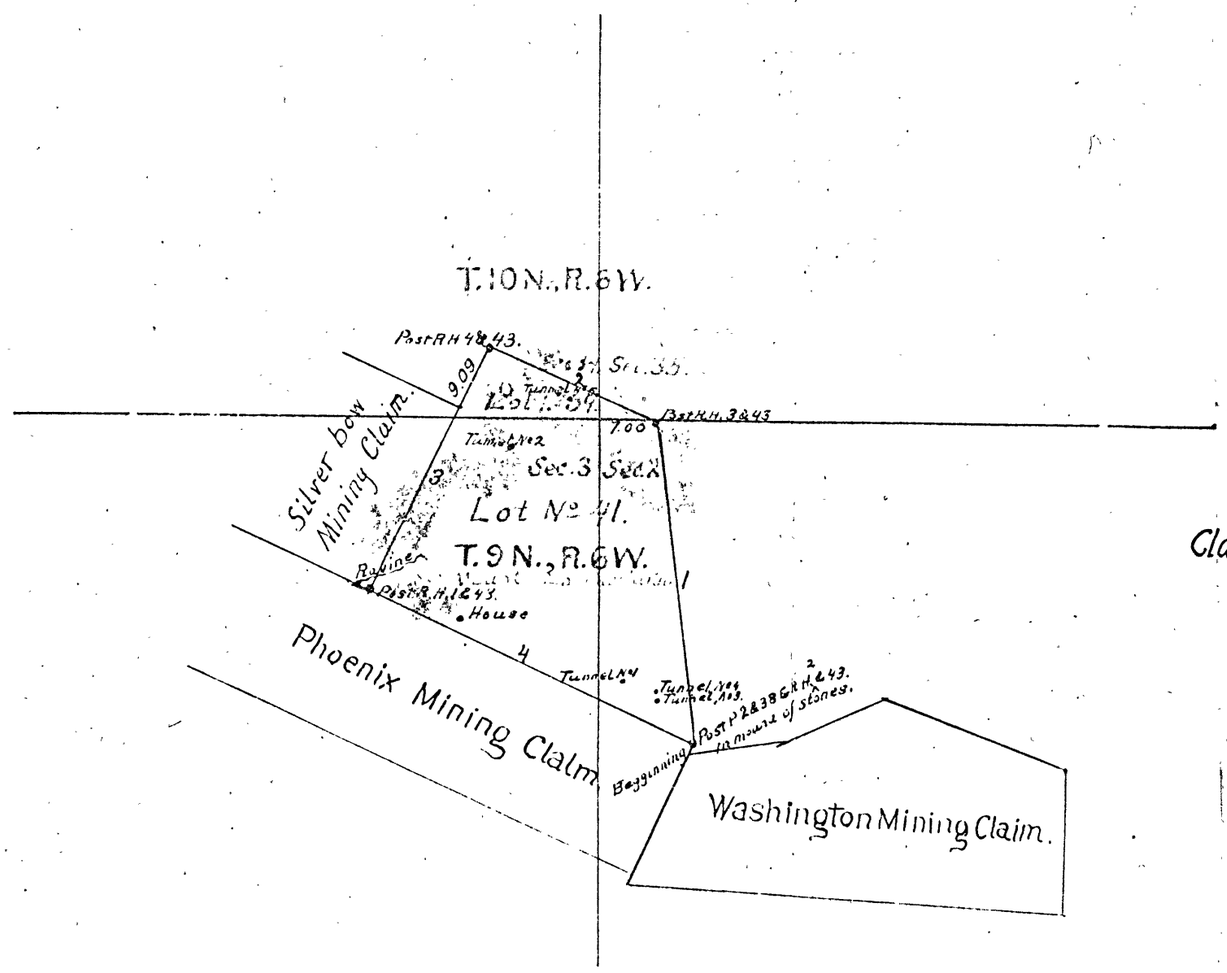
S. R. Hardenbergh
U.S. Surr Gen'l Cal.a

70 511

VOL 83-5

511

PATENTED JANUARY 6, 1873



Survey No. 43.
Mineral District, No. 11.

PLAT

of the

RED HILL QUICKSILVER MINE.

Pope Valley Mining District Napa Co. Cal.

Claimed by the Red Hill Quicksilver Mining Company.

Surveyed by T. J. Dewoody, U.S. Dep. Surv.

August 1871.

Containing 128 6/100 Acres.

Scale 20 Chs to an inch

Magnetic Variation 16¼° East.

Boundaries.		
No	Course	Distance Chs Lks.
1	N 7° W.	42.16
2.	N 65¼° W.	23.97
3	S. 24¾° W	36.36
4.	S. 65¼ E.	46.47

The field notes of the Survey of the Red Hill Quicksilver Mine, from which this Plat has been made, have been examined and approved, and are on file in this Office, and I hereby certify, that the lode claimed is of Quicksilver, and the value of the labor and improvements is not less than one thousand dollars, and I further certify that no portion of this claim is embraced within the boundaries of any other claim, nor does this claim include within its boundaries any portion of another Claim.

U. S. Surveyor General's Office.
San Francisco, California.
September 18th 1871.

J. R. Hardenbergh
U.S. Surv. Gen'l., Cal.

DEPARTMENT OF THE INTERIOR,
GENERAL LAND OFFICE,
Washington, D. C., Aug. 20, 1909.
I hereby certify that this is a true copy of the plat of official survey of the lands to which it relates, on file in this office.

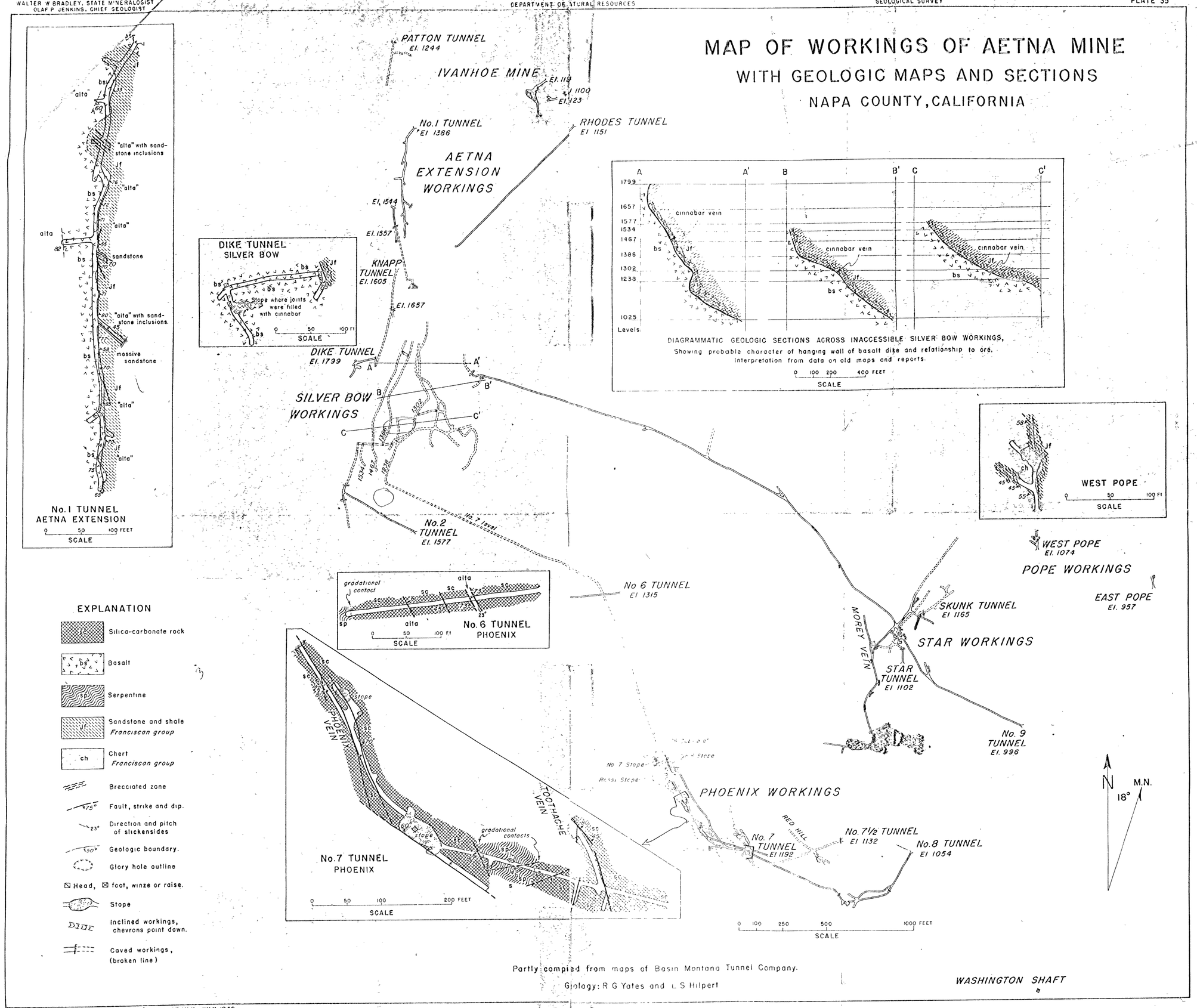
Chief, Cadastral Engineering Div.

70 113

MAP OF WORKINGS OF AETNA MINE

WITH GEOLOGIC MAPS AND SECTIONS

NAPA COUNTY, CALIFORNIA



Partly compiled from maps of Basin Montana Tunnel Company.

Geology: R G Yates and L S Hilpert