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

The following file is part of the Grover Heinrichs Mining Collection

ACCESS STATEMENT

These digitized collections are accessible for purposes of education and research. We have indicated what we know about copyright and rights of privacy, publicity, or trademark. Due to the nature of archival collections, we are not always able to identify this information. We are eager to hear from any rights owners, so that we may obtain accurate information. Upon request, we will remove material from public view while we address a rights issue.

CONSTRAINTS STATEMENT

The Arizona Geological Survey does not claim to control all rights for all materials in its collection. These rights include, but are not limited to: copyright, privacy rights, and cultural protection rights. The User hereby assumes all responsibility for obtaining any rights to use the material in excess of "fair use."

The Survey makes no intellectual property claims to the products created by individual authors in the manuscript collections, except when the author deeded those rights to the Survey or when those authors were employed by the State of Arizona and created intellectual products as a function of their official duties. The Survey does maintain property rights to the physical and digital representations of the works.

QUALITY STATEMENT

The Arizona Geological Survey is not responsible for the accuracy of the records, information, or opinions that may be contained in the files. The Survey collects, catalogs, and archives data on mineral properties regardless of its views of the veracity or accuracy of those data.

BULLY HILL EXAMINATION, JAN.1956

1/23/56.Arrived Redding in P.M. Talked with Ralston that evening.

1/24/56. Arrived by boat at mine 9:30 A.M.Looked over maps. In P.M.went underground on 770 level,north end. Saw some of the old stopes;ground seems to stand pretty well.With an operating mine there would seem to be a good chance to back and pick up zinc ore in the areas where zinc was not mined.I saw such ore on the fringe of an old stope; One such stope was 30 x 40 x 15' high, well inside the dike. Entirely uncaved.

Shear Zone: Has multiple more or less wavy fault planes carrying thin gouge. The rhyolite is fine-sheeted to schistose,in marked contrast to the dike adjoining thr rhyolite on the east;the dike is quite unsheeted,breaks fine-blocky to conchoidal.In places it is fine-grained,but at others shows minute feldspar phenocrystsl.I saw no mineralizationin the dike,except flattish quartz and/or calcite veinlets,3-5 cm.wide.

The north ore body (the one found by Glidden in 1955,drilling according to Horalemon's recommendations, I believe) shows strong sheeting and wavy fault surfaces. Sphalerite is fine-grained with ccpy as manchas and irregular veinlets-ccpy may be post-ZnS. Considerable fine-grained steely PbS. I thought the sulfides occurred in rather spotty masses. The oyritic zone west of the ore b dy is massive only in places;where massive it carries little or no Cu.

In spite of the strength of shearing in the main shear zone,I did not gain the impression of persistent "shears";the fault surfaces are individually discontinuous.

N face stopped in a strongly sheared pyritic zone with silica;

The ore body on the 770m is the upward extension of that first found on the 870.I think the first hunch was from Longyear DD hole drilled from the surface.

Joralemon Report, 2/25/55. 4 out of 5 drill holes (I think all from surface) cut ore, in 3 ore bodies.One being developed now on 870 level.

Total production of Bully Hill mine,perhaps 250,000 tons,ave. Au 0.13 oz.,Ag 6.33 oz., Cu 5.25%;probably graee of Zn,10%.

Combined Bully Hill,Rising Star and Cipper City production,1902 thru 1926, was 514,832 tons yielding 37,600,000 lbs.Cu,25,113,000 lbs.Zn.With 19nyears operaion,this giges average annual production 27,100 tons per year. Total recovered value was $8,969,000,average $472,000 per year.

Bully Hill average production was about 21,000 toms per year or about 70 tons per day. 11.7 tons ore found per foot of development. Based on past production,the mine yields 233 tons of ore per vertical foot.Remainigg pillars plus the new north ore body raise this to 360 tons per ft.

Ore found in old workings during unwatering: 570 N drift;300 level,shaft station. 870 N drift: high Zn ore body crosses it 400' N of shaftl

Bully Hill Ore Estimates: S.H.Ball,1920,124,000 tons.
R.L.Beals 75,000
I.B.J. 100,000 tons,including tonnage around old workings. I would pay to mine 75,000 tons of th this,ave.0.12 oz.Au,7.0 oz.Ag,4% Cu,8-10% Zn.

870 N Ore Body: Ave.width 14'.Results of sampling to 2/9/55,area 165' x 8', 0.23 oz.Au,3,64 oz.Ag,2.01% Cu,9.47% Zn. Length of ore then 220'. At 11 cu.ft. per ton,width 11',gives 220 tons per ft.of depth.

Three drill holes cut this ore body;together with the underground work, these indicate maximum length 345',height 255!Assuming length 340',ht.250', width 8',gives 60,000 tons.Ave.0.12 Au,3.6 oz.Ag.,2.5% Cu,12% Zn.

Bully Hill total ore now 135,000 T,0.12 oz.Au.,555 oz.Ag,3.3 % Cu,10.3% Zn

Plan shows a NW FW vein,870 N,cut by holes

A-1-2,incline width	5.6',	Au.0.4 oz.	mCu,4.446%,	Zn 0.36%
A-1-3	3.5	0.1	3.2	0.05

Possible Profit.- Overall costs $13.00 per ton.
Operating profit 13.00 # "

At 200 tons per day,operating profit $900,000 per year.

Glidden wants to get back money spent.

Investment to put mine in production $1.200,000
Spent by Glidden 1,125,000
2,325,000,to be amortized in 5 years,or at rate of $465,000 per year.

After income tax of $110,000,results wouod be as follows:

$900,000
110,000
790,000 profit
465,000 amortization on investment
325,000 net profit.

Present life less than 2 years . Must find over 100% more ore to make price asked justifiable.

Ore Bodies - Rising Star Mine

Condition of Orebodies

	Oreb.	Tons	Oz. Au	Oz Ag	% Cu	% Zn	% CaO	% Fe	% Al_2O_3	% $BaSO_4$	% SiO_2	Stope Prepared	Tons	Developed Ready for Sill	Tons	accessible but devel. necess.	Tons	Below 900 Lev. To be unwatered	Tons
Direct Smelting Ore	6C'	8150	0.02	0.60	1.80	29.1	1.6	14.0	7.0	6.6	4.5			6C	8150				
	7C'	19580	0.02	1.00	2.34	32.3	2.0	12.7	7.6	3.8	11.5			7C	19580				
	7M-801	17900	0.035	1.79	2.46	21.0	3.4	18.9	7.7	10.2	6.6	7M-801	17900						
	807-907	6330	0.02	0.83	3.04	16.3	3.4	24.4	6.4	1.7	2.9	807-907	6330						
	909-860	2000	0.025	1.00	3.60	26.1	4.2	23.6	4.9	2.8	6.2	909-860	2000						
	860-801-3	4000	0.025	1.00	4.01	8.5	4.5	25.3	6.4	8.1	9.6	860-801-3	4000						
	801-920	20800	0.047	6.28	2.32	22.3	8.7	11.1	6.3	13.5	5.5	801-920	20800						
	920-9D[2]	23175	0.046	8.94	2.20	20.4	12.3	10.3	6.0	12.5	3.2							920-9D	23175
	907-909[3]	8100	0.028	1.40	3.60	26.1	4.2	23.6	4.9	2.8	6.2							907-909	8100
	7-3	3000	0.02	0.70	1.10	32.0	6.5	8.5	8.8	4.5	10.0			7-3	3000				
	810	8470	0.01	0.70	3.37	20.2	8.2	16.1	9.5	3.7	1.0	810	8470						
	9C-10A	20500	0.01	0.70	3.00	20.0	4.2	23.6	4.9	2.8	6.2							9C-10A	20500
	5E-8Z	12300	0.02	0.60	2.00	25.0	2.0	12.7	7.6	3.8	10.5					5E-8Z	12300		
	Totals & Av	154305	0.027	2.89	2.54	23.05	5.57	15.98	6.67	7.13	6.24		59500		30730				51775
	Av. of Gen'l Sample #1				2.64	25.0	2.80	17.5	5.80	4.40	11.40								
																		Prep. necess	
Concentrating Ore	8Z-5-3	18280	0.05	4.51	1.10	27.9	2.4	8.7	5.4	38.3	3.2					8Z-5-3	18280	3 mos	
	8Z up 30 ft	8190	0.05	4.51	1.10	27.9	2.4	8.7	5.4	38.3	3.2					8Z up 30'	8190	3 "	
	5-3 down 50	5550	0.05	4.50	1.10	27.9	2.4	8.7	5.4	38.3	3.2					5-3 d 50'	5550	5 "	
	#4 Tun-906	6150	0.05	12.50	1.22	17.7	2.8	6.7	11.4	31.6	10.6					#4T	6150	6 "	
	#4 Tun 142	4100	0.06	4.70	3.40	9.1	2.0	18.1	5.0	20.0	10.0					#4T	4100	6 "	
	6E-5E10	15000	0.02	0.60	2.00	16.0	1.6	9.3	13.0	1.2	10.0					6E-5E10	15000	3 "	
	6E	23700	0.02	0.80	1.43	20.0	1.6	9.3	12.9	1.2	5.2			6E	23700				
	7D	12000	0.02	0.80	1.43	20.0	1.6	9.3	12.9	1.2	5.2					7D	12000	2 "	
	701	3000	0.02	0.70	1.60	28.1	2.35	7.1	3.0	1.0	3.0	701	3000						
	Totals & Av.	95920	0.039	2.90	1.48	21.49	2.64	9.24	9.67	16.24	5.7		3000		23700		69270		
Iron Ore	802 st.				2.90	1.4	0.4	37.6	4.4	0.5	16.6								

1 hard Zn-Cu Ore
2 down 75' inacc.
3 " 50' "

all direct smelt. ore above 900 — ready to stope in 120 d.

Note - Class. of ore as dir. smelting & conc. based on % $BaSO_4$, but tests show this does not hinder smelting when high.

Estimate of Mining Cost - Rising Star Mine

11 Mach. shifts - stoping	49.50
10 Tram. " - Tramming	40.00
5 mach. shifts - tilling	22.50
6 mucker " "	24.00
5 Timber shifts - timbering	22.50
6 Top carmen	26.50
4 cage	18.00
2 hoist	10.00
2 shift bosses	11.00
2 BS shop	11.00
Misc. mining	14.00
160	248.00
	1.50 direct labor

Timber per Ton	40 ¢
Exp.	25 ¢
Power	12 ¢
Misc. supplies	25 ¢
	2.57
Eng. & Super. 2.75 + 1.75 + 3.50	8.00
Assay - Sampl.	5.00
Shop	5.00
31 x 160	18.00
	0.36

(hundreds) (per month)

Total $2.93 per ton.

Shasta Zinc & Copper

Rising Star & Bully Hill Ore Bodies.

Vic. Winthrop, Cal.

For regional geology see Redding Folio.

Rocks associated with the ore-bodies are

1. Silicified Alaskite, An intrusion
2. "Diabase" dyke to E of mineral zones.
3. Gypsum masses.

See surface maps of R.S. & B.H. mines.

1. Alaskite - Med. fine grained. (granitic)

Texture varies from Alaskite-porphyry to felsitic. Small phenocrysts of qtz & feldspar in mottled ground mass. In places ~~practically~~ resembles a qtzite. No dark silicates. This is the chief country rock in the Rising Star Mine. It contains 3 nearly vertical shear-zones intimately connected with the ore-deposits.

2 "Diabase" An andesite-porphyry dike. This dike is nearly vertical, & is ∥ to the main shear-zones & the strike of the ore-bodies.

3. Gypsum.

Occurs as a country rock. See maps & sections. Light gray, massive to fine banded, highly silicified to very soft. Banding due to shearing, showing inclosures of other rocks. Fine Crystalline. Contact with alaskite generally marked by silicification, & seldom well defined. Pyrite crystals scattered thru G.

Anhydrite - ass. with G. Not common.

Origin - Magmatic solutions from below?

Shasta Zinc & Copper Co. Mines.

Copper City. 2 mi S of Ris. Star.

Main Tunnel, at elev. Sqaw Creek, 1000 in, (NW) on contact of Alaskite & Pit Shales. Mineral zone nearly vert, strikes NE. Shear zone. Lenticular ore-shoots 30-150' long, 14' wide. Longer axis coincides with foliation planes of country. Replacement

Ore - Pyrite, bornite, chalco., Sphalerite

Rising Star See maps & Sections

Ore- Pyrite, chalco, bornite & Sphalerite.

Andesite dike wholly to N & E of ore bodies.

Unwatered to 900 lev.

Lowest level 1100 Lev.

Bully Hill

Main tunnel 1400' SW Shaft at end of tunnel. Lowest lev. 1100'. Adit is 300' lev. Under water below 300' lev. Ore-bodies strikingly lenticular, perfectly conformable to foliations of sheared country. Lodes nearer to andesite dike, increase in richness toward dike.

Gypsum here similar to R.S.

Ore-Bodies. With special reference to Rising Star.

2 types - Lenticular masses of nearly pure sulfides & irregularly replaced brecciated country rock. Ex- ① 801-7 ② 601 Type ② often secondarilly enriched.

Sphalerite is also later than the pyrite. It is rarely in well-bounded crystals.

Galena - with primary chalco., pyrite & blende. Argentiferous.

Chalcocite - confined to upper enriched zone. Relatively rare.

Secondary enrichment is not of great importance, & the oxidized ores are of no importance, so that outlook for ore in depth is good. ?

Character of the Ores.

Pyrite often as chief mineral, with chalcop. as associate. ~~Question as to 2nd'ary enrichment. Is chalcop 2nd'ary~~ ?

Gossan runs fairly high in gold. 2nd'ary enrich. zone below oxidized zone, primary sulf. zone below this, but I think nearly all developed ore-bodies are primary.

Pyrite does not appear to have been an original constituent of the Alaskite, but was formed after solidification. It was deposited 1st of the sulfides, closely followed by primary chalcopyrite.

Costs
Shasta Zn & Cu Co.

Mine Costs, Month & Period ending 7/31/21

Direct Mining Expense	
Breaking	1.52914
Tramming	.19559
Timbering	.08700
Machine drill exp.	.17192
Hoisting	.40335
Industrial RR	.36965
Mine pumping	.05411
Foremen & shifters	.20512
Timbers & framing	.15139
Surveying & engineering	.07599
Lab. & sampling	.05237
Totals	3.29563
Maintenance	
Mine tools etc.	.00266
U.G. mining equip	.14038
Totals	.14304
General OH Exp.	
S.F. office	.21425
Plant office	.12193
Whs	.05589
Gen Exp.	.25677
Gen Super & Lab.	.07757
Insurance	.15644
Bldgs Maint. & Rep.	.00519
Fire Prot.	.00930
Totals	.89734
Handling Stock Pile Ore	.13021
Total Mining Exp.	$4.46622

at average price per ton of ore mined

Ore on hand 7/1/21 1058
Credit " " 7/31/21 1012
Total mining expenses on 2953 T smelted: 13,188 78 @ 4 466/T

Assay Values

	%								
	Pb	S	Al_2O_3	Cu	Fe	Zn	CaO	SiO_2	$BaSO_4$
Mine Run Brand Comp July	.05		5.44	3.31	15.39	20.13	2.24	14.0	8.0
Stock Pile	.20		7.11	26.2	12.83	19.84	1.34	14.0	10.0
Calcines	.19	10.68	6.69	2.87	17.8	21.30	2.74	17.0	6.0

Assay Values

	%					
	Pb	S	Al_2O_3	Cu	Fe	Zn
Mine Run Brand Comp July						

Water - Pipe Installation

Horse Creek Water Line of
Shasta Zinc & Copper Co.

Total Length - 10175

Size & gauge -

		$	Cost per ft.
Cost	Labor	716 77	0 07
	Mat (+freight)	5813 93	0 57
	Tot.	6530 70	0 64

~~Cost per ft.~~

CALIFORNIA ZINC COMPANY.

X. Petition in U.S.Court of Claims.Calif.Zinc Co.,Sacramento Valley & Eastern Railway and Clifton M. Kolb,Trustee vs. U.S. Jan.1947.

These represent that Calif. Zinc Co. is a corporation,Ohio. Sac. Valley & Eastern a Calif. Corp.

Calif.Zinc Co. owns 606 acres mineralized lands in Sections 15,16,21, 22,28, T34N,R 3 W,MDB and M. Valuable equipment on said lands:smelting furnaces,sintering and concentration plant,zinc oxide plant,lab and office buildings,dwelling,boarding houses;mining machinery and equipment. Valuable mines developed: Bully Hill, Rising Star,Copper City. Zinc, copper,gold,silver cadmium are mined and produced.

Sacto Valley & Eastern RR, a wholly owned subsidiary of Calif.Zn. owns a steam RR,with rights of way, easements for occuoancy and operation, extending across sections 15,21,22,23,27,28,29m31,32, T34N R3W;25,26,27, 31,32,34,35,36, T34N R 4W;5,6,T33N,R4W;36,T34N,R5W. Mines to Pitt.

Kolb is Successor Trustee under mortgage deed of Trust,Oct.1 1925 between Calif.Zn Co,a Delaware Corp.,and Union Trust Co.of Ohio and W,M. Baldwin as Trustees,securing payment of $500,000 First Mortgage Gold Bonds of Calif.Zn Co. All obligations assumed by present Calif.Zn Co.,1927.

Calif.Zn and RR are wholly-owned subsidiaries of the Glidden Co.,an Ohio corporation. Mfg, of paints,varnishes,etc.,requiring continuous supply of ores and derivatives,including zinc oxide,zinc concentrates and cadmium. Bought these companies for that purpose. Single,integrated enterprise.

US through Shasta Dam has taken plaintiff's properties in following respects:

Copper City mines, Iron Springs placer,total over 150 acres of highly mineralized ground completely submerged.

All of the right of way and practically all the trackage of RR submerged.

Properties not submerged cannot be operated because:

1. Isolation of part of ppties by waters from other parts.
2. Submergence of only practical means of access.
3. Seepage of water into shafts,tunnels,adits,drifts of Bully Hill and Rising Star Mines.
4. Inability of Zn Co.to mine Bully Hill and Rising Star mines by means of an adit from Copper City. Ia

This taking commenced May 24,1942 and continued to date of petition, and will continue until flow level reaches 1065 ft.

Defendant promised reasonable compensation.By taking ppties damaged to sum of $2,418,209.02;and said sum,plus interest therenn at 7% from date of taking to date of payment,constitutes the reasonable compensation.

Plaintiffs tried to settle thru Sec. Interior & Bureau of Reclamation. No Soap-
Acts of Congress cited.

BULLY HILL HISTORY.

1853: Placer gold discovered near Bully Hill;Pittsburgh Mining District formed. Most of the gold originated at ore lens outcrops on Bully Hill properties.

1862: Gold and silver discovered in copper outcrops of Excelsior Claim and a rush results.Ore soon passed with depth into sulphides,district temporarily abandoned. Some work done at Bully Hill in this period.

1870s: Bully Hill ground again reopened;stated that Extra Mining Co. extracted $640,000 gross in gold and silver from surface ores.Rebellious sulphides finally bankrupted the company.

Early 80's: Property aquired by James Sallee;he made some money from surface ores,and sold out to Capt.J.R.Delamar in ~~1899 or 1900~~

1899 or 1900: Delamar treated profitably the high grade secondarily enriched ore just below the gossan,and in

1905 sold property to Bully Hill Copper Mining & Smelting Co., G.E. subsidiary.

Above from Geological Report on Property of the Bully Hill Mines Co., by S.H.Ball, about 1919.

Looked thru vol79,Jan-June'05;no dope.

Engineering & Mining Journal,vol.81,1/20/06,p.157. An unexpectedly large and high grade copper ore body has been opened on the 800 Lev., Bully Hill mine. Ibid.4/7/06: The smelter (built by Capt.Delamar) will shortly be closed down for remodeling.The old Copper City Tramway is being repaired.

Vol.82,8/4/06. p.219.A RR probably will be built up the Pit River by the Bully Hill Copper Mining & Smelting Co.

Vol.83, 6/22/07 p.1208.The Bully Hill Co.is remodeling the old Delamar smelter which has been idle over a year (i.e. from about May 1906).

Vol.84 12/21/07. Herbert R.Hanley was ass't.super. He designed a skip-tripping device illustrated here.

Vol.85. 1/18/'08/ p.182. The remodeled smelter is about complete. During the shut-down active development has been carried on in the mine at Winthrop. "There and at Copper City bodies of ore have been blocked out." The RR was under construction during this period;the RR was not undertaken until there was enough ore in sight to warrant it.

Ibid. 3/7/08: Editorial. Sacramento Valley & Eastern RR.completed.The smelter was down two years awaiting completion of this RR and being remodeled. In the mines development work continued during this period. The Rising Star and Bully Hill 3-compartment shafts were sunk and equipped with 1000 ton per day hoists. The two large blast furnaces can smelt a total of 800 tons ore perday.

Ibid.3/14/08. p.576.The smelter is not to be blown in until the end of March.

Ibid. 4/4/08 The Company is increasing its force at the mine and smelter.p.727.

OVER

Copper Resources of California.Bull.50,1908.

p.54: During the 1st 10 months after beginning operations in May,1900 (Delamar) Bully Hill produced 50,000 tons of 10% copper ore or 5000 (longs) tons of copper or 11,200,000 lbs.,with an equal value of precious metals.Price of copper during this period about 16.5c per lb. ,or $1,815,000 gross on the 50,000 tons production, or $36 per ton. Precious metals then had an equal value.

p.69: Bully Hill ores have less iron(needed for flux)that Iron Mt.; they have a correspinding increase in % Zn;barite as gangue.

p.78: Bully Hill bonded to Delamar about 1899;after further development he bought it for $225,000.1901,ppty transferred to Bully Hill Cu Mining & Smelting Co.,now controlled by Western Electric.

p.80Ore in shear zones ,E of N,nearly vertical.Ave.width 30'.Upper levels cuprite,malachite etc.,then chalcocite,bornite,then ccpy in low est levels. Zn, Sb. Ehough precious metals to equal half the value in the matte produced.

pp.81-82: 1908 developing at rate of 600 ft.per month.From No.3 level ore goes on RR 1 mile to smelter,which was started May 1901.Smelter cost $200,000;and a stamping,calcining as well as smelting; Bessemer Converters.Charge usually 50% raw ore and 50% calcined ore,8-10% coke,2-3% ls, 1-1.5% ironstone.Matte 35-55% Cu,taken to converters,which make blister copper,98% fine,shipped as large slabs to refinery at Kill van Kill,N.J.

p.106:Rising Star aquired 1900-1901;large high grade ore bodies being developed;has 100,000 tons sproved massive sulphide ore.OBs irregular in outline due to zones of cross-shearing.Copper water from tunnel run over scrap. Wide high tunnel being driven to connnect with shaft 250' below surface (500 level).

p.107: Copper City (Excelsior-Brown-Humboldt-Baxter claims).Development work being carriedon with satisfactory results.Oreshigh-grade,with Au, Ag and high % Zn in parts. Shallow work so far but should go down. RR passes thru property.

~~EMJ 1/11/19. Bully Hill Copper Mining & Smelting Co.has converted old smelter to a 150 ton flotation plant.~~

MSP Vol.94 1907. 1/5/07

The Copper of Shasta Co.,Calif. I.
Donald F. Campbell,28-30.

Bully Hill: p.30. The development of the old Copper City district and the Winthrop mine is being taken up by the B.H.Co. and good OBs are being opened up. Small deposits of oxidized copper are found in the limestone surrounding this district but hitherto these have not received much attention owing to their rough and inaccessible surroundings.

II. 55-58. The active copper development of Shasta Co. dates from 1896,when a strong English corporation disclosed the great body of ore at Iron Mt. Before this only placer mining,and gold and silver from gossans.But as earlyas the 1860s there were small shipments to Swansea of Bully Hill ores.

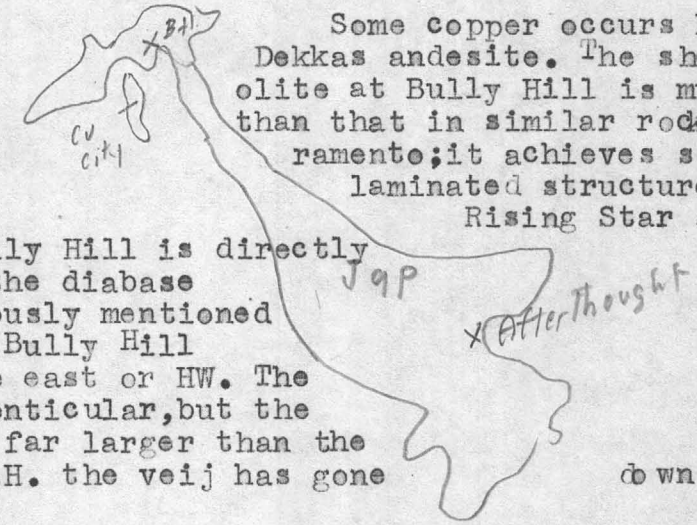
Articles contains extensive data on Iron Mt.

p.58. Bully Hill was opened as a gold mine;the gossan was worked with indifferent results until copper ores was developed at depth.The shaft,600' deep,has an electric hoist.Development is difficult on account of the irregularity of the ore bodies. The drifts are usually driven 20 ft. in the FW with crosscuts at regular intervals to the vein. In the upper workings gouge in the shear zone was rich in oxidized Cu ores.Costs of mining not available; a large amount of the ore broken remains in the mine as filling.Winthrop and Copper City are being developed.With completion of the RR the prospects for a considerable output of copper, gold and silver are excellent.

This ore (apparently referring to that of Copper City and Winthrop) is more siliceous and more nearly self-fluxing (apparently than the B.H. mine ore).It is high in barite;sphalerite also is found in large quantities. In the past,freighting killed profitable copper extraction;hauling coke cost $ 8 per ton (from Bella Vista);and RR rates on the SP and the Bella Vista RRs were exorbitant.

. . The W part of the Shasta copper districts carries larger and more important copper ore bodies;but the Bully Hill ore bodies are higher in Cu,Au,Ag.

MSP Vol.94.5/18/07.625-626. Copper in Shasta Co.,Calif.Letter by Wm.Forstner on abive Campbell article. At Bully Hill, the zone of mineralization trends NE,and dips steeply.It lies within the Bully Hill (Balaklala) rhyolite,which forms an I:



Some copper occurs however in the Dekkas andesite. The shearing in the rhyolite at Bully Hill is much more intense than that in similar rock west of the Sacramento;it achieves sometimes a perfect laminated structure. Of the Winthrop, Rising Star and Bully Hill ore deposits only Bully Hill is directly associated with the diabase intrusion (previously mentioned by Forstner). At Bully Hill diabase forms the east or HW. The ore bodies are lenticular,but the vertical axis is far larger than the horizontal. At B.H. the veij has gone down 900' and is still strong there.

The Bully Hi ll ores are richer in gold,silver and copper and carry conspicuous zinc,also,secondary enrichment is far more important,than W of the Sacto. These ores likewise are more persistent in depth.Bottom not reached in the B.H.mine.

MSP.vol.97,1908. Wm.Forstner:The Genesis of the Copper Ores in Shasta Co. 261 ff. The rhyolite contains as primary minerals qtz.,orthoclase,some plagioclase,no femic minerals.Secondary minerals:mainly qtz., with pyrite,calcite,sericite,kaolin.At a distance from the ore bodies the pyrite occurs as small aggregates of minute grainsand occasionally as bunches,the latter often mainly ccpy.However ccpy is rare at a distance from OBs. Near the ore bodies,the country rock is pitted and the pits filled with pyrite to a greater or less extent,with small inclusions of qtz.Transition zone 1" to 2" wide.

Ore Bodies: Formed within zone of katamorphism, below belt of weathering, i.e. in the belt of cementation. Silica in hot thermal waters is thought to occur in colloidal solution, hence it des not diffuse thru the rock walls, which form a semi-permeable membrane. (Lindgren & Ransome, pp.57, p.220). The thorough elimination of the felspars and qtz shows that alkali and calcium carbonates and CO_2 in excess were present. $CaCO_3$ replaces qtz, which is dissolved by waters containing alkali carbonates, and a corresponding quantity of $CaCO_3$ is deposited in its place.

The ore was deposited in zones of fracture in the rhyolite. The fissures of aqueous circulation were very minute, hence metasomatism was very slow. The microscope shows that in places the pyrite is crushed, at other places not. It is probable that the deposition of the ore bodies was the result of a double process (1) replacement of feldspars and silica by alkali carbonates and CO_2 (2) replacement of this alteration product by sulphides by means of alkaline sulphides and H_2S.

Ibid. 10/24/08. Shasta County as a Smelting Center. S.E.Bretherton, 559-560. Bully Hill Copper Mining & Smelting Co. smelter blown in again March 1908; had been idle over two years while mines were being developed and R was being built at a cost of $500,000.

Ibid.4/11/08. p.782. Part of the smelter was blown in Mar.30.A large sum has been spent improving and enlarging plant capacity.400-500 men will be employed.The RR is shirtly to operate trains.

Mining World. vol.29.8/29/08. Mining & Smelting on the Shasta Copper Belt. A.H. Martin. 309-311. Bothing new. Copper City called important.

Engineering & Mining Journal.

Vol.88. 8/28/'09.

Copper Mines and Smelteries of Shasta Co.
Geo.A.Packard.393-399.

Bully Hill Mines:Pyrite is less notable here than west of the Sacramento River. Copper occurs as ccpy.,bornite,chaclocite,mixed with a large amount of ZnS and some galena;barite. See Wm.Forstner: Copper in Shasta Co. MSP 5/18/'07 p.625; 8/22/'08 p.261.

In Jan.1909 there was little doing at Copper City. Capt.Delamar bought the property in 1909 and put in a smelter.The GE Co.developed enough ore to justify the RR;there was a two year construction period during which the mines were practically closed. p.398: "The pump at the Bully Hill,a quintuplex with brass parts,pumping through a lead-lined iron pipe,was operating in Janurary from two to four hours per shift,or avout nine hours per day,equivalent to 20 gallons per minute. In summer there is little water to pump."(20 gallons per minute may refer to the flow to be handled: 28,800 gals. per day;pumping 9 hours or 540 minutes, means 53 gal.per minute,rate of pumping).

There is little surface gossan,and what there is is much more silicepus than at Iron Mt. Secondary enrichment however hasresulted in higher-grade ores than west of the Sacramento.The copper-gold-silver ore sometimes runs better than $100 per ton. On the lowest Bully Hill level,the 970,in a 20 ft.-wide stopethere is much chalcocite with high silver.p.399: The appearance of the ore,with the excess of zinc,lead and dark copper sulphides,is widely different from that west of the Sacramento."

The shear zones are much crushed:stopes timbered with 10 x 10 sets and promptly waste-filled."Samples are taken at close intervals and much sorting is done,the rock too low (i.e. in copper) to pay being left underground." p.399.

Bully Hill mine efficiency:slightly less than 2 tons per day per man employed;there qs more development being run at Bully Hill than at Rising Star. At Rising Star,slightly better than 2 tons per man-shift.

Because of the long period of inactivity in the mines during the R R construction underground conditions are worse now than they will be later.

Average ore to smelter: Cu 4%; S 20%;SiO2 23%.Charges are run with as high as 16% Zn. A common slag runs as follows: SiO2 36%;FeO 21%; CaO 9%;BaO 8%;Al2O3 12%; Zn 8%.

Mining World: Vol.32 Jan.-June 1910. 1/15/'10/

The East Side of the Shasta Copper Belt.A.H.Martin,99-100.

The low price of copper restricted developments in 1909, (Cu dropped from 20 to 13 cents during 1908),althoug the Bully Hill Co.has maintained a uniformly good yield.

At the Bully Hill mine the country rock is rhyolite,the ore bodies in a mineralized zone trending NE. Shearing occurs in the rhyolite. There are intrusions of diabase and and andesite. p.99: "The copper occurs in the form of comparatively narrow lenses with zinc blende present in large percentages. The secondary enrichment is high, copper values running 4% to 25%;gold and silver values average from $1.50 to $7."

The Bully Hill mine has been opened to 950',and is the main producing property. In the shaft there are two 5-plunger electric pumps with a capacity of 200 gals.per munute under a 700' head."Comparatively little water is encountered save in winter".p.99.

The Rising Star ore is almost indentical with that of Bully Hill. p.99:"The Winthrop and Baxter mines are at this time being extensively developed,with strong bodies of high-grade ore opened.Developments are kept well ahead of production and the company is in a position to keep the smelter operating for an indefinite period on the resrvesopened on the various levels."

300 men are employed;the company worked during the greater part of 1909 despite the low copper price.

Delamar sold to the GE in the early part of 1905.

Ibid. 1/22/'10. p.171.Bully Hill producing 1,000,000 lbs. Cu per month.

Ibid. 6/18/'10. The Forest Service has declined to withdraw its comlaint and Bully Hill will close.

Engineering & Mining Jnl.Vol.89.4/16/'10.p.839.Over 300 tons per day smelted,from Rising Star,Bully Hill, Copper City.H.R.Hanley is in charge in the absence of J.B.Keating.Lawrence May is engineer.

Ibid. 6/11/'10. The General Electric Annual Report shows that the company has invested in its copper properties $1,129,961 represented by capital stock, and $1,918,642 by advances.This includes Bully Hill Copper Mining and Smelting Co.,the RR and also the Hermosa Copper Co.,Grant Co.,N.M.

Ibid.6/25/'10.p.1338.Editorial. Farmers are not complaining against Bully Hill.On Mar.12 1910 US Forest Service served notice to install a smoke-consuming device within 90 days;later they extended this 20 days to July 2.

Vol.90 1910. 7/16/'10.p.134.Smelter closed June 30,1910.400 men are out of work. It is the purpose of the copany to continue on a curtailed scale work in the Rising Star and Copper City (Einthrop and Baxter) mines

Ibid: 7/23/10. p.152. The farmers visited the smelter and had no comlaint.The shut-down was due entirely to the U.S. Forest Service. They issued a ukase whuch came like a clap of thunder. About 1907-09 the company rebuilt their plant at great expense and built the Sacto Valley & E.RR especially for the mine,at a cost not less than $525,000.

Ibid.10/8/10 p.731. S.E.Bretherton (mgr.Afterthought): he had thought the Co. would put in a baghouse,but no,they are pulling up tracks etc.

Ibid.10/29/10.p.879.5000 tons of Bully Hill ore are in the bins ready for reduction at the Balaklala smelter. Price of copper Oct.1910 was 12.65c.

Vol.91. 1/14/'11 p.124. The Bully Hill copper mine closed down about the middle of 1910 responding to a court order in a suit brought to enjoin the Bully Hill Copper Mining & Smelting Co. from damaging farmers' crops. Since that time the company has shipped an average of 100 tons ore a day to the Balaklala Smelter.But Oct.1910 that smelter closed down for the same reason.

1/28/11. p.205.The Bully Hill ore consists of chalcopyrite,chalcocite and bornite, often rich in gold and silver."Much of it carries sphalerite,the zinc content reaching 12% in some places.". At the time of the shut-down the daily production from the Bully Hill, Rising Star and Copper City mines was 350 tons per day.When the smelter was closed by injunction development was discontinued and the blocked out ore in great part ruined before the mines were finally closed."Experiments are now being conducted with a view of devising a separation and treatment scheme whereby it will be possible to recover the zinc in the ores as well as the copper, gold and silver."

Vol.96 7/26/'13.

"What has been the fume damage in California?"

C.H.Eddy 153-155.

All smelters in the Shasta copper belt are closed but one. The Mountain Copper works,established at Keswick in 1895,had in 1906 to be moved to Martinez on account of the farmers and the Dep't.of the Interior. Bully Hill works were started in 1901,Afterthought in 1905. The Bully Hill works were closed by the Forest Reserve in 1910;they have since been experimenting with methods for recovery of zinc,with copper, gold and silver as by-products.

The Mammoth company put in a baghouse,which reduced smelting capacity from 1500 tons ore to 1000 tons per day. The farmers still complained,and a Grand Jury, all farmers,recommended to the District Attorney to bring suit. Eddy visited the farms in March 1913 and could see no damage whatever to crops;in fact they were record-breaking bumper crops.

1909 Cu production,lbs.,with Bully Hill,Mammoth,Balaklala:50,013,511
1910,Bully Hill out July 1: 40,397,284

p.155: "The Noble Electric Steel Co.recently installed three new furnaces and is producing a good grade of steel at Heroult."

Ibid. 11/8/13, p.901. John B. Keating, Mgr.,says work at the smelting plant is progeessing and commercial saving of the zincin the ore shouod come about within 90 days.

Vol.100. 8/7/'15. It is stated that the experimental zinc plant is successful and that a commercial plant may be installed.

Ibid. 11/13/'15, p.814: The Bully Hill Copper Co.has been working on electrolytic zinc for a long time.(Anaconda is contemplating installation of the Great Falls Mont. elelctrolytic plant).

Vol. 101. 1/29/'16. p.241: "rospect for a zinc smelter at Bully Hill is good.It would treat Afterthought ore also. Both properties have large tonnages of zinc ores.

Bully Hill has been experimenting with zinc smelting for the past two years",since the closing down of its copper smelter by the Forest Service,which was afraid that a lot of scrub timber would be lost to the people."

Vol. 103: 4/7/'17. Anchor Shaft being unwatered by San Francisco men.(Walter Arnstein).

Production of Rising Star, Bully Hill, Copper City Mines, 1900 and 1910: 411,000 tons ave. .085 oz.Au.,4.20 oz.Ag.,4.24% Cu.(Bealsm report 1/13/20.

1917: Early in this year the Bully Hill Mines Co.,Inc.optioned the property from the G.E. (Walter Arnstein of S.F. and associates). They unwatered the Rising Star,found and mined lenses of copper ore missed by the former operators,and developed and are developing considerable tonnage of high grade zinc ore.(Ball report,Dec.1919,4-5.)
Rising Star production,total to Dec.1919:about 175,000 tons.
1909: Ave.analysis of 46,761 tons produced from Rising Star:

Cu 3.41%		ccpy	9.8%
Zn 6.69%		ZnS	9.0
Fe 25.18%		Py	46.9
Al(sol) 4.55		Barite	.9
S 31.65		Silic.gangue	33.4 (mainly chlorite and sericite with some qtz.)
MgO 4.80			
Al2O3 insol.	4.80		
SiO2 "	19.20		
BaSO4 "	.88		
	97.61		

Bully Hill Mine production,May 1st 1901 to June 30,1910,220,946 tons ore (Above still from Ball report).

Copper City production: 16,856 tons smelting ore,"which contained high percentages of zinc.The workings are mostly caved,but such inspections as is possible,leads to the belief that zincore in tonnages of consequence exist in that property, a condition which may account for the small production."(A.H.Rogers report,Mar.12,1920,p.5).

EMJ 1/11/19. Bully Hill Copper Mining & Smelting Co.has converted the old smeltery to a 150 ton flotation plant.

EMJ 4/26/1919: The new assay and office bldg,burned April 10.Flotation plant also caught fire but was saved.POmexpress and RR office destroyed; damage $8000.

MSP vol.118,557-561. 4/26/19. A Metallurgical Journey to Shasta,Cal. Herbert Lang. James Sallee(died 1918) was an assayer.Took hold of the Bully Hill mines after they had been practically abandoned for years. After some development he sold to Delamar, In Bully Hill gold occurred rather abundantly at the very surface.

MSP vol.119. Metallurgical journey to Shasta cont. 7/12/1919,p.47:Rising Star produces ore ave.grade 3% Cu.By careful sorting can be dividedinto two classes,(1) 6% Cu,with $1.50 percious metals;sent to Kennett smelter;poorer stuff (2) reserved for concentration. 20,000 tons plus of (1) shipped,1918. Sorting by no means gets rid of all the Zn;it only raises grade of Cu. Surficial enrichment at Bully Hill, Delamar produced great quantities 10% Cu ore in places running $20 Au. Had his own smelter,converter. Handsome profits.Before him,mine produced oxide ores,secondarily enriched;silver-milled with some success; complex sulphides at depth stopped this.p.48:"Altogether it is doubtful if there exists a better illustration of the various phenomena of surficial enrichment than in the mines of Bully Hill.The present workings now 500 feet deep, have reached the zone of unaltered sulphides,of which great quantities are exposed."

ZnS is so abundant in Bully Hill ores it has proven a detriment to smelting.

8/25/19 Metallurgical Journey cont. 265-270. First discoveries about 1860,small rich placers.Next Copper City Silver ores,considerable production up to 1880 ($1,000,000,Bully-Hill Copper City?before 1880). Stamp mill,worked above sulphide zone. Then inactivity;in 90s Jas. Sallee succesfully developed certain claims,esp.at Bully Hill mine. Sold to J.R.DeLamar (died 1918) for $225,000,nearly all cash.

Delamar 5 year ownership (1900-1905) very productive.Smelting began on enriched upper ores;grade fell off with depth as unaltered sulphs came in.First ore up to 15% Cu,with a more than proportionate amount of Au,Ag;but average ore smelted by Delamar not over 5% Cu,with $4-5 precious metals. Delamar foresaw fume difficultysold to GE 1905,$1, 250,000.Smelting works then included a blast furnace,150 T/d;150 T converter plant;battery of 60 roasting stalls with stack;2 McDougal calciners, moderate size etc.

After GE bought,mines.esp.Rising Star,intensively developed;then smleter enlarged smelting resumed.RR completed from Pitto Bully Hill,cost $650,000.Capacity of smleter increased to 550 tons.But during 12 years

of GE owhership hardly 50,000 tons of ore was smelted. Total amount, bith managements:

417,671 tons, of which

Bully Hill mine...220,946		Ave.extraction:	Cu 4.24%
Rising Star.....174,869			Au .085
Copper City..... 16,856			Ag 4.20

Value: Copper, 34,413,596 lbs @ 13c = $4,473,767.48

Au, 34,554 oz.@$20 = 691,080.00

Ag, 1,707,875 oz @ 50c = 853,937.50

$6,018,784.98.

Works closed June 30, 1910, 400 men out.

G.E. did not convert matte; shipped mist of it to Mammoth works, Kennett. Put in 35'x 16' reverb. Wroked poorly, low capacity. Smelting charge difficult for bot reverb and blast furnace. At times silica reached 23%, alumina 12%, barite 27%, zinc 16%; but not all at same time, or furnaces would not have worked at all. Ave.S about 23%, should have used pyritic smelting; but instead selected roasting-smelting method. Should have used reverb entirely; but the small reverb was usedonly for smelting flue dust and fines. Ls bought from Bear Kennett. Ave.slag:

SiO2 36%
Ferrous oxide 21%
CaO 9%
BaO 8%
Al2O3 12%
Zn 8%.

Matte had 39% Cu.

Bully Hill ores: Blende, pyrite, ccpy, with lesser galena, bornite, chalcocite. In some parts of the mines blende predominates; there are areas where it forms 1/2 to 3/4 of the whole mass. Pyrite predominates elsewhere. Careful sorting, company shipped over 25,000 tons, 1918 ave. 6% Cu; to do this they had to reject a much larger quantity ave. perhaps 2%.

Zn:Cu ratio,		
	Bully Hill mine	2:1
	Rising Star	10:1
	Copper City	8:1

Properties now Zn mines. Although Zn increasing with depth, metals irreg.distrib. so that ores range from nearly pure py, 1-2% Cu, very little Zn, to heavy blende ores, 30-40% Zn, correspondingly little Cu, Fe. S content naturally variable: each unit of Zn, 1/2 unit S; Cu, nearly 1 unit S; each unit of Fe in pyrite, a little more than 1 unit S. Make acid out of pure py bodies.

Gangue: silica, alumina, barite.

Bully Hill, owned by GE for 12 years, sold 1917 to Ealter Arnstein and associates, for $750,000 reported. RR etc included. Sum scarcely covers cost of RR. Buyers have develiped Rising Star and introduced flotation. Called Bully Hill Mining Co.; extracted 1918 o ver 27,000T selected ore, ave. 6% plus Cu, $1 or so in precious metals, 5.4% Zn, 30% Fe, May 22, 1919, Beals writes doing only dveleopment; oprining good high grade Zn ore, R.S. Beals estimates:

	Tons	Au	Ag	Cu	Zn
Bully Hill	50,000	.12	6.46	2.33	7.83
Rising Star	147,600	.03	4.00	2.30	23.00
Copper City	25,000	.04	6.08	2.08	17.50

Anaysis of a certain % of the Bully Hill mine product:

Cu 3.33%	Insol:	SiO2	23.54
Zn 7.82		Al2O3	6.40
Fe 12.68		BaSO4	17.55
Al2O3 sol. 4.95			
S 17.15		Au	.12 oz.
MgO 1.47		Ag	6.46
CaO 1.45			

While Bully Hill ppty most important,Arps of great promise.Considerable amounts of heavy sulphide ore,said to carry 5% Cu with 5-20% Zn and $5 Au,Ag exposed;and large milling tonnage being developed (by F.B. Hink). Wodth of ore said to be 100 ft.plus.

EMJ 12/27/19. p.964. Bully Hill Mines Inc. has expended over $500,000 in mine development,1918-1919 and has opened large Zn and Cu reserves in the Rising Star and Bully Hill mines. 1918 30,000 tons 6% Cu ore shipped to Tacoma.R.E.Beals GM.,Walter Arnstein Pres.,S.F.

p.966:Bully Hill Mines Co.has cut force from 70 to 25 men. Development cut out since enough ore for 15 years for the contemplated plant.

EMJ 1/17/20. p.150: 150 ton flotation plant completed.

EMJ 1/24/20 p.288. Will soon start work on B.H. projected Zn smelter.Same process as used by Mammoth will be used.

EMJ 6/26/20 p.1426. Bully Hill Mines taken over by Hayden.Stone Co. D.C.Jackling will be managing director. Shasta Zinc and Copper Co. 200000 shares. Purchased on mine report by Allen H. Rogers,and metall.report by March F.Chase of N.J. Zinc.

Ref. MSP 11/27/20. Zinc Oxide Plant of the Utah Zinc Co.A.B.Parsons.

EMJ 7/17/20. p.135. Shasta Zn and Cu Co.expected to erect a zinc oxide and zinc concenteator plant at Delamar.~~There~~ There are large deposits of zincore in the lower workings of the Rising Star.

EMJ 4/9/21. p.644.Jackling and others vistied Bully Hill where plant being installed.

EMJ 6/25/21. p.1079. Plant startedrecently;160 tons ore per day.Clean slag low in Zn, Cu.Success seems assured. over 2.5 millions in new capital.

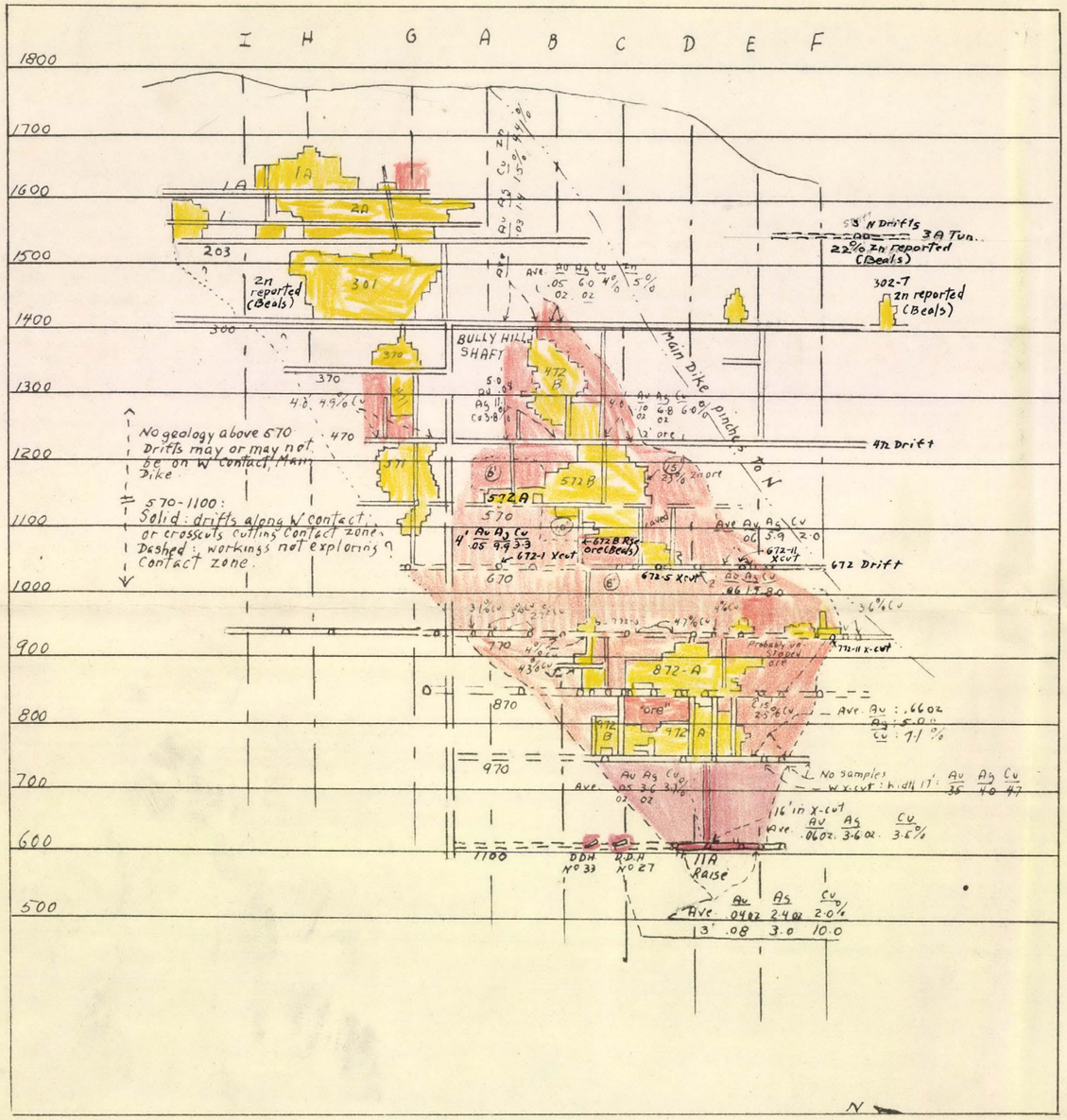
EMJ 8/13/21. Shasta Zn and Cu completed initial run deonstrating success of process.Shut down to put in a refining furnace.

EMJ 8/20/21. vol.112.Metallurgical Progess in Shadta Co.,Calif.Geo J.Young.

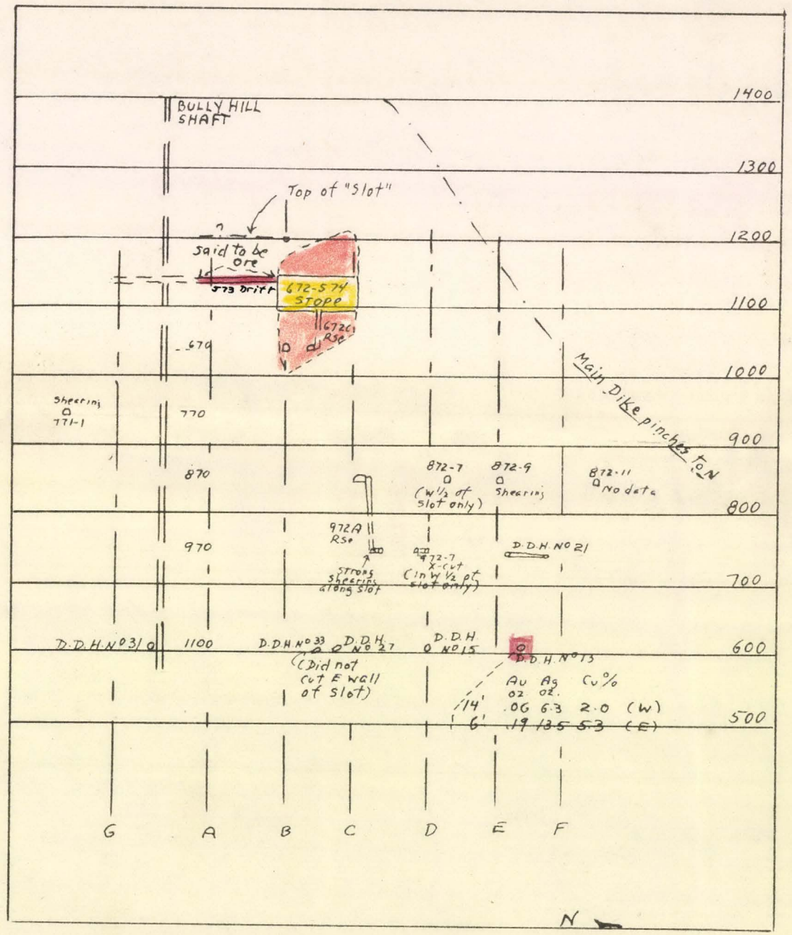
Winthrop: About 1900-1905,small blast furnace and converter plant ope ated by J.R.Delamar. Stall roastingl flue dust briquetted and smelted 150 tons per day;successful.

G.E. biught it, 1905,increased capacity of smelter;matte shipped to Kennett. Increased Zn in ores interfered with smelting.Smelter closed 1910 owing to litigation over smelter smoke. Experimental work on Zn recovery (including electolytic),1911-1915. J.B.Keating, GM.;C.A.Hansen, H.R.Hanley,metallurgical engrs.

1917:Arnstein and associates. 150 ton flotation mill completed 1919 in the building adjacent to the old blast furnace bldg. Selective flotation not so hot;high freight ratesto Zn smelters. Hayden Stone aquired an interest from Arnstein and continued the tests.



VERTICAL LONGITUDINAL PROJECTION, "MAIN" ORE ZONE
(WEST CONTACT OF "MAIN" DIKE)
Scale: 1" = 200'



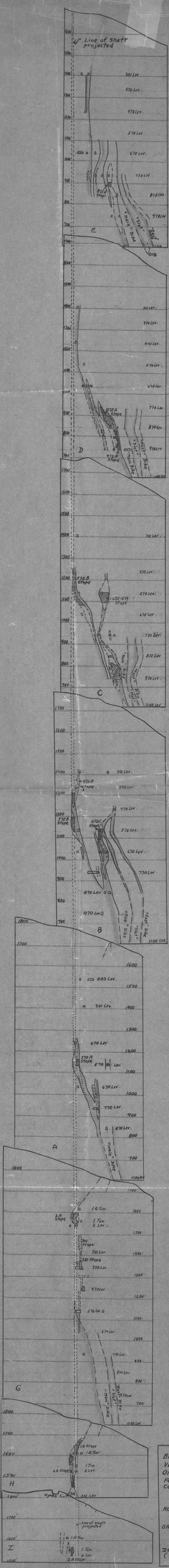
VERTICAL LONGITUDINAL PROJECTION OF "SLOT"
Scale: 1" = 200'

BULLY HILL MINE, SHASTA CO., CALIF.

LEGEND

Stopes:
Extensions, probably unstoped: →
Virgin ore:

Edward Wisser 7/48



BULLY HILL MINE, SHASTA CO., CALIF.
VERTICAL CROSS-SECTIONS THROUGH ORE ZONES

For detail Plans of Sections see Structural Contour Map.

Scale: 1" = 200'

LEGEND

ROCK FORMATIONS
"Main" Dike:
"East" Dike, minor dikes:

ORE BODIES
Stoped:
Extension, probably unstoped:
Virgin Ore:

ZONES POTENTIALLY ORE-BEARING
("Shear-zones):

MEMORANDUM ON BULLY HILL MINE, EAST SHASTA DISTRICT, CALIFORNIA

The Bully Hill mine has a history dating from the 1860s, when gold and silver were discovered in the gossans above the sulfide ore bodies. Sulfides came in at shallow depth, precious-metal content decreased and this early mining was abandoned.

About 1900, the famous Captain Delamar (after whom Delamar, Nevada, and Delamar, Idaho are named), mined succesfully the secondarily enriched copper ores at shallow depths, and in 1905 sold the property to the General Electric Company, as a copper mine. Their operations proved a failure, owing (1) to the relatively low grade of the primary copper ore, and (2) to the presence of abundant zinc, which could not be well separated from the copper sulfides (differential flotation not having been yet invented) and which was a highly deletrious element in the copper smelting. The Rising Star ore bodies, about 2000 ft. southwest of the Bully Hill mine proper, were apparently first developed by General Electric, prior to 1910.

In the early 1920's, D.C. Jackling orgamized the Shasta Zinc and Copper Company, with the idea of smelting the Rising Star Zinc ore locally to make zinc oxide of paint quality. The writer was employed as smpler and geologist at the Rising Star mine, during the first half of 1921. (Samuel Grinsfelder, later of Union Oil, was the engineer). An old copper smelter was moved to the property and adapted to zinc smelting; later a small secondary or refining smelter was erected; all efforts were in vain: it proved impossible to produce paint quality zinc oxide. Seeing the handwriting on the wall I left about July, 1921. Not long after, the operation quit.

In the 40s the property was acquired by the Glidden Company. The formation of Shasta Lake cut the mine from access to a paved highway or railroad, except by a very long, unimproved, mountainous Forest Service road. In 1949 I was retained by the Glidden Company

to assist in preparing a law suit against the Bureau of Reclamation, claiming damages for loss of access. All maps and other data were furnished me, including the geologic maps I had made of the Rising Star in 1921. I was directed to estimate developed ore, possible new ore, costs, net profit, dollar valuation on the old Bully Hill mine alone. No reference was made to the Rising Star. In 1921, ore reserves there were estimated at 250,000 tons averaging 0.03 oz. gold per ton, 2.9 oz. silver per ton, 2.1% copper and 22.5% zinc. At present prices such material would liquidate at about $21 per ton. In 1949 the price of copper averaged 17 c., that of zinc, 9-10 c. The Rising Star material was not considered ore.

I prepared a structural contour stereogram of the mine and a number of cross-sections, both showing localiztion of ore bodies in alaskite (or rhyolite) along contacts with a steep complex dike which splits going down, like a pair of shears, with ore along the outside edges and within the "slot." The actual valuation was never made, because the Glidden Company secured a satisfactory out-of-court settlement from the Bureau of Reclamation.

In spite of their "loss of access" the company started active exploation at the Bully Hill mine. In 1955 diamond drilling from the surface, following recommendations by Ira Joralemon, partly delimited one ore body, with indications of two more. The mine was then unwatered, and developed the proven ore body, first on the 870 level, then its upward extension on the 770.

In 1956 the mine was offered to Bear Creek Mining, who sent me to examine the new showing, which I looked at on the 770. Data given me show that this ore body contains 60,000 tons averaging 0.12 oz. gold

per ton, 3.6 oz. silver per ton, 2.5% copper, 12% zinc. For the entire mine, reserves were estimated at 135,000 tons averaging 0.12 oz. gold per ton, 5.5 oz. silver per ton, 3.3% copper, and 10.3 % zinc.

By 1956, Glidden had spent $1,125,000 in exploration and development (I don't know how). This was the precise price they asked for the property, a totally illogical demand because a large proportion of their rxpenditure had been pure waste. With the mine unwatered and partly retimbered, they estimated total cost to put the mine in production at $1,200,000; this included a 200 tons per day flotation mill. The purchase price plus the sum needed to put the mine in production came to $2,325,000. Taking the Glidden estimate of net profit per ton of $13, I estimated that twice as much ore as then developed would be needed, merely to return the investment. I recommended, therefore, that Bear Creek reject Bully Hill, which they did.

Present Day Aspect.- So far as I know, the Bully Hill mine is again under water (as is the Rising Star). Rise in costs during the 14 years since 1956 would undoubtedly raise the cost to put the mine in production far above the 1956 estimate of $1,200,000 (with the mine unwatered). In 1956 the estimated overall cost of production was $13 per ton of ore mined; today that cost would probably be close to $20, on the basis of 200 tpd; the tonnage potential of the mine (scattered ore bodies, averaging 20 ft. or less in width) does not warrant a greater rate of production.

The ore of course is high-grade; the 135,000 tons might liquidate at about $35 per ton, leaving a net profit of $15 per ton. But the 135,000 tons of developed ore would give only a two-year life at 200 tpd, not economic from any standpoint. I believe that most of the 250,000 tons in the Rising Star mine is still there; but with a liquidation value of $21 per ton, and a probably cost of production close to $20 per ton, it is not ore.

On the basis of information presently available, it follows that the Bully Hill property would hardly be attractive if offered free. Nevertheless, if a deal is being considered, it might be worthwhile to ask for complete records of Glidden exploration and development at the old Bully Hill mine, including location of diamond drill holes, their logs, assay plans of the 870, 770 and any other levels unwatered, and any other pertinent data. I could incorporate these data in my map and cross-sections and be in position better to evaluate these developments.

There is one point about the Bully Hill mine: it was always worked as a copper mine; samples were never assayed for zinc. There might be considerable blocks of ground left unstoped because of relatively low copper and high zinc.

A note of warning is in order regarding the influence of Lake Shasta: the lake is a rereation area, and the Federal government might take a dim view of a mining operation on its shore, even though mill tailings could be disposed of without polluting the lake. Secondly, I had to reach the mine by boat in 1956; unless transportation has greatly improved east of the mine, material coming in and concentrates going out would have to be barged across an arm of the lake; this would require permission of the government, and permission which might be revoked at the behest of wild-eyed conservationists. Finally, the Shasta dam delivers Sacramento River water to the Great Valley on the south; power is also generated. The result is that the level of the lake varies extremely from month to month, making mechanical difficulties for the design of landing facilities for the barges.

Tucson, Arizona
December 10, 1969

Edward Wisser

~~Rising Star~~

Recovered G.V. S.R

Bully Hill

		Recovered	Gross Value	Smelter Return
Au	0.12	0.12	$4.20	4.00
Ag	5.5	4.95	8.90	7.10
Cu	3.3	3.0	30.00	18.00
Zn	10.3	8.0	12.00	4.80
				33.90

.03
29
2.1
22.5

Rising Star

		Recovered	Gross Val	Smelter Return
Au	.03	.03	1.00	1.00
Ag	2.9	2.6	4.70	3.75
Cu	2.1	1.9	19.00	11.40
Zn	22.5	18	12.00	4.80
			$	2095

250

700
200
140000

350

700

3,5

270000
.13

El oro 100W 9 20 S 18

Angangueo 100W 30 19N 62

Temecaltepec 100W 5 19N 5

Sultepec 100E 6 19S 15

Zacualpan 100E 27 19S 30

~~Taxco~~

IXTAPAN DEL ORO 100W 25

19N 27

Mont 100 30E

26 29N

305
12
3660

350
200
10000) 90000
13

4500
305
22500
135000
1372500

1cm = 200000 cm

2000 m

1-7

100 Km = 62.14 m

50

310.70 = 9.7 cm

100mi = 3.11 cm

20
.305
105
600
6105

December 12, 1969

MEMORANDUM ON BULLY HILL MINE
EAST SHASTA DISTRICT, CALIFORNIA

The Bully Hill mine has a history dating from the 1860's, when gold and silver were discovered in the gossans above the sulfide ore bodies. Sulfides came in at shallow depth, precious-metal content decreased and this early mining was abandoned.

About 1900, the famous Captain Delamar (after whom Delamar, Nevada, and Delamar, Idaho are named), mined successfully the secondarily enriched copper ores at shallow depths, and in 1905 sold the property to the General Electric Company, as a copper mine. Their operations proved a failure, owing (1) to the relatively low grade of the primary copper ore, and (2) to the presence of abundant zinc, which could not be well separated from the copper sulfides (differential flotation not having been yet invented) and which was a highly deleterious element in the copper smelting. The Rising Star ore bodies, about 2000 ft. southwest of the Bully Hill mine proper, were apparently first developed by General Electric, prior to 1910.

In the early 1920's, D. C. Jackling organized the Shasta Zinc and Copper Company, with the idea of smelting the Rising Star Zinc ore locally to make zinc oxide of paint quality. The writer was employed as sampler and geologist at the Rising Star mine, during the first half of 1921. (Samuel Grinsfelder, later of Union Oil, was the engineer.) An old copper smelter was moved to the property and adapted to zinc smelting; later a small secondary or refining smelter was erected; all efforts were in vain: it proved impossible to produce paint quality zinc oxide. Seeing the handwriting on the wall, I left about July, 1921. Not long after, the operation quit.

In the '40's the property was acquired by the Glidden Company. The formation of Shasta Lake cut the mine from access to a paved highway or railroad, except by a very long, unimproved, mountainous Forest Service road. In 1949 I was retained by the Glidden Company to assist in preparing a law suit against the Bureau of Reclamation, claiming damages for loss of access. All maps and other data were furnished me, including the geologic maps I had made of the Rising Star in 1921. I was directed to estimate developed ore, possible new ore, costs, net profit, and dollar valuation on the old Bully Hill mine alone. No reference was made to the Rising Star. In 1921, ore reserves there were estimated at 250,000 tons averaging 0.03 oz. gold per ton, 2.9 oz. silver per ton, 2.1% copper and 22.5% zinc. At present prices such material would liquidate at about $21. per ton. In 1949 the price of copper averaged 17 c., that of zinc,

9-10 c. The Rising Star material was not considered ore.

I prepared a structural contour stereogram of the mine and a number of cross-sections, both showing localization of ore bodies in alaskite (or rhyolite) along contacts with a steep complex dike which splits going down, like a pair of shears, with ore along the outside edges and within the "slot". The actual valuation was never made, because the Glidden Company secured a satisfactory out-of-court settlement from the Bureau of Reclamation.

In spite of their "loss of access" the company started active exploration at the Bully Hill mine. In 1955 diamond drilling from the surface, following recommendations by Ira Joralemon, partly delimited one ore body, with indications of two more. The mine was then unwatered, and developed the proven ore body, first on the 870 level, then its upward extension on the 770.

In 1956 the mine was offered to Bear Creek Mining, who sent me to examine the new showing, which I looked at on the 770. Data given me show that this ore body contains 60,000 tons averaging 0.12 oz. gold per ton, 3.6 oz. silver per ton, 2.5% copper, 12% zinc. For the entire mine, reserves were estimated at 135,000 tons averaging 0.12 oz. gold per ton, 5.5 oz. silver per ton, 3.3% copper, and 10.3% zinc.

By 1956, Glidden had spent $1,125,000 in exploration and development (I don't know how). This was the precise price they asked for the property, a totally illogical demand because a large proportion of their expenditure had been pure waste. With the mine unwatered and partly retimbered, they estimated total cost to put the mine in production at $1,200,000; this included a 200 tons per day flotation mill. The purchase price plus the sum needed to put the mine in production came to $2,325,000. Taking the Glidden estimate of net profit per ton of $13, I estimated that twice as much ore as then developed would be needed, merely to return the investment. I recommended, therefore, that Bear Creek reject Bully Hill, which they did.

Present Day Aspect.-So far as I know, the Bully Hill mine is again under water (as is the Rising Star). Rise in costs during the 14 years since 1956 would undoubtedly raise the cost to put the mine in production far above the 1956 estimate of $1,200,000 (with the mine un-watered). In 1956 the estimated overall cost of production was $13. per ton of ore mined; today that cost would probably be close to $20., on the basis of 200 tpd; the tonnage potential of mine (scattered ore bodies, averaging 20 ft. or less in width) does not warrant a greater rate of production.

The ore of course is high-grade; the 135,000 tons might liquidate

at about $35. per ton, leaving a net profit of $15 per ton. But the 135,000 tons of developed ore would give only a two-year life at 200 tpd, not economic from any standpoint. I believe that most of the 250,000 tons in the Rising Star mine is still there, but with a liquidation value of $21. per ton, and a probable cost of production close to $20. per ton, it is not ore.

On the basis of information presently available, it follows that the Bully Hill property would hardly be attractive if offered free. Nevertheless, if a deal is being considered, it might be worthwhile to ask for complete records of Glidden exploration and development at the old Bully Hill mine, including location of diamond drill holes, their logs, assay plans of the 870,770 and any other levels unwatered, and any other pertinent data. I could incorporate these data in my map and cross-sections and be in position better to evaluate these developments.

There is one point about the Bully Hill mine: it was always worked as a copper mine; samples were never assayed for zinc. There might be considerable blocks of ground left unstoped because of relatively low copper and high zinc.

A note of warning is in order regarding the influence of Lake Shasta: the lake is a recreation area, and the Federal government might take a dim view of a mining operation on its shore, even though mill tailings could be disposed of without polluting the lake. Secondly, I had to reach the mine by boat in 1956; unless transportation has greatly improved east of the mine, material coming in and concentrates going out would have to be barged across an arm of the lake; this would require permission of the government, a permission which might be revoked at the behest of wild-eyed conservationists. Finally, the Shasta dam delivers Sacramento River water to the Great Valley on the south; power is also generated. The result is that the level of the lake varies extremely from month to month, making mechanical difficulties for the design of landing facilities for the barges.

Edward Wisser

Tucson, Arizona
December 12, 1969

GENERAL REPORTS

GEOLOGICAL REPORT ON THE PROPERTY OF THE BULLY HILL MINES CO.INC.

S.H.Ball. Probably 1919.

Examination June, July, 1919.

History: Placer gold found,1853,near Bully Hill. Pittsburgh Mining District formed. Gold from ore lens outcrops.1862 gold and silver found in copper outcrops of Excelsior claim (Copper City);rush. Ore soon passed into sulphides with depth,work abandoned. Some work done at Bully Hill at this time. In 70s Bully Hill reopened;Extra Mining Co. said to have extracted $640,000 in gold and silver from surface ores,but rebellious sulphide ores bankrupted company. Early in 80s James Sallee aquired the properties,sold to Capt. Delamar (J.R.),1899. The latter "after very profitably treating the high grade secondarily enriched ore immediately below the gossan"(p.4) sold to Bully Hill Copper Mining & Smelting Co.,G.E. subsidiary. They operated mines with poor results until 1910; known Cu ore then exhausted and mine bottomed,closed down.They afterward experimented in treating Zn ores;knew considerable lenses of this existed in the mines.

Early 1917 Bully Hill Mines Co.Inc. optioned property, They unwatered Rising Star;found and mined Cu lenses missed by G.E.,and developed and are still developing considerable tonnage high grade Zn.

General Geology.- Seds and tuffs dip SE 25°;intricately intruded by large irregular mass of light porphyry trending NE.

Dekkas andesite,oldest,exposed in extreme N end of ppty.Dark grey, s.t. porphyritic. Early Triassic bedded series andesitic tuffs and flows.

Pit shales above this,grades down into it..2000' grey-grey black shale with IB rhy tuffs.Late Triassic. Near alaskite porphyry shale metamorphosed to dark slate or to jasperoid. In Bully Hill,groups and near Copper City.

Alaskite porphyry intruded, in a general way,between Dekkas andesite and Pit formation;light colored fine-grained ,small qtz. phenos. This is oldest phase; a slightly younger rock is of similar general appearance but slightly coarser in grain,more feldspar phenos. (Cf.Afterthought) Latter rock in turn cut on Orphan Boy Claim by similar dikes. Alaskite porphyry is CR of W part of Bully Hill claims,practically all of Michigan group (W of Bully Hill group;Walter Arnstein has them optioned), much of Copper City group. (Apparently oldest type). Younger type covers important areas on Happy Thought,Rookery and Orphan Boy claims;small OCs on Hillside and Redding claims. Can't differentiate always so on map both types mapped together. Age probably late Jurassic.

Both Pit formation and alaskite intruded by dark grey dikes with white phenos;weathers green or brown,concentric shells. Dikes to 120 ' max. in E central part of Bully Hill claims. Basic diorite porphyry under microscope. These dikes parallel to shear zones near Bully Hill mine,shows dikes intruded after alaskite had silicified and after shearing.

Structure: Dekkas and Pit dip SE,but in detail Pit intricately folded. Alaskite intrusion complex;while contacts are as a rule more or less vertical,suggestions that between Dekkas and Pit the porphyry flattened out to roughly horizontal body.

x Michigan group

Faulting common, several periods. Alaskite intruded along an ancient fault, and remarkably sheared. In old Bully Hill workings, faults and planes of shearing are only parallel groups of very small faults, dip very steeply E, strike N. But in other parts of Bully Hill ppty dominant fault strike is N25W, with steep dips either NE or SW. Copper City group, faults and shear zones srike NNW and NNE. Faults often complex, branch vertically and horizontally.

Where fault movement was distributed forming a shear zone, alaskite crushed, recrystallized to a sericite schist, with curved lustrous planes. In places instead of shear zones, breccia of angular rock fragments along the faults.

A few post-mineral flts cut off ore lenses.

Ore Bodies: Lenticular masses of rather solid sulphides; Cu, Zn, Au, Ag. Usually in groups along shear zones in alaskite or at its contact with other rocks.

Ore and gangue: Primary Bully Hill mines ores fine-grained sulphides with lesser gangue. Py, ZnS, ccpy in order of abundance. Bornite, PbS less common. PbS usually associated with ZnS, bornite with ccpy. May be tetrahedrite, 903 crosscut Rising Star. Presence of a little cadmium in Zn produced suggests greenockite, cadmium sulphde. Ag probably as sulphide, perhaps intimately associated with PbS.

Sulphides fine-grained but pyrite may occur as cubes to 1/4". Pyrite deposited well out into CR surrounding the OBs (cf. Afterthought).

Gangue, order of abundance, anhydrite, barite, qtz. ~~Anhydrite~~ Anhydrite or gypsum as a large ore-bearing mass; barite, qtz., fine-grained particles intimately IG with the sulphides. Sericite and chlorite in ore, as residual matter left by incomplete replacement.

Slightly younger gangue minerals: veinlets of anhydrite, barite, or qtz. These many contain py, ccpy, rarely ZnS, These cut the sulphide ores.

Secondary enrichment: ccpy replaces py; bornite from ccpy; ccpy by replacement of all three sulphides. A little covellite. In the secondary enrichment zone anhydrite to gypsum. Argentite reported from this zone.

Nearer surface PbS to cerussite, copper sulphides to malachite, py to limonite. Here, in this surficial zone at Copper City, gypsum on fracture fades, barite in vugs. Native Cu, cuprite, azurite, native Ag reported from this mine.

HT alteration: Silicification of alaskite to dense hard grey rock. Dissem. pyrite and as bycnhes or small lenses. Ccpy - with the py. Second type: soft sheared alaskite with high sericite, probably kaolin. Third type: sheared alaskite sheared silicified alaskite with parallel stringers of anhydrite.

Type of Ore: According to Roger L. Beals, Rising Star:

a. ZnS-barite ore, high Ag. Au. b. Pyrite ore, low copper, Au, Ag. c. ZnS ore, low Cu, Au, Ag. d. Copper-iron ore. c, d grade into each other, often in same shoot. Band of copper-iron often in onewall of Zn shoot, contact sharp

Pyrite ore may be a variant of these other two for in places it carries ZnS as well as Cu. Above No.10 tunnel in Copper City group is ore OC, fragments of brecciated ZnS enclosedin pyrite. While this pyrite may be younger, believed that elsewhere pyrite contemp. with ZnS. Pyrite lenses should be followedin hopes Zn will come in. In the upper part of the OBs pyrite ore enriched by descending waters to commercial copper ore.

Average Analyses.

Type	Barite%	Au oz	Ag oz	Cu%	Zn%	Fe%
Zn-barite	16	.0425	7.7	2.0	21.5	8
Pyritic	--	.02	.5	2.9	1.5	27
ZnS ore	nil	.015	.8	2.7	22.2	14
copper-iron ore	--	.085	.85	8.4	7.3	29

Pyrite type have walls of the hard silicified alaskite. ZnS ore in either gypsum or hard silicified alaskite. Copper iron ore usually in gypsum, but s.t. hard silicified alaskite or sheared alaskite. Zinc-barite, usually sheared alaskite, s.t. eitjer hard silicified alaskite or gypsum.

Bully Hill mine ore was of the zinc-barite type, high in silica, low in S; in OBs with both walls alaskite, Ag and barite said to have been less. Ore mined from lenses in the diorite porphyry dike there was barite-copper with good Au, Ag, due to unuausally high but erratic precious metals. Gold s.t. to 1 oz, silver to 124 oz.

Copper City: zinc-barite, copper-iron and pyritic.

Ore Textures: All typically fine-grained. S.t. massive and composed al most entirely of one of the sulphides, either ZnS, Py, ccpy. Again small blebs of one sulphide end osed in another, or all 3 intimately mixed. Common form of ore: 2 of 3 of the sulphides occur in narrow layers interlarded with one another.

Gypsum of anhydrite bands s.t. in zinc or copper-iron ore. Near edge of OBs gypsum may predominate; farther out sulphs only as scattered parting planes of the gypsum. Ores often preserve sheared structure of th alaskite; all gradations exist between pure sulphides and alaskite.

Ore Bodies: At four places Bully Hill, Rising Star, Winthrop Workings (Copper City) and Baxter Shaft. At each place a number of separate lenses are associated, situated along zones of maximum shearing. Shearing favorable to ore deposition so long as it does not result in formation of a gougy mass. Harder, firmer shear zone best.

Ore bodies, tabular, lenticular with greatest dimensions parallel to schistosity, hence they usually stand vertically. Various lenses along a shear zone are along a plane somewhat shoots in a vein. The sides of the lenses more often than not parallel, although pod-like bodies not unusualy/

OBs vary in size from bunches as large as a hand to masses 200-300' long, 400 ft. high and to 25' wide. But such large lenses often contain poor zones, horses or masses of unreplaced CR. Relatively small average size of lenses in part offset by wt. of ore, 9 cu.ft per ton.

Length of a lens usually about equal to depth, although on average perhaps depth exceeds length. Thickness of lens s.t. 1/4 length, s/t. 1/40 or less. Lenses usually thickest at their center. Since most lenses are 70-200 ft. high, many do not outcrop. Surface showing remarkably small considering large amounts of ore produced.

Owing to branches etc. in schistosity, shoots may split into one or more bodies, either laterally or in depth. But OBs irregular and where one might be expected to continue it may quit and vice versa.

Stringers of ore connect lenses along the same shear zone. Lenses may terminate as blunt wedges or may slowly contract to a knife-edge. "Ore bodies terminate against a gouge-filled pre-mineral fault in a plane, the clayey gouge having stopped the circulation of the ore-depositing waters." Some flat terminations of ore bodies are due to slicing by PM faults.

OBs s.t. flanked by CR containing many small parallel ore lenses; s.t. by CR with dissimilar sulphides; s.t. rich ore on one side of a shear zone, and beyond it wall may be apparently barren.

PM faults similar attitude to pre-mineral, probably renewed movement. Apparently either normal or reverse. Geological maps of Bully Hill mine levels made by GE engineers do not indicate OBs there are faulted. OB on 302-7 (SE part of Jennie June claim) which runs N60W at right angles to the other OBs may indicate an important pre-mineral fault along which it makes.

Outcrops: Gossan areas: siliceous, porous, with light masses fluffy limonite and pulvarulent hematite, brown or red. S.t. cavities several inches across, coated with iridescent limonite. Limonite formed by oxidation of sulphide OBs, removal of most of Zn, Cu, S, retention of stable iron hydroxide and silica, Ag, Au. "Several masses of gossan appear to be bedded and suggest that they do not represent actual ore bodies but were formed below fractures along which iron laden water escaped from the altering ore bodies below. (15-16). Reticulared masses of gossan s.t. cement breccias ofthe silic. mineralized alaskite. All gradations from such small masses to the slight iron stain common on surface exposures of the silic alaskite.

ZnS bodies have considerable py, usually some ccpy, hence their OC also limonite-hematite gossan.

Sample of gossan from Afterthought zinc ore bodies	Ave. unoxidized Afterthought
Au 0.015 oz.	.05
Ag 7.5	8.1
Cu 0.11	2.70
Fe 30%	12.6
Zn 4.7%	18.4
Insol. 23.4%	15.5

Gossan sample immediately overlay ZnS, high Zn content probably due to residual particles of blende. Amount of silver about double that of most Afterthought ore; but weight of gossan is only have that of the primary ore, hence here at least increased Ag due to retention in gossan of Ag in primary ore. Au about same as primary ore (No, E.W. see table).

According to report, probable that at Bully Hill both Au, Ag were higher in the gossan than in the ore from which the gossan was derived;

as gossan was eroded some of heavy Au and the silver compounds caught in cavities of the porous iron ore. Much Bully Hill gossan pans gold, reported that some was in fair size nuggets, altho most fine-grained. Report native Ag, native Cu, cuprite, azurite, malachite stains. By erosion gossan gold concentrated in streams below OC. Placers which first attracted prospectors. Placer streams head against all the important workings.

Gossan seems to have extended from surface 10-40' down. Gossan over (Zn) ore bodies seems thinner than over pyritic or copper-iron OBs, i.e. zinc sulphides occur nearer surface than other sulphs. Relative resistance to alteratiin of belnde shown in No.4 Rising Star tunnel, where fresh blende associated with softened pyrite replaced by chalcocite.

Pyritized silicified alaskite is associated with OBs UG; same rock seen on surface: ore guide, although UG its forms ribs between OBs. On surface it occurs as jagged peaks and irregular hillocks; Bully Hill owes its elevation to resistant nature of this rock.

Outcrops as lenticular bodies trending N, grouped into 4 bands striking NNW. OC is either a dense, slightly iron-stained rock, silicified, kaolinized, or a heavily iron-stained siliceous rock pitted by ex-pyrite solution cavities, or sue to kaolinized parts of the rock. Joints, fractures iron-stained; limonite usually cements brecciated silic. alaskite. Qtz veinlets and uncommon, barite as veinlets or filling small cavities.

Between these peaks and ribs of silic. alaskite the ore-bearing shear zones lie; but non-resistant to erosion hence usually covered by Qal.

At any place relative area occupied by gossan and silic. iron-stained alaskite would indicate chances for ore. Nearness to diorite porph. dikes would be favorable.

Following area has surface indications comparable to those overlying Bully Hill and Rising Star mines:

S 2/3 of Jennie June claim; SW 1/8 of Shasta claim; SW 1/2 of Bully Hill claim; NW 1/4 of Popejoy claim; NW 1/4 of Rising Star claim, N 1/3 of Northern Light claim; 40 acres. North Star claim, optioned by Arnstein, has another favorable area, 12 acres. Of this favorable mineralized 52 acres of ground about 10 acres have been partly explored by the 2 mines to a depth of about 1000'. Other tunnels have pierced favorable area at isolated points but not conclusive. Should diamond drill.

Copper City. 14 acres of favorable ground.

<u>Secondary Enrichment:</u> Gossan is reported to have passed rather sharply into a thin, more or less horizontal band of highly enriched powdery ore, largely Cu_2S with high Au, Ag. Bonanza ore of district. PbS if present in primary ore occurred in the gossan, and in this rich ore much more prominent than in primary ore. Pyrite either removed or altered to soft incoherent particles. Cuprite and native copper common in this zone, in gouges. Below this unusually enriched band were massive 2ndarily enriched ores containing an unusual amount of Cu_2S, secondary, bornite, covellite, ccpy, with good Au, Ag. Zn OBs not especially altered except for increase in Au, Ag. This lower 2ndary enriched zone usually stopped 150-250' below surface; along strong fractures, to 600'. Bottom of 2ndary zone and top of gypsym zone roughly correspond.

MnO2 relatively abundant at Copper City,hence enriched Au may go to greater depth here.(p.19)

Gypsum-anhydrite: former management thought gypsum cut off ore and stopped development on encountering gypsum.

Originally anhydrite;gypsum now dominates. Gypseum masses closest to surface on 500 Rising Star,225' below aurface. Said to have been first encountered in Bully Hill mine on 302 level (340' below surface). From these levels down gypsum in lenticular masses like ore lenses but larger. Expand and contract horizontally and vertically;replace alaskite and next the purer gypsum masses are CR areas with small parallel gypsum lenses. Gypsum lenses end as wedges or planes,in latter case along gougy faults (?). Gypsum often contains contemporaneous OBs. Some Rising Star gypsum lenses 100' wide, 200' long,greater depth.On some levels 4 distinct gypsum bands penetrated. Thinks same waters which formed OBs deposited the anhydrite..Silicification on wall rocks either preceded replacement by anhydrite,or latter process continued after silicification ceased.

Ore deposits by replacement of alaskite,shown by tracesof sheared structure of alaskite in some sulphide ore; by unreplaced shreds of the schistose alaskite in sulphide ore,the shreds retaining their original orientation;byt the common gradation from ore to barren rock;by alaskite horses in the ore,shear planes of which parallel to structure of surrounding country;by the absence of open spaces.

Downward extension: Bully Hill district OBs in an irregular lenticular mass of alaskite,near its E border. This mass has roughly vertical sides and presumably extends down to great depths. Shear zones bearing ore are as strong on 900 Rising Star as above. Excellent primary ore on 800 and 900,grade shouod not change downward.

Mineralization surface probably,5000 to 7000 above present surface, hence the OBs not apt to be suddenly affected in depth. Should be very considerable depth extension.

Rising Star Mine:Only one open to Ball.Unwatered to 900;1/2 of level workings inaccessible. 1100 level is 856' below collar,total depth of shaft 885'. 15,000' drifts and crosscuts,

Mine produced 175,000 tons ore.Average analysis of 46,761 tons mined 1909.(varying tonnages of .4 ore types mentioned)

Cu	3.41 %	ccpy	9.8 %
Zn	6.69%	ZnS	9.0 %
Fe	25.18 %	pyrite	46.9 %
Al(sol)	4.55 %	barite	.0 %
S	31.65 %	Silic.gangue	33.4 % (mainly chlorite,sericite with some qtz.)
MgO	4.80		
Insol. Al2O3	4.80		
Insol. SiO2	19.20		
Insol. Barite	.88		
	97.61		

CR alaskte,variously sheared,altered. In NE part of mine Tunnels 4, 7,schistosity and OBs trend NNW,dip steep E.This part of mine is structurally more closely related to Bully Hill than to Rising Star. Elsewhere OBs and schear zones dip 70° ave.SW.

Rising Star OBs apparently smaller,less regular than those of Bully Hill,judging from Bully Hill old maps. 6 or 7 ore belts in which lenses occur,plus a number of uncorrelated lenses. No tendency of O's to become smaller with depth once 82 level(horizon of maximum secondary enrichment) was passed. 500 ft. level a poor horizon,at shallower depth than that at Bully Hill.

Below 600 2ndary enrichment notably decreases,very little Cu2S on 700.

Recommendations: Follow ore. In addition:

1.Crosscut from 5E to see if low grade Cu values reported are really high grade Zn ores with low Cu.If so,some may connect with 6A stope.

2. Winze and raise from 6A stope.

3. Continue 5-3 drift.

4. Continue 602 drift out in country below OBs of 4 and 7 tunnels. Diamond drill perp. to drift.

5. Open 601-7 and 601-12 crosscuts and see if assays mean Zn ore.If so,drift,sink,raise on ore.

6. Raise from 701 to see if it connects with 601-7.
7. Follow ore on 7-3 NW.
8. Determine extensions of 810 stope.
9.Winze in 406 stope toward 7 tunnel.
10 Continue tunnel 2.
11. Open 804 for Zn ore reported.
12. Follow ore NW in face of 920.
13. Continue 801-5 to NW following ore stringers.
14. Follow ore in wall of 9D.
15. Drift on ore along fault in 903 to SE toward 909 stope.
16. Crosscut from 5A stope SW on 500 to try to get faulted OB.
17. DD horizontally from 800 level from W part of 801-3 stope starting 24 ft. west of winze. Point hole S55W and drill 100 ft. to crosscut mineralized gypsum walls of 801-7 stope.
18. Extend 602-4 crossvut under CCJ ground.

In future,crosscut SE from end of 602-2 crosscut about 540' to cut gypsum and to explore alaskite-diorite porphyry contact which in the Bully Hill mine was locus of good ore bodies.

Bully Hill Mine: Interior shaft just under 800 ft. deep,10,000 ft. drifts and crosscuts.May 1,1909-June 30,1910,produced 220,946 tons ore. Now under water but soon to be reopened." Records of the old management rather definitely indicate that zinc ore bodies were developed but not mined." (p.26). Old mine maps indicate OBs occur in shear zones NNE apparently equally as strong on 972 as on 572,Shear zones dip 80E.Two chief zones,a 3rd seems indicated coming in on 1109 crosscut,Stoped to 110' of surface,in places surface ores mined by opencut to 25' below OC. Surface workings however not extensive. More westerly one has alaskite FW and a shear zone or diorite porphyry HW;more easterly zone in shear zones in diorite porph. Ore lenses in the ore zones opposite one another or en echelon. Ore lenses in VLP pitch 15°.

An OB in 307-7 Xcut N60W,premineral crossfault? 672m770 levels poor but ore came in again below;mine not bottomed. Unwatering justified.

2 odd pages from report by S.H.Ball, August 11, 1919.

Misc.Workings: Fine-grained ZnS on dump of caved tunnel about 50 ft. SE of No.3A tunnel on Shasta Claim. Tunnel now being driven to explore this at depth.

Two tunnels in geulch near center of Norhtern Light Claim have good ZnS ore on dumps.

Michigan Group: Most appears unmineralized but N Star claim has good surface indications. Development to date on these claims discouraging, but if obtainable at reasonable price, Northern Star and Ydalpom claims should be addedto company's holdings.

Copper City Group: CR alaskite porph, Pit formation; one small diorite por.dike. Excelsior claim, small gossan and bold outcrops of the silic. alaskite indicate mineralization.

Winthrop workings on Excelsior claim opened by several tunnels; small opencuts mined surface ore, said to have been rich in Ag.

The OBs disclosed by the tunnels, which are now inaccessible occur in a shear zone in alaskite which seems to be 75-100 ft.wide. NNE, trend of shear zone; OBs make angle of about 45° with this trend, trending N to NW. Lenses small sp developing Rising Star and Bully Hill is preferable.

Baxter workings also inaccessible; appear to have been on a small OB.

General Recommendations.- Special development has been outlined for Rising Star. Following applies to whole Bully Hill District.

1. Ore should always be followed, even lean pyrite as some change may occur laterally or vertically.

2. Drift along shear zones.
3. DD for parallel OBs.
4. Gypsum or anhydrite gangue mineral, hence ore locus.
5. Study old reports; have given much useful information on location of Zn OBs.

DD unexplored 42 acres (out of 52); only 10 acresexplored.

In VLP of Bully Hill mine, stopes occupy 17.5 % of developed area; addition of the zinc OBs developed but not stoped would probably bring this area up to 25 %. If this area had been drilled prior to opening of the mine one hole in 4 would have struck ore, 1 in 2 or 3, highly mineralized ground. Chances elsewhere considered sufficiently good to recommend drilling following 6 holes:

1. SW of Shasta claim. Point just N of W.
2. Center of Jennie June claim. SW.
3. NW part of North Star claim; point south of west.
4. Center of north half of Bully Hill; point N of W.
5. NW part of Bully Hill claim. Point S of W.
6. S center of Bully Hill claim. Point W.

Inclination of holes 45° to 60°; 400 to 500 ft. long.

G.T.Jackson,Mgr.Shasta Zinc & Copper Co. to D.C.Jackling,Pres.
11/28/22

Annual Report,1922.

In early part of year 3 men pumped water from (Rising Star)mine and did odd repair jobs. April 11 small crew put on to clean up various levels,open ditches,replace timber. Tracks put in shape,air, water lines replaced;several stopes filled with waste. June 1-Sept. 30,actual breaking of ore. Stopes all in good shape,timbered up,considerable filling done; but additional filling will be necessary when actual mining starts again.

Only 1922 development was extending 810 drift 55'.Showed good Zn ore to within 2' of face,where OB was replaced by gypsum. Main OBs worked during the period (June 1-Sept.30) were on the 700,800,900. Atte,pted to open 600 lev.OBs ,but little accomploshed a/o poor air, heat, scarcity of men.

12,139 tons broken,trammed,hoisted,dumped into mine bins. Of this 784 tons from leaded OBs,rest lead free.

April,May,all accessible OBs thoroughly sampled and a complete analysis made so that a definite knowledge of where the lead occurred could be obtained. So-called Pb-free OBs carry a little spotty lead. Leaded OBs carry 4-5% Pb.

During stoping grab samples taken after each round;these with grabs of the stockpiles represented 13,396 tons ore delivered to smelter.Analysis:

Au oz	.039
Ag	1.40
Cu	2.62
Zn	20.1

Mining Costs, June-Oct.

	Per ton ore
Breaking	.48456
Tramming	.66814
Timbering	.51271
Machine drill expense	.20389
Hoisting	.19986
Mine pumping	.06857
Timbers & framing	.33630
Laboratory,sampling	.05879
Surveying,engineering	.00140
Foreman,shifters	.21797
Mine tools and Impts	.25463
Idustrial RR	.24168
	3.28880

1921 cost, $4.46622

Mine worked during this period one shift.150 tons per shift could be handled when miners and muckers available. Wages increased 25 c.per day July 19 account of shortage. From Geo.Young,EMJ 8/12/22, wages after this 25 cent raise were:

Miners $4.25
Muckers, smelter labor $3.75
Common labor $3.50

(Note, at efficiency, probable, of about 2.1 tons per man-shift, cost of $3.289 per ton with $4.25 per shift would correspond to cost of about $7.50 per ton, with same efficiency, 1948).

Would have had to further increase wages in Sept, if mine had continuedto operate.

When mine starts again some development will be necessary. Considerable tonnage blocked out above 600, "the orebodies from this level to the surface occurring in the fractured shear zones. Most drifts and crosscuts which have opened up the OBs have crushed or caved, hence no work recommended on upper levels unless intentionnis to mine out the OBs immediately, otherwise continued expense in reopening and retimbering. First work to be done in openingup No.6 OBs would be a raise, 600 to 500 for better ventilation. Later may be necessary to raise, 500 to No.2 tunnel. After 600-500 raise completed, active stoping of OBs developedon 600 should be done as fast as possible/ OBs in Nos.4 and 2 tunnels are leaded, carry good silver/

810-5 stope showed good ore above 800. This OB has not been explored downward, not identifiedon 900. They intend to drift on 5th floor 907 stope into FW to try to cut 810-5 OB. This would give fill for 907 stope.

900 drift should be cleaned out and FW of 9C stope explored.

920 OB one of best in mine at present; leaded, good silver; has been explored by 2 DD holes below 900. Work done by previous owners on 1000 was very limited, hence recommends unwatering this level and crosscutting to try to cut 920 OBs. Unwatering 1000 could be cheaply done in shut-down period. If intended to keep water out of mine, need to employ hoistman, pumpman. Four additional men would clear 1000 of water in about two months, put in new guides and have it in shape for active development work.

Industrial RR, mine-smelter 7700', follows contour, crooked, NG for electric haulage. 1921 gas motors tried, hauled ore for 60 c/ton. This year horses, 24 cents per ton. Proposed tunnel would connect Rising Star mine directly with smelter. Length 2155', plus 1500' trestle, cut and fill, total 3655'. Total cost, including electrical equipment, cars etc. $60,000. Trolley loco and Granby cars should haul for 10c per ton, saving 26 c. over present costs. Developed tonnage 250,000. On this tonnage proposed tunnel would save $65,000 not counting interest charges, as against $60,000 cost of tunnel etc. "In addition to the tonnage blocked out in the Rising Star Mine, there is every indication of a large tonnage yet to be developed." (p.5). Greatest benefit of tunnel it would open up Bully Hill 200' below present No.3 tunnel, do away with expensive surface tram connecting mine with smelter. Centralize two mines with plant.

From stoping summary, 6-1 to 9-30, 1922

Four month totals:	Tons ore mined	Total machine shifts	Total tons waste
	11586	521	1192

ave. tons per machine shift	Board feet lumber/ton
22.2	9.038

Feet drilled per ton
1.383

GEOLOGY, BULLY HILL MINE

See Structural Contour Map and Cross-Sections, in pocket.

BULLY HILL MINE.

Geologic Setting: As stated under general geology, the main alaskite porphyry intrusive mass trends northeast in the Bully Hill region, and the zinc-copper general ore zone parallels the southeast contact, the deposits lying short distances inside the alaskite. As shown on the Geologic Plan of Surface, the Bully Hill ore bodies lie at the northeast end of the ore zone, and some 400-500 ft. northwest of the contact between the alsakite and the Pit shales.

More in detail, the ore bodies at Bully Hill occur in several zones trending nearly north-south (see Structural Contour Map, Bully Hill Mine). The mine has been under water below the 300' level since 1910. The present writer has seen the outcrop and a part of the 300 ' level (in 1921). For the rest, the following description is based on the following:

1. General Electric Co. plans, sections and longitudinal projections.

2. Copper Resources of California (Calif. State Mining Bur.), Bull. 50, 1908.

3. Occurrence of Copper in Shasta Co., Calif. L.C.Graton, USGS Bull. 430 (1910) 71-111.

4. Geological Report on the Property of the Bully Hill Mines Co. Inc S.H.Ball; about 1919.

5. Report by R.L.Beals, Jan.1920.

6. Report by Allan H.Rogers on work of Ball & Rogers. Mar.1920.

7. Report on Bully Hill Mine. R.L.Beals Sept.1920.

The Structural Contour Map and the Vertical Sections show how close is the control of ore deposition by structure. The "Main" ore zone lies along the footwall or west side of the "Main" dike, an intrusion of diorite porphyry (Ball) in the main mass of alaskite porphyry. The Structural Contour Map simulates a model, the top of the model being the 770' level (elevation above sea-level 934'). Above the "top of the model" are the upper ore bodies (1A, 2A, 572A-B, 672A) which lie in the alaskite porphyry along the footwall of the Main dike (Sections G, H.).

The 672-574 stope also lies above the top of the model (see also Sections C, B) and in general, within the Main dike, not just outside it, along its west contact, as with the others.

The 872A-972 A-B ore body lies on the under side (footwall) of the Main dike, and is seen, on the Structural Contour map, through that dike.

Just east of the Main Dike, and paralleling the latter in attitude, is what is apparently a narrower dike which I have called the East dike Between the two dikes is a relatively narrow strip of alaskite porphyry called by me the "Slot". The high grade ore discovered on the 1100 level in DD Hole13, in 1910 just before the mine was closed by the GE Co., lies within this slot. The 672-574 ore body seems to be closely

associated with the top of the Slot (Section B) although going downward it leaves the slot at an acute angle and penetrates the body of the Main dike.

On the Structural Contour Plan the slot and other features are emphasized by shades and shadows.

The dike contacts, then, are the primary ore controls. More in detail the alaskite porphyry along these contacts is typically sheeted or "sheared"; in some cases zones of such sheeting extend into or form solely within the Main dike, and such zones carry ore in places.

The alaskite porphyry carries sparse small phenocrysts of quartz and feldspar in a dense, china-like aphantic groundmass. In a general way this intrusion came in between the Dekkas andesite and the Pit shales; but in detail its contacts are often steep, predominantly so in the Bully Hill region. It is a sill only in a very general sense, and for any local area it is transgressive, extending for instance in the Rising Star mine to a demonstrated depth of 900 feet below the surface. According to Ball (Reference 4) the intrusion was somewhat complex. The fine, sparely porphyritic rock described was the earliest phase, closely followed by a similar rock with slightly coarser grain and richer in feldspar. On the Orphan Boy claim (about 1800 ' W of the Rising Star shaft) this latter rock is cut by typical alaskite, largely feldspar and quartz.

In the Bully Hill region the alaskite porphyry and in places the Pit shale are cut by dikes of a dark porphyritic rock; where fresh the rock is dark grey with prominent white phenocrysts; usually it is green or brown, weathering to concentric shells. The microscope calls it a basic diorite porphyry or acid gabbro porphyry (Ball). Ball concludes that owing to the parallelism of these dikes and the shearing in the vicinity of the Bully Hill mine, the alaskite porphyry had solidified and been sheared before intrusion of the diorite porphyry. This conclusion appears poorly founded; see below.

Concerning these dikes Graton calls them a phase of differentiation products from the magma that is most abundantly represented by the alaskite porphyry and by quartz diorite. The basic dikes show as an extreme phase largely pyroxene and augite.

The typical coincidence of zones of shearing with contacts between alaskite porphyry and basic dikes seems best explainable by the differing physical characteristics of the two rocks. The alaskite is strong, relatively brittle, while the basic dikes are probably soft. Tectonic forces active in a region commonly select such surfaces of physical discontinuity as a contact between brittle alaskite and soft diorite-porphyry. As Graton points out (p.89) the shearing was largely confined to the alaskite porphyry, passing but little into adjoining rocks (e.g. the basic dikes). The brittle rock fractured, the adjoining soft rock probably in large part took up the stress by flow. However a number of "shear zones", parallel to the contact zones, occur within the basic dikes, showing that while the basic dikes might have come in originally along zones of shearing, abundant shearing along the same trends took place after solidification of the basic dikes.

The sheeted zones show in places brecciation as well as sheeting and the development of incipient schistose structure. They are tabular in form, like a fault zone, but in places attain great width in relation

to length. As pointed out by Ball, the zones of shearing in the Bully Hill mine are parallel groups of very small faults; where fault movement was so distributed over a zone, the alaskite porphyry has been crushed and recrystallized into sericite schist with curved lustrous planes.

I have seen narrow bands of incipient schistosity along faults in andesite; the schistosity in the alaskite at Bully Hill should not be confused with regional schistosity; the mechanics that produced it are allied to fracture rather than to flow (dynamic metamorphism). The schistosity is, it is true, connected also with flow; but in this case, to local flow induced by plastic deformation along zones of potential faulting, which did in many cases culminate in rupture.

The Bully Hill mine basic dikes and the shear zones that parallel them are both markedly parallel to the locally north-south contact of the alaskite against the Pit shales, some 400-500 ft. east of the mine (see Geologic Plan of Surface). At the Rising Star mine, in contrast, the main shear zones, striking northwest are roughly perpendicular to the alskite contact, which passes southeast of the mine and trends NE (Geologic Plan of Surface). While the mechanics of this fracturing cannot be deduced on present evidence, they probably spring from stresses operating on the massive alaskite. Thus under the proper stress the north-south alaskite contact east of the Bully Hill mine would be a locus of fault movements, probably the major locus in that area; if so, the shear zones might well be sympathetic zones of faulting, while the basic dikes may well have come in along fissures which were also sympthetic fractures parallel to the north-south alaskite contact.

Ore Bodies.- These are lenticular replacements along the zones of schistosity. Their localization probably in part depended on the degree of shearing, brecciation etc., i.e. the relation between a high degree of shearing and fracturing and the channels up which the ore solutions came. If so, an understanding of the regional tectonics should suggest areas of more intense shearing than other areas and so point to ore. In a very general way, the SE contact zone of the main alaskite mass was such a region. The finally shattered or schistose zones exposed to the ore solutions an area of surface far greater in proportion to its mass than that afforded by the less shattered portions, and so was correspondingly more susceptible to chemical attack, besides affording passage to a greater volume of solution (Graton).

There is often a gradual transition from country rock to ore, taking place over several feet or scores of feet. Here the outlines of the ore body generally correspond with the direction of foliation of the wall rock. Elsewhere ore ends along tight, gougeless, frozen walls, and in still other places, it ends against a minor gouge, which is present at every place along a whole side of an ore body where development has exposed the wall. Where the gouge along such a wall is thicker it contains no fragments of ore or wall rock, but instead often contains more or less perfect pyrite crystals. At most points the actual surface of the sulphide ore, against which this gouge rests, is in a broad way flat and even, but in minute detail is rough and composed of parts of the faces of very small sulphide crystals. These faults are thought pre-mineral.

With the gradational type, ore formed along zones of most intense breciation and schistification. With the type in which the ore abruptly ends against a minor gouge, ore stopped (1) because of the gouge and (2) because in general the rock beyond the gougewas less shatered than thatin which the ore formed. (Graton).

At Bully Hill mine especially, the ore bodies are lenticular tabular bodies with their greater dimensions parallel to theschistosity; hence they usually stand steeply. The various lenses are commonly strung out along the plane of the shear zone like ore shoots in a fissure vein. The sides of the lenses are more often than not parallel, although pod-like bodies occur (Ball; see Vertical Sections). While the larger ore lenses are 200-300 ft. long, 400 ft. deep and to 25 ft. wide, horses or masses of unreplaced CR are not unknown. The lenses are usually thickst at their center.

Since most of the ore bodies are but 70-200 deep, many do not outcrp; and considering the large amount of ore produced the surface showings are remarkably small (Ball).

Due to variations in the direction of schistosity ore bodies may split vertically or horizontally. Stringers of ore may connect ore bodies along the same shear zone. Ore bodies s.t. terminate as blunt wedges, s.t. slowly contract to a knife edge. Ore bodies are sometimes flanked by small parallel ore lenses.

Mineralogy, Texture of the Ores.-The ore bodies are in general masses of rather solid sulphides, although gradations to disseminated sulphides occur (probably mainly copper, judging by Afterthought). They are fine-grained, with gangue present in less abundance than sulphides. Gangue minerals are barite, anhydrite, quartz, calcite. In order of abundance, the sulphides are pyrite, sphalerite and ccpy; bornite and galena are less common. Cadmium occurs as cadmium sulphide, greenockite. Silver probably as argentite.

Pyrite as a casing: deposited much more than the other sulphides well out into the CR surrounding the OBs.

Pyrite was the earliest sulphide; blende is on the whole later, spreading around pyrite grains along certain crude bands which in the hand specimen appear as narrow dark streaks giving much of the zincy ore a banded appearance (Graton). In a few places it can beseen that such bands correspond to the original direction of C" shearing, now replaced. In general, even massive ores frequently preserve the sheared texture of the alskite porphyry which has been replaced (Ball). (Cf Afterthought where massive ore retains shale laminae).

Ccpy in general the youngest commercial sulphide: as irregular branching veinlets in ither sulphides. Where blende is present ccpy prefers association with it rather than pyrite; "in the mines carrying the lowest grade of copper ore zinc is less abyndant than elsewhere". (Graton, p. 104).

For the Shasta copper egion as a whole, bornite is most plentiful at Bully Hill and Afterthought G aton, p.104). On 970 level, with chalcocite, both supposed primary. (But secondary bornite and Cu2S in upper portions of some OBs).

Graton examined thin sections of ore assaying up to over 2% Cu showed no ccpy,only pyrite. Probably very fine-grained IG ccpy.Py is yellower, rougher than average.

Some zincy ore carries more than normal silver.(Check on this, including Afterthought).

Graton, p.105: "Some ofthe fairly massive sulphide that is too low in copper values to be extracted owes this condition to the fact that the copper values have been to some extent removed by leaching;where that is the case the sulphide is likely to be crumbly and may even become mere pyritic sand."...."Conversely,little material not composed in large part of sulphides carries enough copper to be workable,though locally in the Bully Hill and Afterthought districts precious metals make possible the mining of ore that resembles the "waste" of other camps"....."Exclusive of the enrichment that has taken place in the upper portions of some of the ore bodies,which is due to additions of cupriferous material from the oxidized zone above,there appears to be little u niformity in the distribution of richer portions of the ore. In the Bully Hill mine there seems to be a tendency for the best ore to be found near the middle of the ore body,though in places the borders of the ore bodies are rich in barite and correspondingly high in copper as well asin gold."

CR (alaskite) is relatively impervious to atmospheric waters and has protected from oxidation and solution such portions of the ore bodies as lie below it.But the exposed parts of the OBs have been much altered,and at Bully Hill and Iron Mt.this alteration has extended to considerable depths. Iron hat,limonite,some magnetite etc. C u dissolved,removed from original location. Much of this Cu dissipated, but Cu_2S,bornite etc. formed by 2ndary sulphide enrichment in places; at Bully Hill and Iron Mt. these enriched zones of oxide and sulphide ores were of importance,although at both camps the silver,which had likewise been concentrated with the copper from the overlying oxidized masses,were chiefly sought at the time these enriched zones were worked,and therefore much of the Cu lost.

The rock partly impregnated with sulphides,that surrounds the OBs and occurs at other places has at the surface also been altered;sericite to kaolin,pyrite to limonite,which has been partly absorbed in the kaolin and has stained rock red,yellow,brown.Not true gossan but to some extent an ore guide.

Surface Expression of Ore (Ball, Reference 4): Gossan extended down 10 to 40'.Itslower surface was highly irregular,extending as tongues down aling important fractures. The zinc sulphies occur nearer the surface than the other sulphides,i.e .gossan over zinc bodiesis thinner.

One of the CRs for ore bodies UG is pyritized silicified alaskite; it forms ribs between the ore bodies;on the surface it crops as jagged peaks and irregular hillocks;Bully Hill owes its elevation to the resistance of this rock to erosion. These lentivular masses trend N-S and are grouped in 4 bands striking NNW.The cropping is either dense,slightly iron-stained and silicified and kaolinized,or,heavily iron stained silicious pitted by pyrite cavities and ex-kaolin cavities. Iron stains on joints,fractures;iron stain c ementing sil.aslaskite where brecciated. Qtz veinlets,barite as veinlets of filling small cavities.

Ore shear zones between these ribs non-reistant,commonly masked by detritus.

Favorable areas (compare favorably with Bully Hill,Rising Star surface):

1. S 2/3 of Jennie June;
2. SW 1/8 of Shasta claim;
3. SW 1/2 of Bully Hill claim;
4. NW 1/4 Popejoy claim;
5. NW 1/4 Rising Star claim;
6. N 1/3 N Light claim; Total 40 acres.

Not company owned: N Star claim has 12 acres favorable. Of this favorable ground about 10 acres have been in part explored by B.H.? R.S.mines to a deptg of about 1000'. Other tunnels have pierced the favorable area at isolated points but by no means sufficiently to prove its value or non-value. Should D.D.

Copper City group has about 14 acres moreor less mineralized.

2ndary Enrichment: Gossan reported to have passed rather sharply into a thin roughly horizontal band of highly enriched powdery ore , mainly chalcocite with high gold and silver.Bonanza ore of district. Pyrite either removed or altered to soft incoherent wet particles.Cuprte, native Cu reported,esp.in shear gouges. Below this unusually enriched band were solid 2ndarily enriched ores with an unusual amount of 2ndary Cu2Smbornite,covellite and ccpy with good Au,Ag. Zn ores not much altered except for increase in precious metals. This ower secondary zone usually bottomed at 150 to 250 ft.,althoug along strong fractures it probably went to 500 or 600 ft.

History: From May 1, 1901 to June 30 1910,produced 220,946 tons ore. Records indicate rather definitely that zinc ore bodies were developed but not mined. The old maps show OBs in shear zones NNE,equally as strong on 972 as on 572 level. Two chief ore zones and a 3rd appears to be indicated as coming in in 1109 X-cut. Stopes come within 100 ft. of surface;in places surface ores mined by open cuts to 25 ft.

OB in 307-7 Xcut N60W.On premineral cross flt? 672 and 772 levels were poor zones but in lower levels ore came in again and mine has not been bottomed (p.26).

Rogers Report (Reference 6): Shoots 10-40 ft. wide,within a block of ground 1000' N-S and 200' wide. Ax deeper levels opened,less length of this block explored,so that on 970,only 350 ft. Wrk confined to area of main shoots above. To main shoots developed,parallel elenses.West shoot bottomed between 570 and 670,at least stoping ceased at that horizon.,either because of dissapearence of oreor increase in Zn past smelter limit. Other shoot worked only a short distance above 570;continue to 1100 but much diminished in length. "The assay map of the 1100 level shows what is apparently a new shoot discovered in the 1109 crosscut, where 20 feet of ore was opened.Six feet assayed 0.19 gold,13.5 silver, 5.3% copper,the remaining 14 feet averaging .057 gold,6.3 silver and 2.0 % copper."

ORE RESERVES

BULLY HILL MINE. WISSER TONNAGE ESTIMATES, 1948.

General.- All available records were turned over to me by Edward L.Ralston,now manager of mines, The Glidden Co.,in 1948,for preparation of a damage suit against the U.S. for taking of access railroad , flooding of Copper City group of mines,etc. These records,including geological reports,maps,vertical longitudinal projections,cross-sections superintendant and foreman's reports,weekly,monthly etc. were summarized and analysed.

A new geologic map of the surface was compiled,also a structural contour map and cross-sections of the Bully Hill mine were prepared to aid in deciphering structural control of ore bodies and estimate of ore reserves.

The Bully Hill mine was worked as a copper mine,ore being smelted locally until the smelter was shut down by the U.S.Forest Service in 1910 Zinc was injurious to the smelting and either had to be sorted out or avoided by selective mining. For this reason nearly all sampling and estimation of grade cover copper and silver only.

Shasta Zinc & Copper Co.took over the properties in the '20s and moved the Balaklala smelter to Bully Hill with the object of making zinc oxide. I was their geologist in 1921. The Rising Star mine was unwatered,but the BullyHill mine remained under water below the 300 or adit level. In order to get some notion of possibilities at Bully Hill mine,the main ore zone,exposed in the 300 adit,was sampled. Samples running over 5% zinc are tabulated below.

In 1948 the present writer used this sampling to obtain zinc-silver and Zn-copper ratios as a rough guide in estimating probable grade of zinc ore left in the mine. Results are shown on the Metal Ratio charts in the pocket. Blue areas on each chart show the range of copper-zinc,silver-zinc and silver copper ratios respectively. The "norm" of each group of ratios was obtained by dividing total units of one metal on the assay list into totsl units of the other. This is shown on the table of Bully Hill assays appended.

In order to determine whether the metal ratios from the limited Bully Hill mine sampling might be reliable, similar ratios were plotted from mines somewhat similar to Bully Hill geologically,namely, the Rising Star,in the western part of the Bully Hill area,and the Afterthought mine,about 8 miles to the SSE.(I was consultant for Coronado Copper & Zinc Co.,owners of Afterthought,1946-1948).

The combined charts suggest that the Bully Hill metal ratios are reliable,even though confined to lower precentages of the metals. Bully Hill resembles Afterthought more than it does Rising Star,which is essentially a zinc mine. Note the practical idendity of the Bully Hill and Afterthought silver-zinc ratios,and the small divergence between their respective copper-zonc ratios. The Bully Hill line of norm bisects the angle between that for Rising Star and that for Afterthought

In the following estimates of Bully Hill mine tonnage and grade, for blocks with zinc content unknown but thst of copper and silver known, zinc content is estimated (1) on basis of copper content;(2) on basis of silver content. The more likely zinc estimated is selected,or the two estimates are averaged. Degree of reliabilify of results is suggested by the following table:

Block	% Zn,based on Cu.	% Zn,based on Ag	Bottom of block
I	16.0	9144	470' Level
II	12.2	43.0	470
III	19.2	26.5	470
V	Known content 23% Zn		570
VI	10.6	39.0	670
VIII	6-9%	21.1	670
X	10-14	27.0	770
XI	17.0	16.0	770
XII	15.0	32.0	770
XIII	13.7	15.6	870
XIV	12.2	13.6	870
XV	17.0	22.2	970
XVI	9.0	11.7	1100
			1100

Agreement between the two methods for estimating Zn content is much closer from the 770' level downeard than above that horizon. In the upper levels,high silver in proportion to copper gave the high zinc estimates. High silver in the upper horixons is not uncommon with silver-bearing complex metal ore bodies.

On the whole,zinc content based on copper continent is thought to be more reliable than that based on silver content.

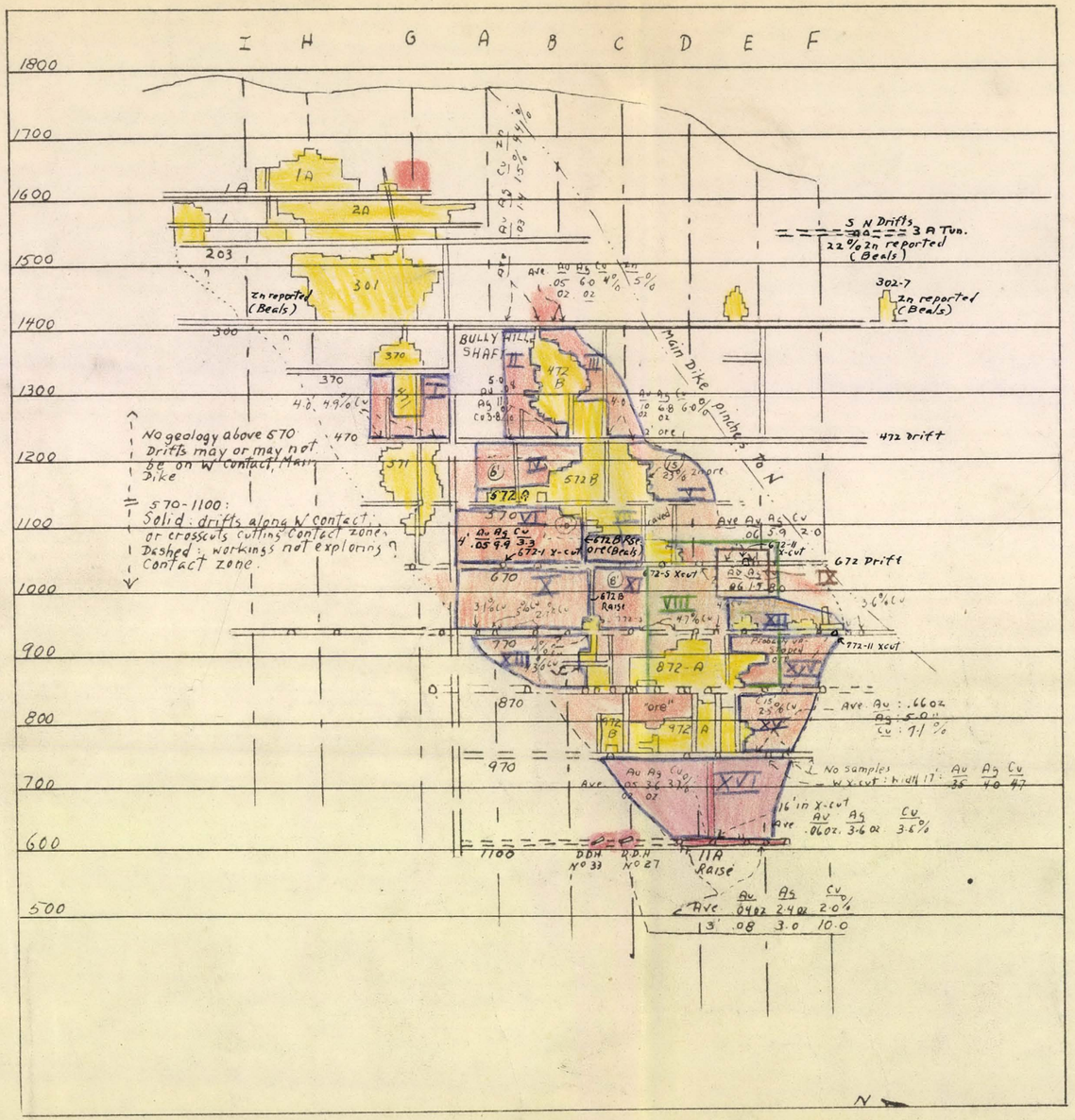
Bully Hill Zinc Ore Estimates:

Metal Ratios

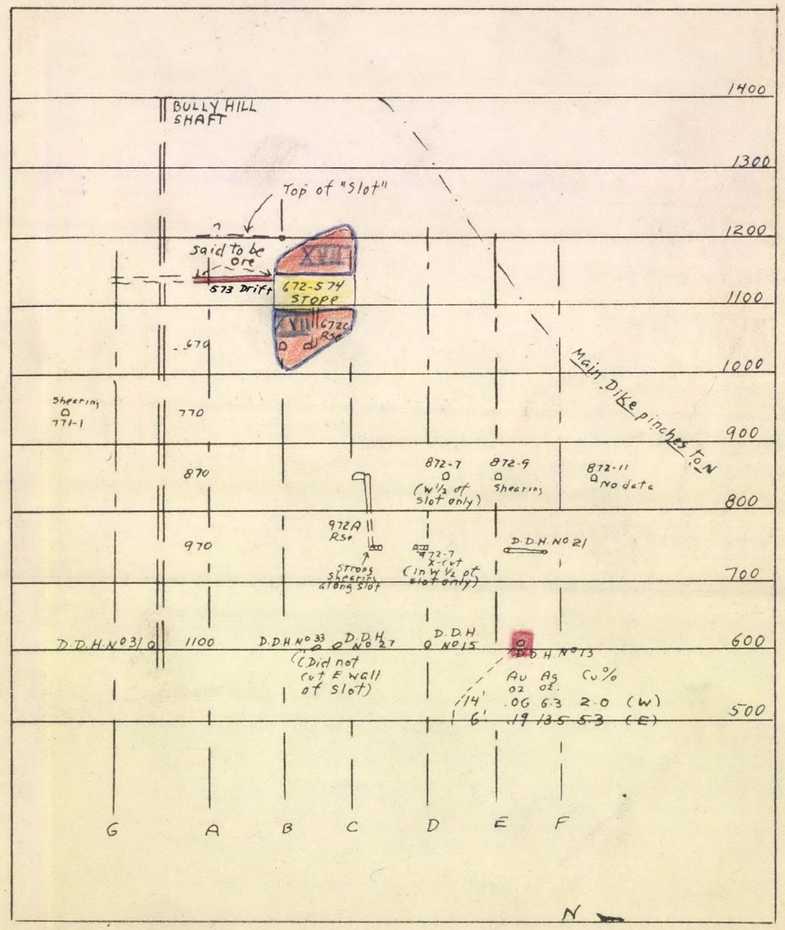
300 Level: Assays, over 5% zinc.

	Ag Oz	Zn %	Cu %	Zn/Ag	Cu/Ag	Zn/Cu
	1.20	8.28	1.83	6.90	1.52	4.5
	4.60	5.70	5.60	1.20	1.21	1.0
	2.50	6.44	2.33	2.57	.93	2.7
	1.30	6.28	1.06	4.83	.82	5.9
	1.70	8.10	1.65	4.76	.97	4.9
	.60	5.89	.50	9.80	.83	11.8
	3.00	10.12	3.16	3.37	1.05	3.2
	2.40	7.00	3.37	2.91	1.40	2.1
	.990	12.42	2.34	13.80	2.60	5.3
	.95	5.06	2.32	5.32	2.44	2.1
	1.10	7.82	1.65	7.10	1.50	4.7
	2.35	5.98	2.24	2.54	.95	3.1
	1.60	9.66	2.22	6.03	1.39	4.3
	3.55	9.66	3.59	2.72	1.00	2.7
	1.35	5.24	1.27	3.88	.94	4.1
Total	29.10	113.65	35.13			
Ave.	1.9	7.6	2.3	3.9	1.20	3.24
				$\left(\frac{113.65}{29.10}\right)$	$\left(\frac{35.13}{29.10}\right)$	$\left(\frac{113.65}{35.13}\right)$

972



VERTICAL LONGITUDINAL PROJECTION, "MAIN" ORE ZONE
(WEST CONTACT OF "MAIN" DIKE)
Scale: 1" = 200'



VERTICAL LONGITUDINAL PROJECTION OF "SLOT"
Scale: 1" = 200'

BULLY HILL MINE, SHASTA CO., CALIF.

LEGEND

Stopes:
Extensions, probably unstoped: →
Virgin ore:

Edward Wissee 7/48

WISSER TONNAGE ESTIMATES, 1948.

Notes from Plans and Sections: Tonnage Estimates.

MAINSHEAR ZONE

No geology above 570. Considerable possible ore above 301 level; old section shows outline of top of ore well outside of stopes on projection. Beals (Reference 7) allots 10,000 tons to neighborhood of 301 stope. To the 370 (S) drift he gives 5000 tons.

470-300 Above the 470 the Projection shows ore marginal to the 471 and to the 472B stopes. Assays as follows:

I 471 area: 4', 4.9% copper. ~~472 B area: 8~~, 2.4 oz. Ag. Length 120 ft., ht. 100', area 12,000 squ.'
Less area of 471 stope.... 2,000
10,000 "

10,000 x 4 - 40,000 cu.ft., /10 - 4000 tons (Beals gives 5000).
Silver-copper ratio 1:2.0, copper abnormally high, relatively.

Probable zinc grade: (1) On basis of copper content: 4.9 x 3.2 - 16%.
(2) " " " silver " : 2.4 x 3.9 - 9.4%

Since smelter slag went 8% and ore smelted, 1909, went 7.83% Zn (Beals, Reference 7, p.2), and since this block was left unstoped except for the small 471 stope, it seems reasonable to conclude that it ran high in zinc. Take 16% Zn.

II 472 B Area. Two stretches (1) S stretch: width 5', assay Au .08, Ag 11.1, Cu 3.8%. Silver-copper ratio 1: 0.34, abnormally high silver. Probable zinc grade (1) On basis of copper content: 3.8 x 3.2 - 12.2%. (2) On basis of silver content, 11.1 x 3.9 - 43%, too high. Take 12%

Tonnage: area - 10,000 squ.ft., x 5 - 50,000 squ.ft., /10 - 5000 T

III (2) N stretch: Width 4', assay Au .10, Ag 6.8, Cu 6%. Silver-copper ratio 1:0.88, not far from normal. Probable Zn grade, (1) on basis of Cu content, 3.2 x 6 -19.2. (2) on basis of silver content, 6.8 x 3.9 - 26.5 %. Take 19% Zn, based on reseemblance to Afterthought ores.

Tonnage: Fringe along N edge of stope, length 50', vertical ht. of paralleogram 170', area 8500 squ.ft., x 4 - 34,000 cu.ft., /10 - 3400 T

Total tons, N drift - 8400 tons. (Beals, 6000 T).

570-470. (1) 572A area. Section A shows prospective ore extending above 572A stope to a horizon 25 ft. below the 470 level; Section B shows this
IV probable ore extending up to the 470 level. Average width about 6 ft. Area: 8600 squ.ft., x 6 - 51,600 cu.ft., /10 - 5200 tons. No assays.

(2) Adjoining 572B stope on the N. Here 15 ft. of 23% Zn ore were
V reported, in the N breast of the stope. Area: 100 x 80 - 8000 squ.ft. Considering probable tapering to N, take average width 10 ft. 80,000 cu.ft. or 8,000 tons. (Beals gives no estimate for Main Shear Zone, 572 level).

Assay: 23% Zn. With normal copper zincratio - 3.2, would give 7% Cu. With normal silver ratio of 3.9, 5.9 oz. Ag. Call gold .06 oz.

670-570. (1) Shaft to 672B Raise. Section A shows probable ore below 572A stope, 570 to below 670 levels. Average width 7'. Section B, about the same. On 670 level, shear zone tends to pinch in places, however. Take 6' average width.

VI

Area: 190 x 80 - 15,000 squ.ft. x 6, - 90,000 cu.ft., /10 - 9000T. (Beals gives 3000 tons in connection with 672-1 crosscut, in the center of this block, and 10,000 tons associated with 672B raise, at N end of block.)

Assay: 672-1 crosscut, over 4': Au .05; Ag 9.9; Cu 3.3%. Zinc, (1) on basis of Cu., 3.3 x 3.2 - 10.6%; (2) on basis of silver, 9.9 x 3.9 - 39%, too high. Silver-copper ratio 1: 0.33. Silver too high. Take 12% Zn

(2): N of 672B Raise: Section C gives average horizontal width of about 12 ft. Area: 90 x 40 - 3600, x 12 - 43,000 cu.ft./10 - 4000 tons. No assays.

VII

(3). There appear to be two parallel lenses toward the N end of this level. Beals' 672-5 and 672-11 crosscuts ore body (18,000 tons) seems to lie along the immediat e west contact of the Main dike. The other body is the one drifted on opposite the one just mentioned.

672-5 and 11 OB. Ave. Au .16, Ag. 6.6, Cu 1.5%. (Gold $5.60, silver $5.94, copper $6.30, total nominal value $17.84, present prices). Ground plan: 170 x 15 - 2500 squ.ft. (670). Allow upward extension to 670, downward to 870 (total 200 ft.)

VIII

Subject Stope - 2000T

Volume 5700000 cu.ft., or say 50,000 tons. Note: Upward extension taken from Section D. On 770, this ore zone appears to show up in following crosscuts: 772-18, 772-16, 772-14. Average assays from these:

Au .09 Ag 4.0, Cu 3.0%. (See Structural Contour Map and Sections D, E).

On the 870, this zone appears represented in X-cut 872-6 but not in the next crosscut to the N, 872-4 1/2. Assays in 872-6 are as follows

Au .06 Ag 5.5 Cu 2.2%. 870 is taken as bottom of possible ore.

Arithmetical average of assays:

Some marginal ore around 872A stope, 870 to above 720

	Au	Ag	Cu	Zn on basis of Cu	Ditto on basis of Ag	
672 Level	.16	6.6	1.5			
770	.09	4.0	3.0			
870	.06	5.5	2.2			
Ave.	.10	5.4	2.2	6-9%	21.1	Take 15% Zn

Parallel to the above ore body, on the 670, the main or 672 drift followed another ore showing, a distance of 60 ft. This may be called the 672 Ore Body. Thirteen samples average as follows:

IX

Au .05 Ag 4.8 Cu 2.2 Zn, based on Cu: 6-9% Zn, based on Ag: 18%
Take 15% Zn.

Horizontal width 6'. See Structural Contour map and Sections D, E. Whether any of the west crosscuts, 770 level, cut the downward extension of this ore shoot appears doubtful (see Structural Contour Map); hence an arbitrary vertical extension has been assigned this OB of 80 ft. 60 x 6 x 80/10 - 2900 tons.

Insert

770-670 Cont.

XII. 772-7-A Ore Body. There is probably a block of ore, along the Main contact or just within the dike, between block XI and Block XII. (See Strtctural Contour Map and Long. Proj.). Samples are too sparse to admit this possible block. There is also a stretch of ore in 772 Main drift west of 772-7-A ore body, and another in 772-15 crosscut between 672-5-11 ore b dy where cut in that crosscut and 772 drift. These showings are not considered .

772-7-A ore body is represented by 21 samples, average:

Au	Ag	Cu	Zn, basis Cu	Zn, basis Ag	
.24	8.3	4.7	15%	32%	Take 20% Zn

Width 12 ft. Area 6700 squ.ft. (on projection) = 80,000 cuft/10 = 8000 tons.

High Zn would explain why this block but little stoped.

770-670 (Other than 672-5-11 and 672 downward extensions mentioned above).

X Shaft to raise at 220 N. The main contact may carry ore here. Samples are scattered but nearly every one is ore. 23 samples average as follows:

Au	Ag	Cu	Zn (based on Cu)	Zn (based on Ag).	
.11	6.7	3.8	10-14%	27%	Take 18% Zn

(High presumed zinc content is probably why this stretch not stoped).

Length of stretch 220' Height; height 90'. Probable width 6'. 11,000 T

XI Adjoins X on the north. (~~North of XI most or all the ore along and outside the Main contact appears represented by 672-5-11 and 672 ore bodies, already accounted for.~~) Area 90 x 90 = 8100 squ.ft. Ave. width 8', 65,000 cu.ft., 6500 tons.

XII Insert

6 samples averaged as follows:

Au	Ag	Cu	Zn (on Cu)	Zn (on Ag).	
.06	4.0	5.2	17%	16%	Take 16%

870-770. (Other than 672-5-11 and 672 ore bodies downward extension).

XIII See Vert. Long. Proj. Probably not the downward extension of Block X (See Section A). Sublevel 50 ft. above 870 enters this block, average 4.3% Cu. At normal ratios, should contain 11-15% Zn., 4 oz. Ag. .05 AU. Area 8400 squ.ft. Thickness about 5', 4000 tons.

Cu basis = 13-7%, Ag " = 15-6 "

XIV There is probably a block ofore between Block XIII and 872A stope. This is omitted. Block XIV is the downward extension of Block XII, and the northward extension of the ore body stoped in 872A stope. Only four samples are available, 870 level. These assay as follows:

Au	Ag	Cu	Zn (on Cu)	Zn (on Ag)	
.29	3.5	3.7	12% (12.2)	13% (13.6)	Take 13%

Width: 12 ft. Area on VLP: 9400 squ.ft. x 12 = 113,000 squ.ft./10 = 11,000 tons.

970-870

XV There is probably some ore S of and bove 972-A-B stope; this is not considered. Block XV lies north of 972A stope, and is the downward continuation of Block XIV (See section E). 15 samples (including the 4 from Block XIV) average as follows:

Au	Ag	Cu	Zn (on Cu)	Zn (on Ag).	
.52	5.7	5.3	17%	22%	Take 20%

Width 14'. Area from VLP 8500 squ.ft. x 14 = 120,000 cuft. = 12,000T.

1100-970. XVI. Unmined. Assays: 120' on 1100, main drift; 16' in crosscut, 1100; 120 ft. in 11A raise. These avaregae as follows:

Au	Ag	Cu	Zn (on Cu)	Zn (on Ag).	
.05	3.0	2.8	9% plus	12% plus.	Take 12%.

11.7%, 20

Area: 27,000 squ.fr. Width 20 ft. = 540,000 cu.ft. = 54,000 tons.

SLOT

XVII The 672-574 ore body (see Structural Contour Map, VLP of Slot, and Sections B,C). if not actually in the slot, near its top, are very close to the slot. Block XVII consists of the extensions upward and downward of the 672-574 ore body. ~~xxxx~~ Average crosssection area of extensions: 1750 squ.ft., Length perp. to sections 110', - 192,000 cu.ft. say 20,000 tons.

No assays available.

The 573 drift is said by Beals to have been in ore for the distance shown on the VLP. Below this, on the 670, there is a drift showing a 2' seam of 1.5% Cu ore; this is not though to be on the same ore body as the 573 drift ~~(see Sections~~ (superimposing plans of 570 and 670). Failing exploration up or down, no tonnage is assigned this 573 ore.

On the 1100 level, east crosscut 1109 along D,D, Hole 13 cut ore for a total width of 20 ft. See VLP. Here again, no tonnage may be assigned this ore body.

ORE SUMMARY-BULLY HILL.

Block	Tons	Au	Ag	Cu	Zn	Beals Equivalent	Tons	Au	Ag	Cu	Zn12%
						301 Stope	10,000	.07	9.5	4.0	
						370 Drift	5,000	.07	7.0	2.5	
I	4000	-	2.4	4.9	16%	470 "	5,000	.07	5.0	2.5	
II	5000	.08	11.1	3.8	12%						
III	3400	.10	6.8	6.0	19%	472 "	6,000	.06	6.8	4.1	
IV	5200	No assays									
V	18000	.06?	5.9?	7.0?	23%						
VI	9000	.05	9.9	5.3	12%	672-1 Xcut	5,000	.05	9.8	3.2	
VII	4000	No assays				672B Raise	10,000	.06	4.0	2.0	
VIII	48000	.10	5.4	2.2	15%	672-5-11	18,000	.07	4.9	1.4	
						672-3 drift	1,000	.08	5.5	1.5	
IX	2900	.05	4.8	2.2	15%	(2' seam)					
X	11000	.11	6.7	3.8	18%	772-3	9,000	.07	4.3	5.0	
XI	6500	.06	4.0	5.2	16%						
XII	8000	.24	8.3	4.7	20%	772-7A	10,000	.12	7.0	3.6	
						772 N end	2,500	.05	2.2	2.5	
						772-11 (N end)	7,500	.15	4.0	4.0	
XIII	4000	.05?	4.0?	4.3	12%?						
XIV	11000	.29	5.5	3.7	13%						
XV	12000	.52	5.7	5.3	17%	972 sill	15,000	.10	5.0	2.5	
XVI	54000	.03	3.0	2.8	12%	1100 Drift	90,000	.05	3.0	2.5	
XVII	20000	No assays									
						573 drift	10,000	.04	2.8	2.0	
						672 " N end	3,000	.04	3.0	1.8	
	216000	.11	5.06	3.44	14.7		124,000	.06	5.1	2.9	

~~Plaintiffs tried to settle thru Secty of Interior and Bureau of Reclamation. No soap.~~

~~Acts of Congress cited.~~

~~1.~~ Report by R.L.Beals Jan.1920.

Summary:

Rising Star, Bully Hill and Copper City mines 1900-1910,produced 411,000 tons of ore ave. .085 oz Au ($2.98 @ $35), 4.20 oz.Ag,4.24% Cu. Copper ore mined from a portion only of the developed shoots.

Rising Star unwatered 1917,developed,1918,1919,for zinc. Development of Rising Star to date has developed 181,000 tons Zn ore,30,000 tons copper-iron ore. Probable ore connected with this positive ore is 155,000 T.

Records then available suggest 75,000 tons probable ore,Bully Hill, 25,000 tons,Copper City.

Rising Star assured ore:181,000 tons .03 oz.Au ($1.05 @ $35),3.18 oz.Ag,2145% Cu, 24.65% Zn.

Introduction:

Claims bought 1900 by Capt. DeLamar,operateduntil 1905,then bought by General Electric Co. This company built RR from smelter site at Winthrop to Pitt. Standard gauge.

1900-1910,zincore opened in all the mines,esp.Rising Star.

Geology.

Ore dense,massive sulphide in sheared zone in the quartz porphyry.Little disseminated ,sharp change at margin of OBs. Clean extraction.

Types of ore: 1. Zinc copper ore with Au,Ag. High barite.82 level, Rising Star. Bully Hill, Copper City ores of this class,tho with higher gold, copper.

2. Zinc copper ore with 10-20% Fe. Less than .03 oz.Au and 1.0 Oz. Ag. Low in barite. 6A ore Rising Star typical.

3. Copper iron ore with less than 3% Zn.Au,Ag low;gangue is silicified QP.

These types occur in separate lenses in the same shear zone.

Bully Hill Mine, copper,gold,silver content showed no decrease after primary ores encountered between 370 and 570 levels,

Rising Star:ore on 900 and records of 1000 level show no drecrease in grade or size of OB. Some evidence of increase of silver on 900.

Rising Star Mine.

Since reopening of properties,1917,most of work on Rising Star. Ore massive ccpy,py,ZnS. emarkably free of other sulphides. Only traces

of other metals.

Six well-defined shear zones:

1. Zone marked by No.4 and No.7 tunnels.On E side of mine.Ore characterized by gold,silver content.Practically virgin.

2. Zone marked by 82 level zinc stope and 5-3 stope.E of shaft;undeveloped below main tunnel or 500 level. Ore a massive high zincore, low in copper and iron,carrying silver and gold.

3. Zone marked by 810,9C and 10A workings.Zn-Cu ore,low Ag,Au.

4. Zone marked by 7B,6D,5H stopes. This zone has produced high grade copper ore;it has not been developed for Zn,although high Zn appears when zone reopened on 700 level at 7-3 drift.

5. Zone marked by 6A-920 series of stopes. Developed;consists of a series of lenses. At S end ore was a copper pyrite,6% Cu,4% Zn.N of this lens ore is 20-40% Zn with 2-3% Cu. On 600 this ore carries 1 oz Ag;it becomes progressively higger in Ag to 920 stope,where average is 8.9 oz. Ag.

6. Zinc;marked by 5A stope. Undeveloped.

7. Series of copper-iron ore bodies 3-5% Cu,25% Fe,markedby 606, 707,808 OBs.Developed at N end of Rising Star workings.Excellent possibilities.

Assured Ore: Mainly in 82 OB of Zone 2,and the 6A-920 OBs of Zone 5. Chiefly due to development having been concentrated in those places.

	Orebody	Tons	Oz Au	Oz Ag	% Cu	% Zn	Area	Depth	S.G.
Developed Ore, Rising Star,	6E	19500	.02	0.80	1.75	26.4	3000	65	10
	6C	7000	.02	0.60	3.50	30.0	900	66	8.5 cutt
	7C	21600	.02	1.00	2.30	36.0	2115	87	8.5 T
	7D	11330	.02	1.00	1.75	26.4	3000	40	9
	7M-801	17900	.035	1.79	3.10	23.2	1735	92	8.0
	801-920	20800	.047	6.28	2.61	22.9	1901	92	8.0
	807-907	6500	.02	0.83	3.29	17.1	662	78	8.0
	909-801	10000	.025	1.00	3.50	22.0	Tonnage guessed at		8.0
	909-down	5600	.028	1.40	5.00	16.0	900	50	8.0
	920-down	14100	.046	8.94	2.91	15.8	Zone 5	50	8.0
	703	3000	.02	0.70	1.00	25.0	240	50	8.0
	701	3000	.02	0.70	1.70	25.0	480	60	8.0
	810	5000	.01	0.70	2.80	23.0	800	50	8.0
Totals,Ave,	147,300	147,300	.028	2.53	2.64	24.76			
	82-5-3	19300	.035	4.51	1.56	25.3	1636	Zone 2 95	8.0
	82 up	8700	.04	4.19	1.59	27.1	2322	" " 30	
	No.4 Tunnel	6500	.05	12.50	2.20	17.0	1050	Zone 1 50	
Cumulative totals,ave.		181800	.030	3.18	2.45	24.65			
	808 Cu ore	30,000	.02	0.50	3.00	2.00		Zone 7	

For more complete analysis see Chase Rep't 1920, last p.

6A (5th) Ore Zone: Made up of a number of parallel lenses en echelon. At S end shoot of copper ore mined by former management from below 700 to 82 level. W and N of this copper lens lens of zinc-copper ore developed and partly stoped. Recently a 3rd lens of high zinc ore opened, NW of the zinc ore in 6A stope.

See Sketch Plan of 6A zone,longitudinal section of the zone and cross-sections E,F,G,H.

6C Ore Zone.- Appears to be N continuation of 6A ore body.Hard massive sulphides,low insoluble,low in Au,Ag. Continues up to 500.

6E Ore Zone.- Another lens in this 5th or 6A ore zone,adjoining 6C on the N. Continues above 500. Ore originally a massive sulphide with gypsum gangue and gypsum bands;this largely leached,ore now crushed, soft. Residual enrichment of ore. Limit of this lens to N not been reached."Work now in progress to reach this ore on 500".

7-D Ore Zone.-The ore block called 6-E,with 3000' area on 600 is estimated as extending 40' below 600.X-cut from 702 raise 50' below 600 has developed the leached zone at the S end.Zinc ore pentrated 6' above the roof of this crosscut. On 700 the 701 stope shows massive Zn ore with gypsum walls.Raise from 701 stope is up 30' in Zn ore. Continuity of this ore and its connection with 6E ore not proved but probable.

7-C Ore Zone. This ore developed by W half of 7-A stope,the 7C raise,702 raise,702 drift,50' up raise,and the 7C crosscut. Sill floor of 6A stope from 601-6 crosscut to top of 702 raise is in ore of same grade etc.as that developed in 7C workings.

801-920 Ore Zone

7M-801-2,807. 709 drift andreopened crosscuts 701-5,701-7,7M give width of 10',length,100' on 700.

801-2-920.9D. See ore reserve table.

920-9D. Down 50 ft. Downward extension with same average grade and width is shown by diamond drill hole cutting ore 50' below 900.

807-907. See table.

909-801-3,801-5. Partly stoped,909 and 860 stopes. See table.

909 down 50 ft. See table.

701.Clean zinc ore with gypsum walls.Good prospects. (Limits not exposed).

7-3 or 703. Six ft.ore developed by drift and 7D raise up 60 ft. 50 ft.vert.taken as developed ore.Length 80 ft.

810.-Area opened by 810 drift and crosscuts 800 squ.ft.;50 ft. ht.

82 Ore Zone.-Developed from old 82 level,110 ft.above 500,by crosscuts K,K and 82-2-1. The ground was reopened by Tunnel 2 and OB sampled at N end and at crosscuts A,K,Additional ore found beyond crosscut K. On 500,5-3 stope partly reopened. A new drift,504,run from shaft,and at N end of 5-3 stope a raise was put up 60 ft.on the ore. Development of this block hasnot been completed.

808 Copper Ore.Opened by 808 drift and 804-802 stopes. On 700, 707,704 stopes were opened on this ore;on 600, the 606 stope.This by former management just prior to closing of mine,1910. About 17,000 tons mined by former management ave.better than 3 % Cu.This ore carried 25-35% Fe,15-25% insoluble,chiefly silica.

PROBABLE ORE,RISING STAR.

Cheif value of mine lies in probability of additional ore. Probable ore in this report is ore of which there is a record or which is now partly exposed,but not enough work done to call positive. This estimate of probable ore does not include possibilities either laterally or in depth;does not represent possibility of mine.

Zone 1.-Developed by Nos.4 and 7 tunnels;has6500 tons assured ore in connection with 406 stope.In No.4 tunnel,2 additional lenses opened,respectively 80 and 50 ft.long. In No.7 tunnel 50 ft.below No. 4,ore exposed for length of over 100 ft. 10,000 tons probable orein the two tunnels.

Possible ore: well-defined ore-bearing zone exposed for length of 200 ft. in No.4 tunnel,same distance in No.7.No work on Zone 1 below No.7 tunnel.

Zone 2.-Marked by 82 zinc OB and by the No.2 tunnel.5-3 stope, 5-3 drift in this zone. Probable ore in connection with 82 Zn OB between 82 level and 500 is 10,000 tons. Downward extension of 5-3 OB 50 ft. below sill makes 5000 tons. 5-3 drift N of 5-3 stope in ore for 100 ft.in length;large mineralized zone indicated.Probable 10,000 tons above 600 indicated here. No development on this zone below 500.

Zone 3.OB marked by 9C stope worked up to 800, This shoot opened by former management on 1000. See sketch map, 900 and 1000. 1000 is 134 ft.below 900.Ore opened by a crosscut and short drifts on the 1000, by raise,1000 to 900,an intermediate stope 2 floors high between the levels and the sill of the 9C at top of raise. Considers ore practically proved though 1000 has not been unwatered.

Area 9C sill:1425 squ.ft.
Area 7th floor 10A stope: 1650 squ.ft.
1000-900:134 ft.
2 stope floors extracted. 20,000 tons probable ore above 1000.
10,000 tons guessed at below 1000.

No work done above the 810 to develop possible extension upward of the lens.Good chance for ore here.

4th Zone: Mined from 800 to 500;Cu. 7-3 Zn ore in this zone.Tho' high Zn given for both N and S ends of the stopes,can't estimate probable ore until this ground reopened. Zone undeveloped below 800: good chances.

Zone 5.-Developed,600 to 900,by new work. 500,old records show the ore zone. On surface,170 ft.above 500,large gossan OC checks with zone. Work in mine to date shows extension of sulphide ores to 20-50 ft.below surface. Extension of this 6A zone to within 40 ft. of surface proved by mining Cu ore at the S end. At N end the extensions 100 ft. above 500 or 50 ft. above the 450 crosscut developing this zone will give 50,000T probable ore.

Below 900 DD holes show extension of 920 OB for 50 ft. with same width and average grade. Downward extension of 100 ft. on this OB, which is found from 500 to 950 (bottom of drilling) would give 25,000T

Downward extension of S end of 6A-920 lens below 909 and 907 stope to 1000 would give 15,000 tons ore.

Zone 6. Marked by 5A stope. This stope was opened by sill floor 15 ft. below 500. E of the zone there is a strong fault carrying fragments of ore. Probable extension of this ore lies SE of any mine workings.

Zone 7. Copper-iron ore.Cut on 900 and 1000;it extends above 600. Where opened O_b was 100-150' long by 6-14 ft.wide. Good chances.

Summary- Probable Ore.

Zone	Tons	Type	Indicated Analysis. Au Oz.	Ag Oz.	Cu%	Zn%
1	10,000	Ag-Zn	.03+	4.0+	3.0	20.0-
2	25,000	" "	.03+	3.0+	3.0-	25.0-
3	30,000	Cu-Zn	.03	1.0-	3.0+	20.0+
Reported in Zone 5 4	65,000	" "	.03-	1.0-	2.5+	20.0+
5	25,000	Ag-Zn	.03+	6.0+	2.5-	20.0-
	155,000					

BULLY HILL MINE

Has not been unwatered.Following based on assay plans and sections and especially on weekly letters describing development in the mines from date of their purchase till close down 1910. These letters were obtained July 1919.Work in Star mine has shown corresponding records of that mine reliable.

Type of Bully Hill ore has important bearing on property.

Ave.anaysis ore mined (treated) 1909.

Cu	3.33%
Zn	7.83
Fe	12.68
Al_2O_3-$BaSO_4$	4.95
S	17.15
MgO	1.47
CaO	1.45
Insol.	47.49
Au	0.12 oz.
Ag	6.46

Composition of insoluble: Al_2O_3 6.4%
SiO_2 23.54
$BaSO_4$ 17.55
47.49

Above zinc content does not represent zinc in the mine:old letters say Zn gave trouble in the smelter. Letters say at N end 572B stope ore was 15 ft.wide,ran 23% Zn. Sorting,selective mining to avoid sending Zn to smelter;development of lower levels rushed to attempt to provide ore lower in Zn than that found on 470 and 570 levels.

Ore has less pyrite,higher gangue,so can concentrate,so that with consistent Au,Ag,Cu ore as valuable as higher Zn ore of Rising Star. H.R.Hanley (Hauley?) says Ag increased with the Zn.(Some suggestion of this at Afterthought-E.W.).

Several parallel shoots developed below main tunnel (370)level, shown by sections to be only partly mined.On 570,670 and 770 assay plans indicate good-sized shoots. Three good shoots indicated on 1100. No impoverishment on 1100.

Thinks over 75,000 tons Zn ore in Bully Hill mine;probably new shoots,laterally above 1100,and below 1100.

Reopening of main tunnel begun in October (1919);400 ft.double track tunnel now retimbered. Tunnel supposed in hard rock from pt. 500 ft.in,and shaft said to be in good shape. Cost of unwatering etc. to 1100 should not exceed $30,000.

Probable ore 470-770, and 970-1100. On 570,continuous ore assays in 573 drift for over 100 ft.beyond stoped portion. No mining above or below 570 on this ore. 670,continuous ore assays for 150 ft. at N end of level,in both the main drift and in crosscuts. Weekly reports show this ore had higher silica ,very bad due to high zinc and lack of iron in other ores being smelted.

On 770 shoots indicated by good assays in N drift and crosscuts for 300 ft. Part of this ore corresponds to that on 670. 870 stope carried up to this ore from the 870. This part of mine appears to have been practically untouched giving 250 ft. vert.by 100 to 300 ft.horiz. that is ore-bearing. From assays,and widths of ore shown by the cross-cuts should be 50,000 tons here. N end of 570 in ore for 100 ft. beyond 570B stope. Ore reported 15 ft. wide,23 percent Zn.

1100: 3 OBs. One,in 1109 X-cut at the N end,opened June 1910,the month mine was closed. Other two correspond to the stopeson the 970. No ore stoped below 970. Sill floors there have area of over 3500 squ.ft. Probably ore in connection with these OBs above 1100,25,000T.

COPPER CITY MINE.

Opened by 3 tunnels on Winthrop claim and a winze down 150 from lowest tunnel..On Baxter claim shaft 160 ft.deep connecting with main tunnel, No.8. These claims opened 1875 for Ag. Later aquired by Bully Hill Min.Co., workings extended. 20,000 tons mined.;development opened a number of shoots,small portions mined. Good content of Au,Ag,Cu., but Zn,Barite even higher than at Bully Hill;could only smelt very small quantity per day.

See plan: two main zones developed,parallel to and near contact of rhyolite intrusion in which the OBs occur. Ore croppings strong,persistent. Lowest development shows no change in type of ore.

The 20,000 tons from two stopes;stope floors show ore mined over

widths up to 30';lenses "not small". These two stopes carried up from bottom level practically to surface.

1917 portion of No.10 tunnel opened.At "A" massive Zn ore found. Carload shipped to smelter:

Au .04 oz. Ag 6.86 oz. Cu 2.08% Zinc 17.50% Silica 8.60% Iron 5.60% S 15.30% Alumina 8.4% Barite 32%	Ore here 15 ft.wide. Raise from No.10 tunnel here up 80 ft.to surface at mouth of No.11 tunnel. OC at mouth of Tunnel 11 mined by open-cut,smelted for Au, Ag. No 10 tunnel is in zinc ore from the small stope mentioned (carload) to junction of cross-cut from the tunnel to the top of 921A stope. This ground not mined.

Ground beyond 921A stope not reopened. Old records show two ore zones (CC and DD on plan). These shoots unmined except for a portion at 802B raise.

Probably at least 25,000 tons of ore in this part of the mine.This is based mainly on showing in No.10 tunnel and the stope maps and records.

Fall of 1918 Baxter shaft reopened to 60 ft.by lessees;carload of ore shipped from the ore opened near the shaft.This ore lies under gossan near the shaft. Ore where mined 10' wide. No.3 tunnel cuts this ore where shown on map. Here 8' of ore.Every indication of long ore zone here.

MINING.

Rising Star opened to 900.Mine has a 10-drill compressor,hoist, pump. Shaft 3 comp. Ore stored in bins, mouth of 500 tunnel,hauled to smelter over narrow-gauge track by gas loco.

Costs,1918, 85 tons per day, 5 mos.

	Mining per ton ore-smelter wts.	Developing
Supervision,labor	$1.78	0.42
Supplies,timber	0.42	0.11
Explosives	0.13	0.06
Misc.supplies	0.45	0.31
Power	0.14	0.04
	$2.92	0.94

Ore averages 9 cu.ft.per ton,drills and breaks easily.

1919,development drifting, $7.54 per ft. 2 compartment (square set) raises,timbered and lined, $11.50 per ft.

ORE TREATMENT (In part).

Ores dense sulphides.

	Rising Star Composite sample all OBs except 82 level Zn ore	82 Level Zn Ore	808 Type Cu Ore
Gold oz.	.030	.025	.02
Silver oz.	2.30	3.20	.88
Cu%	2.47	1.04	6.86
Zn%	25.87	28.33	3.50
Fe%	12.69	6.81	30.00
S%	30.31	23.77	34.80
CaO%	3.30	1.45	--
Al2O3%	6.85	4.73	4.60
BaSO4%	6.9	25.60	--
SiO2%	8.07	5.30	16.80
Pb%	.12	1.25	--

~~3.~~

REPORT ON EXAMINATIONS OF THE BULLY HILL MINES? Dated Mar.12,1920.

Based on work of Rogers and Ball;report written by Allen H. Rogers, died 1938.

Bully Hill Mines Inc. has option on ppty from Bully Hill Copper Mining & Smelting Co. (GE).

Bully Hill group,24 claims, 500 acres;Copper City group, 6 claims, 66 acres.

Mines formerly worked for copper, smelted locally. Zn ores avoided; in exploring for copper large high grade Zn bodies exposed. Present company after zinc as well as Cu,Au,Ag.

Au,Ag go with barite.

Rising Star ore has more iron than Bully Hill ore,hence served to flux latter. More Zn at Rising Star.

Rising Star Ore Reserves: March 12,1920.

Stope	Tons proven	Tons probable	Au oz	Ag oz.	Cu%	Zn%
82-AK	20,000		.040	7.2	1.5	26.1
500 to 6A	28,000		.020	.6	2.5	25.0
500 to 6D		10,000	.020	.6	2.5	20.0
6A to 7A	17,000	26,000	.020	.6	2.2	22.0
6D to 7-3		9,000	.020	.7	3.2	21.9
7A to 801		14,000	.020	.6	2.2	22.0
7M to 801	16,000		.036	1.8	3.3	23.0
801-60						
920-907	21,400		.043	4.9	3.0	20.3
860-909	2,000		.028	1.5	6.3	16.0
900 down 50'	17,800		.044	6.3	3.8	17.2
9C to 1000		12,000	.010	.6	2.5	20.0
Dumps	3,300		.028	2.4	2.6	22.0
	126,300	71,000	.028	2.4	2.6	22.0
	197,300					

Ore developed on only one level:no tonnage assigned:

Tunnel 4,OB of considerable importance,ave. .05 oz Au, 12.5 oz.~~oz~~.Ag 2.2% Cu, 17.0% Zn. Can be easily explored from 5-3 workings with but little additional work.

810,a small OB,iunexplored on any other level.

701, " " " " " " ";explored upward ,shrinks rapidly;but no exploration downward,

Considerable depth extension predicted;Rusing Star has produced 200,000 tons copper ore to 900;including existing reserves,will have yielded 400,000 tons to 900, 620' below surface. Still promising chances laterally A further 200,000 tons ore is reasonable.

In N part of Rising Star body of low grade cuprif.py developedon 600,700,800,36,000 tons ave.2.7 % Cu,with no other values. NG to mine and treat for copper,but OK as flux:would cover cost of extraction and treatment.

Bully Hill Mine.- Workings mainly in Popejoy claim. Opened several years earlier than Rising Star, by Tunnel 1,2 and 3; from 3,shaft to 1100, 797' below elev.Tunnel 3 (300). 100 ft.level interval. Allowed to fill with water in 1910;since then No.3 tunnel caved.

Several shoots of ore worked, 10-40 ft. wide,occurring in a block of ground 200' -, E-W, 1000' long. As deeper levels opened extend of ground explored became much less;on 970 only 350 ft.in length explored,work confined to area of main ore shoot. Teo main shoots,apparently in parallel shear zones, trend N,dip steep E. W shoot gave out between 570 and 670,at least stoping ceased at that horizon;ma y have been because of Zn increase. E shoot worked only a short distance above 570,continued to 1100,but according to maps,mua narrower there. Assay map of 1100 shows what is apparently anew s oot discovered in 1109 Xcut:20 ft. of ore opened. 6 ft.,.19 oz Au, 13.5 oz.Ag.,5.3 % Cu, remaining 14 ft.,.057 oz. Au, 6.3 oz.Ag., 2.0 % Cu.

No Zn assays reported.Shoots appea to have picnhed between 670 and 770,but maybe on account of excess Zn.

Occasional referenc s to Zn encountered,in reports thruout life of mine. Not as freqent or precise as might be wished ,but possibly Zn everywhere present and only called for mention where met unexpectedly or unusally excessive. Only direct evidence from oldrecords of Zn in Rising Star was assays reported from 6A stope. In Bully Hill,some Zn assays on 470 and 570 levels,about time that according to correspondence a magnetic separation plant being consideredd for separation of Zn from the ore.

R M and B beliege that zincy ores will be found in quantity in Bully Hill mine,tho perhaps lower grade than Rising Star;lesser zincoffset by higher Au,Ag. Higher % gangue minerals,Bully Hill ore more amenable to concentration.

No way to calcultate Bully Hill reserves,no zincassays except those noted above. Copper ore stoped. Might be assumed that samples showing high silver and low copper indicate Zn ore;if so,consierable tonnages indicated.

Copper City Mine: Credited with production of 16,856 tons smelting ore,which contained high Zn.Workings mostly caved;such inspection as is possible suggests that zinc ore in tonnages of consequence exist there; this Zn ore may account for the small production. Mine an asset,value of which must be determined by development in the future.

Conclusion: "The proper ty is clearly very valuable and is sufficiently developed to warrant the immediate construction of the plant recommended." (p.8).

REPORT ON BULLY HILL MINE. Sept.22,1920.

R.L.Beals,General Super.,to W.Arnstein,306 Hobart Bldg.S.F.

Based on assay plans,geologic maps and sections made for Bully Hill Copper Mining & Smelting Co.,duration operation of the mine. Similar records of Rising Star foundreliable during reopening ofthe mine.

These maps and sections obtained in June 1920. At time of A.H.Rogers report Dec.1919 these data not available; could not correlate OBs on different levels without the cross sections.

Geology: Shoots in Bully Hill parallel contact of the alaskite and a series of basic dikes,on the E of the alaskite,calledby Ball diorite porph.

Wodth of ore zone 100 to 300 ft. as developed. A heavily sheared zone,shearing and OBs are parallel to alaskite.

Several parallel shoots developed, som in the alaskite,some between the alaskite and diorite, some in the diorite. Reports and sections indicate as great a width of ore zone on the 1100,bottom level,as above. Ore on bottom levels of same grade as that developedbelow the main working level,the first level below the zone of 2ndary enrichment. Length of ore bearing ground developed is 1000'. At both ends of this developed zone probabilit of further lateral extension ,indicated both by the plans and by the surface.

Ore Estimate: See table. 124,000 tons. In addition,there are a number of partly developed shoots or extensions of shoots shown on which info insuffiedent to base tonnage estimate.

Assay plans complete as regards Cu,Au,Ag. No zinc assays except some from different parts of the mine not in a form to permit tonnage estimate

Weekly letters on development to high Zn content of ore in No.2 tunnel 301 drift,307 stope etc. indicate a good grade of Zn ore available. Stated that N face of 572 stope was 15 ft. wide,22 % Zn.

Ave. grade Zn from Bully Hill mine smelted during 1909,last full year smelter operated, was 7.8 % Zn. During this period a selection of orein the stopes,selective mining of higher Cu ores. During same period Rising Star ore averaged 4.6 % Zn. For 2 months in 1909 Zn exceeded 10 % in Bully Hill ore. Ore smelted in 1909:

Cu	3.61 %		
Zn	7.83 %	Au	.118 oz.
Fe	13.40 %	Ag	7.15 "
Al_2O_3	11.10 %		
S	17.30 %		
SiO_2	22.3 %		
Barite	19.20%		
	94.7 %		

1909 Rising Star ore averaged: Cu 3.51 %, Ag 4.67 oz.

The zinc ore opened in the 3A tunnel runs 22 % Zn. Ore on dumps shows high % of zinc;in making estimate average grade of Zn in the ore taken as 12%.

Developed Ore, Bully Hill Mine.

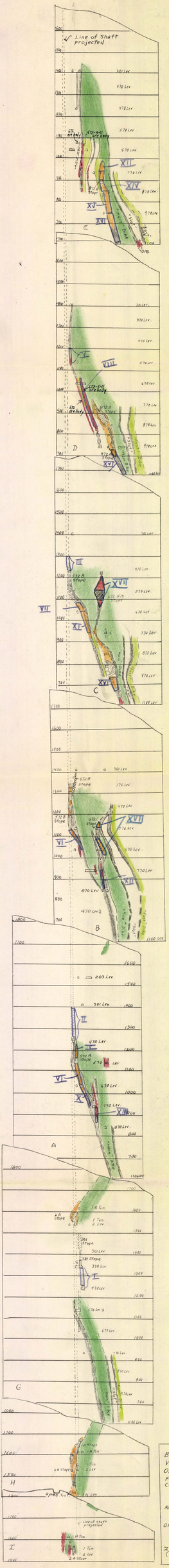
Location	Tons	Au oz.	Ag oz.	Cu %
301 stope	10,000	.07	9.5	4.0
370 drift	5,000	.07	7.0	2.5
470 drift	5,000	.07	5.0	2.5
472 "	6,000	.06	6.8	4.1
573	10,000	.04	2.8	2.0
672-1-xcut	3,000	.05	9.8	3.2
672 B raise	10,000	.06	4.0	2.0
672-3 drift	1,000	.08	5.5	1.5
672 drift, N end	3,000	.04	3.0	1.8
672-5-11 xcuts	18,000	.07	4.9	1.4
772-11 xcut	7,500	.15	4.0	4.0
772 Drift,N end	2,500	.05	2.2	2.5
772-3	9,000	.07	4.3	5.0
772-7A	10,000	.12	7.0	3.6
972 sill	15,000	.10	5.0	3.0
1100 drift	9,000	.05	3.0	2.5
	124,000	.06	5.1	2.97

Bully Hill Mine: Operated thru 940' crosscut tunnel connected with shaft,vertical, from this tunnel 800' to so-called 1100' level.

Longitudinal Section of mine shows a large ore shoot extending S from the shaft on the tunnel level for 500 ft. Half of this shoot has been mined. Reopening the south drift 301,Tunnel Level,connecting with No.1 tunnel 140' above will give access to this orebody and ventilate the workings. Tunnel is 301' level, elev.1403.

Below the tunnel level the 370,470 and 570 levels were driven in the sheared ground;stopes were opened. Reopening would be expensive. 670,770 levels driven in solid,no mining,hence easier to reopen. Same for 1100' level.

Volume of water in Bully Hill mine below tunnel level is probably between 1,500,000 and 2,000,000 cu.ft. Time to unwater 90 days. Shaft said to be in good condition.



BULLY HILL MINE, SHASTA CO., CALIF
VERTICAL CROSS-SECTIONS THROUGH
ORE ZONES

For positions of Sections see Structural Contour Map

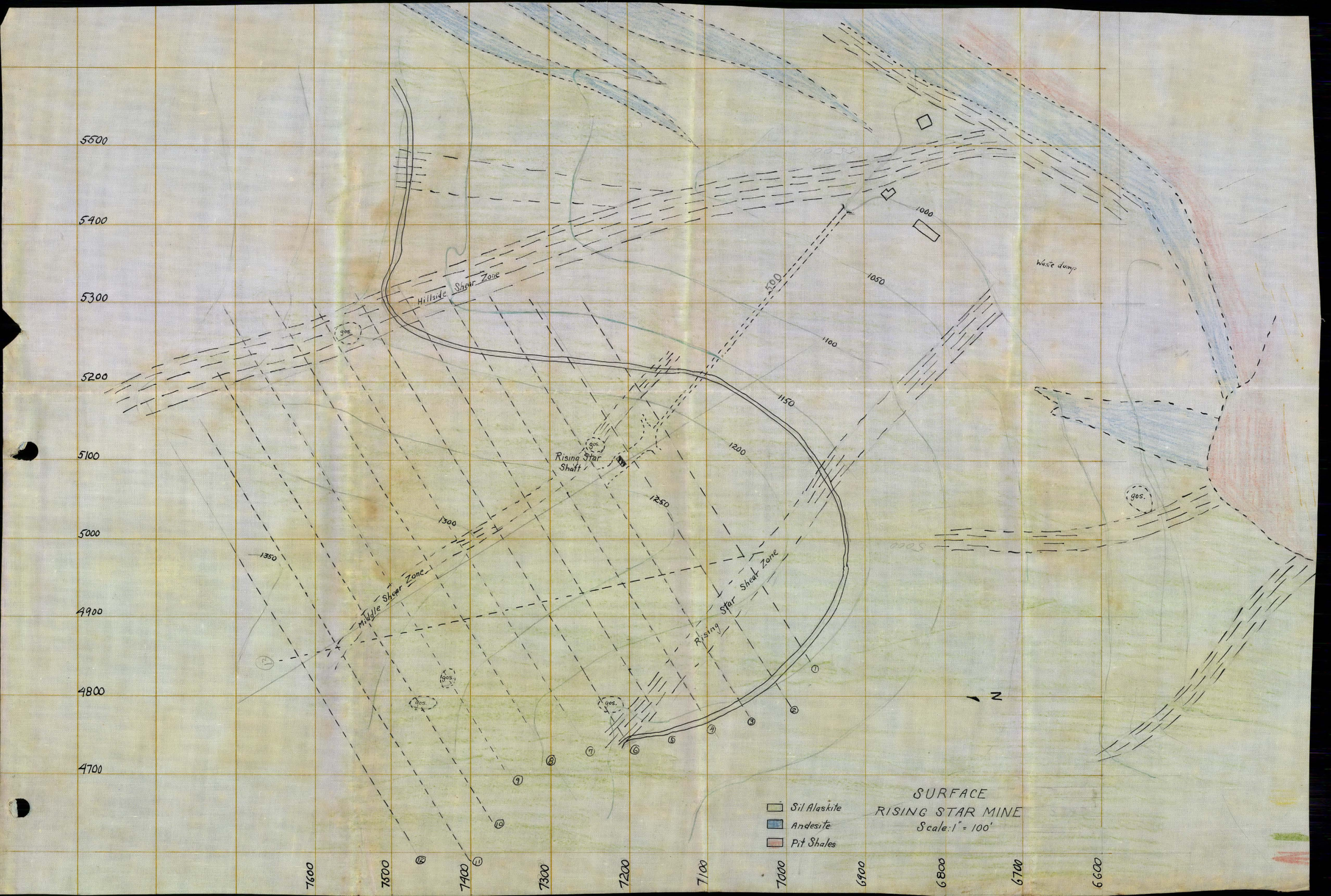
Scale: 1" = 200'

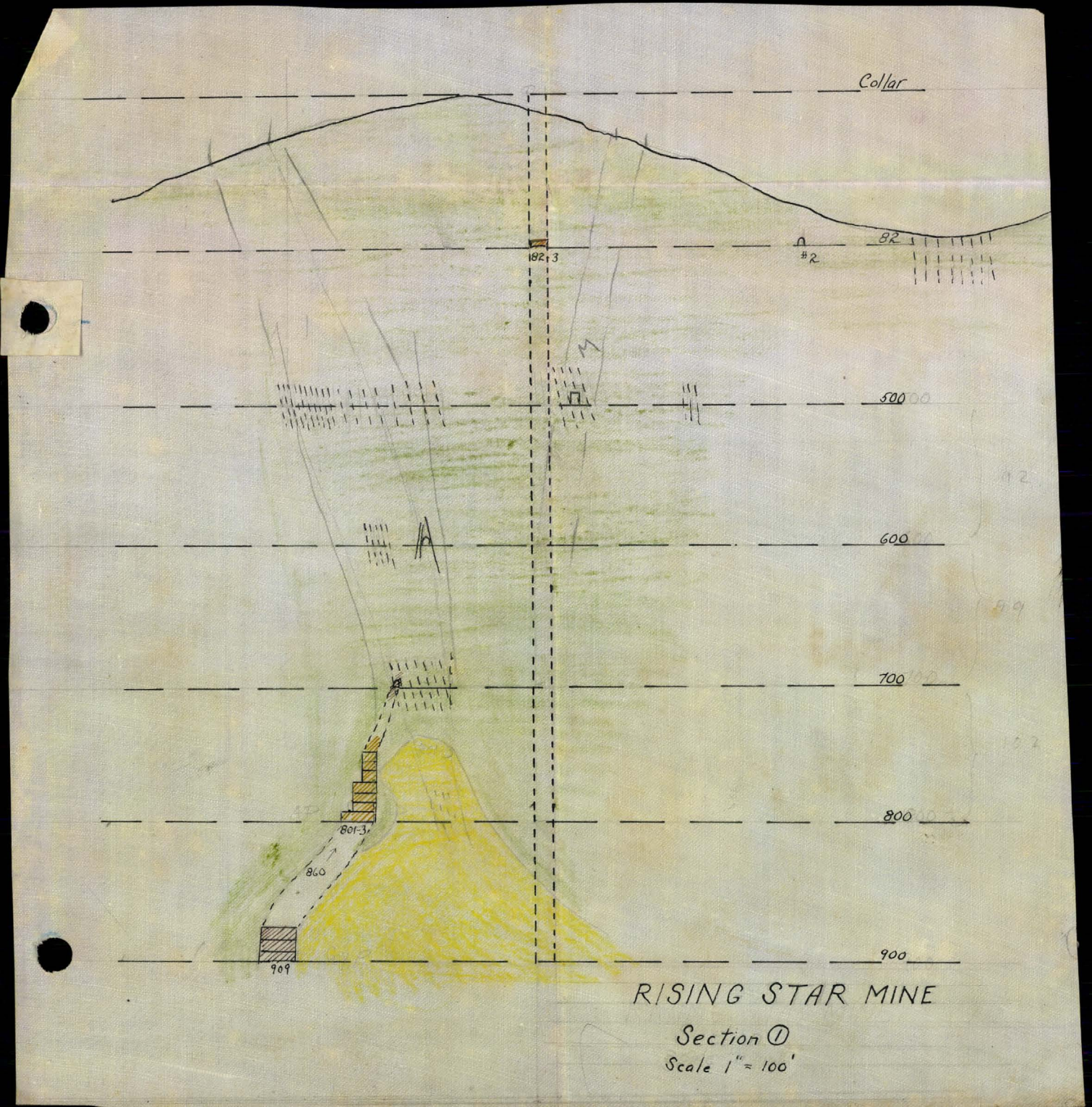
LEGEND

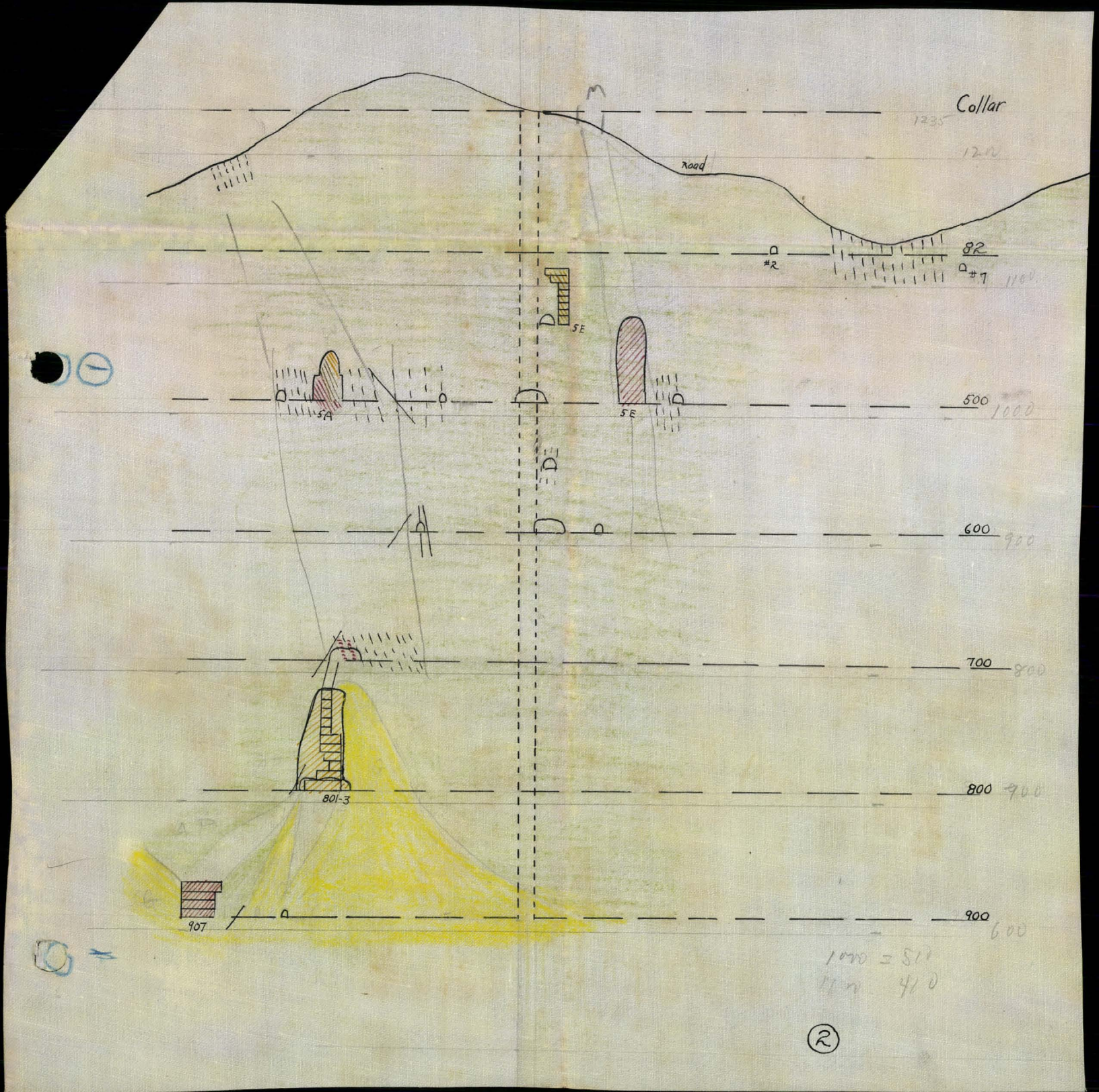
ROCK FORMATIONS
"Main" Dike:
"East" Dike, minor dikes:

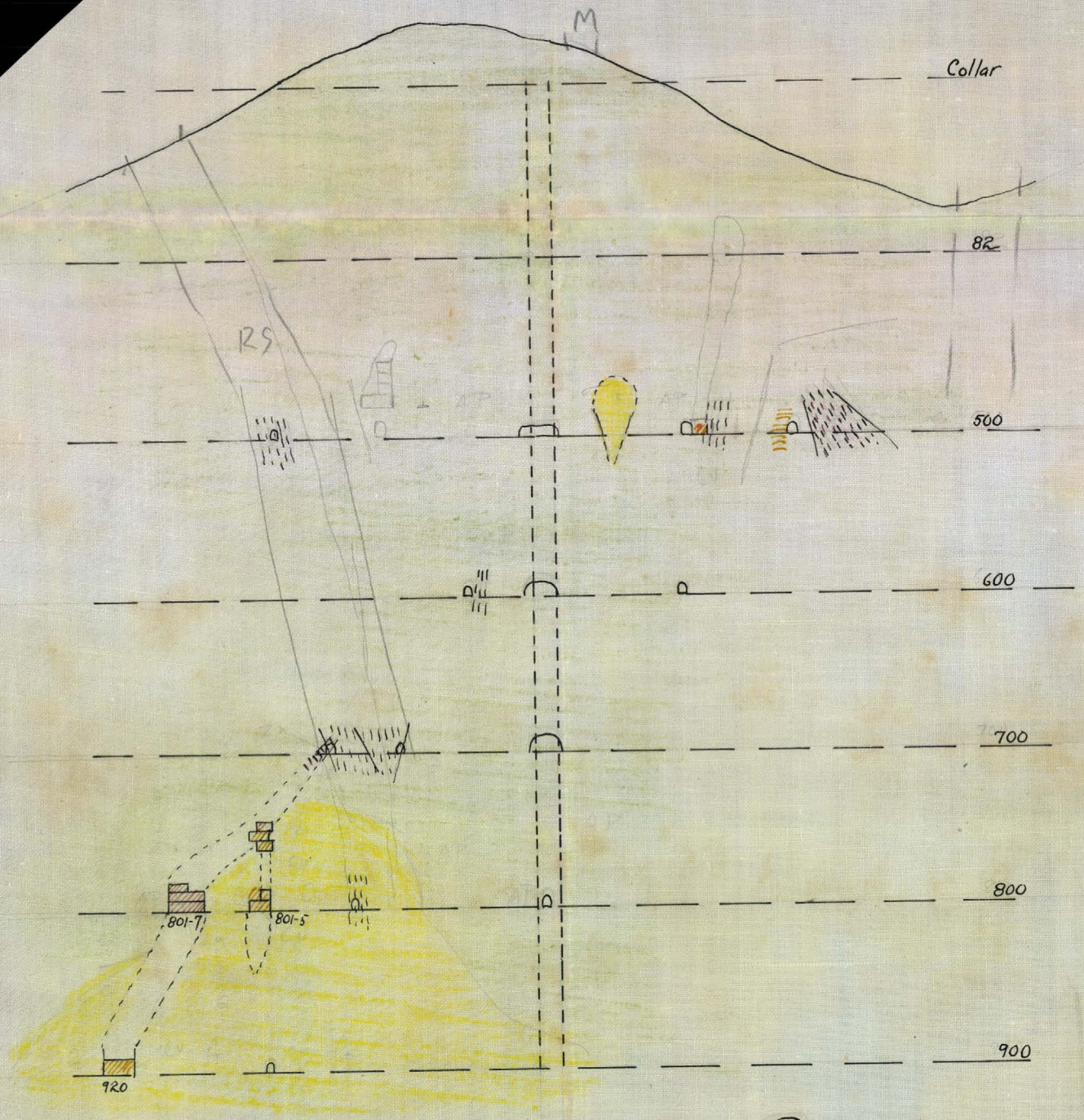
ORE BODIES
Stoped:
Extension, probably unstoped:
Virgin Ore:

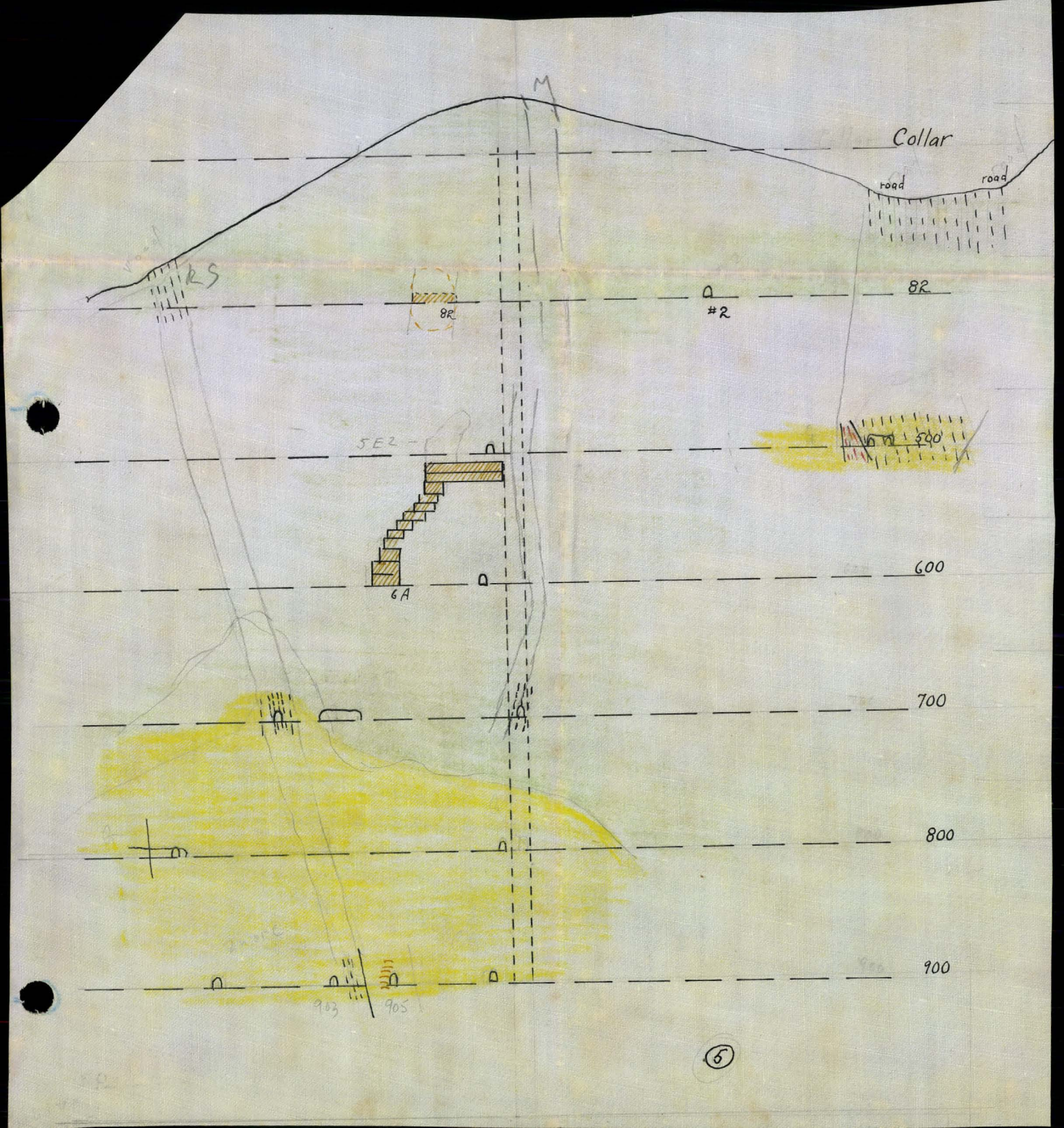
ZONES POTENTIALLY ORE-BEARING
(" Shear zones):

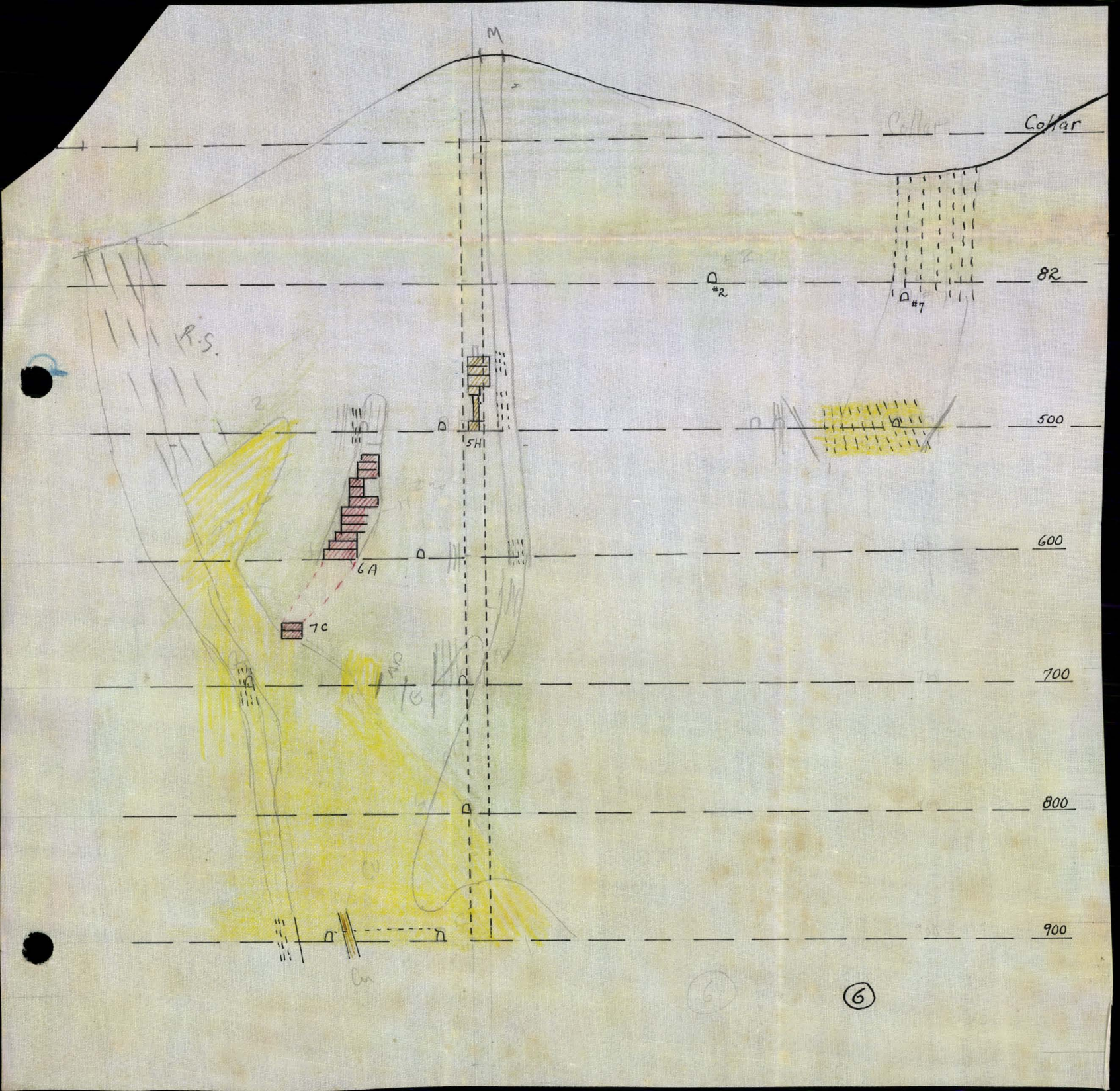

5500
5400
5300
5200
5100
5000
4900
4800
4700
7600
7500
7400
7300
7200
7100
7000
6900
6800
6700
6600
Hillside Shear Zone
Middle Shear Zone
Rising Star Shear Zone
Rising Star Shaft
Waste dump
gos.
1000
1050
1100
1150
1200
1250
1300
1350
N
Sil Alaskite
Andesite
Pit Shales
SURFACE
RISING STAR MINE
Scale: 1" = 100'

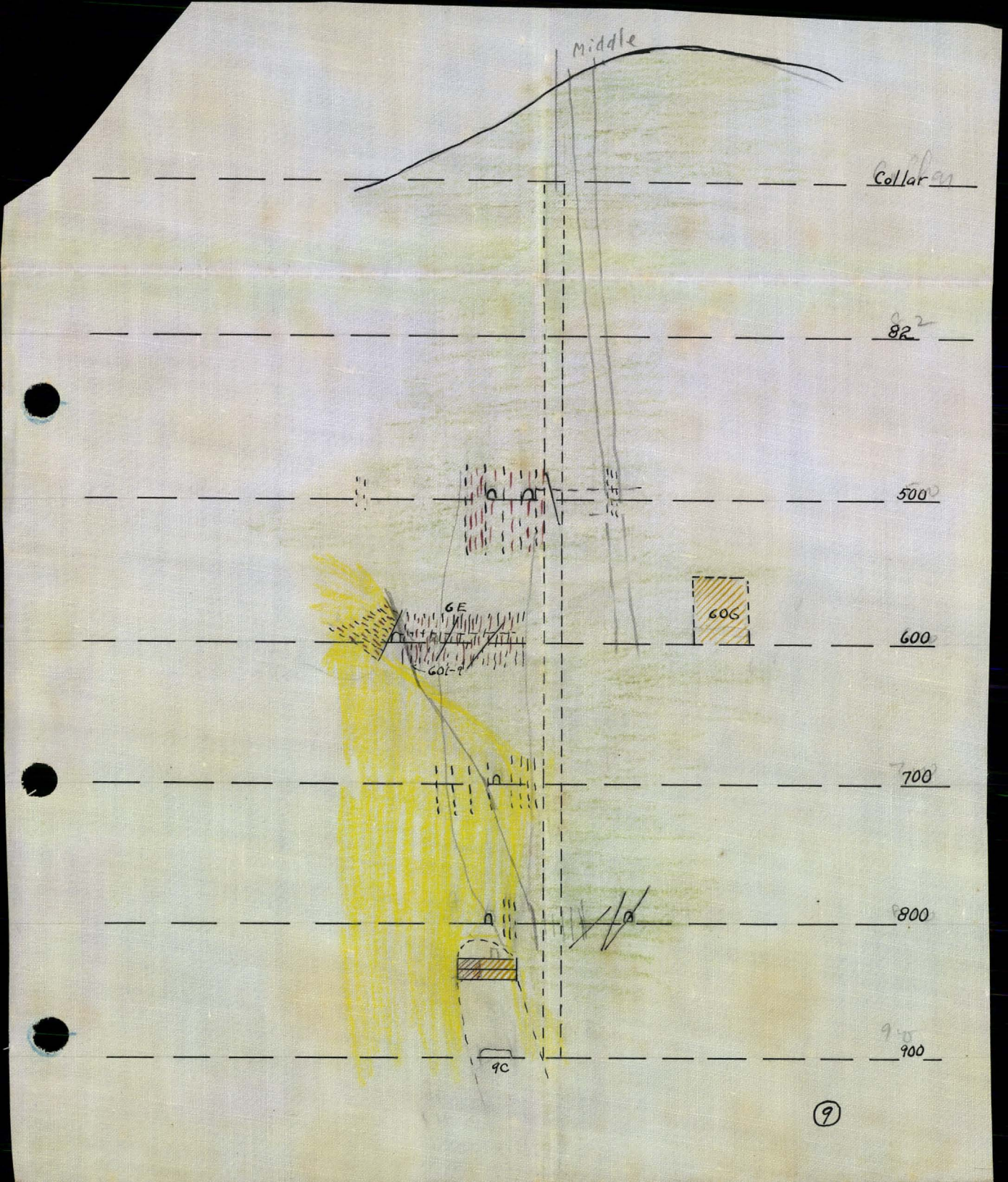

Collar
182-3
#2
82
500
600
700
800
801-3
860
900
909
RISING STAR MINE
Section ①
Scale 1" = 100'

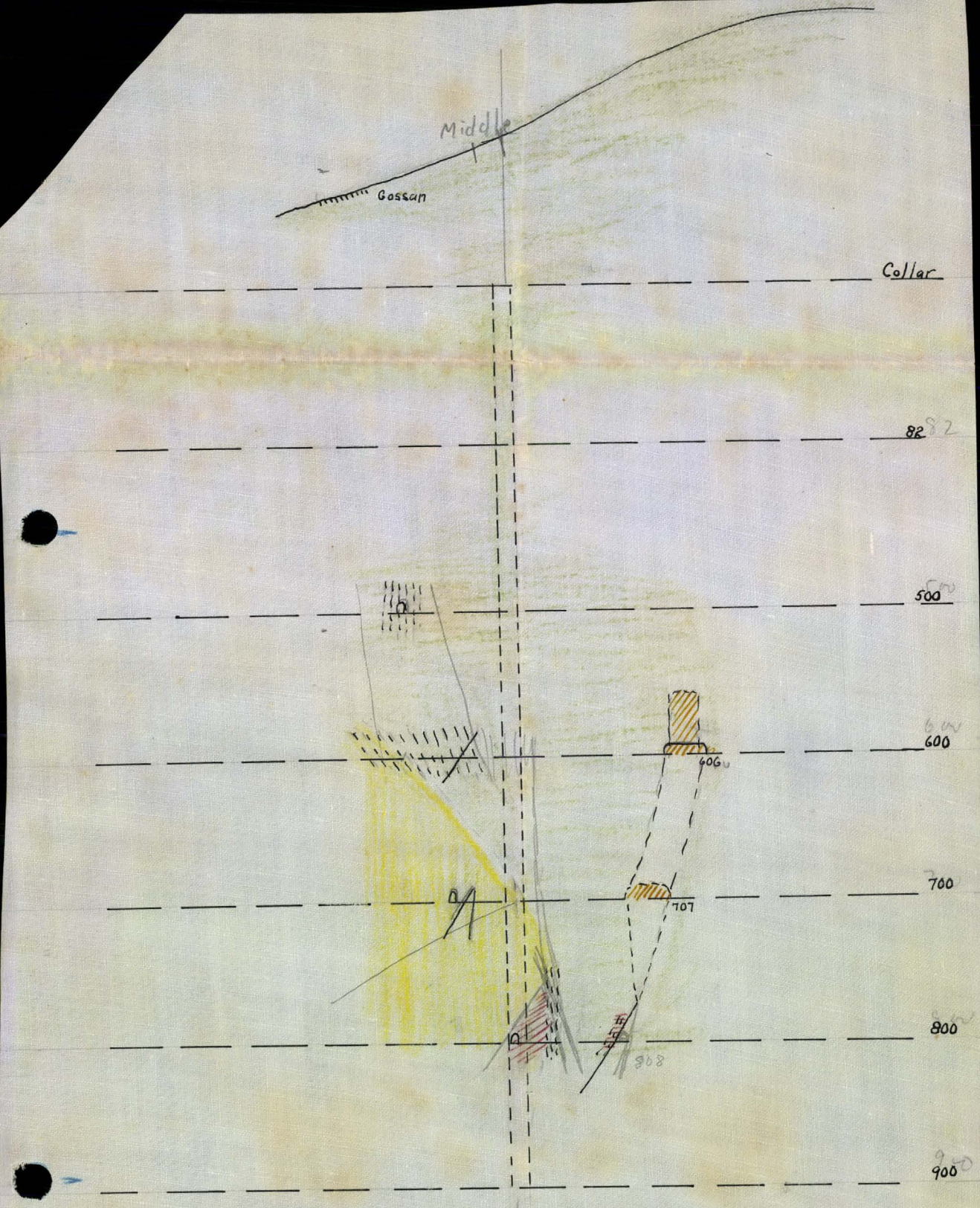

Collar
1235
1200
Road
82
#2
#7
1100
5E
5A
5E
500
1000
600
900
700
800
801-3
800
900
907
900
600
1000 = 510
1100 = 410
2

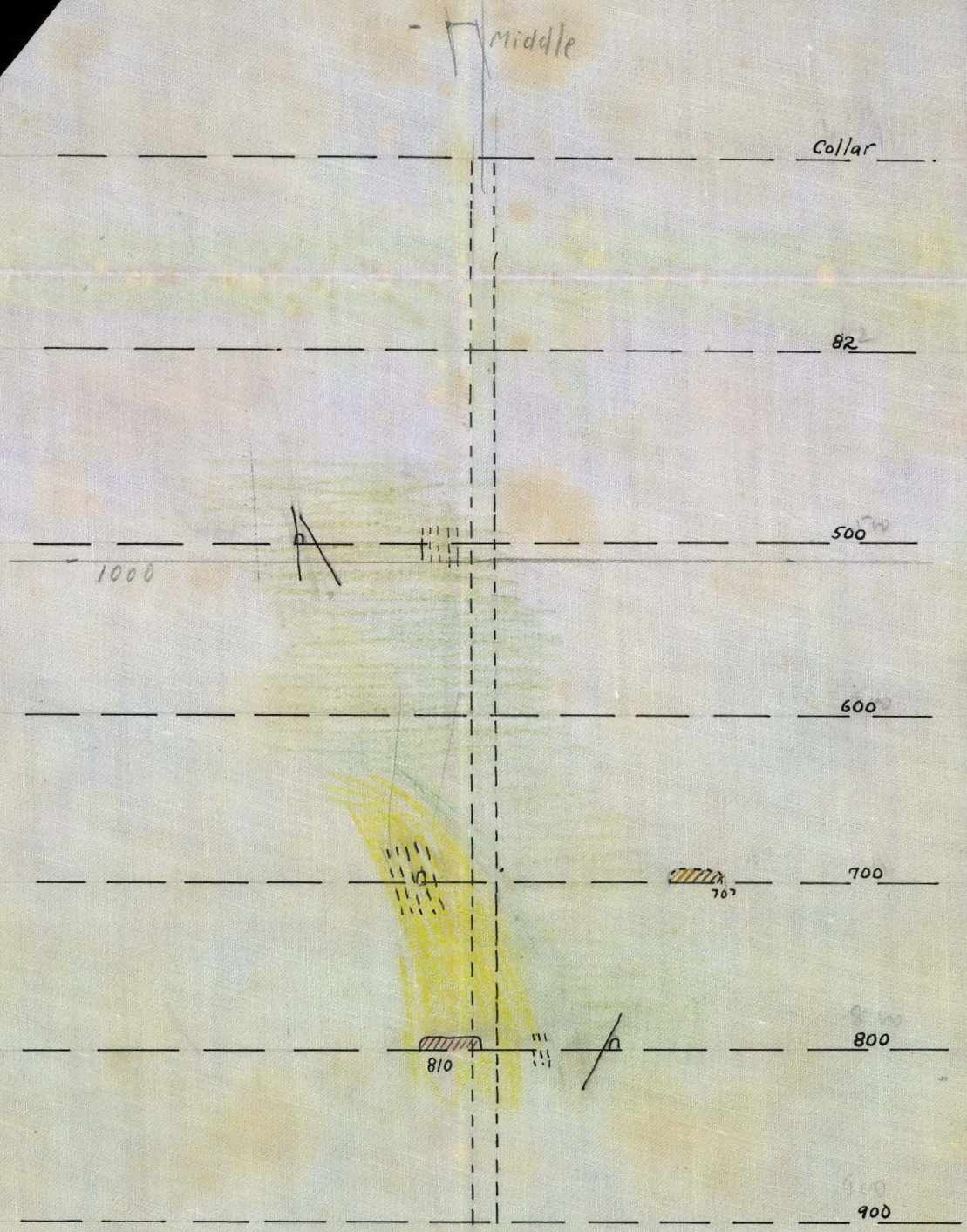

M
Collar
82
RS
500
600
700
800
801-7
801-5
900
920

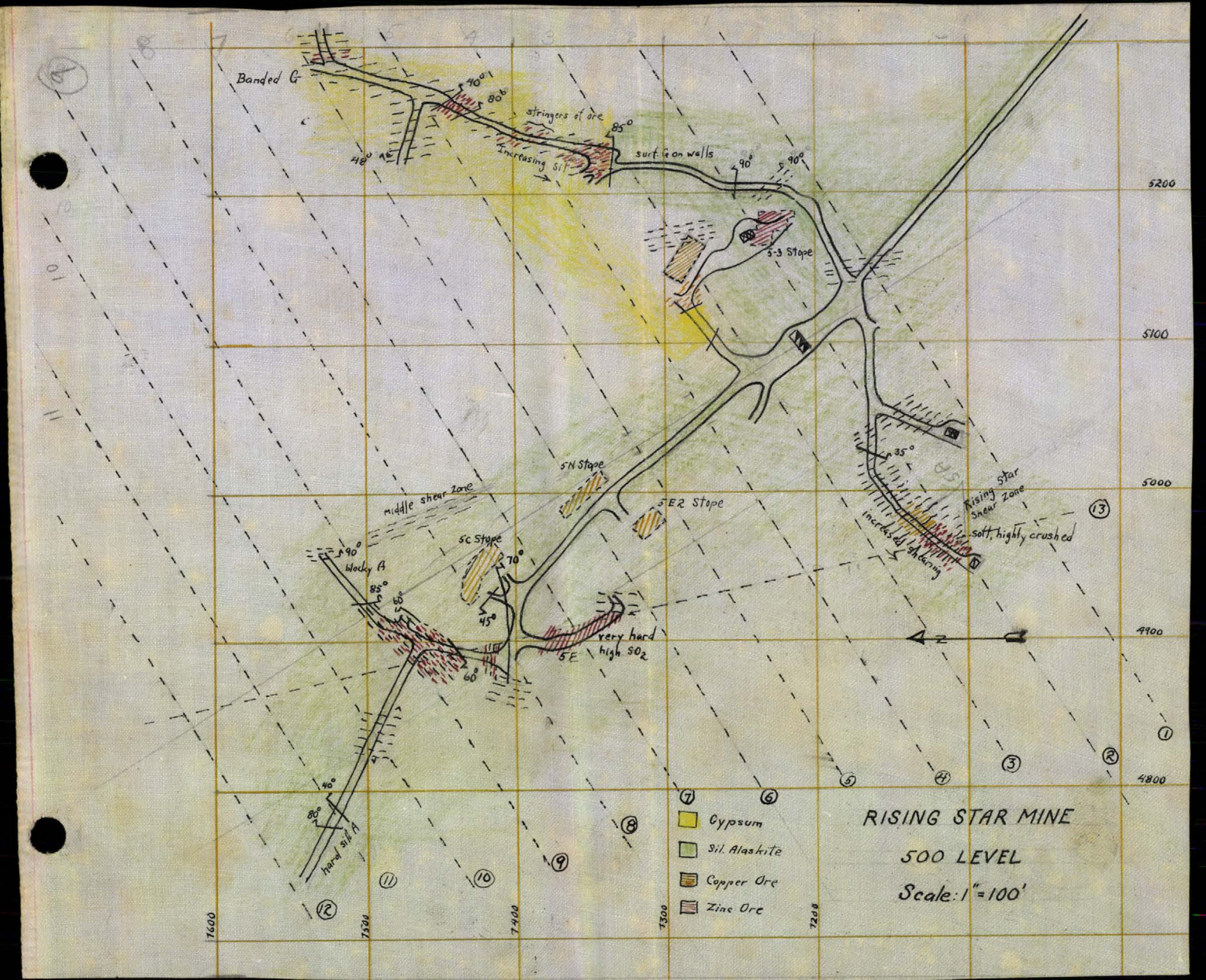

Collar
road
road
RS
82
8R
#2
5E2
500
600
6A
700
800
900
903
905

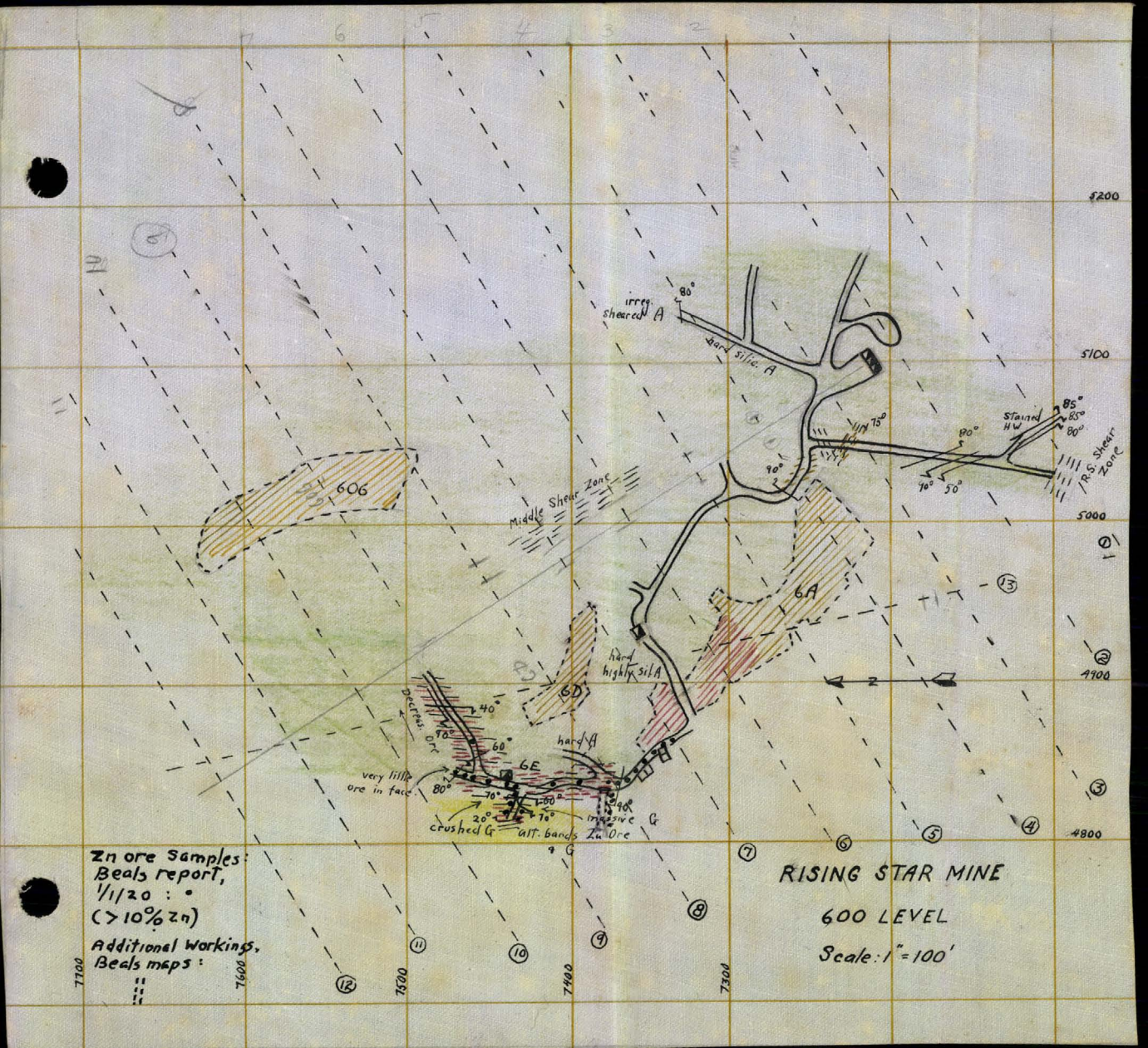

M
Collar
82
#2
#7
R.S.
500
5H
600
6A
7C
700
800
900

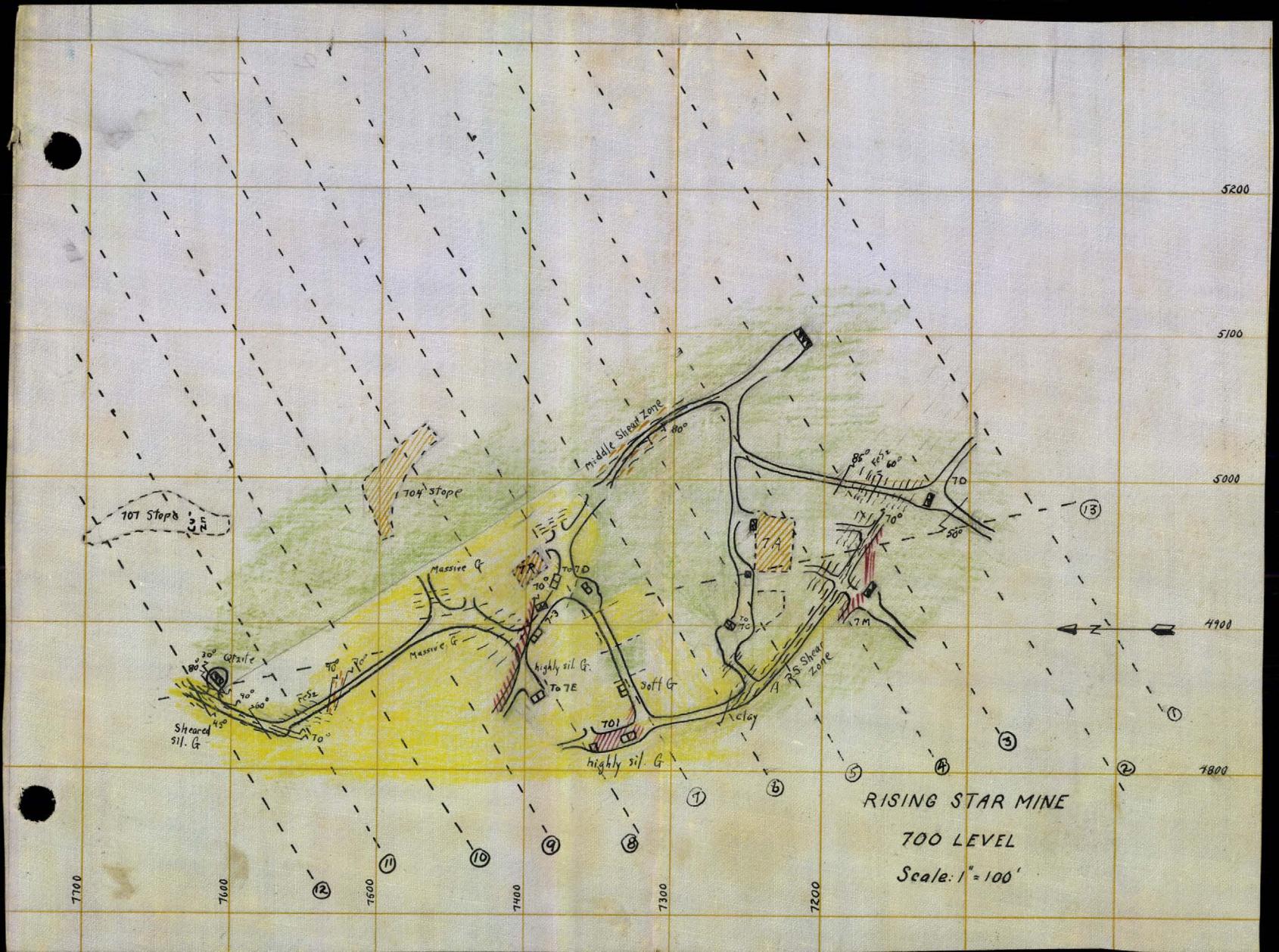

Middle
Collar
82
500
600
700
800
900
6E
60L-?
60G
9C

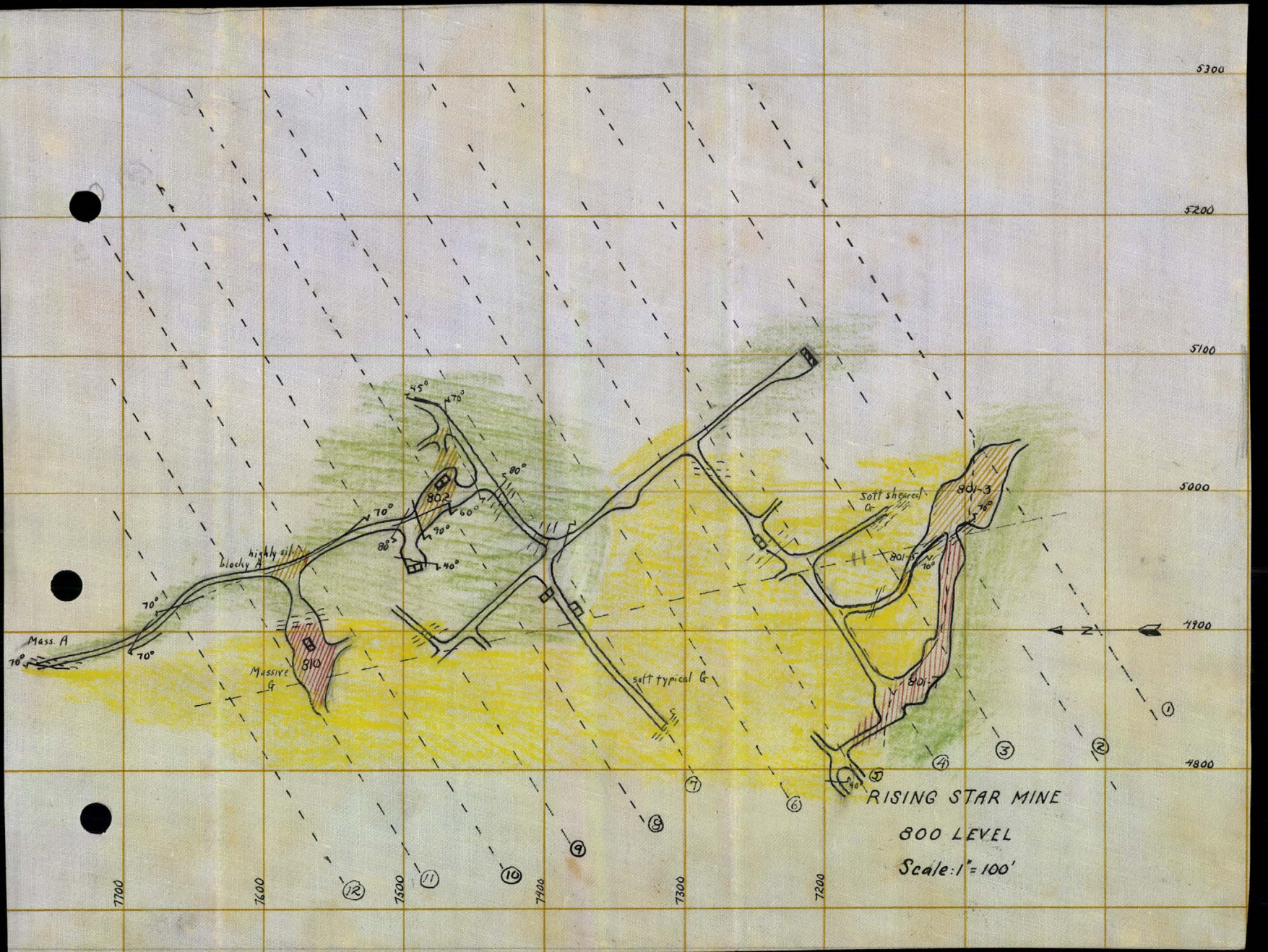

Middle
Gossan
Collar
82
500
600
606
700
707
800
868
900

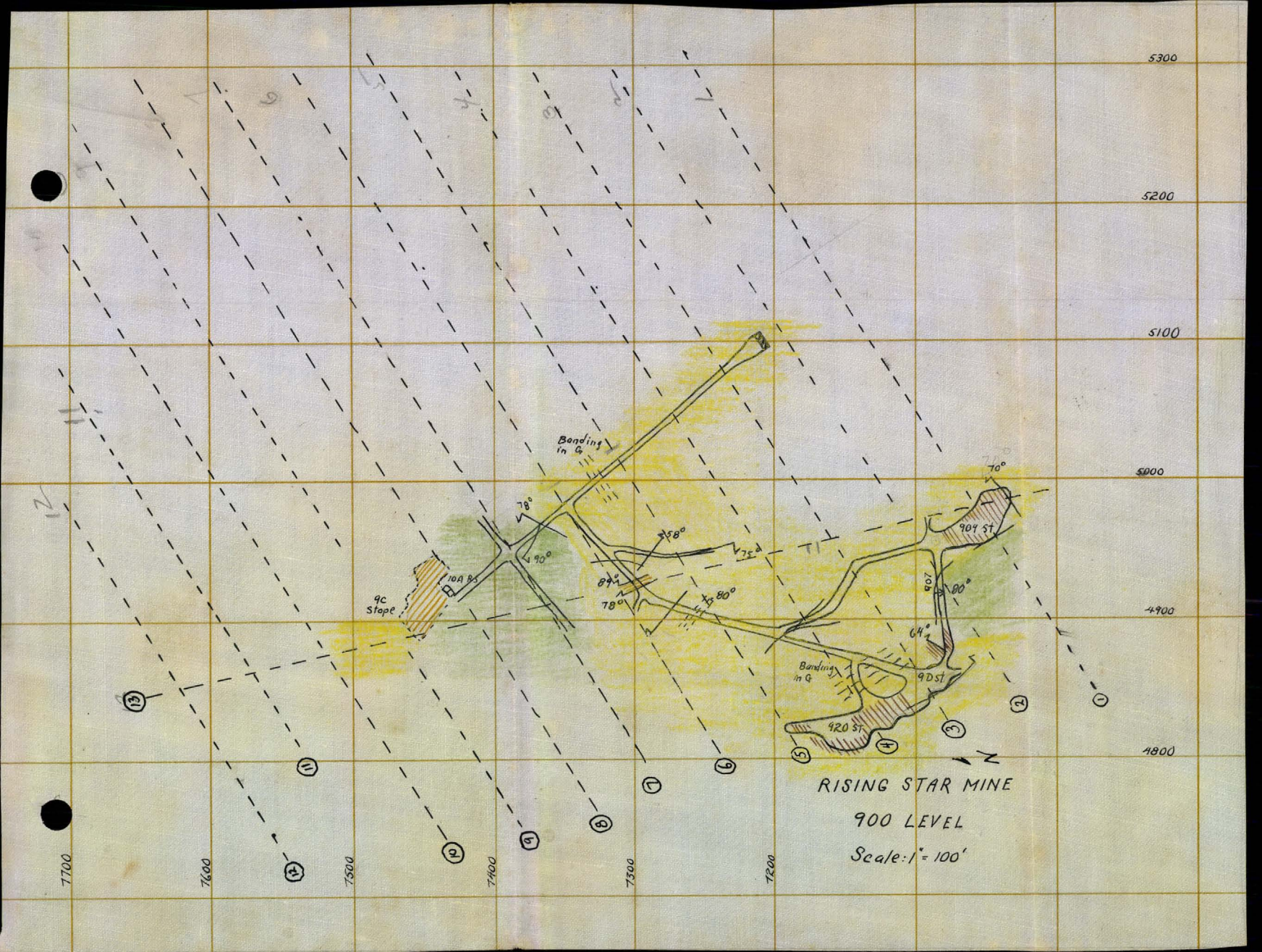

Middle
Collar
82
500
1000
600
700
707
800
810
900

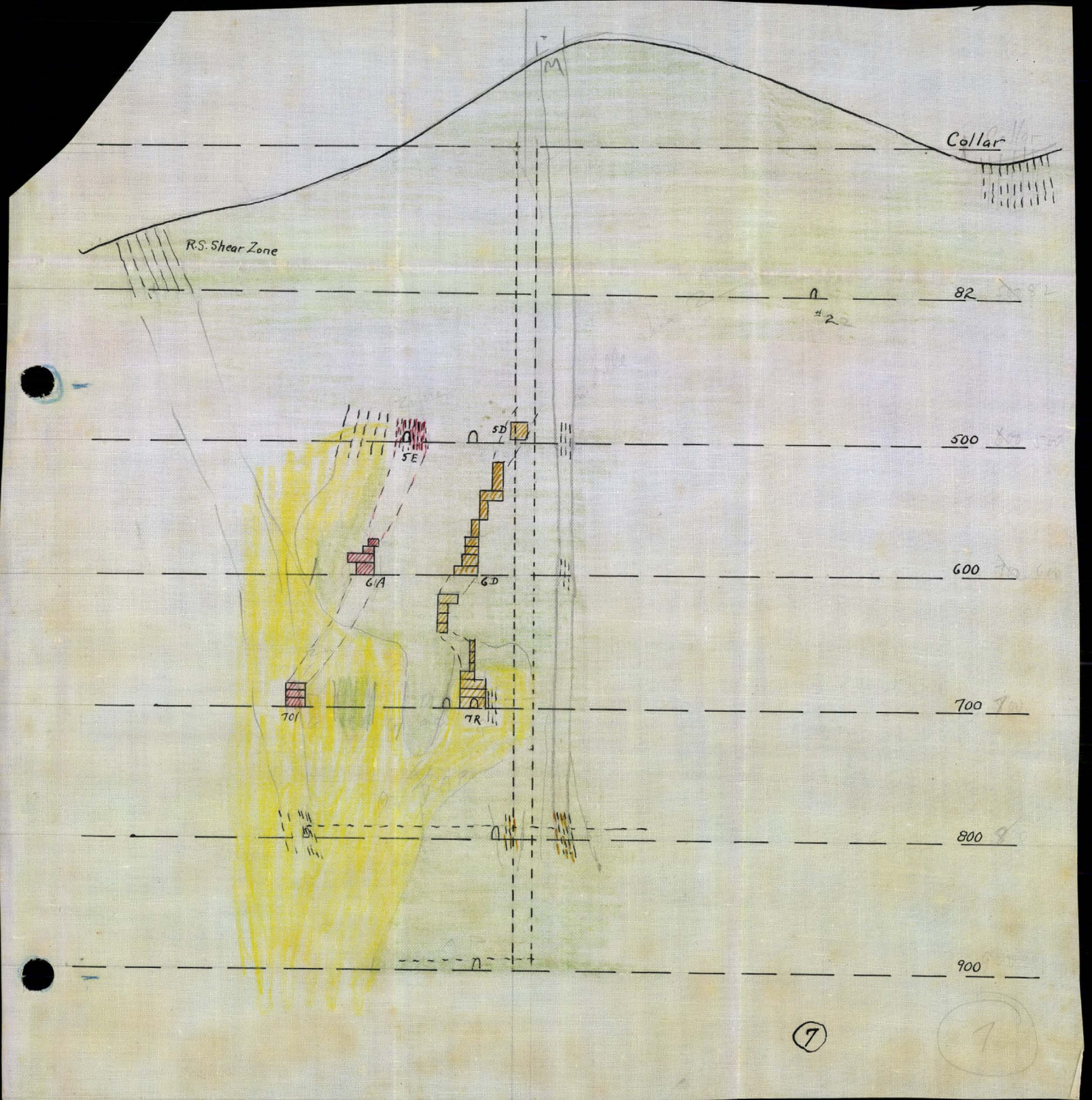

Banded G
stringers of ore
increasing Si
surf. G on walls
5-3 Stope
5N Stope
middle shear zone
5E2 Stope
5C Stope
blocky A
very hard
high SO2
5E
hard sil A
Rising Star Shear Zone
soft, highly crushed
increased shearing
Gypsum
Sil. Alaskite
Copper Ore
Zinc Ore
RISING STAR MINE
500 LEVEL
Scale: 1" = 100'
5200
5100
5000
4900
4800
7600
7500
7400
7300
7200


RISING STAR MINE
600 LEVEL
Scale: 1" = 100'
Zn ore samples:
Beals report,
1/1/20 :
(>10% Zn)
Additional Workings,
Beals maps:
irreg. sheared A
hard silic. A
Stained HW
R.S. Shear Zone
Middle Shear Zone
606
6A
6D
6E
hard highly sil A
hard A
decreas. Ore
very little ore in face.
crushed G
alt. bands
massive Zn Ore
G
5200
5100
5000
4900
4800
7700
7600
7500
7400
7300

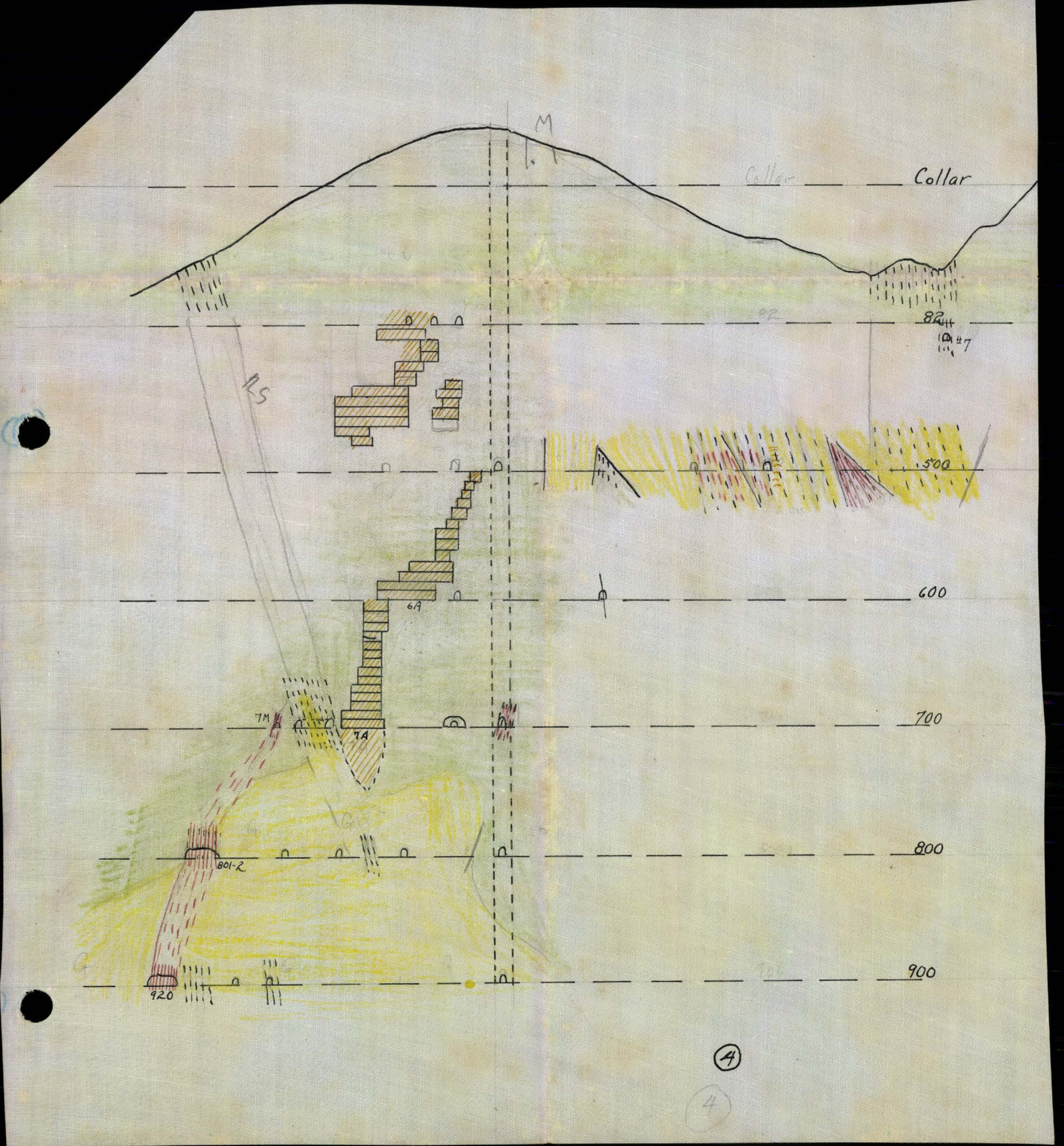

RISING STAR MINE
700 LEVEL
Scale: 1" = 100'
707 Stope
704 stope
Middle Shear Zone
Massive G
Qtzite
Sheared sil. G
highly sil. G.
To 7E
soft G
clay
RS Shear Zone
highly sil. G
701
To 7D
7A
7M
5200
5100
5000
4900
4800
7700
7600
7500
7400
7300
7200

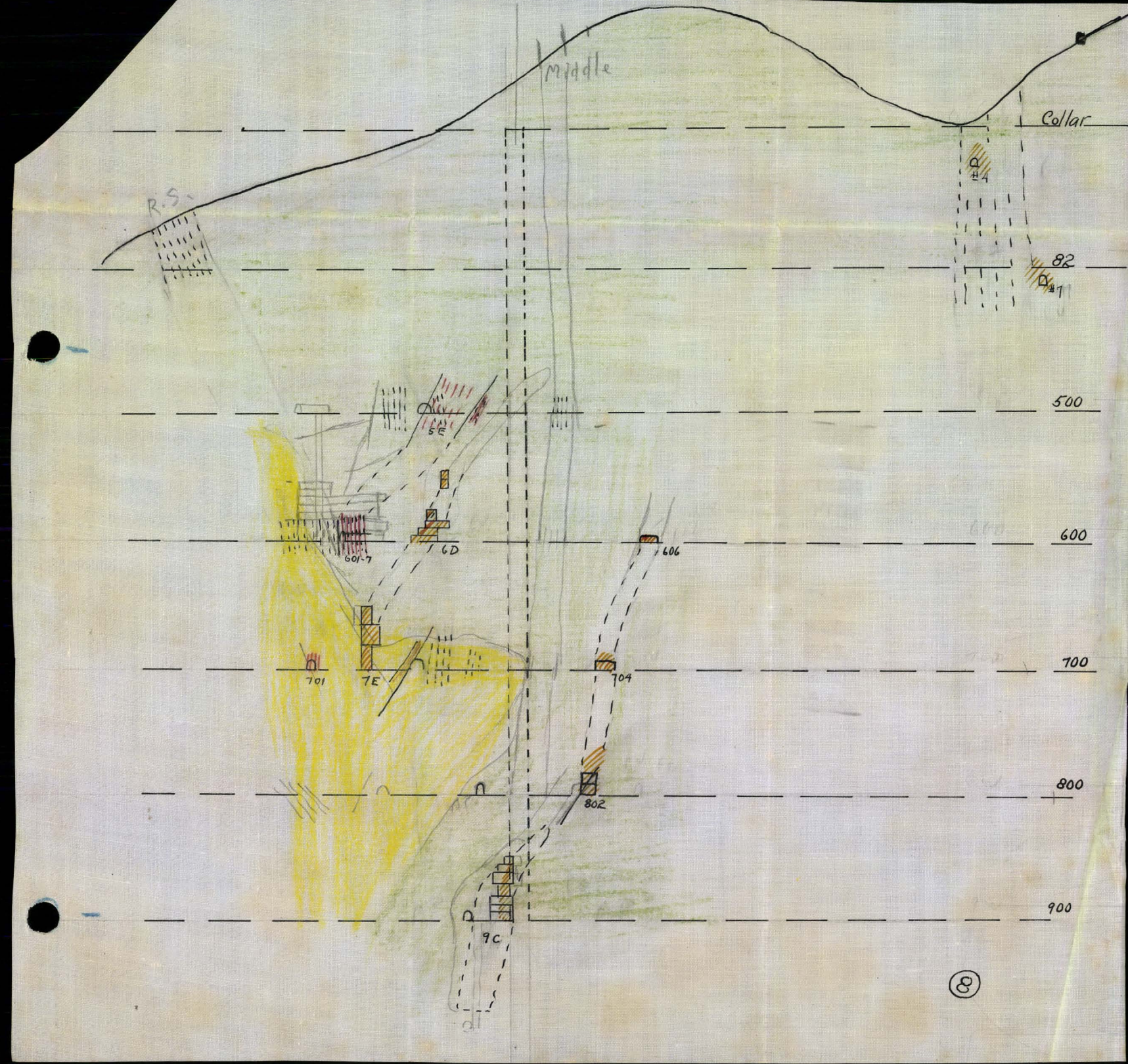

RISING STAR MINE
800 LEVEL
Scale: 1" = 100'
5300
5200
5100
5000
4900
4800
7700
7600
7500
7400
7300
7200
N
Mass. A
70°
70°
70°
Blocky A
highly sil.
Massive G
810
802
45°
70°
80°
60°
90°
80°
40°
soft typical G
Soft sheared G
801-3
70°
801-5
70°
801-7
40°
1
2
3
4
5
6
7
8
9
10
11
12

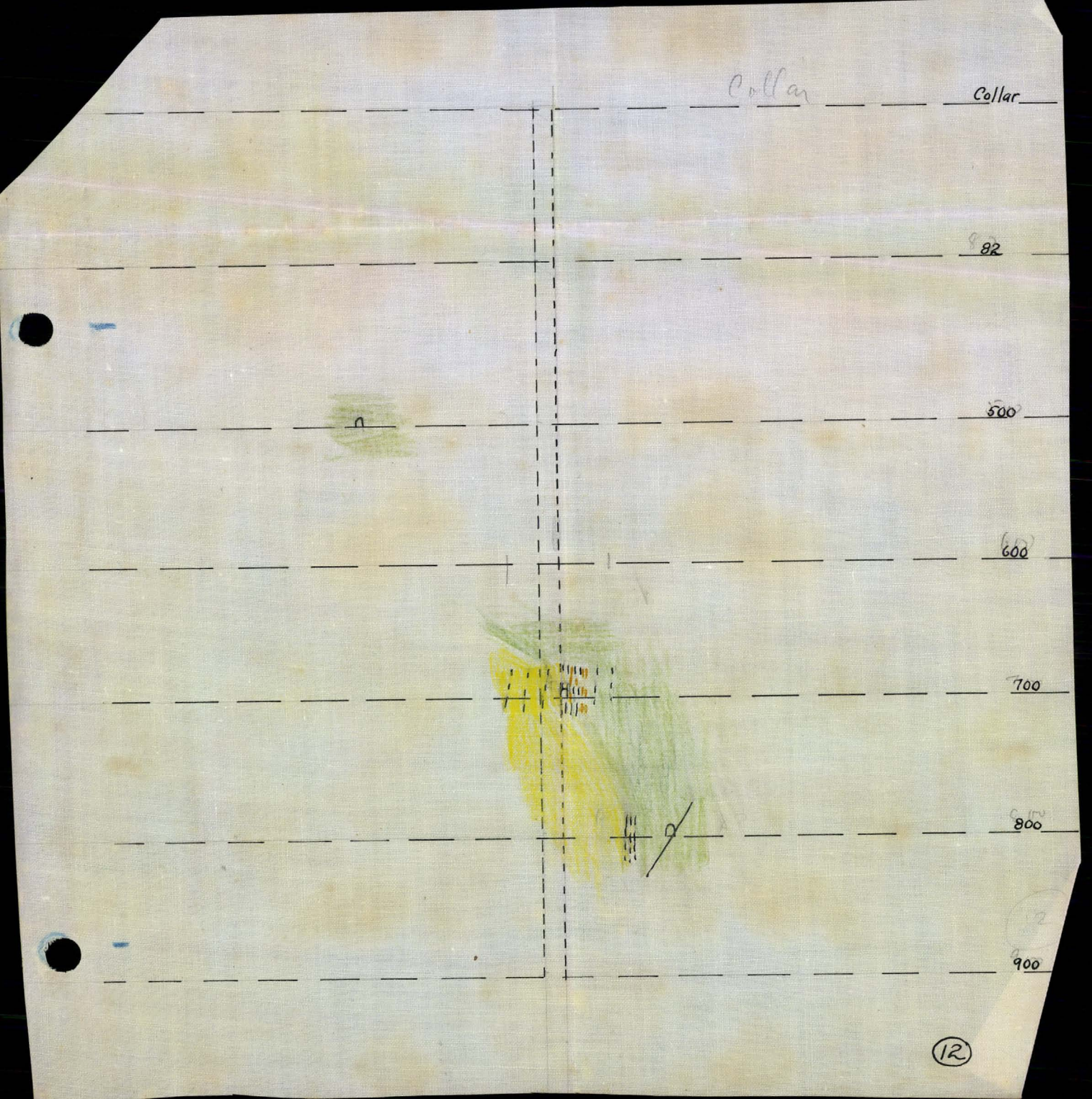

5300
5200
5100
5000
4900
4800
7700
7600
7500
7400
7300
7200
Banding in G
78°
90°
58°
75°
84°
78°
80°
10A Rs
9C Stope
70°
904 ST
90°
64°
Banding in G
9D ST
920 ST
N
RISING STAR MINE
900 LEVEL
Scale: 1" = 100'

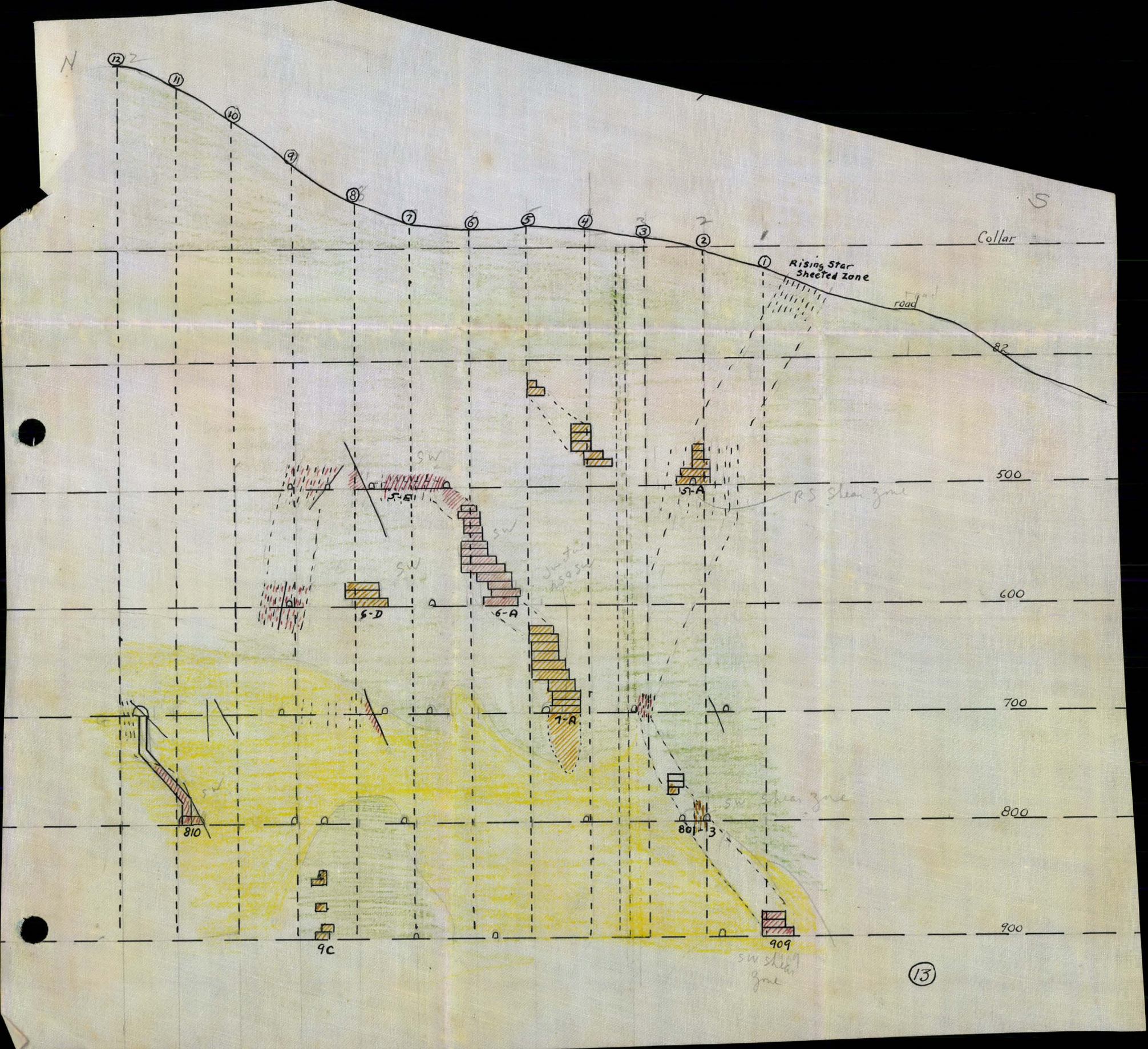


7


M
Collar
Collar
82
#7
500
600
700
800
900
6A
7M
7A
801-2
920


Middle
Collar
R.S.
#4
82
#1
500
5E
600
601-7
6D
606
700
701
7E
704
800
802
900
9C


Collar
Collar
82
500
600
700
800
900


N
S
12
11
10
9
8
7
6
5
4
3
2
1
Collar
Rising Star
Sheeted Zone
road
500
600
700
800
900
5-A
5-D
6-A
7-A
810
9C
801-3
909
RS Shear zone
SW Shear zone
SW Shear zone
13