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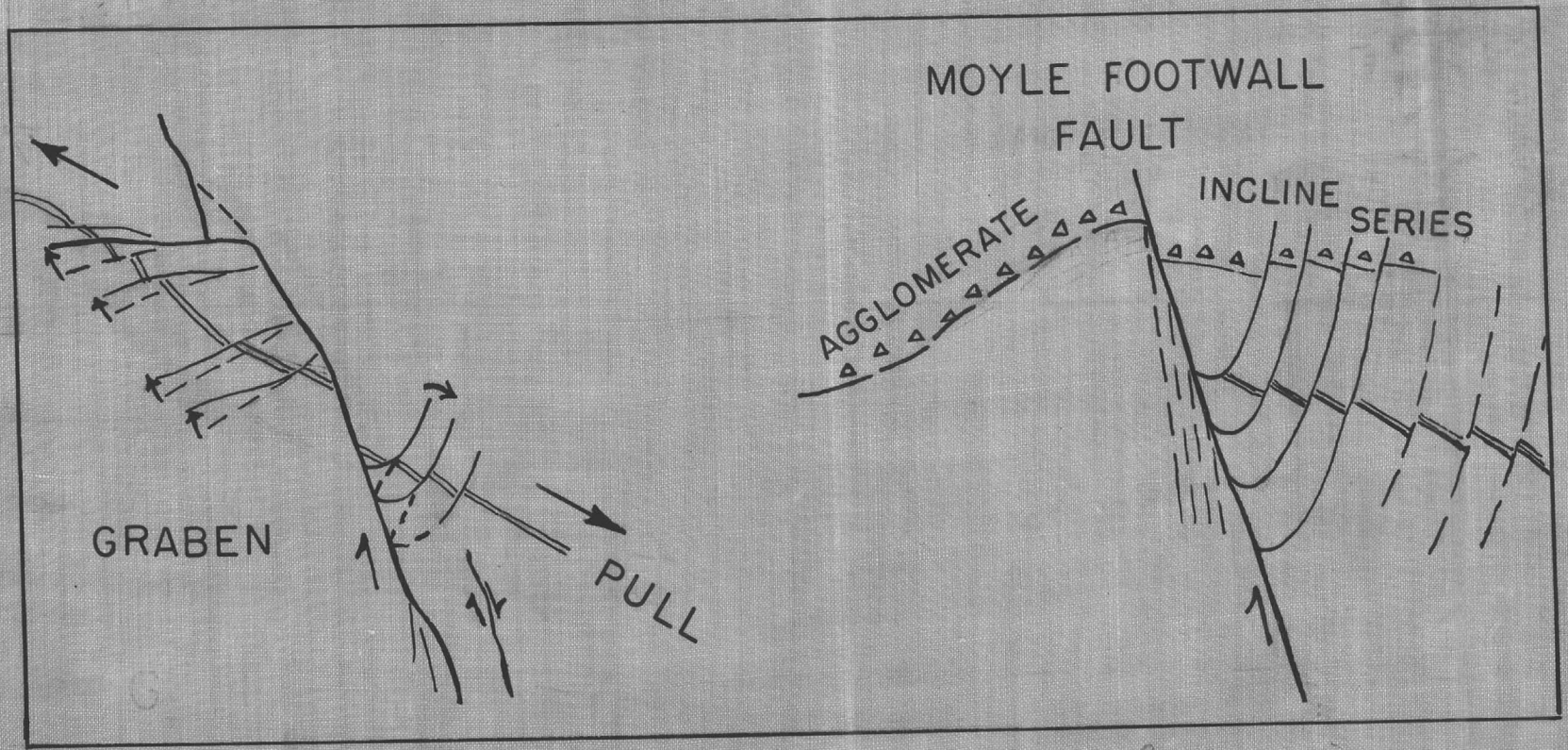
Weaver



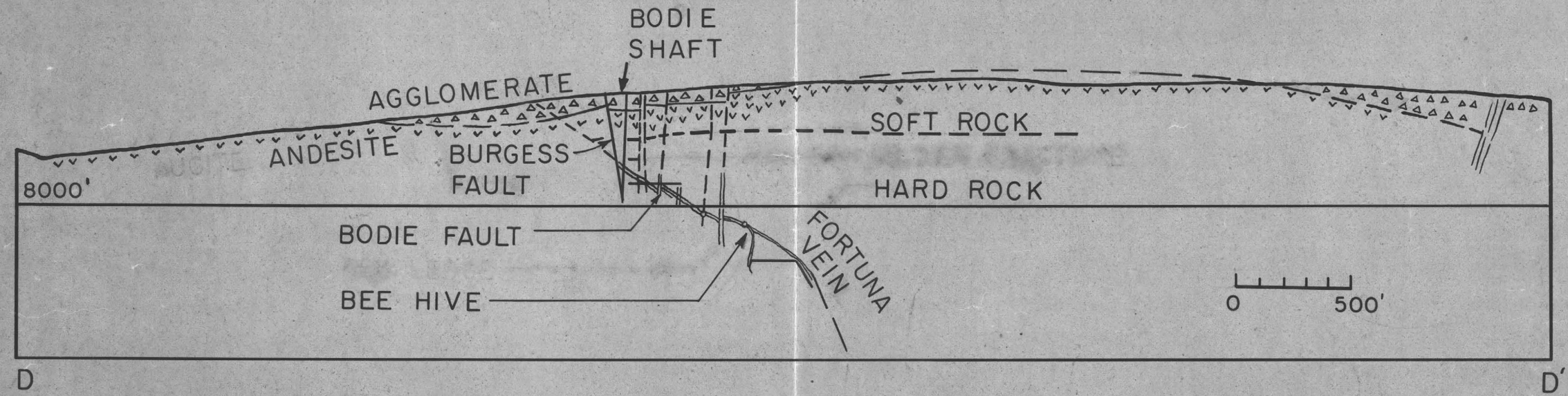
— 2¼" —

Insert side by side with Fig 25

FIG. 26

26.5

Reduce to ⅓ present size



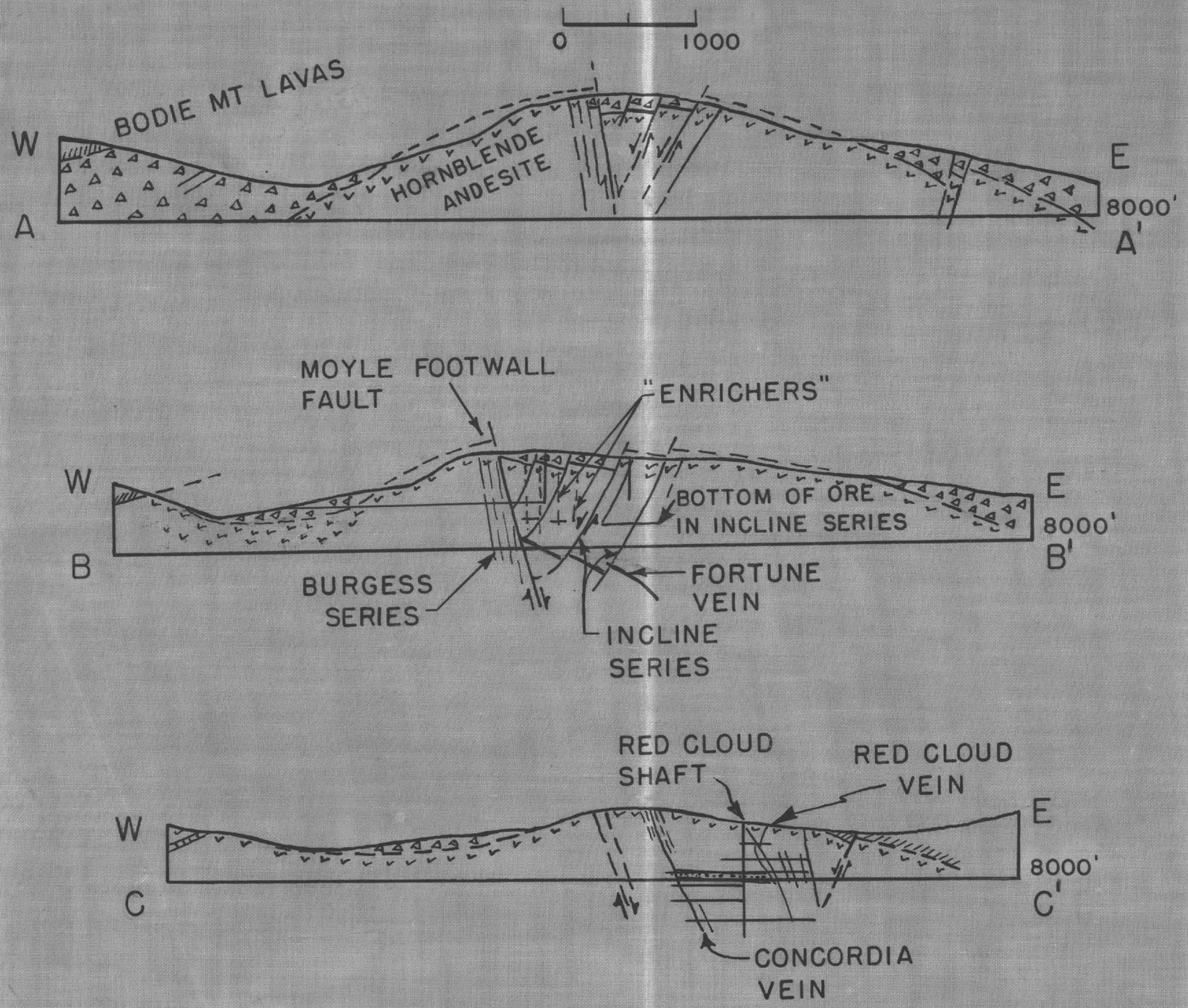
Print on page opposite Figure 23 attach below section C-C'

FIG 24

Combine with A-A to C-C

⅓ 13

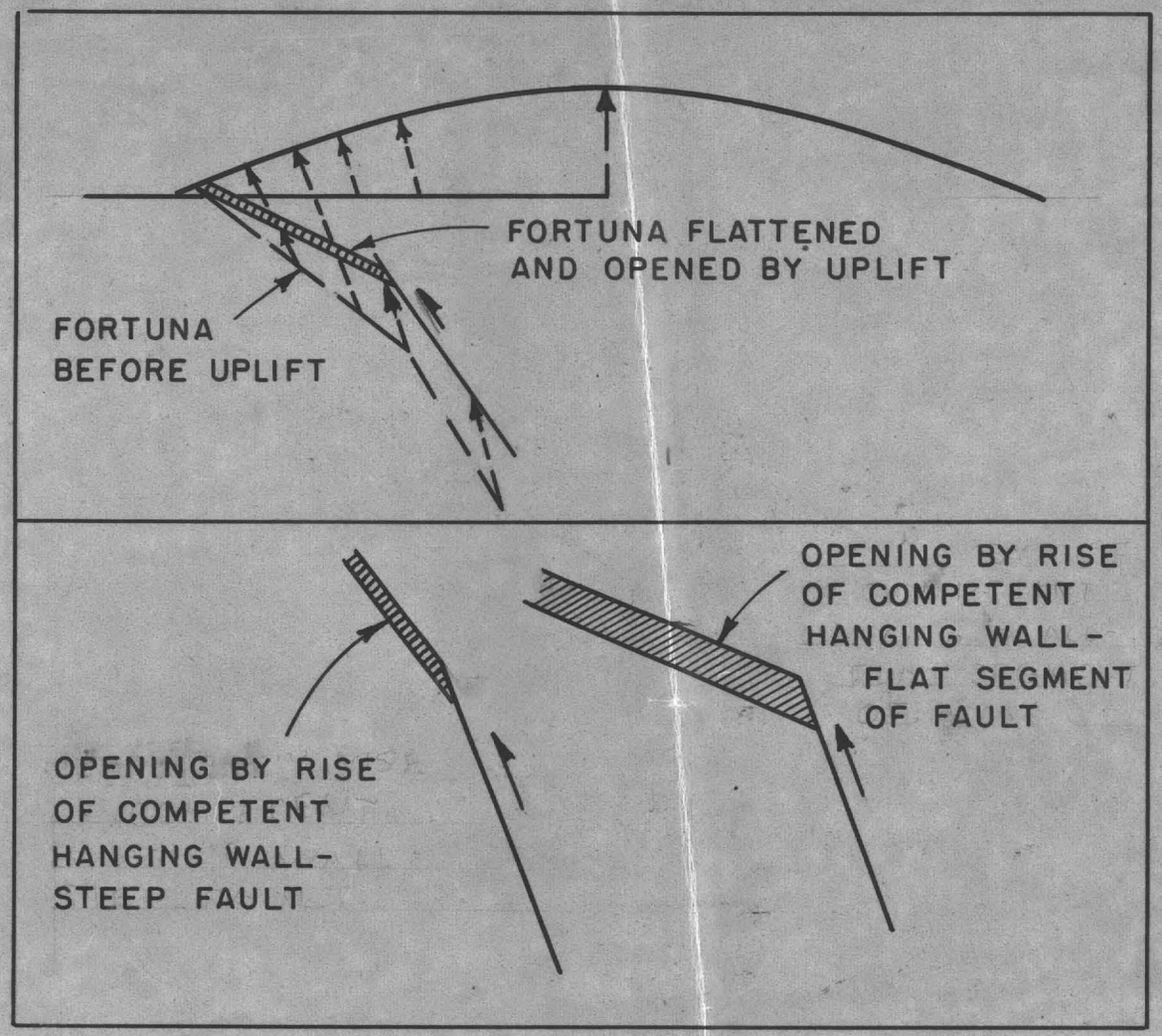
33.3



Print opposite page 23

Reduce to 1/3 present size

FIG. 24 (Combine with DD)



Print side by side with Fig. 26

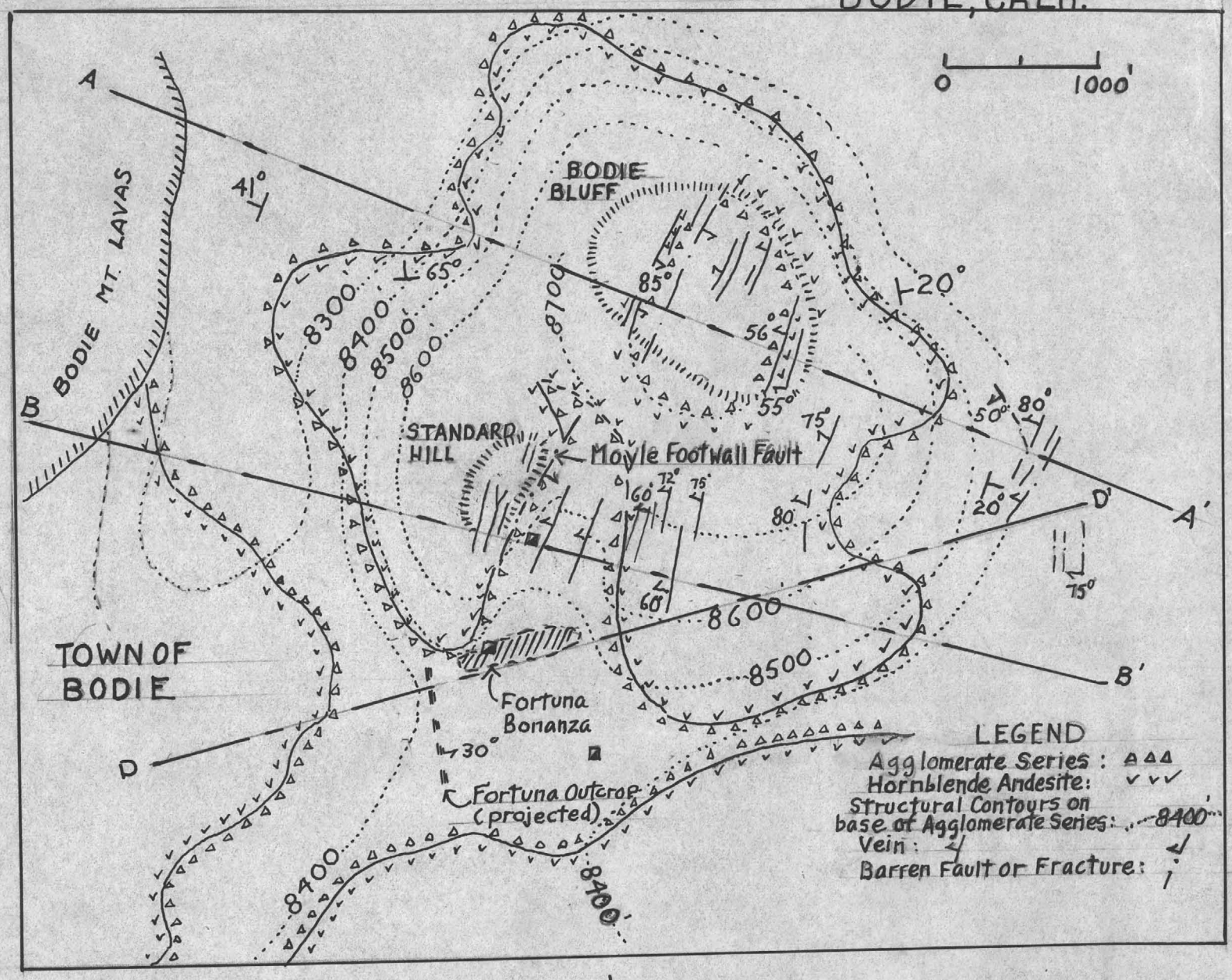
- 2 1/4" -

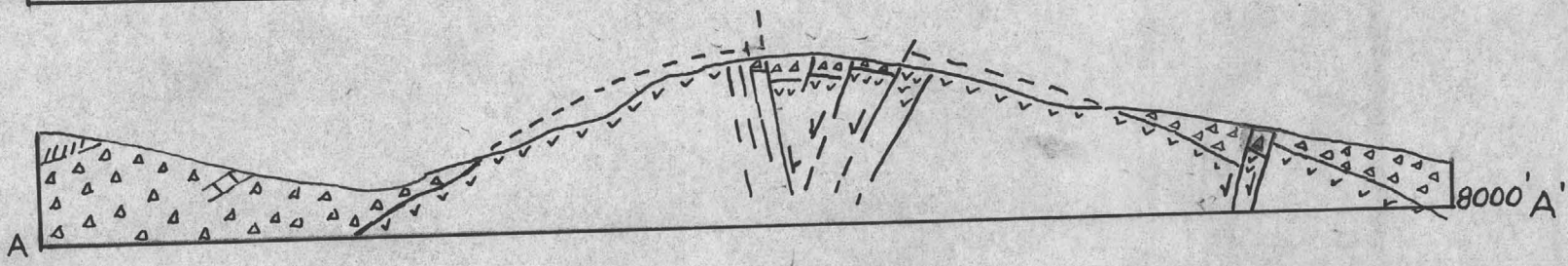
FIG. 25

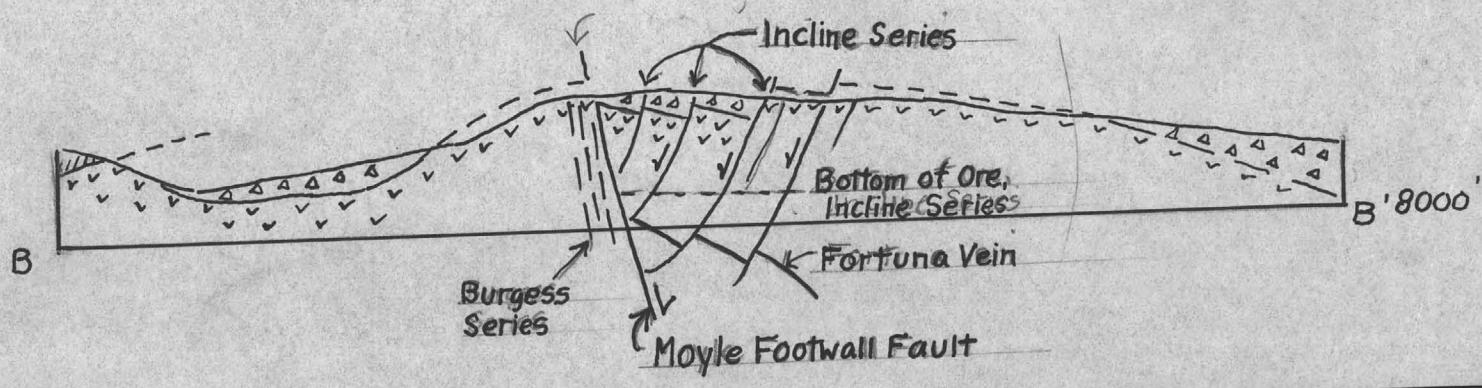
335

Wm. Byrd
D. 152C

BODIE, CALIF.


0
1000'
A
A'
B
B'
D
D'
BODIE MT. LAVAS
BODIE BLUFF
STANDARD HILL
Moyle Footwall Fault
TOWN OF BODIE
Fortuna Bonanza
Fortuna Outcrop (projected)
8700
8300
8400
8500
8600
8400'
41°
65°
85°
20°
56°
55°
75°
50°
80°
72°
75
60°
80
20°
75°
60
30°
LEGEND
Agglomerate Series :
Hornblende Andesite:
Structural Contours on base of Agglomerate Series: 8400'
Vein :
Barren Fault or Fracture:


A
8000' A'


Incline Series
Bottom of Ore, Incline Series
B
B' 8000'
Fortuna Vein
Burgess Series
Moyle Footwall Fault

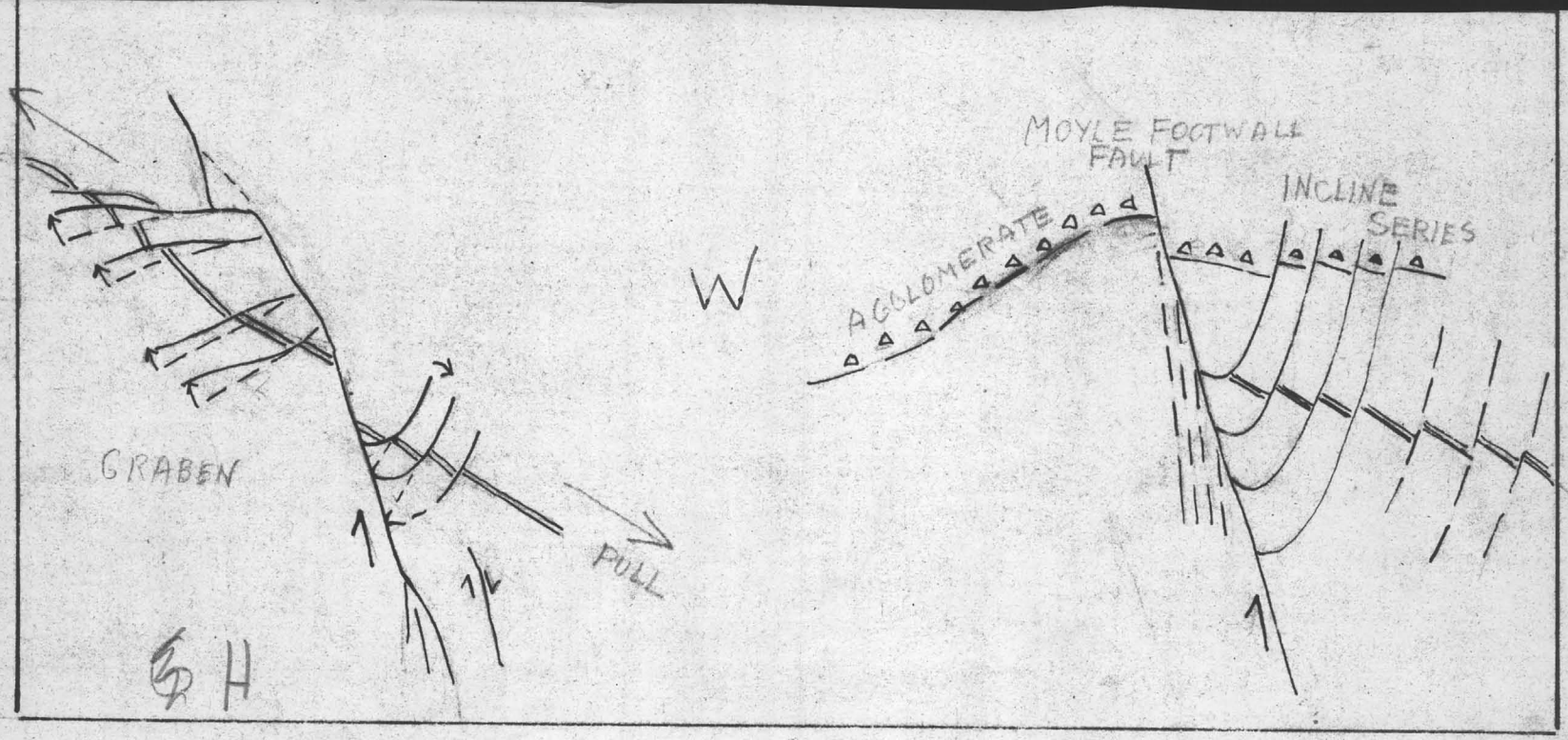
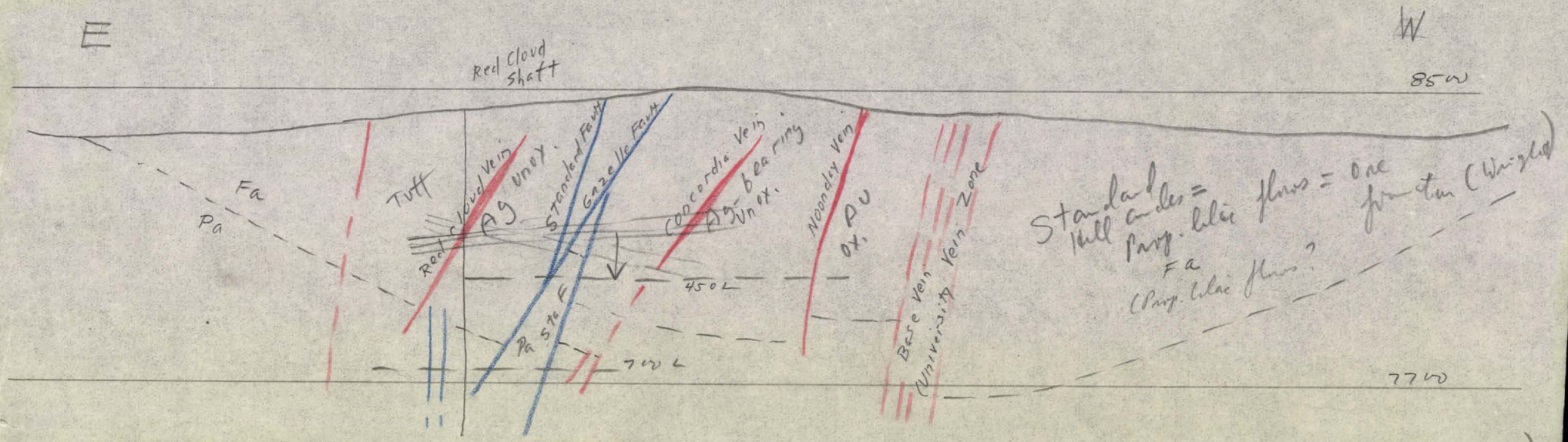

MOYLE FOOTWALL FAULT
INCLINE SERIES
AGGLOMERATE
W
E
GRABEN
PULL
SH

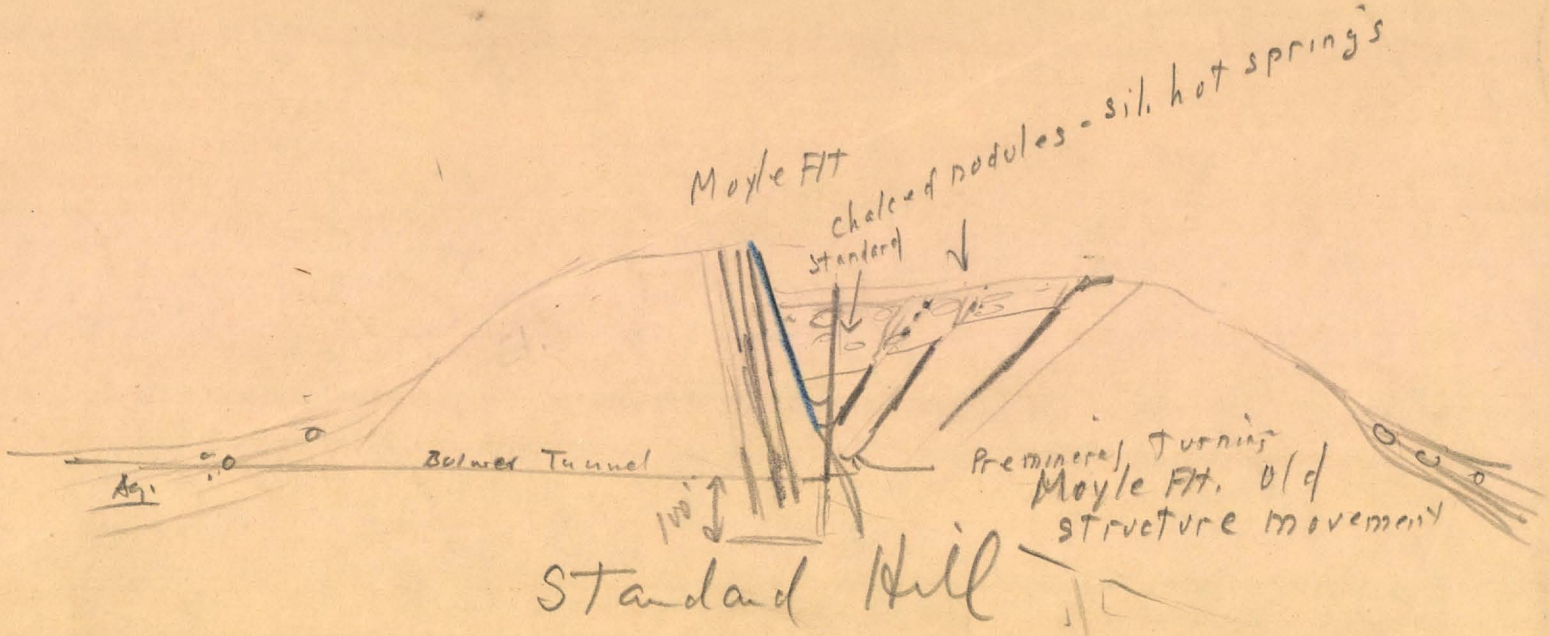
FIG. ~~32~~ 25

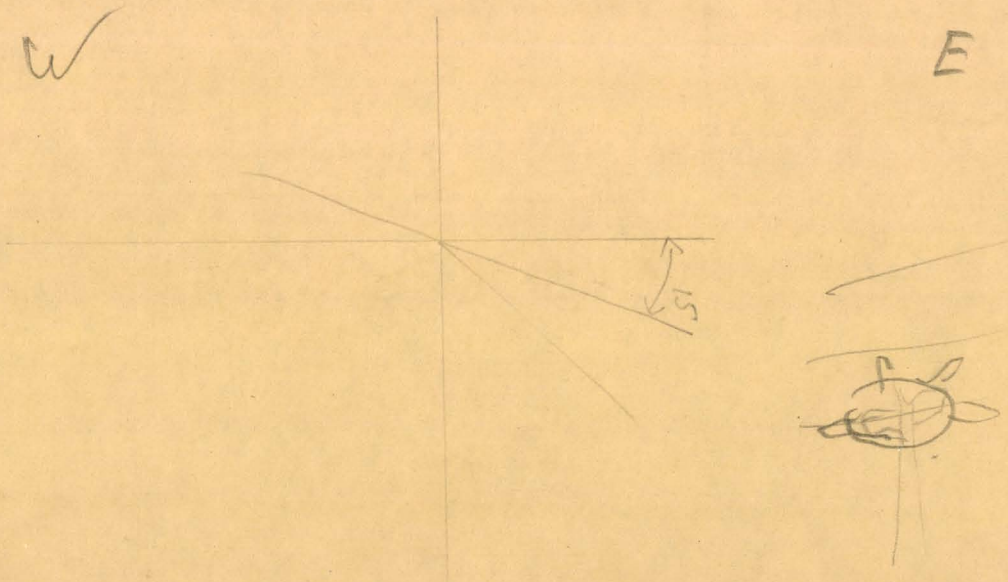


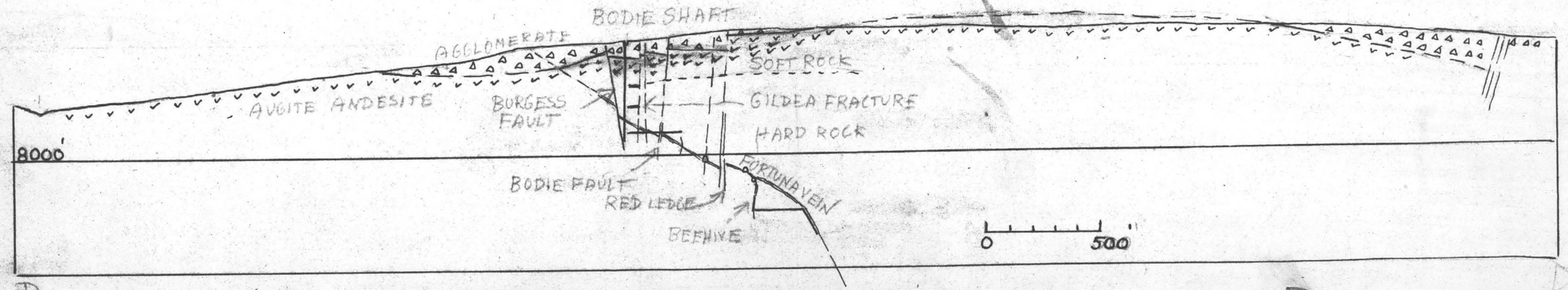
L. B. Wright (is not right)

E-W Section thru
Red Cloud Shaft
1" = 400'

Wf


Moyle Flt
Chalcedonodules - sil. hot springs
standard
Bulwer Tunnel
Ag.
100'
Preminerel Turning
Moyle Flt. Old
structure movement
Standard Hill

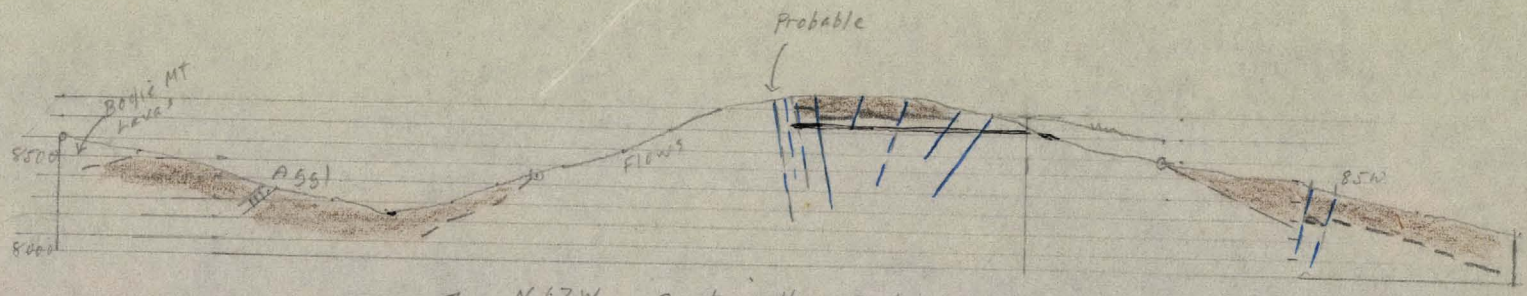

W
E
5



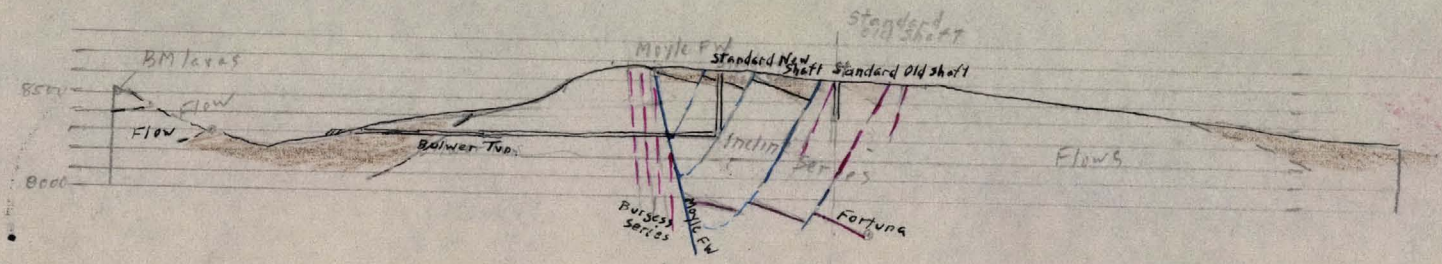
D

FIG. 32-E

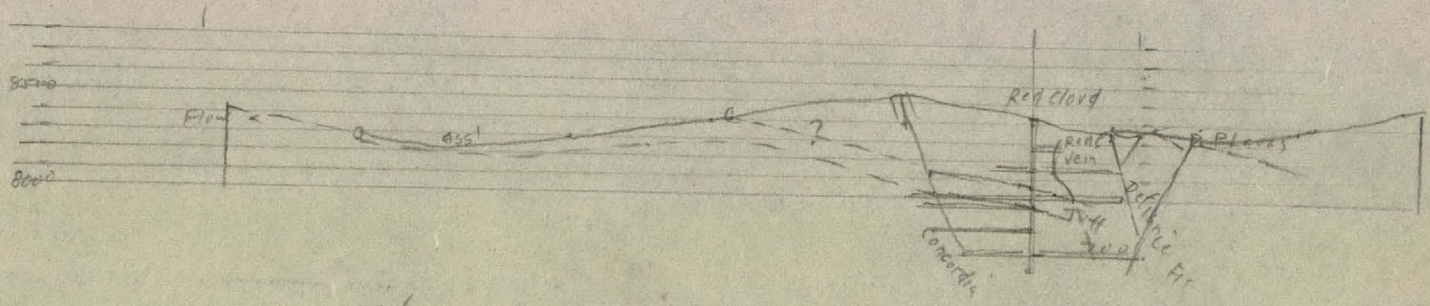
FIG 2B



N 67 W Section thru Bodie Bluff

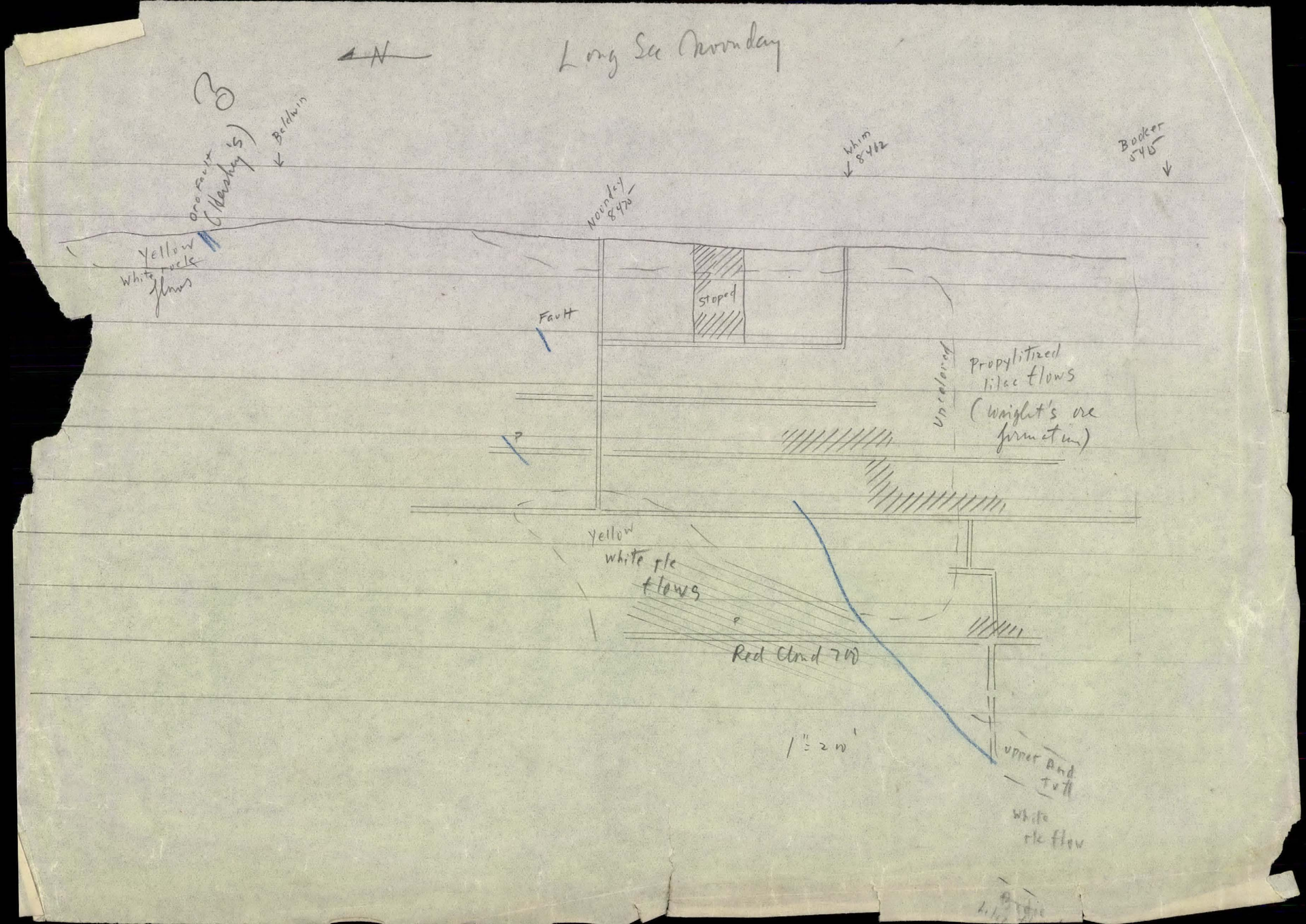


N 35 W Section Thru Standard New Shaft
In part diagrammatic



NW Section Thru Red Cloud Shaft

Long See Mounday



Ferguson – S ~~H~~ quadr. Hawthorne Quad.

Strat. Sec.

1. Qtb Pleistocene & pliocene basalt.

2. Ta Pliocene? lavas, agglom. chiefly andesitic flows

3. Tcg " ? cgl., ss., & lev. tuff.

4. Tr Upper Miocene? Lavas, chiefly rhy

5 Te Upper Miocene ~~rhyolite~~. Esmeralda
Sh., SS., coal.

Bodie Mt Lavas PM.

Bodie complex = 6 Tl Upper Miocene rhyolite
Pre-Esmeralda lavas.

Probably Miocene

7. Jg Late Jurassic? gr., di, q-d, q-m

8. J Lower " SS & LS

9. Tr Triassic Seds & alt. lavas.

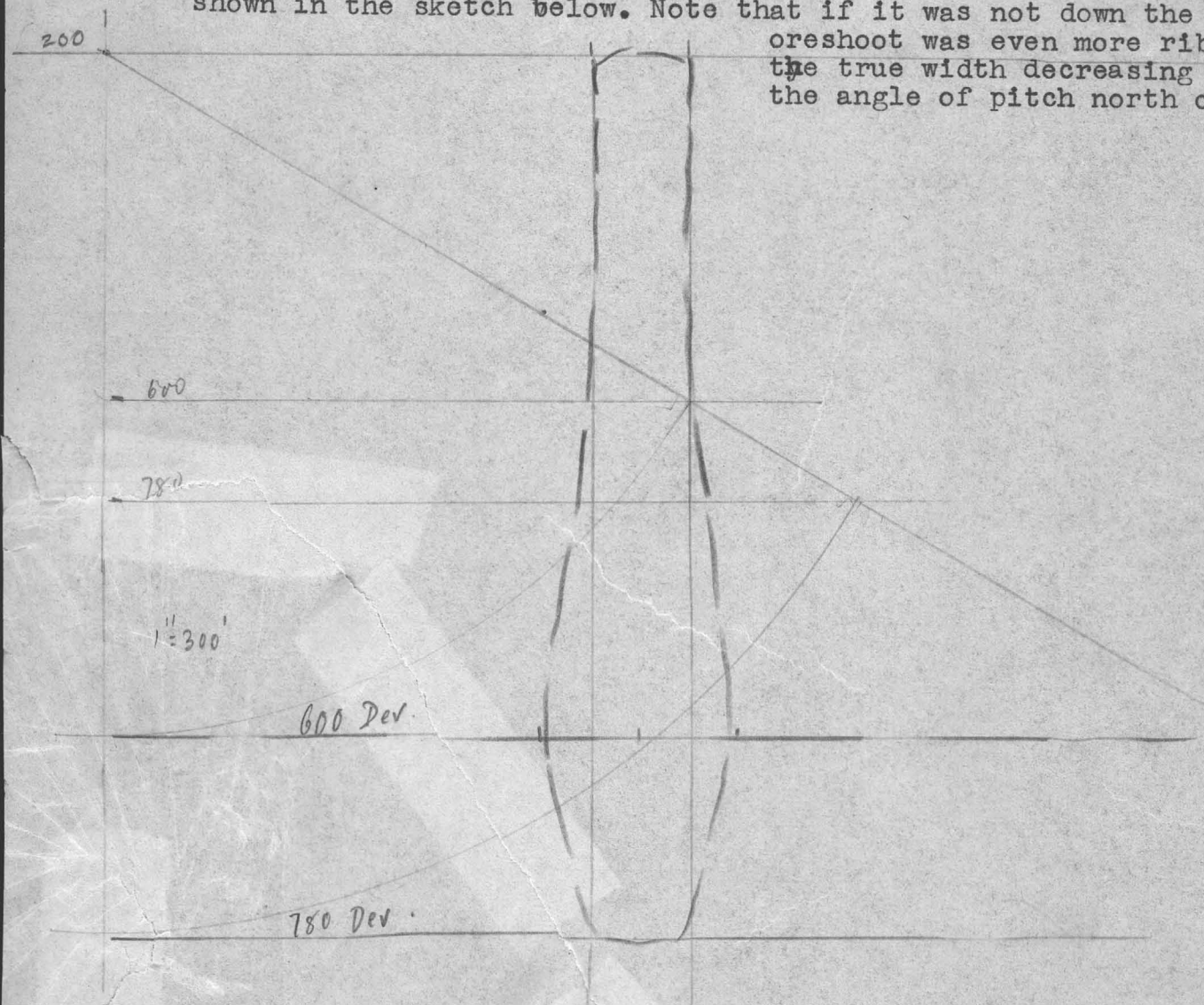
Federick thinks Tr is equivalent to parts of Ta

Ferguson has lumped under Ta the Bodie complex & the Bodie Mt lavas near Bodie.

Same

Shape of Orebodies.

Bodie, Calif. Fortuna vein. The Bodie mine bonanza extended from just below the 200 to the 780,580' vertically or 1160' down the dip. The maximum horizontal length was 350' on the 600' level, average length about 175'. The oreshoot must have been extremely ribbon-like, more like a Mexican manot than anything else. The pitch is not given, but Irelan's section showing the stopes suggests that it was nearly down the dip, as shown in the sketch below. Note that if it was not down the dip, the oreshoot was even more ribbon-like, the true width decreasing the flatter the angle of pitch north or south.



The Fortuna has never been identified to the NW, N of the Standard shaft. To the SE it has been followed into a region of decomposed andesite,indicated on the surface by the gulch and depression in the ridge between the Mono shaft and the old Champion shaft.

Vein Descriptions. Mineral Associations.

Bodie, Calif. "Younger Lodes" of Irelan,
North part of the belt: Syndicate, Bechtel, Standard and Bulwer Mines. These strike N-N20°E, parallel to the dikes, and dip W, 35°-85°, most of them steep. Most are narrow but closely spaced; often the entire distance between two of them is shattered, and the mineralization extends several feet from one of the fissures into the shattered rock.

Both the older and the younger veins are in part fillings of open fissures, in part a gradational replacement of thinly sheeted country rock between the main structural planes of the fractured zones by the vein-forming materials once in solution. In the orebodies themselves the quartz shows the same sheeting as does the country rock, giving a sort of banded structure. The veins contain angular and rounded fragments cemented by quartz and ore minerals. The quartz is sometimes sugary as if crushed and comminuted by later movements; this is seen especially in the main Standard and Gildea veins, and in general is commoner with the larger than with the smaller vein fissures. In the extreme north end of the belt, the Younger veins, which are small, dip steep E, W of a north-south plane, and steep W, E of it; true banded vein structure is best developed here.

Jammed x-joints

In the Bodie mine, the only two producing members of the Standard or Younger series are the Burgess and the Bruce, respectively the south continuations of the Cook and the Bruce of the Standard mine; they produced for only 150' south of the boundary, and beyond the S end of the ore there was no quartz filling: the veins turned to fissured, barren zones in the andesite.

In the Standard mine, the members of the Standard series gave 59% of the mine production, 1877-1888. The ore gave out just below the 500' lev., as they did at the corresponding 300' level of the Bodie. The main Standard vein was the largest but not the richest ore-carrier of this Younger series: 90' wide on the 385' level, average 20'. It dips 40°W (the others run 2-6' wide, dip west 65-80°. In the long crosscuts at the 700, 1000 and 1200' levels of the Standard, all these Younger fault fissures become zones of numerous small veins of nearly barren quartz; some may even be marked merely by certain zones of thinly sheeted country rock.

Gold-silver ratio. 1883. 1:1.91. Native gold was 675 fine, rest Ag. The silver occurs as argentite, cerargyrite, and as native flakes and wires. A mixture of earthy FeOx and MnOx occurs; magnetite, from the higher oxidation of the pyrite; this is rich in gold. Moderate pyrite. Quartz, more or less calcite, some gypsum. Calcite is relatively abundant in the Noonday and other veins in the S part of the belt; not abundant in Bodie or Standard.

(Irelan).

Most of the (Younger) veins are 1-3' wide, spaced 3-100' apart. Oreshoots 20-200' long, pitch to S. Main vein (of Standard) was up to 60-70' wide, ore to $400/T. Outcrops obscured by debris, but veins often pinch toward surface. Nearly all discoveries made by crosscutting. Crosscuts more than 200' aprt may entirely miss valuable orebodies. The veins bending upward on east side of Moxie Fw. fault shows movement to have been normal. Veins on W side undisturbed.

Most of the veins are banded, and displacements of the bands show several enlargements of the fissures since the primary deposition. MnOx in vugs carries some silver, no gold. Best assays near one wall or the other, indicated by fine scaly gouge or by small blue spots of telluride in the

R.P. McL

Vein Descriptions Cont. Bodie.

quartz.

R.P. McLaughlin. MSP 6/22/07. Mostly H.S.
Brown

Albite, sometimes as large crystals, seems associated with the vein quartz; gold panned from specimens containing mixed quartz and albite, but gold thought to occur only in the quartz.

Brown separates the Younger series into the "Incline series", in the Moyle hanginwall, and the "Burgess series", in the footwall. In both the quartz is well banded and sharply separated from the walls. Incline veins show relatively little coarse gold, but have lowest silver proportion; Burgess series has exceedingly coarse gold. The Incline series are those curling up at the Moyle fault mentioned by McLaughlin above. Incline falls into two sets: (1) Massive, beautifully banded flint-like qtz, sometimes massive, sometimes badly cracked, but always with much ocherous red clay, such as would be derived from wall-attrition in feldspathic rock. Fine sharp chips of the same qtz can be washed from the mass; values this stuff carries doubtless come from these chips. In these veins both walls are rarely well defined. (Apparently one is). Main Standard and Incline veins. (2) Less clay; well-banded, rather porous quartz, soft and at times crumbly, as if crushed by weight rather than by attrition. Bullion vein. Thought to be later than Incline vein, because they are close together; had Bullion existed at time Incline was grinding on its walls, it would have been effected. The veins of group (2) may carry good-looking qtz. and no values. However, "enrichers", small high grade veins branching off, generally into the FW (i.e. up, and toward the east, making small angle, see sketch) These carried high-grade 1000' or more from its main vein.

Put in Tertiary analogy

Vein shown vertical in the sketch; not certain that the wall the enricher makes out into is the footwall; if so it suggests footwall went down relatively, not up.

All incline series veins dip W; typical width 14-20"; walls well-defined, good; in their neighborhood the andesite is well oxidized, while that around the Fortuna, even at high levels and when much decomposed, shows no iron stain and exhibits bright pyrite crystals. A few unimportant members of the Incline series lie beneath the Moyle footwall; the albite crystals mentioned were found near the surface in veins of this series. On the 260' level, Standard mine, nearly pure crystalline calcite occupies the full width of the Bullion vein.

Burgess Series. Note here that Brown says: "If we exclude the enriching veins from this category...all of these veins lie below the Moyle footwall. They are small, nearly vertical.." This seems to imply that the sketch given of the enricher is misleading, possibly even a plan, but probably the enricher in this case is making out into the HW, corresponding to normal movement on the main vein.

The Burgess veins have a slightly banded structure, at times comb-like on an axial line and frequently with a rich scale of hard quartz frozen on one of the walls. This runs-old stopes cleaned out, scale taken. "Shale" on one wall is a good ore guide. Looks like dried clay, mixed with sand, and shows in films 1/16 inch thick, suggesting an attrition product. The wall rock of the Burgess series is less oxidized than that of the Incline series, for few of the Burgess veins reach the surface; surface waters pass down the Moyle. These seams have been so rich that a 1/2 in. one has been stoped. Values are sometimes found some distance out in the CR. Angular andesite fragments entirely cemented by vein quartz. Andesitic breccia sometimes accompanies the fissures, sometimes carrying chips of what looks like trap. Picked up from distant rocks by the viscous breccia, believed a

Vein Descriptions-Bodie. Cont.
dike. Burgess veins have been profitable for ~~xxxxxxxxx~~ a distance between E-W planes some 600' apart,as against 3000' for the Incline,1000' on the Fortuna.

R.Gilman Brown,Trans.AIME 37 (1907),343-357.

The veins of the Younger system pinch to mere seams at 500' to 700' from the surface,and lose their value at 400'-500'. In the Syndicate Mine, at the extreme north end of the district,the veins becomeunproductive 250' below the surface. The veins here are more numerous than farther S, but smaller.

Eakle,McLaughlin etc. Cal.State Mining Bur.,Dec.1916.,139-145.

Fortuna System:- These are represented by the Fortuna vein of the Bodie mine,and probably by the east-dipping veins of the Addenda,Paris, Noonday, Red Cloud etc. along the central and more southerly parts of the Bodie belt. This series has a higher relative amount of silver than the Younger series, and the relative amount of silver increases with depth. Structurally, however,the older lodes are of the same type as the younger. The Fortuna series veins strike somewhat west of north and dip 30-50°E.

The Fortuna vein was first cut in the Bodie shaft,at the 346' elevation,and was valueless there. A crosscut on the 432' level however again cut the Fortuna 125' east of the Bodie shaft;here it was as rich as the Bruce bonanza. Fortuna strikes N10°W,dips 30°E,increasing below the 600' incline level to 45°. Average width probably less than 2'. ~~The bonanza extended~~ In many places it was only a few inches wide,but in the richer parts of the oreshoot the wall rock carried gold next such narrow rich streaks. The bonanza extended from just below the Bodie 200 to the 780 (580' vertical);greatest horizontal length(350') on the 600. Average length of stopes 150-200'. Fortuna cut in several levels of the Bodie mine (south of the Standard),on the 1000' level and above;and followed S into the Mono (adjoining Bodie on S),where it yielded a small bonanza. Followed from Lent shaft into the Dudley (must have been at quite low level):no ore.

The Fortuna is faulted by each member of the younger,west-dipping series (See Irelan-Plate I).Also faulted,but slightly,by many fault planes dynamically related to the younger fissures (i.e. same attitude,but behave differently;see Irelan,Plate III) 3 movements shown in Plate III:(1) slipping down of Fortuna along fault a-a;(2) formation and filling of Gildea fault-fissure;(3) faulting on b-b displaced both the younger and older lodes by just the width of the Fortuna vein at that place. The Fortuna and Gildea keep their structural characteristics even where side by side: Gildea qtz. comminuted,sugary,with angular,sometimes slightly rounded wall rock fragments;Fortuna qtz.hard,firm,frozen to either wall,and with comb structure. Gildea followed line of least resistance in HW of Fortuna. It throws off several small veins into the FW,as shown;e in the sketch faults the Fortuna,but without displacement. Where the younger lodes fault the Fortuna within the bonanza on the latter,some ebrichment of these usually low-grade younger veins occurs,extending a few feet above and below the Fortuna.

The quartz of the Fortuna bonanza is hard, white,crystalline,often with comb structure,usually frozen tightly to the walls:selvages rare. Ore minerals native argentiferous gold,native silver,cerargyrite and argentite,with pyrite, some magnetite and earthy iron oxides derived from pyrite. Rare ccpy,copper carbs.Argentite often crystalline,and both it and the native Ag often occur as thin,loose leaves adhering to,or held

between,the apexes of the qtz prisms filling drusy cavities. In one vug on the Rich vein,below the 622 ' level of the Bodie,a few crystals of pyrargyrite were found. Stephanite,pyrargyrite were abundant,in addition to the other minerals mentioned,in the Oro,Addenda and other mines south ofthe Bodie. Also reported in Fortuna vein workings in the Mono ~~workings~~ mine farther south.

The Fortuna vein bonanza ends curiously by making straight down from the footwall on a narrow vertical stringer,taking off just below the 601 lev. (Irelan-Plate I). This vertical offshoot is 1"-1' wide in the Fortuna FW;it seems to cross the Fortuna and exist in the latter's HW as a plane of parting. This vertical vein parallels in attitude the Red vein,and lies 100' east ofthe latter. The Fortuna itself is barren down the dip from the place where the vertical vein takes off. On either side of the FW split the wall rock is thinly sheeted,and native silver,as fronds and wires,occurred for 1' on each isde of the narrow quartz vein. Below the 784' level the vertical vein broke up into seams of low grade quartz. On the 1200' level of the Lent (~~mark~~ ~~ke~~ corresponds to 1277' lev.of Bodie) the Fortuna dips more steeply,and carries quartzonly in small, isolated bunches and veinlets, occasionally rich in precious metals but insignificant. The fissure consists of thin parallel sheets of highly altered rock and clay,strongly pyritized. Polished,striated surfaces suggest extreme compression and rock movement.

(Irelan,8th An.Rept.Cal.State Min., 382-395).

The strong Fortuna fissure is at times accompanied by andesitic breccia,on one or the other wall,or partly cemented in the vein;suggests vein followed an earlier dike (since Red vein andother dikes are brecciated). Not proven;and the breccia is in places absent. In confirmation of Gilman Brown's sensational antithetic faulting section of the Fortuna, he states that on the 432' lev.,Bodie,where both the later series (Incline and Burgess?Probably the two sets of the Incline series)cross the Fortuna the latter is cut three times in the same plane in the same cross-cut. This seems to be mathematical anithetic faulting. See elsewhere.

The Fortuna is the only Bodie vein that looks like a deep,strong fissure;but this permanency is of structure alone,and does not apply to the mineralization,for the vein becomes impoverishedrapidly with depth. Sphalerite,rare above,increases to a large precentage;gold values weaken to nearly nothing;silver diminsihes to a few sparse patches of wire silver in masses of impure,bluish white kaolin. The vertical FW offshoot mentioned by Irelan is by Brown called the Beehive. He notes the strangeness of this occurrence:the Fortuna vein,carrying high gold in relation to silver (bullion shows roughly 1:1 ratio) is robbed of all its gold and much of its silver by the Beehive dropper,bearing mostly silver,itself soon petering out,as regards both fissure and contents;while the Fortuna continues down into the earth as a well-defined fissure marked mostly by strong alteration,a feature notably absent above,where alteration is so slight that flat stopes ~~Sat~~ stand open over large areas,with no sign of weight on the few old timbers.

The Fortuna bonanza was richest where the younger veins intersect it,though rich ore was found not alone on these lines,and it does not appear to have been essential that the bodies in the later series should extend down to the Fortuna. Rich zones have been found on the Fortuna equally up and down the dip from the intersections. In all cases seen the Fortuna retained its flint-like frozen qtz,and the younger veins their banded,more porous qtz. Crossings perp.to the vein walls mark lines of demarcation between rich and poor material.

ORE HORIZON. VERTICAL RANGE OF ORE.

Bodie, Calif. Fortuna oreshoot bottomed at about 760' vertically below Collar of Bodie shaft. Other veins said to bottom at about 500'. (Irelan). Veins ramify on reaching the so-called recent volcanic breccia covering the surface; if latter is really post-mineral as claimed, it seems probable that the bottom of this formation represents nearly the original top of the ore, as stopes are mentioned coming up to the under surface of the capping with ore giving out due to the ramification. (Irelan).

Practically all the sources indicate a decided regularity in the bottoming of the ore in the different veins: all (except apparently that on the Fortuna) bottoming above 500' below the general surface.

The Fortuna bonanza extended from just below the Bodie 200 to the 780, i.e. about 580' vertically, or 1160' on the dip. (Irelan).

The Vein System of the Standard Mine, Bodies, Calif.

R. Gilman Brown: Trans.A.I.M.E. Trans.38(1908), 343-357.

These separate from the main mass of the foothill complex (O) the W. N & E but fun've is rooted into complex

Production. $14,500,000, 1879-1908; $5,000,000 dividends. Came from above 1000' level from more than 100 veins, 0.5" specimen rock to 30' clay and qtz., distributed thru a zone 2000' wide, representing 3-5 distinct periods of formation.

General Geology.- In an island of Tertiary hbl-andes. surrounded by complex of igneous rock and breccias. At summit of E S.N. foothills, within the Great Basin a few miles from its W edge, marked here by Mono Lake. Ave. OC elev. 8700'. Andesite ~~Island~~ Dikes from 50' to 1000' and greater 12,000' N-S, 5000' wide, reaching extreme ht. at N end of 1000' above adjoining small canyons. Standard mines in center of ~~island~~. Standard wks.- Bodie, Mono, Lent shaft, on S; Bulwer-Belvidere, on W; Bodie Tun & Tiega. on N. Summit on Harrington tun., on E

Outcrop.- Large blocks flinty low-grade qtz.; large albite xx float. In upper workings large albite xx associated with qtz.; s.t. albite xx mere shells studded internally with fine qtz. prisms. Gold panned from mixed specimens qtz-flds.

Vein System.- Oldest Fortuna; ~~Incline~~ Burgess youngest. Order of yield: Incline, Fortuna, Burgess.

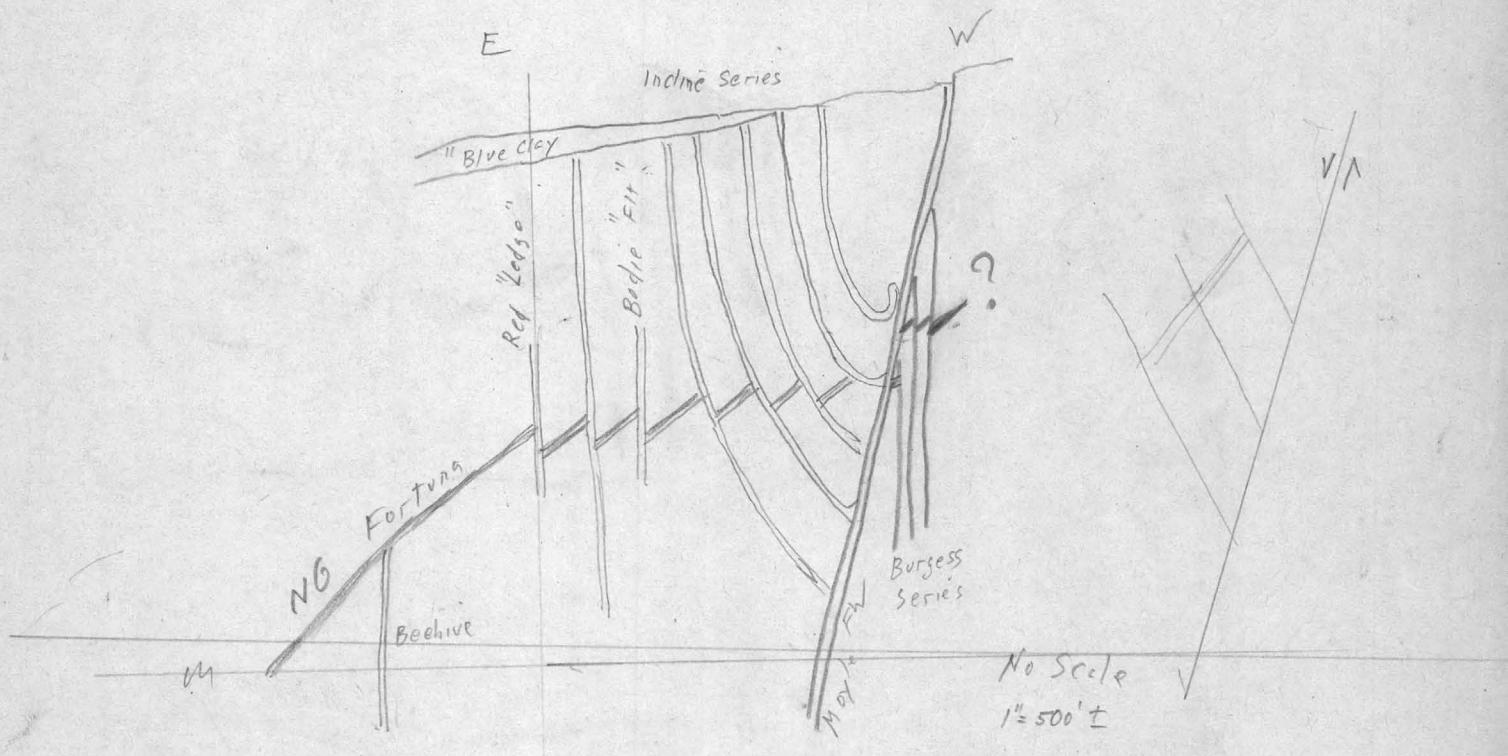


Fig.1: Cross-section of vein system, Standard mine. Complexity caused by faulting of Fortuna system by each succeeding one increased by divergence in strike, which makes of each disjointed vein segment a polygon that is far from a parallelogram. Incline system in HW, Burgess in FW of strong fault, the Moyle FW. "Red Ledge" or "Red Vein" and "Bodie Fault" are dikes, probably andesite.

Fortuna ore hard, flinty, s.t. bluish, qtz., frozen to walls. Bullion highest in Ag. Incline, less coarse Au, low in Ag. Burgess, very cse. Au. In both the Incline and Burgess, qtz. well-banded, sharply separated from walls.

Fortuna Series.- Strong fissure, s.t. accom. by andesite breccia on one or other wall or partly silic. in vein, as if mineraliz. had followed line of an earlier dike. Fortuna and Beehive only productive vein of this series; latter gave richest ore of mine. Fortuna strongest fissure of mine; but down dip Au decreases, ZnS increases; Ag diminishes to a few sparse patches of wire in masses of dirty bluish-white clay. Beehive drops from Fortuna near lower bdry. of Bonanza zone. Only a few inches wide, cased in hard rock, extremely rich in Ag, worked 150' down. In bottom dwindled to mere marker. Fortuna bullion carried $10 per oz.; Beehive all silver, peters out; main Fortuna continues down as well-marked fissure with extensive WR alteration but low-grade, whereas above the flat rich stopes still stand open.

Fortuna explored below Bonanza zone by 3 levels & connections passed barren for greater distance down than above. This proved Fortuna was productive

Bonanza region of Fortuna best developed and richest where veins of other series intersect it, altho' rich ore found not on these lines. But Fortuna always yielded fine ore at zones of intersection with Incline and Burgess series, when those veins carried OBs above, whether the junior vein did or did not extend to Fortuna horizon. Rich zones found on Fortuna equally up or down the dip from the intersections. In all cases Fortuna retained its flinty frozen qtz., the junior veins their banded, more porous qtz. But as stated rich ore found on Fortuna 100' or more from any vein-crossings, e.g. in zone above Beehive, E of any profitable veins of Beehive series.

This generally acted upon after Bodie-Standard consolidation. Fortuna recognized as scarcely within Standard mine. Knowing the Sline = vein = compromising its seam white qtz. it under strike would bring OBs then being worked on Burgess & Mg wire veins - drift started, found ore.

Internal crossings or fractures appear to be confined to the Fortuna vein, and to lie about perp. to the vein plane. Ore stops on these.

Fortuna profitable zone 1000' long; to NW, vein never identified N of Standard shaft; to SE it extends far past Mono shaft into decomposed andesite.

Incline Series.- See Fig. 1. Values fade out at 500' horizon; but appearance persists, as Gildea, 700' depth and below Fortuna. Many of the series end at shallow depth at Moyle FW. Moyle broken zone 10-40' thick; and Incline veins curled up on fault zone in masses of broken qtz.; but there are no Incline veins below the Moyle.

Two types Incline vein-filling: (1) massive, beautifully banded flinty qtz., s.t. firm., s.t. badly cracked, but always with red ocherous clay, possibly derived from wall-attrition in felspathic rock. Clay has fine sharp chips of the same qtz.; values in clay come from chips. Both walls are rarely well-defined in Incline veins. Examples of (1): Main Standard and Incline veins. (2) Less clay; well-banded, rather porous qtz., notably soft, at times crumbly, as if crushed by wt., not attrition. Bullion vein, very near Incline. Had Bullion existed at time of Incline, it could hardly have escaped grinding on its walls; no such grinding. Bullion later.

Pay m

500' is max. pay depth for Incline veins; ave. bottom 400'. Ore shoots parallel each other in Incline vein system.

(2) veins has small "enricher" veins branching off, generally into FW; extremely rich, yielded half-ton per man per month; s.t. followed 100'. The very low-grade (2) series veins have been enriched by "the later formation of small high-grade seams in their mass" (p 372). Enrichers s.t. branch out and up into the CR. Smallness and high-grade (as well as orientation, probably-E.W.) suggests enrichers belong to Burgess series. But they lack Burgess coarsness of gold and type of qtz. Further,

they accomplish no noticeable faulting. Hence may be 3rd group of Incline series. Note: Not all (2) Incline veins owe their richness to the enrichers.

All Incline veins dip W;ave.width 14-20". Walls good, well-defined. Near veins andesite well oxid.,unlike andes.near Fortuna,which even at high levels ans where well decomposed shows bright py. xx.

Albite xx mentioned found near surface in Incline veins. Bullion vein 260' lev. showed full width crystal. calcite.

Burgess Series.- All below Moyle FW.(Except possible confreres, the enrichers). Small, nearly vert.fissures,slightly banded structure, at times comb-like on an axial line;often with a rich scale of harc qtz. frozen on one wall. Dried clay on one wall,mixed with sand;shows as films,1/16", attrition product? Unfailing marker for rich ore.

Wall rock of Burgess veins notably less oxidized than that of Incline series-below Moyle. Burgess veins so rich that 1/2" stoped. Burgess bonanza,Bodie 300' level S of Standard line-values some distance out in CR. Coarse gold in the "porphyry". Mined 12' wide;only 30' above the Fortuna vein.

Angular andes.frags.cem.by qtz. Andesitic breccia,like that found in one of the walls of the Fortuna,shows in Burgess veins;s.t. contains chips of basic trap not found in neighborhood.

Incline "pay area" included between vert.planes 3000' apart;Burgess pay area,between E-W vert.planes only 600' apart. 1000' on Fortuna profitable.

Moyle FW.- On surface as 12' scarp W of Standard shaft;here ground has settled into the big stopes. Scarp 1500'. UG,fault has rolled up edges of veins that butt onto it into big arches of crushed ore.(Fig.5) Moyle dies out in the dead zone to the N;not known what happens to S; intersection with Fortuna, which it must fault, not identified (? see Fig.1). Moyle may have had gyratory motion. Possibly followed some other vein in crossing Fortuna But could not have had extensive displacement.

Dead Zones.- Two E-W dead zones crossing andesite ridge:1 south of Mono shaft,the other 2500' N of this,850' N of Standard shaft, Both outcrop as depressions on W slope. UG they show heavy decomposition of CR (cf. Sta. Ana);contain no ore, most veins deteriorate to mere discolored seams.(Pre-ore alteration-cf. Real del Monte). Fortuna explored for long distance in S dead zone;shows gypsum. Brecciation,but no qtz. Vein fractures antedate Fortuna;"the fact that the Fortuna and other fissures weakly enter the zone is what would be expected,for no fissure or line of circulation could be conceived as staying open in a pulpy mass such as this is today."(p.356).

Beyond N dead zones veins come in again with good value;but lost identity in transit,and reversed their dip;other character.same.

Dikes.- No effect on miner. Red Ledge,decomposed breccia.4' wide, red.

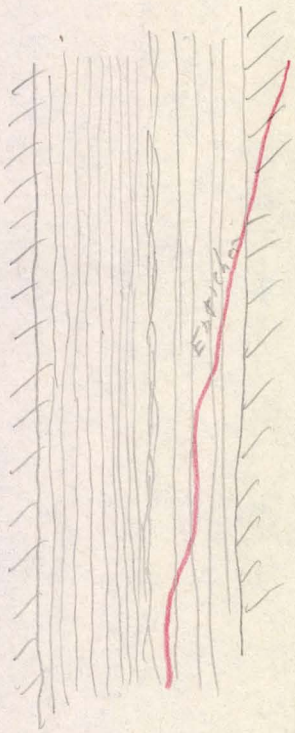


Fig. 4

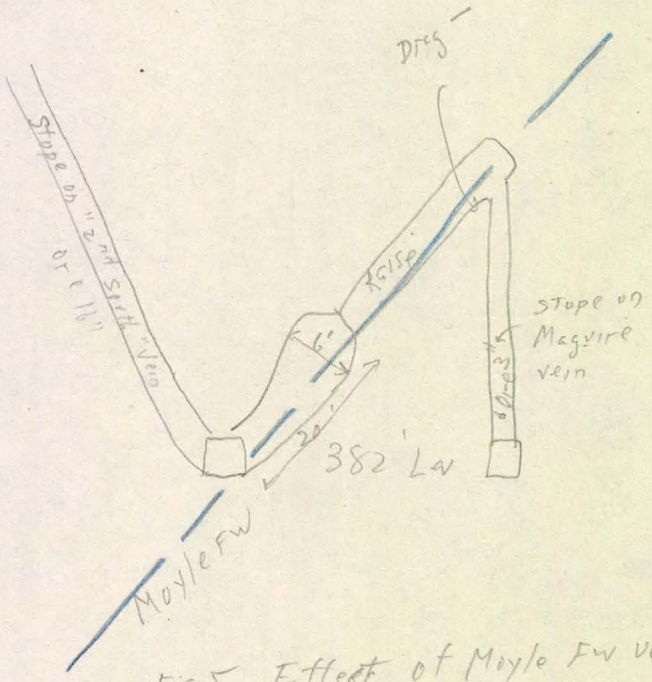


Fig. 5 Effect of Moyle Fw V6.

BODIE GOLD-SILVER DISTRICT, MONO CO., CALIF.

Source Data:

1. 8th An.Rep't State Mineralog., 1888.Wm.Irelan Jr. 382-400.
2. Geology of the Bodie District, Calif. R.P.McLaughlin: MSP 6/22 '07,795-796.
3. The Vein Systems of the Standard Mine,Bodie,Calif. R.Gilman Brown, Tr.AIME 38(1908) 343-357.
4. Report by D.H.McLaughlin 7/21/31.
5. Conversation,maps etc. F.Frederick.Accompanying surface map by Frederick.

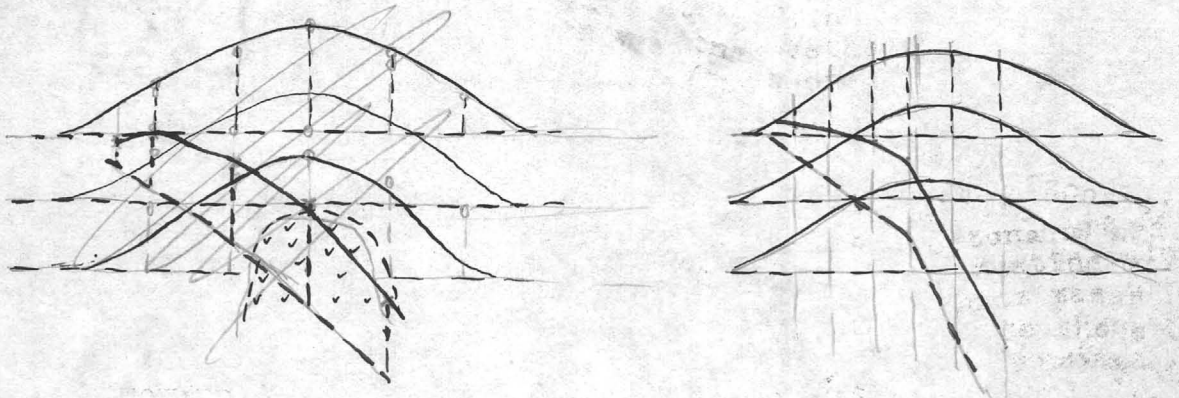
Rock Formations.- The stratigraphy has not been satisfactorily workedout. Beyond question are the recent basalt flows and agglomerates originating in the Beauty Peak volcano,some 6 mi.NNE of the town of Bodie, and the Pliocene? Bodie Mt. andesitic flows with intercal. agglomerates. The flows are porphyritic with coarse feldspar phenos.; the groundmass is some times glassy. The formation is several hundred feet thick and originated at Bodie Mt., 3.5 mi. E by N of the town of Bodie. The Bodie Mt. formation is thought to be post-mineral because no mineralization is seen in it; but from considerations advanced below,it is likely that the formation is pre-mineral,hence the mineralization is also.

L.B.Wright, Oscar Hershey and D.H.McLaughlin all differ,in various ways,as to stratigraphy and structure. Regardless of the true stratigraphic section,the rocks mapped underlying the Bodie Mt. formation are of only two (unaltered) types: (1) agglomerate,0-300'.Andesitic,with fragments to 4" but rangesin places almost to tuff of the grain-size of sand. (2) andesite;no bedding seen. Fine-even-porphyritic with aphanitic groundmass. The age of these rocks is probably Miocene.

Frederick thinks there are two flows with the agglomerate between them,but the structure as shown on the accompanying map and the FF sections thru Bodie Bluff and Standard Hill suggests only two formations, the agglomerate ~~on top with flows beneath~~ as one or more large lenses in flows. The lower Red Cloud levels show tuff intercalated in the flows. Hershey thought general dip to SE,with lowest formation (basal andesite) at NW end,overlain successively by purple or lilac tuff and by Bodie Bluff andesite,and with a Queen Bee andes. in SE end of district at top of column. Wright agreed on basal andesite up through Bodie Bluff andes.,but thought Queen Bee same as basal and that the basal andesite and the lilac tuff band (probably FFs lilac agglomerate) oytcrop in a band surrounding the district:bowl structure. McLaughlin agrees that Queen Bee and basal andesites are probably the same,but do s not know whether they lie at top or bottom of section;thinks evidenc is definitely opposed to bowl notion,and sees no evidence against a dome stru cture with basal-Queen Bee andes. as uppermost formation. FF agrees with this.

Structure. Frederick sums up the structure by saying that Sugarloaf is the "stem" of a general N-S uplift of the range, an uplift which includes the Bodie Mt. series (Pliocene?). For the Bodie Bluff and Standard Hill area, the map and 1st two sections confirm this; uplift is shown by the attitude of the agglomerate, and strongly suggested by the longitudinal faults and fractures, fan-like in cross-section, and by the in-faulted graben of agglomerate in the Bodie Bluff vert. section, and the Incline series of antithetic faults, Standard Hill vert. section. South of Standard Hill (Red Cloud vert. section) structure less clear, probably more faulting than shown; but in a general way, the uplift appears to continue past Sugarloaf.

The earliest fault or fracture is the Fortuna, which is oriented like a marginal thrust with reppect to the Bodie Hill portion of the uplift. The displacement on this fault is not known; but descriptions show that ore on the Fortuna was confined to the upper horizons (above the 600' level-see Irelan section), where the dip is flat, and that below that level, where the dip steepens, the Fortuna is barren, it is a sheeted zone showing strong slickenside and striae in highly altered rock (pyritized clay). This suggests zigzag control on a thrust fault; if as D.H.McLaughlin suggests, some of the Bodie andesite is intrusive, then if anywhere the core of the Bodie Hill uplift should be intrusive, and the Fortuna a marginal thrust. Both its divergence in strike and the fact it is antithetically faulted divorce it in immediate genesis from the Moyle FW and the antithetic faults next to be described. The productive horizons of the Fortuna are so flat that it seems difficult to visualize opening by thrusting along this part (although from the descriptions, the Fortuna quartz was probably largely replacement: "flint-like, frozen" in contrast to the banded qtz of the younger veins; nevetherless comb structure and drusy cavities on the Fortuna suggest open-fissure filling in places);



If the Fortuna had originated as a marginal thrust, flattening toward the surface (it would shoot out flat toward the nearest base of the uplift, if the latter were then incipient-this not shown on section) then continued reverse movement would make a tendency for opening in the flatter segment, and the increasing doming would make the segment flatter and flatter, hence continued opening-checks with Fortuna mineralized sheeted zone. Finally the segment wouldget too

flat and opening would cease due to gravity-failure of the bridge.

But meanwhile the stretching of the skin of the dome has induced graben formation along the crest of the (elongated) dome. The Moyle fault forms on the NW border of the graben zone, and a fan-shaped pattern of longitudinal fractures-cross-joints with respect to the arching visible in NW-SE section. Apparently uplift was asymmetric, stronger along the NW fkank of the elongated dome.There is some suggestion of this in the sections through Bodie Bluff and Standard Hill (attitude of agglom.) but the chief evidence is the dominant Moyle fault and its antithetic satellites,the Incline series.

In H.Cloos' experiment on graben,(Ref.:) he showed horizontal stretching unaccompanied by doming;here the graben block moves down,the footwall abuttments remain stationary. But with graben on the crests of uplifts,it would seem that the abuttments should be the active moving blocks,while the graben block might remain nearly stationary with respect to a horizon above sea-level.Friction along the graben faults would set up feather joints or complementary shear planes in the graben block,probably feather joints if the block were competent and did not flow.As active uplift continued in the FW abuttments,a zone of plastic flow ("fault drag")would be set up close to the fault,where force vs.friction would be at a maximum and the feather joints within this zone would show strong "drag".

The accompanying Tectonic ~~Chart~~ sketch compares Brown's Standard Mine section with H.Cloos original graben experiment,except that the latter has been turned upside down to correspond with the FW being the active block.Here lack of flow in the inactive block induced feather joints rather than antithetic shear planes(since the latter go with rock flowage)These joints are unrotated away from the syntheic fault,but within the limited zone of plastic flow,they are "dragged". In contrast, the antithetic faults within the active block have their pivots of rotation right on the plane of the synthetic fault,and these joints are rotated throughout their length. This distinction seems the best so far obtained for ~~xxxxxxxx~~ distinguishing the active from the inactive block.

As shown on the Standard Hill section,also that of Brown and that Irelan, these antithetic faults (they became such through their totation,and solely from that reason) fault the Fortuna vein and the ~~wole~~ beds (Standard Hill section).As suggested on the Standard Hill section, some of these antithetic faults ~~may~~ be complementary shear planes.

Mineralization continuedduring the antithetic faulting. The earlier mineralization, on the Fortuna was relatively high in silver and low in gold. The antithetic faults or Incline series carried gouge but also comb quartz;these veins are relatively higher in gold. Finally, presumably after antithetic faulting ~~had~~ possibly in part because the faults were sealed with quartz anduplift was diminishing, a series of tension joints, parallel to the axis of the elongated dome,and forming the W side of a fan structure,formed in the FW of the Moyle fault. (Standard Hill and Brown Sections). These show comb quartz and no gouge; they carry relatively the highest gold (free) but still some silver. This is the Burgess series. The metallization on them is believed to be the latest,but since according to Frederick,some of these fissures cut the Fortuna, some were cut by the latter,it seems likely that the

R.P. McLaughlin says the Bulwer veins are in "very solid country"

Burgess fractures are part of the original fan pattern of cross-joints, which according to Balk are among the earliest fractures connected with intrusive uplifts, to form; but they were not much opened until formation of the goggy Moyle fault gave them the Foeppl effect (see especially Brown section).

As shown on the plan, the Fortuna vein meets the Moyle fault at an oblique angle, near the south end of the Standard mine. It is not clear from the data whether the Fortuna was ever positively identified in the Moyle fault footwall; Brown shows it thus in his section, but the displacement he indicates seems too small for the Moyle fault; ~~and~~ ~~but~~ he says the Fortuna was never identified north of the Standard shaft, hence if it was found in the Moyle fault footwall it soon died out to the NW, as a vein. The result of this is, the Fortuna was one of the main producers in the Bodie mine, together with the Burgess veins; while in the Standard mine on the north, which the Fortuna hardly penetrated, the Incline series were the productive veins. The plan suggests that Bodie Bluff, north of the Standard mine, represents the apex of a cupola on the crest of the main N-S uplift, and that the Bodie-Bulwer mine lies on the south side of this cupola. The graben is dying out to the south here and the antithetic faults become less numerous andless rotated, as is shown by comparing Brown's Standard Mine section with Irelan's Bodie mine section. The Beehive dropper, a vertical thin high-silver vein in the footwall only of the Fortuna, (Irelan section) marks the end, down the dip, of the Fortuna bonanza. It was probably the channel up which the silver solutions ascended and is quite likely a tension fault openedby Foeppl effect beneath the Fortuna, which had, if not gouge, at least a clay casing caused by early HT alteration.

The later, gold mineralization on the Incline veins locally enriched the Fortuna, for Brown says the Fortuna always yielded fine ore at intersections with veins of Incline (and Burgess?) series where those veins carried OBs abobe, whether the junior vein did or did not extend to the Fortuna (presumably the vein-fracture did descend). The rich Fortuna zones extended about equally up or down the dip from such intersections. However, rich ore was also foundon the Fortuna well away from any vein crossings. On the other hand, the Incline veins in their turn, according to R.P.McLaughlin, are said to have been enriched at their crossing with the Fortuna, and not to have carried ore below the Fortuna. Referring to the tectonic sketch, there would have been a tendency toward "normal" fault movements on the Fortuna, and this might well have openedup the Incline veins near the Fortuna (R.P.McLaughlin says "Most of the veins show a banded structure and displacements of the bands show several enlargements of the fissures since the ~~during~~ primary deposition,")

Within the Fortuna quartz, small fractures which appear sympathetic with the Incline series have localized ore.

The shoots in the Incline veins pitch south (R.P.McLaughlin); they parallel each other (Brown). This may mean that they occur within a distinct zone trending across the Incline series, possibly perp. to the strike. Referring to the map, which shows approx. position of Fortuna bonanza, a focus of mineralization near the Standard Old Shaft is suggested; possibly the solutions rose from this on the Fortuna or up the Moyle fault. As shown on section thru Sandard New Shaft B-B', this

epicenter is under the very apex of the uplift.

Brown shows that the Incline veins themselves have "enrichers", very high-grade, usually in the FW; these are oriented like the Burgess veins, and are feather-joints off the antithetic faults, oriented so that their planes contain the axis of uplift. The Incline veins carry albite in their gangue.

The Burgess veins, according to Brown, are a breccia of angular andesite fragments cem. by qtz.-confirms their joint-like nature-walls separated.

True banding is best developed at the extreme N end of the district, where the veins form a fan-no graben or faulting-simple fissuring

The Incline series, and apparently especially above where they are dragged into antithetic faults, are often mineralized sheeted zones-see Balk, cross joints. An apparent sheeting in solid qtz may be as explained by McKinstry: replacement of sheeted rock. The veins are in part replacements.

The fact that the Burgess veins show no drag by Moyle proves they are latter than movement on Moyle and later than Incline veins. Checks explanation above. These veins very little oxidized-did not reach surface, stopped under Moyle gouge.

The Incline veins shown on the Standard Hill section, according to Frederick, petered out above, where the antithetic faults along which they made entered the agglomerate, and showed, in the agglomerate, nodules of chalcedony indicating siliceous hot springs. Hence the top of the ore bodies must have reached within a couple of hundred feet of the then surface. The agglomerate was a trap.

BODIE DISTRICT, MONO CO.CALIF.

Abstract: Report by D.H.McLaughlin, July 21, 1931.

Visit July 14-18 inclusive.

Four possibilities for an ore supply tested: (1) Dumps;(2).low grade in Bodie Bluff and Standard Hill where ground between old workings has stringers in sufficient abundance to justify hope for large tonnage. (3) ore beneath old stopes on known shoots and in new shoots in the S end of the district;(4) new shoots on veins in central part of district where little mining done.

Summary of Results to Date.-Mainly concentrated on 1st 3 possibilities. Some surface work in central area. Dumps:326,000 tons ave. $1.86 Au,main Standard dump; 37,000 tons milled, checked grade,low cost,but only 50% recovery. Low grade:results to date of sampling show top of Bodie Bluff non-commercial; on S side Standard Hill,shovel cut 190' long, 40' wide ave. $0.79. Cross-cut samples show zones of rock along veins probably ore,but separated by wide barren zones. Central area between Moyle fault and Standard vein most promising,not yet tested.

Exploration in S end of district discouraging. 16,000' development, mostly 700' level Red Cloud mine. Four small OBs found,produced 6647 tons. No ore blocked now. OBs in S end rarely reach 700;shoots that do exist ther spotty and small. One face now runningS on 700 to get under workings on slope of Queen Bee Hill, one face going N into central part of district beyond the Oro mine.

Exploration in Central Area.- 2000' stretch of lower ground along the main ridge. Little evidence for ore here. Power shovel cut long trench showed a number of qtz stringers carrying a little gold. Detritus mainly on surface. Abundant qtz.float along a few poorly defined zones. Gold can be panned in a number of places,but app. no systematic distribution of values. Workings from the N mainly followed veins until discouraged by lack of ore. Mono fault,E-W? Said to have cut off veins (but not ore) but data vague. Workings on one level in Oro mine terminated on the north against a fault trending east. Central area crosscut with max.back 174' by the long Aurora tunnel,and along same general line by crosscuts from Goodshaw shaft at several levels;longest, 620' east-west crosscut, 450' lev. No ore app. found. Two veins cut in Aurora tunnel,one followed sev.hundred ft.App. no ore found.

Rock at mouth of Aurora tun.andon dump of Goodshaw shaft a firm andesite closely resembling rock on Silver and Standard hills. Elsewhere thruout Central area soft white rk. exposed,indistinguishable. Hershey thinks this overlying firm andesite,which he presumably correlates with Bodie Bluff andes. to N. Latter wall rock for mostof northern OBs,and possibility of its existence at depth in Central Area main reason for exploring there,at depth. A drift on 700 Red Cloud has continued benath old Oro workings,now ready to continue into Central area, by continuing the drift in direction effectively to crosscut the ground. Face now in bleached tuff;recently crossed broke H_2O zone,probably fault at north side of Oro mine. Muck must be hauled 1600' to Red Cloud shaft. Heavy pumping, bad ground.Adequately to explore central area requires 2000' drifting and crosscutting. Should get more dope from old workings

and more precise knowledge of rocks and formations before spending the $50,000 indicated.

Geological Considerations.- Both Hershey and L.B.Wright assume Bodie formations consist of sequence of thick layers of flows and tuffs, slightly bent and intensively faulted into mosaic of blocks. Both think a distinctive por.lava, locally glassy,lowest exposed member. Hershey m makes formations to SE successively higher,and has a Queen Bee andesite at top of column.Wright agrees with lower Hershey sequence(basal andesite,overlain successively by purple or lilac col.tuff and by the Bodie Bluff andes.) but thinks basal andesite and lilac tuff OC in band surrounding the district. He therefore thinks basal andesite and Hershey's Q.Bee andesite the same. McL. asks for microscope but is inclined to think also that Q.Bee and so-calledbasal andesite the same;but he doesn't know whether this formation is at top of bottom of section. Wright considered it at the bottom,making structure bowl-shaped with layers dipping toward center. Evidence seems definitely opposed to this."Indeed, I have not seen any very positive evidence which rules out the possibility that the original structure was more or less dome-like,with the surrounding rim of locally glassy andesite (Mr.Hershey's Queen Bee) and basal andesite and Mr. Wright's basal andesite),as the uppermost formation."

Flts N-S roughly parallel to main veins,also number of strong cross-flts. Can hardly see any cross faults,nor can any one dike or vein be positively identified on either side of any fault, to give displ. Recommendations for deep devel. in S area andin central area based on theory Bodie Bluff andes,host rock for main OBs in N area,will be found at depth, and weak veins near surface would improve in BB andesite. Soundness of this depends on (1) accuracy of formation correlation,correcness of determination of nature of formations, whether flows, tuffs,breccias,either pyroclastic, contact or fault, intrusives, and (2) on structural accuracy.

If correlation of basal ande.with Q.Bee andes. holds a different structural picture holds,whether this formation proves to be an upperor a lower unit. Possibility that the andesite which forms such a large part of the rock in the heart of the district is intrusive not considered. Hershey thinks his Silver Hill andesite is an upper flow,above BB andes. and above a white rk which he thinks a distinct formation above BB andes. The Silver Hill andesite is massive, fairly uniform,porphyritic,with zoned plagioc.phenos,fairly abundant bi,very sparse qtz in light gray to gray green matrix.It extends from N slopes of Queen Bee Hill at least to Silver Hill and is main rock exposed in extensive Red Cloud workings and other S mines. Bottom nowhere exposed, Red Cloud shaft,880',does not get thru it;same andes.shown in winze on 627 OB below 700 lev. Further, this seems same rk as that on Standard Hill just NW of Standard dump, called the BB andes. The rk to the N on top of BB itself somewhat different but could be part of same intrusive mass. He understands deepest Standard workings in same rock.

White rock,which forms major part of surface in Central Area,is called a distinct formation,above BB andes.and below the Silver Hill rk.

to the S. White rock an altered andes. very similar originally to rk. on Silver Hill and on Standard Hill. Graduation from solid fresh andes. to white rock, soft,can be seen. Same thing shown in Aurora tun,which starts in massive fresh andes. and gradually passes into white rock identical with rock forming surface to the west,in which the Hershe shovel trench was dug. Change prob. due to introduction of sericite,fg silica and some dissem.pyrite. Alteration esp. notable where oxid.has been thorough and where sulphuric acid from the py.has kaolinized the felds. This type of alt. probably not confined to the massive andes;it may also affect the tuffs;but the white rk where studfed was always altered andes.

Hence possible thats small stock in Bodie district; all profitable veins in it. Practical appect:if andesite intrusive, no deeper formation will be met within range of mining. Hence no improvement in depth of veins, for no different formation.

Rich ore mined from veins in almost fresh andes. in places,but usually rock bleached in a zone at least a few feet wide along the veins,Where bleaching most extensive and rock softened by kaolin,vein usually barren. These relations probably linked with sequence of alteration and mineraliz.

In central part of Standard Hill surface composed of bleached rk.Said that the veins between W-dipping Standard vein and the E-dipping group near Moyle flt. were not productive on the upper levs.in this rk.,but became ore-bearing when followed down into more solid andes.Has been assumed that this overlying rk.was a different, less favorable layer,and that the ore was confined to the deeper BB favorable andes. Mebbe so, but white rk. in Central Area merely alt.andes.,altho of coursefirmer andes. may be met with and it is possible insignificant syrface veins may improve in that.

Asks for microscope and detailed,recorded geology,especially details of vein structures, which he thinks may be better guides to ore than general notions on favorable rk. layers.

Body mineraliz. shallow type,seldom persists to great depths. Main ore shoots sub-ore at from 400' to 900'. Thinks ore bottom still in same andes.failure in depth cannot be blamed on rock chance.1200' depth Lent development saidto have found no ore. Small spotty shoots on 700 McCloud.

Red Cloud Development.- 608 shoot on vein NE of Red Cloud shaft;in Red Cloud vein zone,but not known on what branch. Small; follows intersection of main vein(dip 58E) and a small vein coming in from HW with NE trend and steeper dip.Rake of ore seems to be N. Heads ave.$8.15.

Red Cloud vein seems to pinch out, 700 lev.N. Concordia vein,as seen in drift S from shaft X-cut, 700 lev.,is barren calcite.On 400 lev. shoot was 400' long,dropped to 170' on 450,because bottom on the N side raked flatly S. S part of stope continues almost to 700 near Noonday wze,and app. ended against a flt,almost parallel to the vein,which seems to pull it apart. 700 here shows strong fracture,much go and drag vein matter.Noonday wze (old) goes 100' below 700,picking up vein there in E X-cut. This app. is vein segment below the flt.

Best 700 ore is on E-dipping branch of Noonday vein. 120' ave.$122 Au 53 oz.Ag,3.5'. But producedonly 3200 ton ave.$11. Triangled out at 150' below 700. Stope ends above 700 where dip steepens and stringers with usuall Noonday dip come in from E side. Vein dips E above 450,steepens to vert.,then turns and dips 70W at ore shoot mentioned, 700.

Work on Standard Hill & Bodie Bluff.-The massive andes.on Bodie Bluff is locally brecciated & has numerous qtz veins on blocky fractures as well as on a few stronger fractures parallel to the general trend. Open pit possibility. Ave.grade 300 samples area 250 x 350',$1.40.Samples from qtz stringers and qtz float. These 5% of rk,so whol would ave. 7c.

Standard Hill,west side,firm rock with many veiblets forms bluff in FW of Moyle flt. (Deep debris E of Moyle).qtz float andfrags of sil.WR abundant in this debris. 190' cut ave.79c.

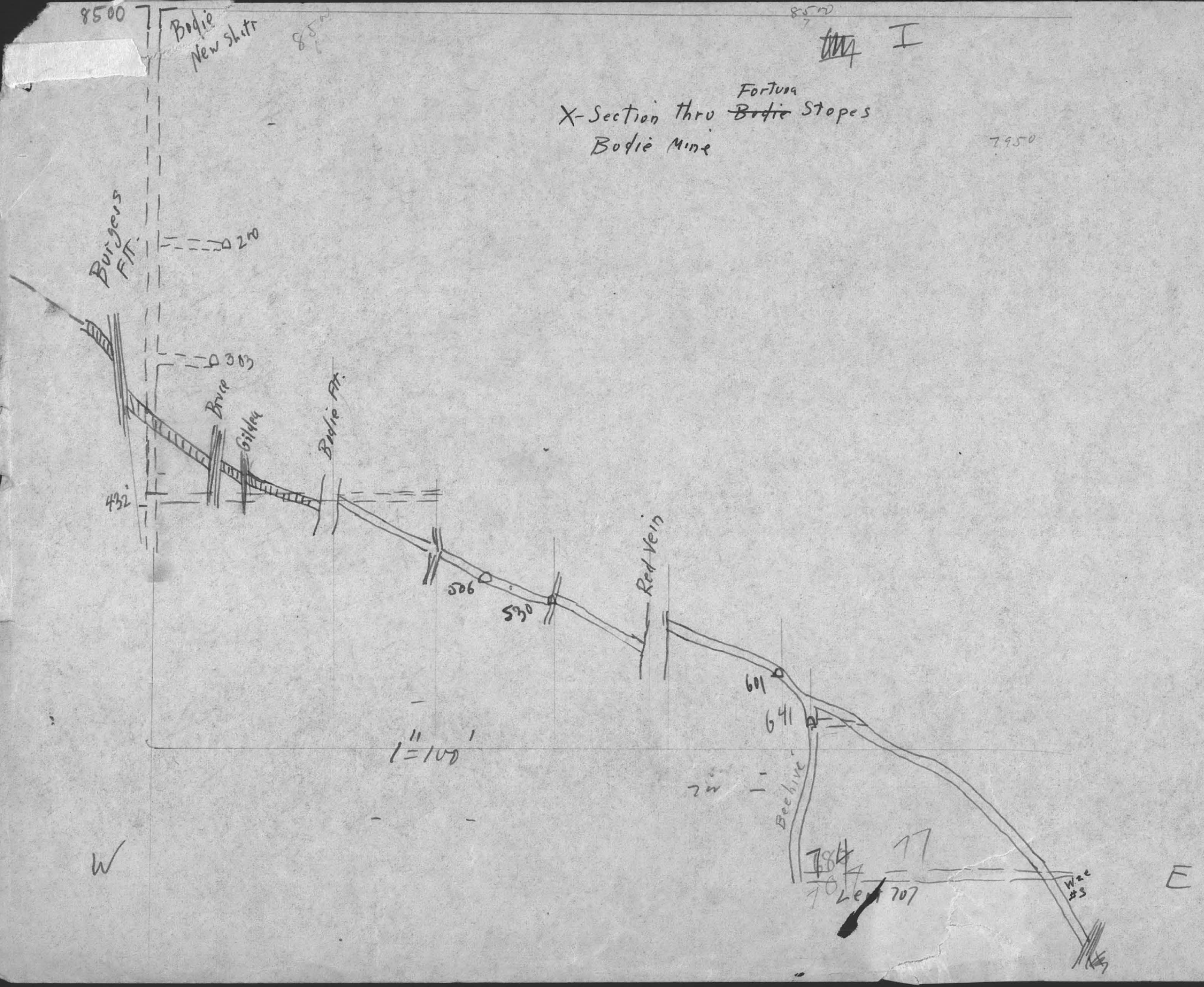
Conclusions.- Does not accept former work etc. Thinks his picture more in accord with evidence he saw. Needs 6 weeks to 2 months detail wk.

HERSHEY'S COMEBACK July 31,1931.

McL overlooks,in intrusive argument, fact that in Red Cloud wkgs tuffs occur under Silver Hill andesite at surface,indicating SE dip of layers.

I

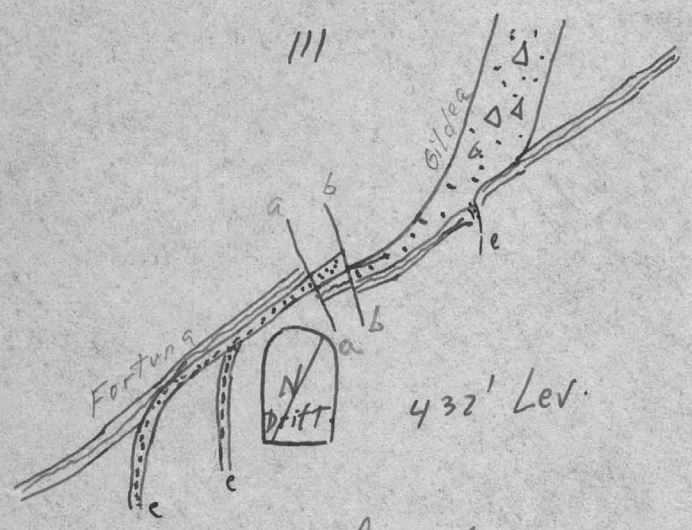
X-Section thru ~~Bodie~~ Fortuna Stopes
Bodie Mine



(E) Wkgs from East shaft, Sunk jointly by Bodie & Morno Cos., 1000' E of their old shafts, Fortuna vein seen again at several hongins below 644' level, where East shaft cut it. At such places recovered by X-cuts, after series of flts gs, some with 50' throw. Found again, 1200' lev. East shaft. Dip steeper than in upper levels.

In these lower levels qtz only in small isolated bunches & veinlets; these s.t. rich in Au Ag but --. But pressure always = thin, ∥ sheets of alt + rk & clays, impreg with py XX & shining, polished, striated surfaces.

the Jnt. vein at that place. Gilden qtz sugary, ashed with Δ & ST O WR. Jnt. had. fnt, pyg to walls — comb. stuff. Gilden follows J for 20' — dip — took line least res. — also where yop. tools flt. Jnt. in Rattlers Bonanza, some gouch at of these elsewhere in pyt. this never, quite barren vein, but. a few above & bel. the other vein.



Fortuna Fizen, comb-stuc hard white XX qtz — few gouges.

Miss — nat. argentif Au, Ag nat., cerargy., argentite Py mag & FeOX. CCpy & Cu ox — Ag. often cryst. Both Au & nat Ag dep in thin, loosely adhering leaves wpm, & held between apices of qtz XX filling drusses in the vein. Pyrg. in the very Rich Va, below 670' Bodie.

Du Oro, addenda etc S of Bodie, steph & pyrg. abund. in add. to usual nat. — These also in Jnt. vein farther S, in Mono workings.

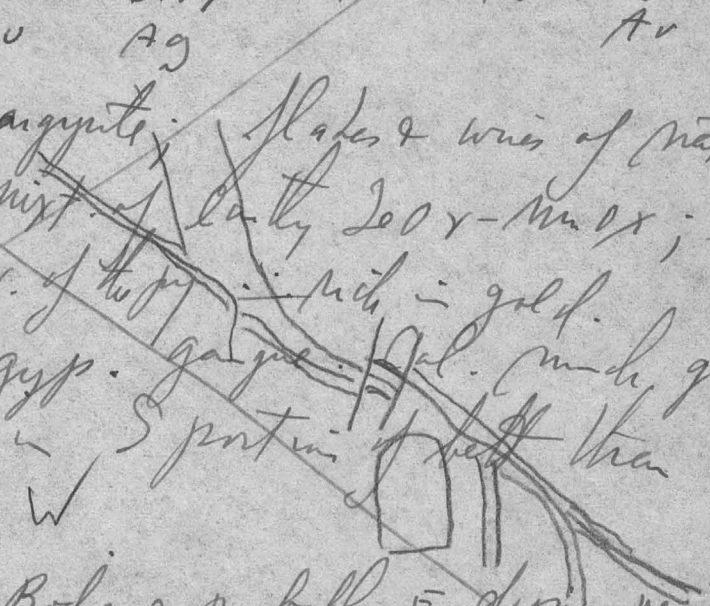
Strangely abrupt termination of Jnt. Bonanza just below 60' (64'?) (6th incline) lev. See plate I. Wing 23' deep — (narrow (1"-1") vein left FW of Jnt. steep vein. Place of pay only in HW of Jnt. In alt. this vein ∥ ± to Jnt. vein described. (100' E of Jnt vein) This vein was & seemed to drop abruptly from the Jnt. FW of whose bonanza it formed the crown. — Jnt. flattens down dip from this vein. WR thinly sheeted either side of this FW split, & 1' each side of this narrow qtz vein, nat. Ag pockets & wires. This small vein broke up in to seams below 784' lev.

L 6 15.

Qv-Ag - younger ser. 1883 Standard Ore

1.65 : 3.14 "Nat. Au" = 675-305
Au Ag Au Ag

Ag - Arg., cerargyrite. flakes & wires of native
magnet. mixt. of early low r-mn ox; ± py.
Magnet. from higher ox. of the py. rich in gold.
QTz, ± cal, ± gyp. gange. Gal. much greater
in Monday etc. veins S portion of belt than in Bodie
& Stand.



Older Series - Int. of Bodie & probably E-dipp. veins
Addenda, Paris, Lucerdia, Monday, Red Cloud etc. along central
& more S parts of the Bodie belt. Higher rel. Ag than younger ser.
Au loses rel with depth. But structurally same type as younger veins
Strike ± W of N, dip E 30-50°.

Int - 1st cut in Bodie shaft, 40' bel. 306. 432' lev. x-cut N6
cut vein, 125' E of shaft - Rich thing N 10° W, 30° E, min. to 45°
below 600' lev. Ave. width > 2', often few". WR enriched.
Bonanza (variable) from 200' - of Bodie to 382 (?) lev - largest
dev. on 600' lev. 350' length. Ave. of stopes 150-200. Seen in
Stand also. Exc. 1000' & above. Foll. sev. 100 ft S - to Mono grd -
another Dudley bonanza. Followed at lower level from Bent
Shaft workings into the Dudley mine, lying S of Bent shaft. E
of the Mono - bonanza

Everywhere filled by each member of yger. W-dip seen
of veins. See E-W x-sect. thru Int. stopes in Bodie mine
Filled also (-) by many flat planes dip. amically rel. to later yger fill - fig.
Plate III 432' lev. Bodie shaft. 3 disp - (1) On a-a,
Ore in rich gulden flat fis. (3) b-b' dip. both yger. & older lodes by just the width of

Younger Lodes (Veins of the Syndicate, Bechtel, Standard & Bulwer Mines on the N.) These follow those structural planes of the andes. which app. have some dynamic relation with the dikes. ∥ dikes — N – N20E dip W, 30 – 85. Entire dist. bet. 2 ∥ prsnc shcts & min. extends several ft. from fiss. – to this shatter of andes

Both older & yg veins in part a filling of open fiss., in part grad. repl. of thinly-sheeted CR bet. ~~the~~ structure planes of pac. zones by the Vein-form. mats rec in sol. In OBs themselves qts shows same sheet CR giving end of banded struc. Vein has Δ and O. by qs & are lin. – s. qs st sugary as if crushed & comminuted by later movements. This esp in main Standard & Golden Mine in the larger than in the smaller fault fissures.

Younger lodes ~~Best dev~~ Most abnd, most prod. in Standard mine N of the mine but smaller. ~~At extreme~~ N end of the min belt

~~The (small) younger veins dip E, W of a N-S line, W, E of it, but steeply & both cases. Band of bi-struc. best dev. here.~~

In the ~~Bulwer~~ mine Burgess & Bruce only 2 prod. mens. Standard Ser. These are resp. S extensions of Cook & Bruce of the Standard m. They were prod. in only < 150' S of bdry – beyond end of ore no qts filling – vein = fissured, barren zone in the andes.

These Standard OBs prod. 59% ~~$~~ 1877-1888 Peter out bel. 500' lev. of Standard mine, as they did at cor. hing. of Bodie (below 300' lev. there) Main Standard vein largest but not richest ore carrier of the younger ser. 90' wide at 385 lev. Ave 20'. Dip 40° W (less than others of series – 2-6' wider, W dip 65-80)

In the long x-cuts at the 700, 1000 & 1200' levels of the Standard, these younger flt-fiss. = many small veins nearly barren qs & perhaps by certain zones of thinly sheeted country rock.

Syncline raise – extreme end below
mineral bett veins only – barren Sil. Tuff 120'
Lower Oscoda Tun. Synch X-cut over Tuff 120'
Wildly by X-cuts from Synch Sil. Tun. 500' below Osc
Lower Mary Small barren veins

Bodie, Calif Mono Co.

Bodie on from the 8th A.R. State Min. Wm. Irelan Jr. 382-4 1888.

CR "later hbl.-and." flows. Bodie veins in oldest. Late Tert. or post Tert.

Bodie on from the 8th A.R. State Min. Wm. Irelan Jr. 382-4 1888. CR "later hbl.-and." flows. Bodie veins in oldest. Late Tert. or post Tert.

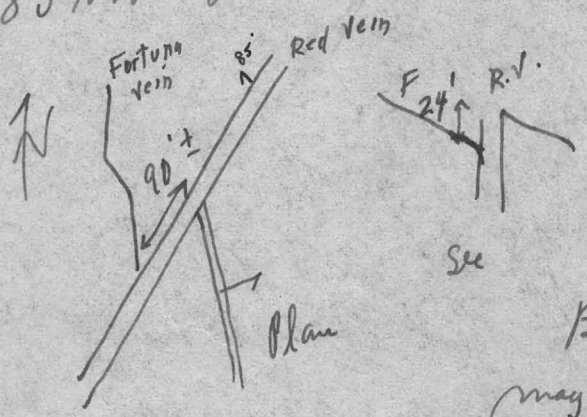
Flows vary from coarse, trachytic like to brownish-black, basaltic.

~~Bodie Hill andes. – light green, porphyritic with felds. in very small xx. Plag., app. some orthoc, quartz & hbl. – qz in bm. felds. drilled, chlor. present, even in perfect spec. & to greatest depths.~~

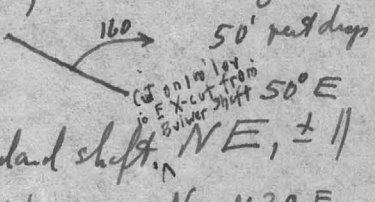
~~Andes. seem to dip SE 60°.~~

Volc. breccia covers Bodie ridge. Seems recent – has qz & vein-wall-rk. andes. Capping – few veins OC. But – as nobody are stoped up, they ~~divide~~ ramify upon nearing the hang. of which the brec. overlies the andes, & they give out abruptly when that cont. is reached. Prob. channels for the later andesitic fce. Shown by several cross-cutting dikes in this bodies. bm now clay, but dist. mig. thru the matrix are Δ & O of older except in rks. also alt.

"Red Vein" of Bodie mine. (Hum from ors jay) 6-10' N20°E, dips 85 NW. Faults older Fortuna vein by a right-inclined thrust



Larger vein or dike, app. volc. brec., flts (Not sent shaft above 600 lev.) Fort. vein, throw to the E, hade making 160° with incline of Fort.



Still bigger dike – cut in standard shaft. (cut on main lev. in E X-cut from Bulwer shaft)

Bulwer veins. Strike of these dikes gen. N-N20E mag. dip steep W, mostly.

2 Sets of veins – "Older" – main representative the Fortuna vein in the Bodie mine "younger" – Standard Series. These fault the older.

Bodie Mine – Both sets show intensive shearing of walls ∥ fissures – slick, striae, brec material +, cem. by qz in the bodies (in relief of tension consequent on great lateral compression?) Schistose foliation along walls – these rich in Au & Ag – this structure, tho' orig. due to compression, retarded flow of sols. & gave increased surfaces of deposition.

been carried on, in the Mono Lake basin and on the glacial deposits flanking the Sierra Nevada, which resulted in interesting reports of doubtful economic value. The postponement of work at Bodie until its regular turn among the quadrangles, will reduce the chance of rushing into an "ante mortem" examination.

The gold-bearing quartz veins are confined, as far as present developments have shown, to a single ridge about one mile long in a north and south direction and about a quarter of a mile wide. This ridge is readily distinguishable from the surrounding hills by its light color in contrast to the dark rock extending for miles in each direction. Two theories would account for the formation of the hill. One is that it is a volcanic neck pushed up through the surrounding igneous rock (similar to the occurrence at Tonopah), and the second theory is that the ridge rock is the older and has been exposed by erosion, being preserved above the surrounding country by its greater hardness (as at Goldfield). Geologic work that would establish the relation of this hill to the rest of the country should prove of great service in prospecting.

The veins are 'true' fissures in the andesite, carrying gold and silver in about equal amount, and nearly all of them strike north and south with the ridge, varying but little over 10° either way from a vertical dip. The accompanying sketches are drawn to show the general structure and exact measurements are neglected. Most of the veins are from one to three feet wide and occur from three to one hundred feet apart. The ore-shoots are from 20 to 200 ft. long and dip southward in the veins.

A larger portion of the productive area has passed into the control of the Standard Consolidated Mining Company and my observations have been confined mainly to the extensive workings on this property. The Syndicate property to the north of the Standard has been developed by adits to a depth of about 500 ft. The Standard shaft is 1,000 ft. deep, there being about 400 ft. of water in it at present. The Southern Consolidated property, south of the Standard, has been opened by shaft and other workings to a depth of over 600 ft. The greatest depth attained in the district is at the Lent shaft, which is 1,200 ft. deep, over 600 ft. being under water now. Almost without exception the veins have failed to carry pay-ore to a greater depth than 500 ft. below the surface, but the great number of veins (over one hundred) and the great width of at least one (the Main vein of the Standard was worked by square sets; it was 60 to 70 ft. between walls at its widest, the ore being worth frequently $400 per ton) have made a long life and large production possible. Outcrops of encouraging size and value are rare, being obscured by surface debris and also pinching out. Nearly all the discoveries have been made by cross-cutting. The size and value of the veins vary so much that cross-cuts more than 200 ft. apart may entirely miss orebodies of considerable value.

A marked geologic feature exposed in the workings is a fault-plane (locally called the Moyle foot-wall) extending about 2,000 ft. north and south and dipping about 60° east. The present caved condition of the old workings prevents a study of this fault as far as is necessary to establish its relation to the vein systems. This fault-plane was once the basis of an apex suit, the contention being that it was the main lode of the entire system. Broken pieces of ore and clay fill the fissure, but it has never been worked as a vein. Consolidation of the contesting companies waived the necessity of a final legal decision after one jury had brought in the non-committal verdict that each party to the suit should be awarded what really belonged to it.

The Standard shaft cuts the fault-plane at a depth of about 500 ft. and settling due to stopi[illegible] on the east, or hanging-wall side, has caused a scarp of 12 ft. on the face, moving the collar of the shaft the width of a c[illegible] partment (5 ft.) diagonally out of line to the north an[illegible] east. The veins break and bend upward as they near the fault from the east side, showing the faulting to have been normal, as is the case in all the other faults observed. The veins on the west side are in very solid country and are undisturbed. More evidence is needed to establish the relation of the veins on the two sides of the fault, as a very great movement would be required to displace a single vein system into the present position, as shown in the sectional sketch.

About 700 ft. north of the Standard shaft there is a broken zone not less than 100 ft. wide north and south and of indefinite extent east and west. The zone is composed of leached andesite and clay, which is probably the final product of the leaching. There are also occasional fragments of quartz. This zone is probably an area of faulting and displacement of later date than the vein formation. North of the zone the vein system as far as developed seems to be the same as in the section at the Standard shaft with the omission of the Moyle fault-plane, which is not traced underground and gradually disappears on the surface as the scarp is followed either way from the Standard shaft. An old property line is near this zone; in the leached and crushed rock the Tioga shaft was sunk to a depth of about 800 ft., cross-cuts being run east and west from each 100-ft. station. No ore was exposed by these workings and they were abandoned, although recent developments have opened up the vein about 400 ft. farther north, and these veins are now supplying most of the ore produced in the district.

Southwest of the Standard shaft there is an area of blue clay, exposed by the underground workings but concealed on the surface by talus. Striated surfaces in this clay show movements in all directions and the entir[illegible] mass may be decomposed andesitic talus.

The oldest vein in the series is the Fortuna, lying in the southern portion of the Standard property and apexing in the mass of blue clay. Its strike and dip, so markedly different from that of any other veins in the district, make it remarkable, aside from the fact that it has been one of the richest. Where the younger veins cut the Fortuna, it is normally faulted from one to ten feet. The younger veins are said to have been enriched at the junction and none of them were worked out below, indicating an upward circulation of the ore-bearing solution through the Fortuna. If any of these junctions were still undisturbed by mining operations they would doubtless show important evidence in regard to age of veins and time of movement. The lower workings on this old vein are under water from a depth of about 500 ft., but accounts seem to show that it split up and was lost at the bottom. Near the present water-level is the open stope on the only vein worked below the Fortuna, called the Bee Hive 'dropper.' The Fortuna continues past this junction without apparent change, while the 'dropper' does not extend up farther. Reports show this orebody to have been bottomed in less than 200 ft. below the junction. As will be seen from this description, the probable sources of the ore-bearing solutions are concealed below the water-level in the old workings.

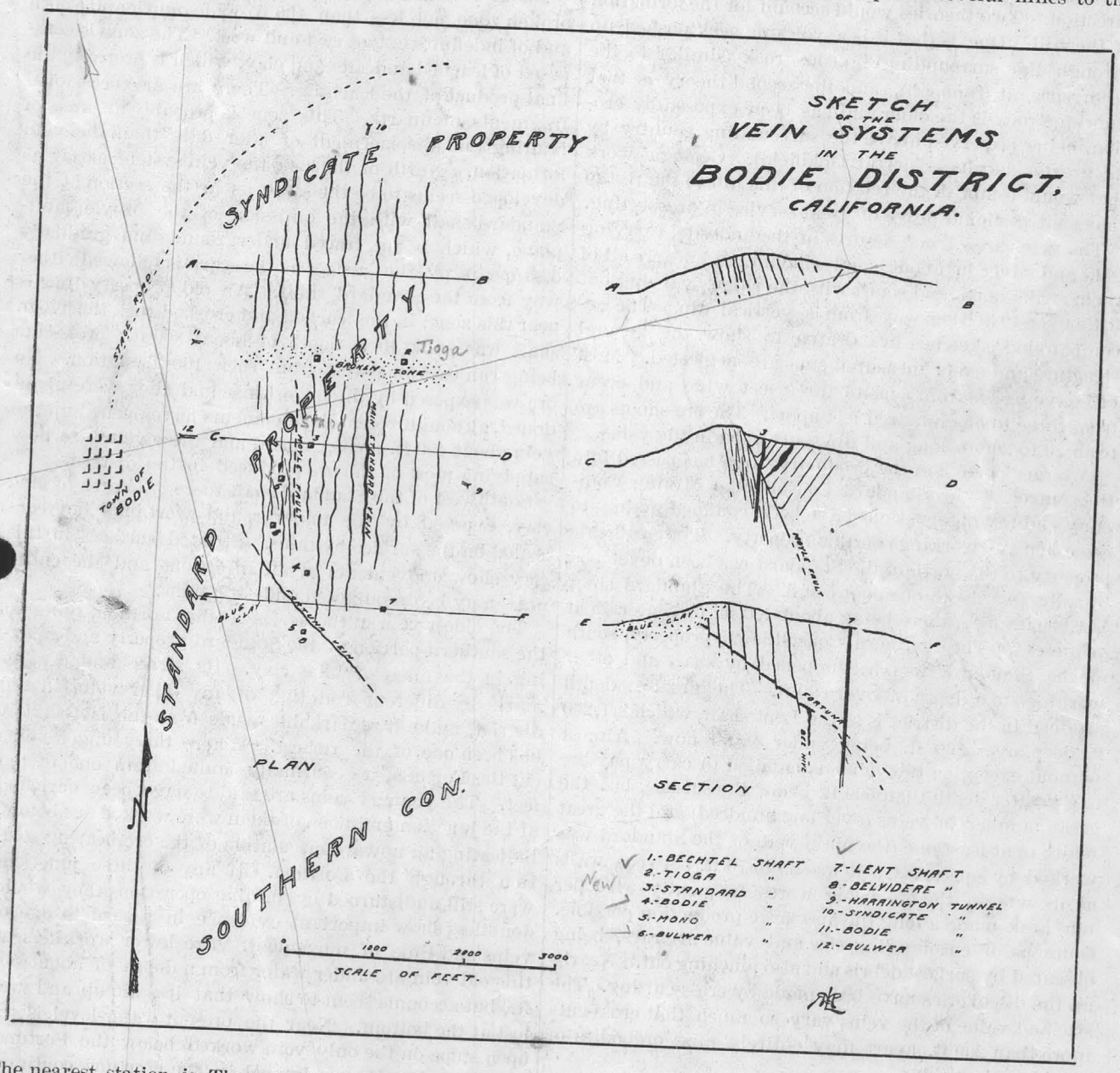
Most of the veins show a banded structure and di[illegible] placements of the bands show several enlargements the fissures since the primary deposition. A peculiarity of the ore is the occasional occurrence of manganese dioxide in vugs. The dioxide is loose and clayey in texture and carries some silver to the exclusion of gold. The best assays are usually found on or near one wall or the other, as indicated by fine scaly gouge or by small blue spots (of telluride) in the quartz.

Geology of the Bodie District, California.

Written for the MINING AND SCIENTIFIC PRESS
By R. P. McLAUGHLIN.

The following description of Bodie is offered because but little has been published upon this mining centre which, at one time, ranked among the foremost gold districts of California, its large production corresponding in a way with the present conditions in neighboring districts of Nevada.

The Bodie district is situated in Mono county, about six miles from the State boundary line between California and Nevada, and almost due east from San Francisco.



The nearest station is Thorne, at the southern end of Walker lake, in Nevada, on the Colorado & Carson railroad. The stage journey of forty miles west takes one past the old camp of Aurora and into the town of Bodie, at an elevation of 8,200 ft. above sea-level.

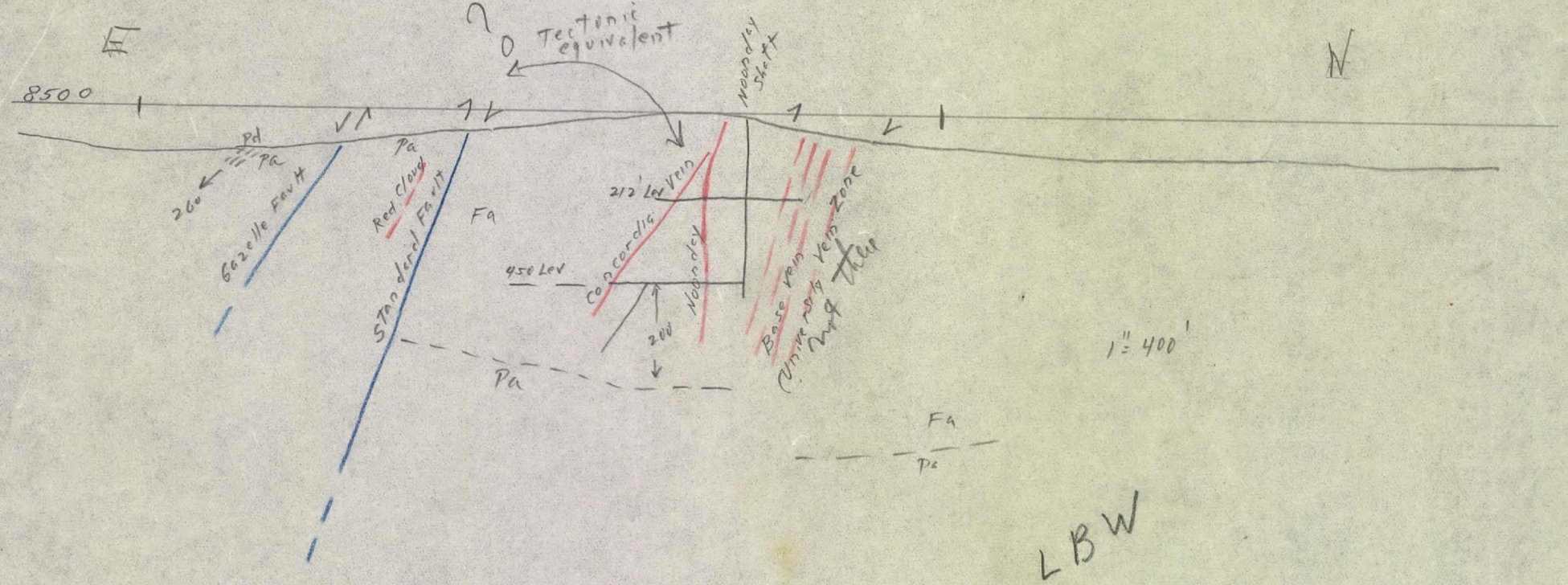
Historically the camp offers all the picturesque features portrayed in the stories of Mark Twain and Bret Harte. The "bad man from Bodie" was a phrase current throughout the Western States a few years ago as indicative of all that was rough in character. Gold was known to exist here in the early '60s, but it was not given much attention until about 15 years later, when rich ore was found. The boom days of the Comstock were almost past and the rich strikes at Bodie attracted the population of Virginia City in a rush probably as maddening as any of recent years. It was hoped that another Comstock lode had been found and the town became a miniature Virginia City with all of good and bad that the name stands for in mining and finance. At one time there were 30 companies operating hoists within the area of a square mile and a population of 10,000 was claimed for the town. The collapse of many ventures left the hillside strewn with monuments of reckless expenditure based on wild hopes.

The country for a number of miles around Bodie is andesite and volcanic mud containing fragments of andesite. The andesite is probably a surface flow on top of slate and shale, which are exposed several miles to the south, turned up at a steep angle as though by the Sierra Nevada granite, which extends along those mountains about 15 miles west of the district. In some of the underground workings near the Lent shaft, at a depth of about 500 ft., are found inclusions of black chert possibly altered from the underlying sedimentary rocks. Although the Bodie district has turned out several million dollars in dividends and is still a steady producer, and the only important mineralized area yet developed in the large county of Mono, no work has been done there by the U. S. Geological Survey. A few years ago, assistance was offered, by one of the Bodie mining companies, to take up this work, but it was refused by the Survey, on the ground that there had been criticism on some of its work as "post mortem." Other work has

Age of Intrusives.

Bodie, Calif. Appear to be two sets of dikes. The late tuffs 3 miles S of Bodie are cut by dikes of "dark igneous rock"; evidently fresh, and probably Pleistocene basalt. (Eakle & McLaughlin, op.cit.p.145). Irelan (op.cit.) describes a series of highly altered dikes striking N-N20E mag., dipping steeply west, i.e. same attitude as "Younger vein series". These must therefore be closely linked in time with the mineralization; besides paralleling the younger veins in attitude, they are heavily pyritized, now oxidized to hematite. A good guess is they are just pre-mineral. Apparently they are of andesitic composition; description does not make clear whether they are true breccia dikes or badly shattered, formerly normal dikes.

The Red Vein dike faults the Fortuna vein; since the dike is vertical, there is no evidence to show whether this movement is normal, reverse or horizontal. The section across the Fortuna vein by Irelan, showing all vertical displacements down on the W side of the Younger fracture system, suggests horizontal movement, because this apparent vertical displacement would be caused by consistent west side south horizontal movement, whereas with vertical, tension movements, one would expect the blocks to drop down more or less haphazardly, giving w side down movement in some cases, east side down movement in others. But W. Gilman Brown's section points strongly to antithetic faulting in a vertical plane, connected with normal faulting on the Moyle fault; if Brown's section is right, antithetic faulting with rotation of the Younger series (subsidiary planes of some kind to the Moyle) is the only mechanics to explain the displacement. See elsewhere.



LBW

Noonday Shaft

E-W Section

LEGEND

Beauty Peak, Basalt flows & aggl. Pink

Bruche Mt. Andesite flows & aggl. Gray

Agglm. Brown

Flow apple green

FF

1" = 200'

E-W Section thru Red Cloud Shaft

Stratigraphic Section.

Bodie, Calif.

Youngest. "Basic Lava". Tuff, agglomerate, flows, basaltic and probably coarsely porphyritic andesite in places. Said to be post-mineral, but see under Since Beauty Peak, the source of some of this material, two miles N of Bodie, is uneroded, while the "older andesite" of the Bodie camp proper is highly eroded, the Basic Lavas are probably Pleistocene and post-mineral. Some basic dikes cut the tuffs 3.5 mi. S of Bodie.

A.S. Eakle, R.P. McLaughlin Mines & Min. Res. Alpine Co., Cal. State Min. Bur., Rept. 15-16, 143-5. Hornblende Andesite. This is the country rock of the veins; the latter are said to be confined to this rock; the hornblende andesite is pictured as having stood up as a hill while the basic lava material was poured out to cover the hill. (Guadalupe y Calvo). The hornblende andesite is light green, porphyritic, with small feldspar phenocrysts; these are plagiocalse with apparently some orthoclase, with mica and some hornblende. Quartz in the groundmass. The feldspars are dulled, and chlorite is present even in the freshest-looking specimen, and from the greatest depths. The members, apparently massive beds, of this formation appear to dip SE 60°.

Irelan, Wm., 8th A.R. State Min., 1888, 382-400.

Metamorphic Complex. Not exposed in Bodie, but pieces of chert in the andesite at 500' depth in the mines suggest that basement may lie at relatively shallow depths. The complex, where exposed 4 miles N of Bodie, consists of chalcedonic quartzite; elsewhere it is plainly sandstone. The Sierra Nevada granite, east contact, lies some 15 miles west of Bodie.

Eakle & McLaughlin, ibid., p.139.

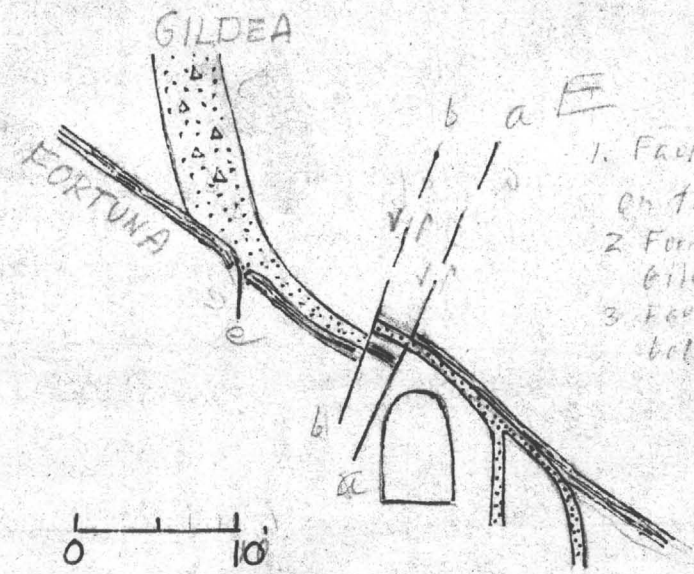

GILDEA
W
E
b
a
FORTUNA
c
b
x
0
10'
1. Faulting of Fortuna on fault x-a
2. Formation & filling of Gildea brecciated vein
3. Faulting on b-b displaced both lodes

FIG. 32 F

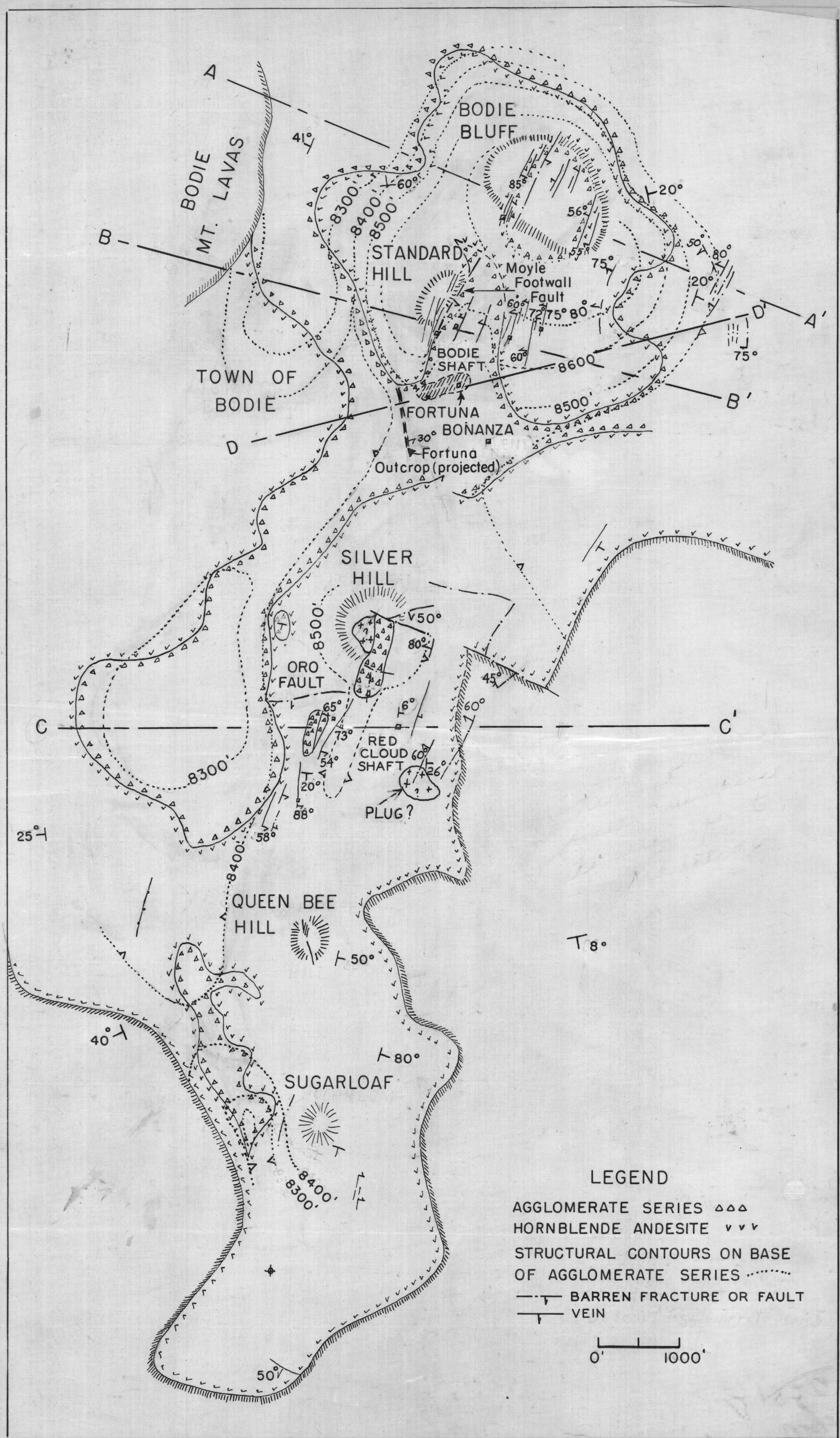


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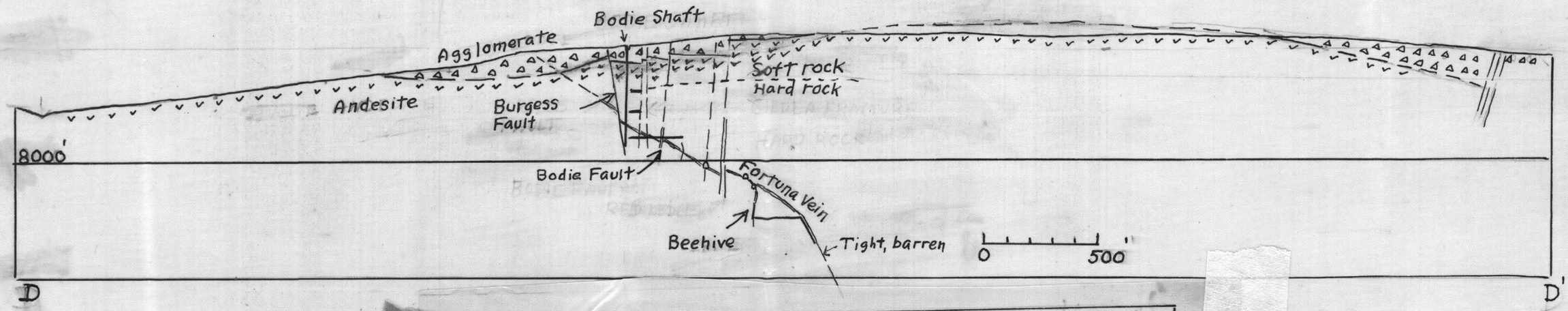
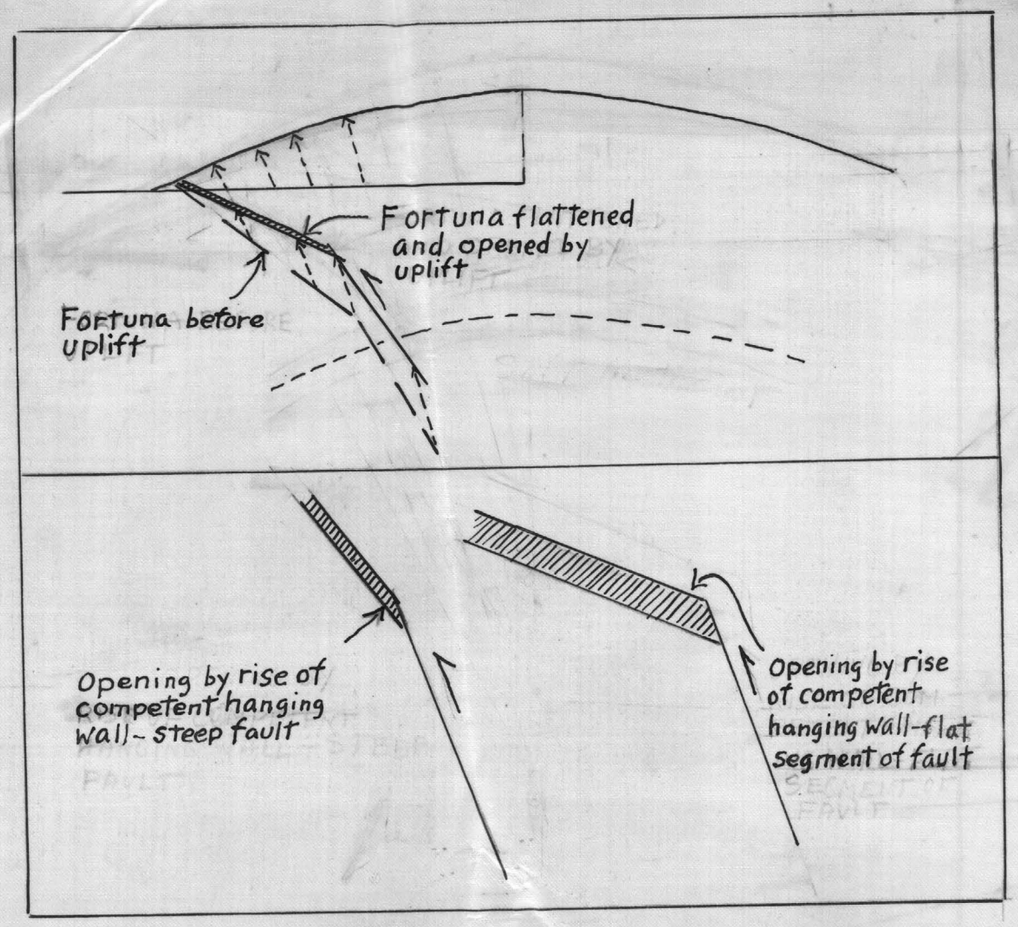
FIG. 23 A

BODIE, CALIF.


Bodie Shaft
Agglomerate
Andesite
Burgess Fault
Soft rock
Hard rock
8000'
Bodie Fault
Fortuna Vein
Beehive
Tight, barren
0
500'
D
D'


Fortuna flattened and opened by uplift
Fortuna before uplift
Opening by rise of competent hanging wall - steep fault
Opening by rise of competent hanging wall - flat segment of fault