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

Carole
w/ encl

Don White
521 E. Willis St.
Prescott, AZ 86301
602-778-3140

July 31, 1989

RECEIVED AUG 3 1989

Anthony F. Budge
Carole A. O'Brien
Ronald R. Short
A.F. BUDGE (MINING) LTD.
4301 N. 75th Street
Suite 101
Scottsdale, AZ 85251

Dear Tony, Carole, and Ron:

Accompanying is my statement for locating and organizing some base maps for John McKenny at U.V.X. I gather that he'll be compiling geology at 1"=20' for areas where mining may well teach us something about the gold occurrences that can help find more. Indeed I continue to develop ideas on that and believe there are a number of areas that deserve detailed geologic appraisal. Such studies can best be done in tandem with review of the mined out 902 area and information gained there as well as new understanding from the 809-9 area (alias 900 stope). Such studies would be of incidental cost compared to the value of even one more small body worth mining. But such undertakings are not just a day or two of dabbling.

I could foresee about one man-week reviewing John's geologic mapping and doing some of my own, one week wrapping up the 911- area maps and sections that you put on indefinite hold last year, and a few days to synthesize proposals. Such work could lead to some more underground diamond drilling or perhaps direct tunnelling and long-holing.

I feel strongly that as long as you've come this far at the U.V.X. it is in your best interest to complete the job. I believe my 80% finished work on the 911-area is crucial to that end, as is review of what should come out of the mining to date.

If you agree, allow me to spend about three man-weeks over the next couple months and I believe it'll be time well spent.

Sincerely,

Don

Don White
Geologist, C.P.G.

DW:sk

Enclosures

Ron

Don White
521 E. Willis St.
Prescott, AZ 86301
602-778-3140

October 28, 1988

Anthony F. Budge
Carole A. O'Brien
Ronald R. Short
A.F. BUDGE (MINING) LTD.
4301 N. 75th St.
Suite 101
Scottsdale, AZ 85251

Dear Tony, Carole, and Ron:

Enclosed are my October statements for work on five of your projects, summarized as follows:

PROJECT	FEES	EXPENSES	TOTAL
Plain View Tails	$1,330.00	$273.38	$1,603.38
U.V.X.	950.00	135.58	1,085.58
Vulture	570.00	19.00	589.00
Minneapolis Mine	285.00	-0-	285.00
Iron King Tails	95.00	9.00	104.00
TOTALS	$3,230.00	$436.96	$3,666.96

Sent to you each a week ago was my report on the Plain View Tailings and some short memos on Vulture and Iron King tailings matters for Dale Allen. Accompanying here is another Vulture memo requested by Dale to help him check excavation tonnages and gold recoveries.

I have just commenced the data review on the Oatman property known as the Minneapolis Mine which Ron wishes me to visit as soon as possible. I plan to try to be there for a day or so next week. Carole has forwarded reports on two submittals she'd like visited and evaluated, the "Golden Hillside" near Apache Junction, and the B&C claims near Mt. Union in the Bradshaws. I should be able to do both those during November too.

Completed in October but not charged to Budge, was 2½ days devoted to a vertical section and plan of the U.V.X. 809 area with contoured gold, silver, iron, arsenic, antimony, molybdenum, tin, selenium, thorium, and zinc and many other plots. The data comes from assays and geochemical analyses of drill core samples sent out last January and largely compiled in July. The 2½ days this month was all that was required to complete and formalize the graphics and contour and color the same. Development is already reaching the 809-2 zone with development ore being stockpiled. I can not imagine not wanting to have plans and sections to show the chemistry of what is and will be mined. That data is crucial to guiding and positioning drifts and crosscuts and raises and, ultimately, stopes. Yet Ron maintains he doesn't need it "yet" and hence won't pay for it. I trust that he'll want it in November. It's all part of the data I'd use in preparing a case with the smelters. It shows which areas are going to cost what in iron penalties and how much gold there is to override those penalties. It shows which areas may have other payable commodities including tin up to 1/2 percent and copper to 5½ percent. Not wanting that data compiled is not going to help anything.

Many high grade sample assays have come in from U.V.X. during October. All of them correspond to zones predicted from drilling to exist and assay about as they've been found in development openings. John McKenney and I will try to prepare a more formal comparison of rib assays, car samples, and drill-indicated reserve blocks as soon as we can.

Sincerely,

Don

Don White
Geologist, C.P.G.

DW:sk

Enclosures

STATEMENT FOR GEOLOGICAL SERVICES

CLIENT: A.F. Budge (Mining) Ltd.
PROJECT: Plain View Tailings, Colorado
PERIOD: October, 1988

Don White
521 East Willis St.
Prescott, AZ 86301
602-778-3140

	DATE	DAYS	MILES	LODGING	FOOD	OTHER	DESCRIPTION	ACTIVITY
Sat.	Oct. 1, 1988	1/2				10-3 2.40	Postage	More drill X-secs compiled, upper tailings.
	10-5	1/2				23.61	U.P.S. freight to Dawson Labs	Phone calls, compositing samples, shipping., etc.
	10-10	1/4	18			7.69	Photo reprints for memo	Picking up pulp + rejects + organizing same.
	10-11	3/4	4			8.00	Typing; photo captions, etc.	Typing, photo mounting, milling file research.
	10-12	1/2	—			5.00	Photo mounting @ #5/hr.	Report graphics
	10-18	1/2	22					Picking up assays, pulps, rejects, boxes for repacking
	10-19	1/2	—			61.24	U.P.S. Freight to Dawson Labs	Pkg. samples (P.V. rejects from assaying) + shipping. Compiling data on sections
	10-20	1	4			~105.00	October phone billing (~90% P.V. Proj.)	Assays on plan + sections, memo.
	10-21	1	8			25.00	2½ hr typing	Memo, charts, plans, typing
Sat	10-22	1	—			12.00	Coloring + assembly of rept.	Coloring, duplicating, assembly, posting
Sun	10-23	1/4	—			4.64	Postage	File organizing + two more copies of rept.
	10-26	1/4	—			2.00	Typing	Short memo on uncertainties of density, volume
	TOTAL	7	56					
	RATE	190.	.30					
	$	1330.	16.80			256.58	$273.38 Total Expenses	

TOTAL BILL: $ 1,603.38

Don White
Geologist, CPG

STATEMENT FOR GEOLOGICAL SERVICES

CLIENT: A.F. Budge (Mining) Ltd.
PROJECT: U.V.X.
PERIOD: October, 1988

Don White
521 East Willis St.
Prescott, AZ 86301
602-778-3140

DATE	DAYS	MILES	LODGING	FOOD	OTHER	DESCRIPTION	ACTIVITY
Sat. Oct. 1, 1988	1/2	—					Plotting new 925 + 809 assays + computing intercepts.
10-3	1	76			6.91	Photos – developing	U.G. w/ John McKenney. Assay discussion w/ Ron + John.
10-10	3/4	76					Picking up pulps from assayer, sorting, labelling. U.G. checks on all faces. Mtg. w/ J. McK.
10-14	1	76					Collecting smelter submittal samples. 925 sublevel assays plotted.
10-19	3/4	76			10.67	Film + batteries for flash	Pulps from I.K. + sorting at U.V.X. – U.G. checks
10-24	3/4	72					Sorting pulps; U.G.
10-27	1/4	4			4.00	Typing	Monthly memo, letter, etc.
TOTAL	5	380					
RATE	190.	.30					
$	950.	114.	—	—	21.58	$ 135.58 Total Expenses	

TOTAL BILL: $ 1,085.58

Don White
Geologist, CPG

STATEMENT FOR GEOLOGICAL SERVICES

CLIENT: A.F. Budge (Mining) Ltd.
PROJECT: Vulture
PERIOD: October, 1988

Don White
521 East Willis St.
Prescott, AZ 86301
602-778-3140

DATE	DAYS	MILES	LODGING	FOOD	OTHER	DESCRIPTION	ACTIVITY
Oct. 5, 1988	1/2	—					Mtg. with R.R. Short re: other expl. potential.
10-17	1	18					Memo on age dating & exploration Mtg. w/ Dale & to I.K. Assay. Memo on placer potential
10-18	1/4	4			8.00	Typing	Memos & typing, duplic. posting
10-23	1/4	—					Ag distribution plan & coloring, etc.
10-25	3/4	4					Memo on reserve blocks/excavation
10-27	1/4	4			2.00	Typing	Typing, assembly, posting
TOTAL	3	30					
RATE	190.	.30					
$	570.	9.00			10.00	$ 19.00 Total Expenses	

TOTAL BILL: $ 589.00

Don White
Geologist, CPG

STATEMENT FOR GEOLOGICAL SERVICES

CLIENT: A.F. Budge (Mining) Ltd.
PROJECT: Minneapolis Mine, Oatman, AZ
PERIOD: October, 1988

Don White
521 East Willis St.
Prescott, AZ 86301
602-778-3140

	DATE	DAYS	MILES	LODGING	FOOD	OTHER	DESCRIPTION	ACTIVITY
Sat.	10-8-88	1/2	—					File review, digging up reference info.
	10-25	1/4	—					Calls to Perry Durning + Pete Drobeck re other's work
	10-26	1/2	—					studying other's reports + data
	10-27	1/4	—					" " " "
	TOTAL	1 1/2	—					
	RATE	190.	.30					
	$	285.	—	—	—	—	$ Ø Total Expenses	

TOTAL BILL: $ 285.00

Don White
Geologist, CPG

STATEMENT FOR GEOLOGICAL SERVICES

CLIENT: A.F. Budge (Mining) Ltd.
PROJECT: Iron King Tailings
PERIOD: October, 1988

Don White

521 East Willis St.
Prescott, AZ 86301
602-778-3140

DATE	DAYS	MILES	LODGING	FOOD	OTHER	DESCRIPTION	ACTIVITY
Oct. 18, 1988	½	30					Sample for Dale Allen's test work, Dug outs + duplicated old memos on I.K. analyses + metallurgy,
TOTAL	½	30					
RATE	190.	.30					
$	95.	9.00					

$ 9.00 Total Expenses

TOTAL BILL: $ 104.00

Don White

Geologist, CPG

Ron

Don White
521 E. Willis St.
Prescott, AZ 86301
602-778-3140

August 31, 1988

Anthony F. Budge
Carole A. O'Brien
Ronald R. Short
A.F. BUDGE (MINING) LTD.
4301 N. 75th St.
Suite 101
Scottsdale, AZ 85251

Dear Tony, Carole, and Ron;

Enclosed are my August statements for work on the Aztec submittal and U.V.X., summarized as follows:

PROJECT	FEES	EXPENSES	TOTAL
Aztec	$1,425.00	$773.70	$2,198.70
U.V.X.	1,187.50	162.93	1,350.43
TOTALS	$2,612.50	$936.63	$3,549.13

Thus my total bill for August, 1988 is $3,549.13.

The first week of August was completely devoted to the Aztec tailings evaluation in Nevada, as reported in my memo of August 29th. I was then away two weeks.

Other than the Aztec writeup, my time since returning has been devoted to the U.V.X. Two days were spent underground, one to sample the new 925 sublevel crosscut at the top of the 902-3R, and one to map and sample the old 807 crosscut newly accessed via the 890 drift on the 800 level.

The 925 sublevel crosscut reveals a 26-foot thick silica grit zone, virtually identical to the lithology and thickness predicted by drilling and plotted on the 925 (903-50') plan. The assays are not yet available for the entire crosscut but those few near the east end taken earlier vary from 0.15 oz/t to 1.9 oz/t gold, depending on how iron rich and how far from the beige-banded silica contact one samples. This too matches my expectations based on the nearest drillholes. I think everything opened to date bodes well for the accuracy of earlier interpretations and the likelihood of the Morgan zone proving up as an orebody.

Up on the 800 level, the 807 crosscut reveals a spectacular intercept of the snow-white silica grit just west of the Morgan winze (caved off in diorite). It is right where I had predicted from the one drill intercept, 809-9. We shall have assays on that and adjacent silica in a few days.

The 890-1 Raise is progressing toward the 700 level but may not be taken that far if the 809-2 zone is cut by about 40 feet or less above the 800 level.

My remaining time on U.V.X. has been spent wrapping up the 1"=20' plans for the Morgan (Central Verde) area as was nearly done last month but put off by the Aztec job. Those plans for all levels from 550 through 1100 are accompanying.

Ron tells me that John McKenney will be set to take up duties of day-to-day mine geology and surveying by late September. I look forward to familiarizing him with four years worth of knowledge of the U.V.X. rocks and mineralization. I believe every second or third day should be spent with him for a few weeks, then something like one day per week. Ron and I have talked in terms of about one day per week as the likely useful long-term supervision and ongoing exploration needs for my time.

September will be devoted in large part to the Plainview tailings evaluation up near Cripple Creek, Colorado. I'll try to keep up-to-date with U.V.X. sampling immediately before and after the two weeks or so to be spent in Colorado.

One day very soon will be spent acquiring some preliminary samples on the Golden Turkey and Golden Belt mine tailings near Cleator, east of the Bradshaw Mountains. By month's end I hope to get back to plotting and interpretting some of the trace metal geochemistry from U.V.X.

Sincerely,

Don

Don White
Geologist, C.P.G.

DW:sk

Enclosures

STATEMENT FOR GEOLOGICAL SERVICES

CLIENT: A.F. Budge (Mining) Ltd.
PROJECT: Aztec submittal
PERIOD: August, 1988

Don White

521 East Willis St.
Prescott, AZ 86301
602-778-3140

DATE	DAYS	MILES	LODGING	FOOD	OTHER	DESCRIPTION	ACTIVITY
Sun July 31, 1988	½	158	Kingman w/ [illegible]	6.00	11.28	Film	To Kingman, AZ
Aug 1st	1	440		21.00	13.66	7½' Topo quads. + BLM land map.	To Hawthorne, NV
8-2	1	172	121.78	24.00			Locating, walking out and augering tails
8-3	1	155	(4 nites in Hawthorne)	24.00	8.48	Box wrench for auger.	Augering tails + recon. of others
8-4	1	127		22.00			Augering tails + fixing tires + plotting data
8-5	1	587		18.00			Return to Prescott
Sat. 8-6	½	18		—			samples to I.K. + organizing data.
8-9	½	4					Plotting maps of sampling, etc. Calls, duplic.
8-28	½	—					Plotting assays + outlining rept.
8-29	½	4			4.00	Typing	Memo, typing, assembly.
TOTAL	7½	1665					
RATE	190.	.30					
$	1,425.	499.50	121.78	115.00	37.42	$ 773.70 Total Expenses	

TOTAL BILL: $ 2,198.70

Don White

Geologist, CPG

STATEMENT FOR GEOLOGICAL SERVICES

CLIENT: A.F. Budge (Mining) Ltd
PROJECT: U.V.X.
PERIOD: August, 1988

Don White
521 East Willis St.
Prescott, AZ 86301
602-778-3140

DATE	DAYS	MILES	LODGING	FOOD	OTHER	DESCRIPTION	ACTIVITY
Aug. 8, 1988	1	72			21.60	Alphagraphics duplicating acct.	U.G., check on 902-3R, 902-4R, and 891 x-cut, Calls to assayer + updating plans
8-9	1/4	—					Calls to assayer + UVX re: development ores,
8-25	1/2	—			66.00	August phone billing	Plotting assays, calls, filing
8-26	1	76					U.G., sampling of 902-3R and 902-4R
8-27	1	—					Morgan-area 1"=20' plans.
8-28	1/2	—					" "
8-30	1	76					890 + 807 areas; sampling, mapping, assayer,
8-31	1	4			6.93	Film for U.G.	Morgan 1"=20' plans; samples to I.K. assay
TOTAL	6 1/4	228					
RATE	190.	.30					
$	1187.50	68.40	—	—	94.53	$ 162.93 Total Expenses	

TOTAL BILL: $ 1,350.43

Don White
Geologist, CPG

Don White
521 E. Willis St.
Prescott, AZ 86301
602-778-3140

September 29, 1988

Bondar-Clegg & Co., Ltd.
130 Pemberton Ave.
North Vancouver, B.C.
Canada V7P 2R5

Dear Sirs,

You have forgotten to do step "3" of my very simple and specific letter of June 3rd (attached). Please do so now (e.g., locate my 100 pulps with "809" sample number prefixes -- your report #V88-04149.0 and ship them via U.P.S. to me at the address above).

Sincerely,

Don White

Don White
Geologist, C.P.G.

DW:sk

cc: Carole A. O'Brien
Ron R. Short

Don White
521 E. Willis St.
Prescott, AZ 86301
602-778-3140

September 30, 1988

Anthony F. Budge
Carole A. O'Brien
Ronald R. Short
A.F. BUDGE (MINING) LTD.
4301 N. 75th St.
Suite 101
Scottsdale, AZ 85251

Dear Tony, Carole, and Ron;

Enclosed are my September statements for work on four of your projects, summarized as follows:

PROJECT	FEES	EXPENSES	TOTAL
Plain View	$3,420.00	$1,170.28	$4,590.28
U.V.X.	950.00	144.65	1,094.65
Golden Turkey	475.00	47.70	522.70
Vulture	190.00	49.50	239.50
TOTALS	$5,035.00	$1,412.13	$6,447.13

Accompanying are my latest memos on the Golden Turkey and Plain View tailings investigations. The Golden Turkey will not require any more of my attention until economic review of the target and landowner negotiations proceed further. The Plain View evaluation will involve considerable time during October to complete sections, plot assays, calculate reserves, and coordinate the metallurgical testing (compositing and shipping samples).

Time devoted to the U.V.X. includes both trying to keep current on sampling of new workings (despite being away in Colorado and working on other Budge projects) and orienting John McKenney to the U.V.X. geology. The latter necessarily involves voluminous file reproduction so John can have all the data available there. Copies have always gone to Scottsdale and England and Jerome files have to be built. John now has both file and separate working copies of all the 1"=20' level plans, drill sections, drill logs, reserve plans, and geochemical plots to date. I have also set him up with the most salient publications on the district and memos produced throughout the project. We have spent some time underground together but need that more regularly. Other obligations have intervened of late.

John's priority task is bringing the surveying back up to date. While he's pursueing that I am keeping the geologic mapping and rib sampling current. Accompanying is a plan of the 809 area showing the new 809 x-cut, the sampling of the 807 tunnel with its grit and gray silica compared to nearby drill holes (very favorable new findings) and the location of the

890-1 Raise. That raise is now some 40 feet up and being taken laterally at that level both E and W. It is in translucent gray, very hard silica, just as expected for the 809-2 zone. Grades there are a little over .10 oz/t Au, less than 1.0 oz/t Ag, again just as predicted for that elevation, as on drill sectoon 809-181.

Sampling of the two x-cuts on the 925 sublevel (25 feet above the 950 level, about 50 ft. beneath the so-called 903 level and hence "903-50" on my reserve block plan) indicate about the grades expected. The 902-3 R should have cut 24 ft. at .22 Au/ 1.8 Ag in block 41 by a literal reading of the reserve plan. The 902-3 R x-cut is, however, located near the SE extreme of that block, near to a block with no significant grade at all and interpolation would discount one's expectations. Indeed, we find 25 feet of .15 Au/2.5 Ag by assay of ten samples along the length of the 902-3 R x-cut between beige-banded silica wall rocks.

At the more southerly 902-4 R x-cut we have the same situation. The x-cut is located near the margins of four adjoining reserve blocks, high and low Ag, high Fe grit and high and low Au, low Fe grit. The assays of ten samples the length of the x-cut indicate 33 feet of .10 Au/3.7 Ag, just about as expected. Gold grades should improve along the NW drive from the 902-4 R and the SE drive can be abandoned as gold will only get leaner that way.

Two key objectives in opening up the sublevels are to test the mineability of the grit and to test for variance of production grades from drill-indicated grades. The grit thus far has been found to stand remarkable well, even where opened 10 ft. wide by 30 ft. long. Grades may not be matching the wishful thinking we all tend to be guilty of but thus far they are matching a wise interpretation of what the drilling has indicated. Joining the 902-3 R and 902-4 R on the 925 sublevel will require about 120 feet of drifting beyond that completed to date. Raising to the elevation of the 903-25 ft plan is also commencing. With those exercises completed we will have all the better indications of whether actual grades match up to drill-indicated grades. The next couple months will be rather exciting in that regard.

My little paper on the U.V.X. for the Northwest Mining Convention, co-authored with Bob Hodder, should be ready for your review soon. I'll get a draft off as soon as I have Bob's editing back. We'll have to run a copy by Paul Handverger for his approval too.

The Vulture tailings excavation looks good. I recently staked out the boundaries of what is known to run adequate gold in the NW area and chatted with Gene, the scraper operator. His care in getting to the bedrock contacts and picking up all the small embayments will pay off. He's doing a good job at that so far.

With Carole at the Vulture too, we witnessed the first doré pour. It was gratifying to see product from lots of hard work. I recommend Ron and I talk about other exploration of the Vulture property soon so that any that is desireable can get going this season and not next summer!

Sincerely,

Don

Don White
Geologist, C.P.G.

Enclosures

STATEMENT FOR GEOLOGICAL SERVICES

CLIENT: A.F. Budge (Mining) Ltd.
PROJECT: "Plain View" Tailings (Colorado)
PERIOD: September, 1988

Don White
521 East Willis St.
Prescott, AZ 86301
602-778-3140

	DATE	DAYS	MILES	LODGING	FOOD	OTHER	DESCRIPTION	ACTIVITY
	Aug 31, 1988	1/4	4					Duplicating rept., ordering sample bags, meeting w/ Ron
	Sept. 9	1 1/4	345	21.95	12.	4.32	Roll film	(Noon-10 pm) Driving AZ. + N.M.
Sat.	9-10	1 1/4	462	168.52 (9-10 to 9-18)	22.			(8am-7pm) Driving NM + CO - Arrived Victor
Sun.	9-11	1 1/4	4		4.			(9am-6pm 9-10 p.m.) Spotting holes with RRS. (Baseline X-lines, pickets)
	9-12	1 1/4	15		—			(8am-5pm 10-11pm) Commenced drilling in rain. Plotting holes + data.
	9-13	1 1/4	17		12.	10.49	Supplies for drilling	(8-4 5-7) Drilling + sampling To Cripple Cr. for supplies
	9-14	1 1/4	4		18.	4.75	Duplicating	(7am-5pm) Drilling + sampling — library research in Victor
	9-15	1 1/4	4		20.	64.00	U.P.S. Sample freight	(8am-4pm 4pm-6pm) - Drilling + sampling, Drying + packaging samples.
	9-16	1 1/4	15		14.	11.13	Pkg. tape - 3 rolls	(8am-3pm 3-5, 7-8) Drilling, sampling, drying, + packaging
Sat.	9-17	1 1/2	15		30.	— Included dinner for driller + wife		(8am-8pm) Drilling, sampling, drying, pkg'g.
Sun.	9-18	1 1/4	4		17.	72.89	U.P.S. Sample freight	(8am-6pm) Completed drilling + sampling + shipping.
	9-19	1 1/2	429	23.84	21.	17.56	U.S.G.S. Publications + duplicating fees.	(7am-8pm) Victor → Denver U.S.G.S. research Driving I-70
	9-20	1 1/2	476		20.			(7am-8pm) Driving home via UT, AZ
	9-21	1/2	18			7.96	Film developing + prints	Organizing gear, files, samples. Assay submittals,
	9-23	1/2	—			~12.00	AT+T calls from Victor, CO.	Plotting initial 5 holes' assays; calls < Assayer, Scottsdale
	9-27	1	18			11.87	Photo reprints for rept.	Picking up rejects; assay requests, plotting sections
	TOTAL	18	1830					
	RATE	190.	.30					
	$	3420.	549.	214.31	190.	216.97	$1,170.28 Total Expenses	

TOTAL BILL: $ 4,590.28

Don White

Geologist, CPG

STATEMENT FOR GEOLOGICAL SERVICES

CLIENT: A.F. Budge (Mining) Ltd.
PROJECT: U.V.X.
PERIOD: September, 1988

Don White
521 East Willis St.
Prescott, AZ 86301
602-778-3140

DATE	DAYS	MILES	LODGING	FOOD	OTHER	DESCRIPTION	ACTIVITY
Sept. 1, 1988	1	4					Morgan plans, monthly billing, blueprinting.
9-2	1	4			5.00	Typing	Typing, blueprinting more, duplic. coloring, etc.
9-22	1	72			18.00	Coloring (3hr)	Checking 925 sublevel - meeting & orienting John McKenney.
9-23	½	4			4.80	Postage (Scottsdale)	Duplicating drill logs, plans, sections & files for UVX on site use + John McKenney
9-26	1	76			5.71	Colored pencil replacements	Sampling on 925 sublevel - meeting w/ J. McK.
9-30	½	—			8.14	Postage of sample to R.W.H.	Assays + geology on 809-area plan w/ new wkgs.
					55.00	Sept. phone billing re: UVX.	
TOTAL	5	160					
RATE	190	.30					
$	950.	48.	—	—	96.65	$ 144.65 Total Expenses	

TOTAL BILL: $ 1,094.65

Don White
Geologist, CPG

STATEMENT FOR GEOLOGICAL SERVICES

CLIENT: A.F. Budge (Mining) Ltd.
PROJECT: Golden Turkey Tailings
PERIOD: September, 1988

Don White
521 East Willis St.
Prescott, AZ 86301
602-778-3140

DATE	DAYS	MILES	LODGING	FOOD	OTHER	DESCRIPTION	ACTIVITY
Sept 3, 1988	1	89				(9am–7pm)	Augering tails, sampling dumps, measuring.
9-4	1/4	18					Samples to assayer. Calculating tonnages
9-21	1/4	4					Sorting photos, ordering reprints, compiling captions
9-28	1/2	4			~7.00	Photo reprints	Additional assays + short memo on status.
9-30	1/2	4			~5.00	Typing	Photo mounting, memo completed, typing
TOTAL	2½	119					
RATE	190.	.30					
$	475.	35.70	—	—	12.00	$ 47.70 Total Expenses	

TOTAL BILL: $ 522.70

Don White
Geologist, CPG

STATEMENT FOR GEOLOGICAL SERVICES

CLIENT: A F Budge (Mining) Ltd.
PROJECT: Vulture
PERIOD: September, 1988

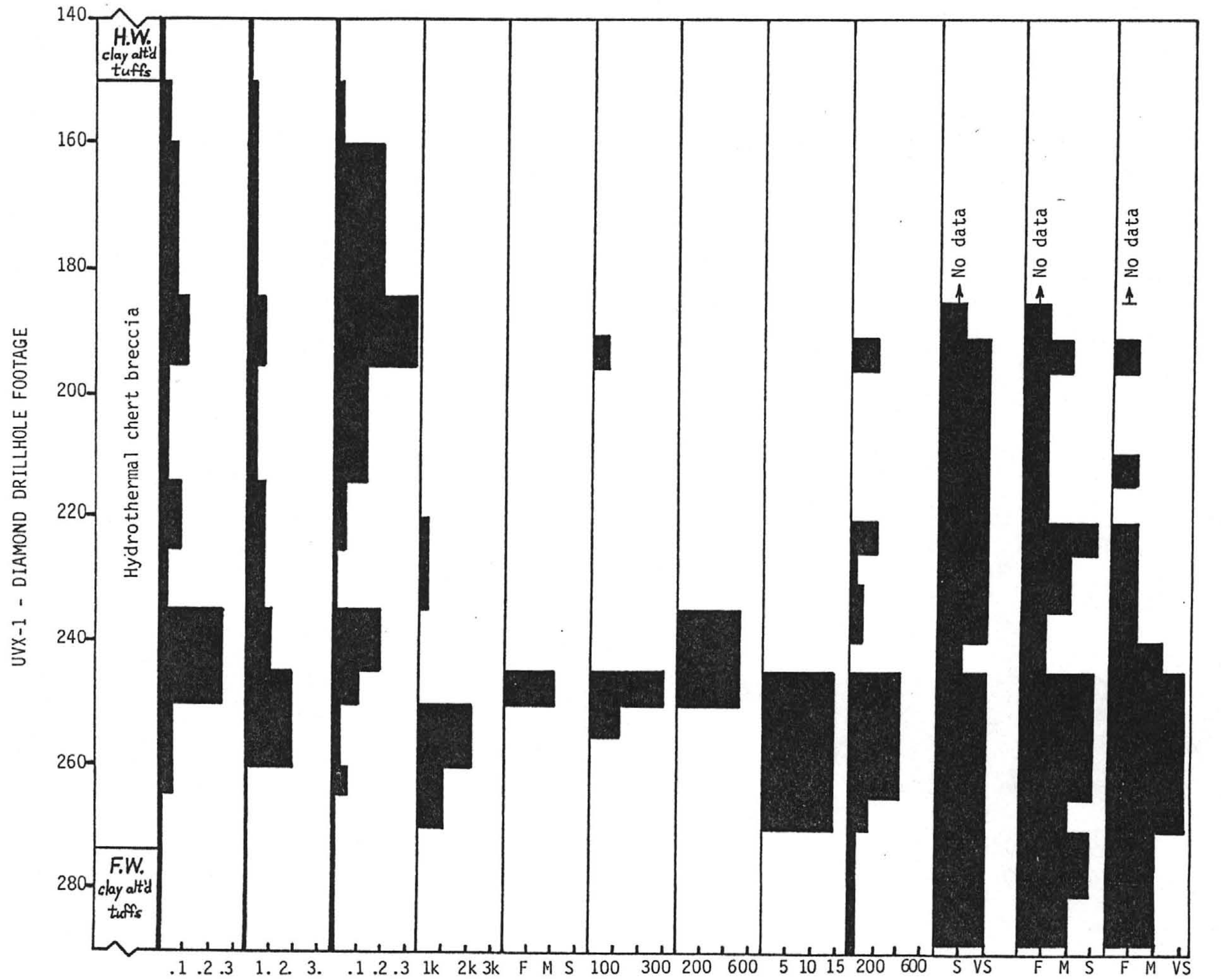
Don White
521 East Willis St.
Prescott, AZ 86301
602-778-3140

DATE	DAYS	MILES	LODGING	FOOD	OTHER	DESCRIPTION	ACTIVITY
Sept. 29, 1988	1	165					Staking NW tails for excavation, walking out w/ Gene (operator), Photos, Sample to assayer for Dale Allen,
TOTAL	1	165					
RATE	190.	.30					
$	190.	49.50					

$ 49.50 Total Expenses

TOTAL BILL: $ 239.50

Don White
Geologist, CPG



	Au oz/t	Ag oz/t	Au/Ag	As ppm	Sb semi-quant.	Bi ppm	Sn ppm	Mo ppm	V ppm	Cu semi-quant.	Pb semi-quant.	Zn semi-quant.
Hanging Wall	<.005	⩽ 0.4	<.05	< 200	Not detected	< 20	< 10	< 5	< 20	Strong-Very strong	Not detected-Medium	Not detected-Strong
Less mineralized chert	<.005-.05	0.2-2.0	.1-.5	200-400	Not detected	< 20	10-50	< 5	20-200	Strong-Very strong	Faint-Strong	Not detected-Strong
More mineralized chert	.05-0.5	0.2-4.0	.1-.5	400-3,000	"Medium"	20-300	50-1500	5-25	200-500	Very strong	Strong	Very Strong
"Gold stope" high grade	0.5-5.0	0.5-8.0	.1-5.	-	-	-	-	-	-	-	-	-
Footwall	<.005	⩽ 0.4	<.05	< 200	Not detected	< 20	< 10	< 5	< 20	Very strong	Faint-Strong	Medium-strong

TRACE ELEMENT ASSOCIATION WITH GOLD AT THE U.V.X. MINE

FIGURE 4

Ron Short

M E M O

TO: Carole A. O'Brien, A.F. Budge

FROM: Don White

DATE: May 11, 1988

SUBJECT: Jerome Town Council meeting discussion related to U.V.X.

A number of issues related to U.V.X. were discussed at the Jerome Town Council's regular meeting, 7pm, May 10, 1988. Because some citizens were concerned about the DOT road plans and rumored Budge trucking, those issues were listed as the first agenda item for the session.

I was warned a few days earlier by Phil Harris, Jerome State Park director, that rumors of collusion between "U.V.X." and the ADOT were circulating. Many Jeromians newly aware of the D.O.T. plans for improving the U.V.X. Mine road, and also hearing rumors of impending production from the U.V.X., figure there is more than coincidence in that timing and are incensed that "a state entity is aiding private enterprise at the taxpayers' expense." To allay any further rumors, it seemed wise to explain to everyone the timing of the DOT project and the status of the U.V.X. So, with Carole's approval, I accepted mayor Ray Rantapaa's request to attend the council meeting and make a statement.

Everyone was all ears as I:

a) Introduced myself and reminded them we had met three years earlier over the vent-fan noise issue which was solved rapidly by moving the fans underground.

b) Pointed out that other noise issues had come up in the last two years, including compressors, tractors, and dumping of rock, and that all of them has been settled amicably between locals and Pete Flores, supt.

c) Explained that about two years of core drilling had recently culminated and had delineated about half a dozen small bodies about the size of small ranch houses on their sides.

d) Explained that these bodies are about 1,000 feet deep and miniscule by comparison to the copper stopes mined in the 1920's and 30's.

e) Described how the engineers, financial analysts, and myself were now figuring just what is and what is not worth mining and that no decisions are yet made on whether or how to mine or where to ship or how to process.

f) Provided some minimal history on the road project and, upon introducing Mr. L. Brady of the DOT and Dave Mellgren, DOT design engineer, offered to answer any questions. There were several questions in addition to praise for the noise abatement.

Mr. Brady of the D.O.T. then gave a more detailed account of the road improvement plans but was very nervous and, in typical bureaucratic fashion, worded things in such a way as to beg misinterpretation. He told of being "approached" in March, 1985 "by the Budge geologist" regarding potential haulage and consequently increasing the asphaltic content of the planned road from 2 inches to 4 inches, at an estimated extra cost of $40,000. He described the "special request" retaining wall opposite the shaft collar. Questions then addressed to him were very insinuating that such aid to the mining effort was surely improper. It took both his efforts and my own to explain that a) the road plans predated Budge's exploration, b) the "approach" was a casual encounter at the mine site between D.O.T. engineers putting out enlarged easement survey stakes and myself, concerned for what those stakes inside our lease meant, c) subsequent negotiation over roadway widths settled on the retaining wall as the best compromise between routing, safety, and cost, and represented the give and take between DOT easement needs and Budge security and operating room needs, d) DOT plans for a thicker road surface were their own, in response to the design review meeting, and not at Budge's request.

Up to that point in the meeting, all had been civil and speaking was in the order recognized by the mayor. Then a young mother made quite a scene by shouting that "UVX is taking seventeen feet of my back yard." She was asked to wait till she had the floor but jumped up and down and hollered how unfair it was for mining to spoil her lifestyle. It became apparent that she lives somewhere in the wedge of land on the "hogback", between Hwy 89A and the UVX Mine road and my guess is that Verde doesn't even enter the picture. Her issue is probably with the D.O.T. and/or a misunderstanding as to where her boundary is. Either way, it's something that can be worked out.

At that point Paul Handverger was recognized and proceeded to bore everyone with history of "long haired people" moving to town in the early sixties and how he has "no regrets about allowing that." He pointed out Verde's help for the community in terms of rentals for artists' studios at the High School, water, easements for sewer lines, and free ground for sewage disposal. He was interrupted several times by rude comments from Lisa, the woman who still felt Handverger was to blame for everything. The mayor had to have the constable remove her from the meeting.

Many more questions and statements followed, mostly critical of the road plans and mine haulage. One of the councilmen asked the DOT fellows whether Jerome couldn't restrict the road to some low weight limit following its reconstruction and transfer of ownership to the town, as is apparently the plan. This may well be within the town's legal rights and set Verde and Budge up for a legal fight on haulage.

Councilman Richard Martin then pointed out that he was in Jerome for 10 to 15 years worth of Big Hole Mining Company's operation (through 1974) in the U.V. Pit, including haulage of many loads per day right through town with no appreciable impact. He stated "we owe it to Verde to cooperate." He went on to put the DOT pavement thickness and retaining wall issues in perspective by maintaining that DOT had also agreed to route the present non-conforming trestle sewer line in a new trench and pipeline at a cost of some $45,000. without charging the town. That too is state taxpayer aid of private entities, "the stockholders of Jerome."

The mayor then insisted upon moving on to the next agenda item despite many more hands raised for permission to speak. Many folks were in attendance only for the road issue and were incensed not to be heard. They stomped out, insisting upon another meeting.

Overall, I would say our understanding of the purpose of the meeting was fulfilled. Information was shared to help allay rumors and issues were aired to sense the community mood. It seems that another meeting is likely. The only problem I could foresee will be some legal trick pulled by the towns folk, perhaps related to their exercising jurisdiction over the road after its completion. There may be some advantage in using the road for haulage before that time to establish some precedent.

DW:sk

M E M O

TO: A.F. Budge, C.A. O'Brien cc: P.A. Handverger

FROM: Don White

DATE: April 1, 1987

SUBJECT: Road improvement plans for State Park access at the U.V.X.

By chance I learned of and was able to attend a public meeting yesterday (March 31, 1987) for "design review" of road improvement plans in and around the U.V.X. It was fortuitous that I attended for the plans have much impact upon Verde's property, Budge's lease, our future operational plans, and, in reverse, our plans should affect their road design.

The Arizona State Parks and Dept. of Transportation teamed up with plans to improve access to the Jerome State Historic Park (e.g., Douglas mansion museum) by widening and straightening the access road to "better handle big campers, trailers, and buses." They contracted Coen Engineering to draw up the attached plans. The plans call for right-of-way acquisitions that would cut into our leased and already limited surface working area. Note on sheet number 18 that the new "R/W Esmt." cuts considerably into the engineering office (our present core storage and work spaces) to the north and the old Edith hoist foundation area to the south. The engineering office was, in their words "to be relocated."

At the informal review session which included a walk along the road, I pointed out the impracticality of relocating the engineering office to which they readily agreed. I also pointed out the importance to us of work space adjacent to the Edith shaft (which can't be moved!). We discussed our present limits to N and W by existing road, to S by hoist equipment and the need to retain vehicle access to the shaft from the east. That leaves a very small area just N of the Edith shaft (where the old Edith hoist foundation is) for shaft-proximity ore handling equipment (e.g., bins, loadouts, surge piles, conveyors, etc.). That is the same area that would be all the more infringed upon by shifting the new, wider road further S to avoid demolition of the engineering office. Possible alternatives include any combination of a) narrowing the road, b) extending the curve to the W by cutting into the hill and shift the Bell family's access road W as well, and c) building retaining walls to minimize the encroachment toward the Edith.

Other topics of discussion I brought up included our need for continued access, likelihood of ore haulage, and the very names of the roads being discussed. They had envisioned construction this fall (depending upon right-of-way acquisitions, etc.) including full tearing up of the old road (i.e., closure) with alternate access via the steep, windy, rough road from town via the Little Daisy shaft area. Clearly this would prevent timber, rail or other large deliveries. They acknowledged the need to coordinate worker access for shift miners and drillers, etc.

It seems to me several things ought to be done immediately:

1) Coordinate our response with Verde Expl. Ltd. I have phoned Paul Handverger who was not otherwise informed of any of this. My question to him was what right-of-ways presently exist since our lease does not document them. He promised to dig out the appropriate file which apprently includes a 1950's recorded easement for the road only. The present trailer/camper parking area is "permissive use only", meaning it can be withdrawn any time by Verde (Budge as lessee) if so elected (e.g., space needs for surface plant).

2) Decide internally what our needs are with regard to:

   a) Surface plant and storage; will the present trailer parking area be an issue?

   b) Shaft area space plans; will a wider road easement around the Edith be a problem and if so what solutions do we recommend?

   c) What haulage loads do we anticipate? Axle loadings and bed lengths are important to pavement thickness and turning radii.

3) Formally notify the appropriate authorities of our concerns, including:

   a) Road name corrections; the road in questions is the "U.V.X. Mine Road" on all old maps, etc. They have called it the State Park Road, effectively and unwittingly a name change. We should retain the old name. The alternate road up to Jerome is the "Little Daisy Road" I believe, though the Coen Engineering plans have now dubbed _it_ the UVX Mine Road. This too should be corrected.

   b) Our concerns for the engineering office.

   c) Our need of space near the Edith shaft.

   d) Our likely need of space where the trailers presently park.

   e) Our interest in seeing ore haulage accomodated in their design for turning radii, pavement thickness, and entering route 89A at the intersection on the hogback.

   f) The need for continued access to the mine for shift work and coordinating closures for the sake of scheduling large deliveries or shipments.

   g) Our wish to work together with them for a better road for everyone's benefit.

Clearly this is an opportunity to mold their project to everyone's advantage. They want right-of-way enlargements from us. We can't afford space in some areas but may be able to in others. In return we may be able to get a better, safer, haulage road.

Persons involved in the project include:

David J. Mellgren, P.E.; Civil Engineer who directed the design review meeting, March 31, 1987.

Highways Division
Arizona Department of Transportation
Roadside Development Services
205 S. 17th Ave., Rm. 228E
Phoenix, AZ 85007
(602) 255-8629

Tim Brand, Facilities Planning and Development Manager

Arizona State Parks
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Michael Bruder, ADOT rights-of-way coordinator

Highway Division
Arizona Department of Transportation
R/W Plans
205 S. 17th Ave., Rm. 330E
Phoenix, AZ 85007
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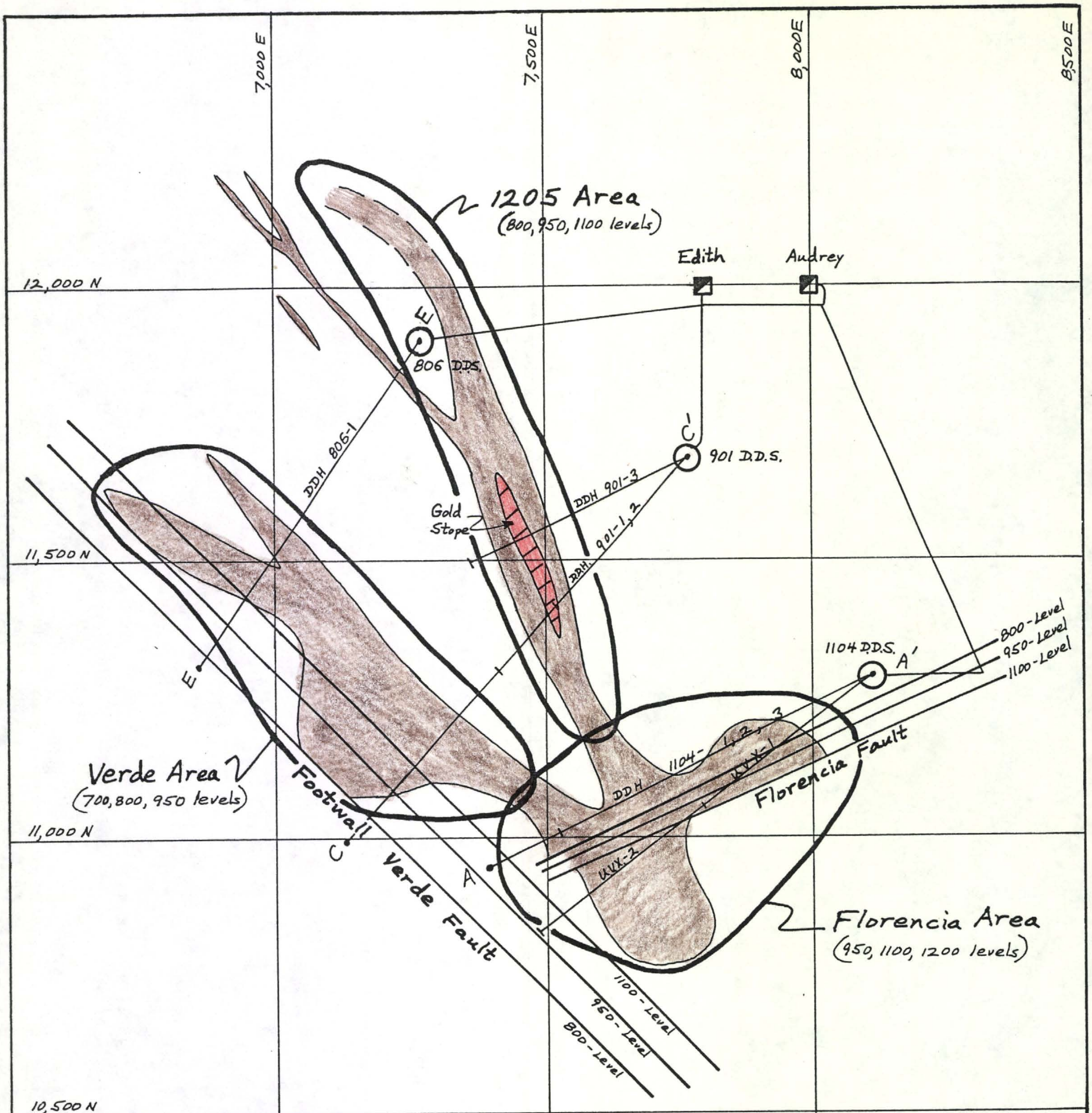

U.V.X. GOLD PROJECT

Sketch map showing:

chert bodies/target areas, key cross sections, diamond drill stations.

N

1" = 250'

Figure 1

D.C. White & R.W. Hodder - Feb. 1986

A BRIEF GEOLOGIC HISTORY AND FIELD GUIDE TO THE JEROME DISTRICT, ARIZONA

Paul A. Lindberg
205 Paramount Drive
Sedona, Arizona 86336

INTRODUCTION

On May 3, 1986 a post-meeting field trip will tour the Jerome mining district of North Central Arizona. A visit will be made to the United Verde open pit (inactive) and examine the Proterozoic stratigraphy and structure of the pit area and along Highway 89A where the section is well exposed in Deception Gulch and Hull Canyon. Field trip stops are numbered in Figures 1 and 2 and are referred to in the text.

Because of field trip logistical constraints, Stops No. 1 and 2 will be referred to later in the geologic text. Stop No. 3 is at the United Verde open pit and Stops No. 4-11 examine the well-exposed geologic section along Highway 89A.

The guide is designed to give the field trip participant a broader view of the complex geology of the district than the limited field trip exposures can provide. It presents a current interpretation of the geologic history of the northern part of the region which is based on past work but provides new information that has been obtained since 1971. From then to the present day a wealth of additional data has resulted from detailed re-mapping of the surface geology, studies of extensive diamond drill cores which have penetrated to the Proterozoic through Phanerozoic cover rocks, re-examination of underground mine records and rock specimen suites from sites no longer accessible, stratigraphic and structural correlation studies, and the application of modern models for the origin of the Proterozoic massive sulfide ores. The interpretive synthesis prepared by the author is based on team efforts by Verde Exploration Company, the Anaconda Company, CoCa Mines Inc., and Phelps Dodge Corporation.

All mines in the district are now inactive but mineral exploration continues. The United Verde open pit exposes the top 500 feet of an elongate, N.N.W.-plunging orebody which extends for another 4200 feet in elevation below the flat bench leading into the pit area. Gold exploration is currently being conducted within the gossan zone of the nearby United Verde Extension (U.V.X.) mine.

JEROME DISTRICT MINERAL PRODUCTION

The mines at Jerome have provided the major share of Proterozoic massive sulfide ore production from all of Southwestern United States. The United Verde deposit was by far the largest and the entire massive sulfide body was probably in excess of 100 million short tons. It is not known how much more of the body was eroded to its original discovery level. The bulk of the elongate, plunging body is predominantly pyrite which forms the upper portion of the mass. Chalcopyrite and sphalerite occur in the basal portion and comprise the major ore minerals contained in a gangue of pyrite, qyartz, and minor accessory minerals. Small amounts of surficial supergene ore (silver rich) were mined from the topmost part of the United Verde body, but most of the ore represents a primary grade. Production yields of 4.43% Cu, 1.49 oz/t Ag, and 0.041 oz/t Au plus a small amount of by-product zinc were obtained from the basal ore which was mined. There may be zinc reserves left within the United Verde massive sulfide body.

Although the original primary ore mineralogy and grades of the United Verde and U.V.X. massive sulfide bodies were probably very similar, the U.V.X. deposit became highly enriched by subsequent supergene events. Perhaps up to a third of the U.V.X. enrichment dates from Precambrian time, but most of the bonanza ores were generated during Tertiary time as discussed further in the text. As the upper part of the U.V.X. sulfides came in contact with meteoritic groundwaters, copper was carried downward from the oxidizing mass in acidic solution where it replaced chalcopyrite and pyrite in the primary ore. Rich chalcocite ore, some quite massive, was produced by the supergene process. The U.V.X. mine produced 3.9 million short tons of 10.23% Cu, 1.65 oz/t Ag, and 0.046 oz/t Au.

Other mines in the Jerome district included the Copper Chief, Cliff, Verde Central, and Shea. The Copper Chief ores were mainly oxidized but a small amount of copper-bearing sulfide ore was produced. The gossan ores were mined chiefly for their precious metal content. The Cliff mine produced a small amount of high grade Cu-Ag massive sulfide ore. The Verde

Central deposit is reported to have produced 121,000 short tons of ore grading 2.94% Cu. The Shea mine is unique to the district in that it produced small amounts of silver from tetrahedrite ore contained in a quartz-siderite vein (Lindgren, 1926). In addition, there are scores of smaller deposits, some of which had minor production, that are scattered along a relatively narrow zone of Proterozoic rock outcrop for 4.5 miles on the N.E. flank of Mingus Mountain.

PREVIOUS WORK AND ORE-FORMING THEORIES

The literature on the Jerome district up to 1958 is ably summarized in an authoritative U.S.G.S. professional paper by Anderson and Creasey (1958). Their paper was prepared soon after the closure of the mines at Jerome and the theories of ore genesis that they presented were current for that era. It was widely believed that the massive sulfide ores were formed by selective replacement of portions of the Grapevine Gulch sediments and an intrusive quartz porphyry. They reported on the widespread alteration within the Cleopatra quartz porphyry underlying the orebodies but were unable to fully explain the cause.

The 1:24,000 geologic map which accompanies the professional paper incorporated the work of G.W.H. Norman who mapped the Jerome district to the southeast as far as Oak Wash, located about 5 miles from the village of Jerome. His 1:4,800 scale mapping and the abundant mine records by mine staff geologists over the years provided the main data base upon which the Anderson and Creasey (1958) synthesis was made.

Exploration personnel who were active in the area during the 1960's and very early 1970's, however, came to the conclusion that the replacement model for the origin of these Proterozoic massive sulfide deposits was inadequate to explain their formation. By 1971 the volcanogenic concept for explaining massive sulfide origin was becoming accepted in the Jerome area (P.A.Handverger, pers. commun. and private company reports, 1971) and, of course, elsewhere (Sangster, 1972). For more than 15 years the volcanogenic model has played a key role in most massive sulfide exploration programs in the Jerome district.

Anderson and Nash (1972) re-interpreted the model presented earlier by Anderson and Creasey (1958). Their conclusion was in harmony with local geologists who recognized that the important Cleopatra quartz porphyry was not an intrusive, but was a crystal tuff and part of the volcanic stratigraphy. The United Verde and U.V.X. massive sulfide ore deposits rest conformably on the topmost surface of the Clepoatra. Anderson and Nash (1972) re-classified the rhyolite crystal tuff as the Cleopatra Member of the Deception Rhyolite. The present author proposes that the term Cleopatra Crystal Tuff (cct on maps and sections) is more appropriate to describe a discrete formation that is directly related to ore formation and separated from older and younger volcanic strata by unconformable surfaces.

Lindberg and Jacobson (1974) emphasized that the United Verde and U.V.X. deposits lie on opposite limbs of the Jerome anticline. Each of these bodies exhibit opposite-facing stratigraphic tops and its own unique Mg-chlorite footwall alteration (Handverger, 1975). Norman (1977) adheres to the hydrothermal replacement model for ore generation.

GENERAL DESCRIPTION OF THE VOLCANOGENIC MODEL

Within the volcanic and sedimentary rocks of the Jerome district abundant volcanogenic characteristics can be seen that relate to the process of ore formation and rock alteration. Before proceeding further into the details of the local geology, some general aspects of the volcanogenic model will be discussed.

Volcanogenic massive sulfide deposits and their lateral exhalite equivalents should be considered to be part of the stratigraphic succession, albeit a rare and localized type of strata. Modern observations of the deep sea floor within the last decade have at last provided geologists with direct evidence for the previously hypothesized ore-forming process. It needs to be emphasized, however, that modern "black smoker" sulfide accumulations are associated with basaltic crust and many such bodies will ultimately be consumed at a subducting plate margin. Those that are accreted to the land mass would be classified as a Cyprus-type. In contrast, massive sulfide bodies that are formed with an evolved, submarine silicic volcanic pile, such as in an island-arc environment, will stand a much higher chance of being accreted to a continental land mass and preserved in the record. A scenario such as that has been proposed for the Devonian West Shasta massive sulfide district in Northern California (Barker, et al., 1979 and Lindberg, 1985).

The interaction of sea water with hot submarine volcanic rock permits large hydrothermal cells to form in the substratum. Hydrothermal solutions that result from such cells vent onto the sea floor and undergo dramatic temperature reduction and loss of pressure at the rock/water interface. Sulfide crusts are precipitated from mineral-laden hot springs at the vent site. Sulfide stockworks and/or veining will typically form in the immediate footwall of the surface-laid sulfide laminates and masses. Continued hydrothermal attack on the base of the growing sulfide body forms the classic replacement textures that are so often reported in literature on massive sulfide deposits. The highest economic metal values are most often contained near the base of such bodies, while delicate primary sulfide laminations are often preserved toward the top and outer edges of the body.

Footwall rock alteration formed by the hydrothermal cells will vary with the size of the system and the nature and composition of the fractured substrate. Magnesium salts contained within the heated seawater are carried in hydrothermal solution. Most of the metal, sulfur, and silica values can vent to the surface in solution but the magnesium reacts with the footwall rocks where it can be concentrated in impressive amounts (i.e., the "black schist" below the ore deposits at Jerome). The high content of Mg relative to Fe in these chlorites distinguishes them from the iron-rich chlorites formed during regional metamorphism (i.e., greenstone belts).

Siliceous volcanic rocks will often exhibit widespread footwall sericite alteration and may be associated with silicification near the vent site. In some cases silica depletion can occur at the vent itself and be concentrated laterally. An example of a lateral silica enrichment zone occurs immediately southwest of the United Verde deposit where the conspicuous, erosion-resistant Cleopatra Hill presents an anomalous geomorphic feature.

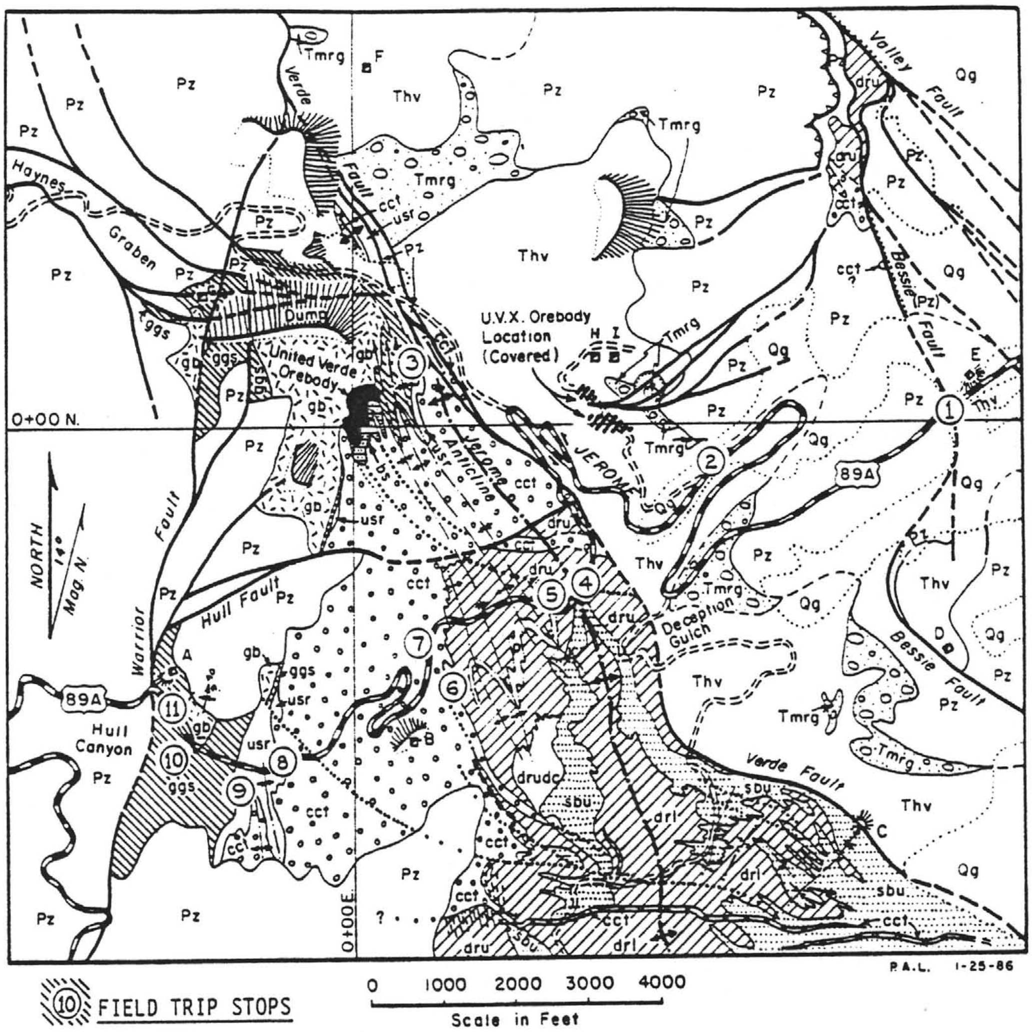

Figure 1. Geologic map of northern part of Jerome district, Arizona. Modified from Anderson and Creasey (1958) with detailed post-1971 mapping by P. A. Lindberg, P. A. Handverger, and C. Meyer.

Rock Types:

Thv Mid.-Late Miocene; Hickey Basalt and included sediment
Tmrg Eocene(?)-Mid. Miocene; Mogollon Rim Gravels
(Laramide Uplift and unconformity)
Pz Paleozoic sediments, undifferentiated
(Major unconformity)

Proterozoic:

gb Intrusive gabbro sills (pre-folding)
ggs Grapevine Gulch formation; volcaniclastic sediments and turbidites; grades to N. and N.E. into andesitic flows and hyaloclastites, basalt flows, and crystal lithic tuffs (see text)
usr Upper Succession Rhyolite; flows, breccias and tuffs
ms Massive sulfide; exposed and concealed (United Verde Horizon); coeval with exh=bedded exhalites and uvs= other minor, non-exhalitive bedded sediments
bs "Black schist" alteration (Mg-chlorite type)
cct Cleopatra Crystal Tuff
ms Massive, semi-massive sulfide (Verde Central Horizon)
dru Upper Deception Rhyolite; flows and breccias; includes polygonal flow marker horizon (p) and dacite (drudc)
sbu Upper Shea Basalt; flows and breccias
drl Lower Deception Rhyolite; flows and breccias
(sbl) (Lower Shea Basalt; inferred beneath drl; not exposed)

Map Symbols:

Mine shafts: A=Jerome Grande, B=Verde Central, C=Verde Combination, D=Gadsden, E=Texas, F=A&A, G=Haynes, H=Edith and I=Audrey (U.V.X.)

Mine dumps

Folds: Primary (N.N.W.)
Secondary (E.-N.E.)

Proterozoic cauldron fault zones related to ore formation; pre-folding; some fractures filled by cct feeder dikes

Late Miocene normal faults and re-activated Laramide high-angle reverse faults

Typical footwall alteration of a siliceous volcanic host rock exhibits depletion of Na_2O and enrichment of K_2O and MgO. Beyond the reach of the hydrothermal alteration zone these values remain normal for the particular rock composition in question. The volume of a massive sulfide body is small when compared to the large volume of altered footwall rocks. Sericite (with chlorite and silica) typically forms within a broad zone of alteration in a rhyolitic host rock, for example, while chlorite (with sericite and silica) becomes dominant near the active zone of venting. Depletion of metals from altered footwall rocks accounts for some of the concentrations found in the resulting orebodies.

Submarine vent sites can assume a wide variety of geometries within a volcanic pile. Solutions may vent along pipe-like sites as seen in some Kuroko, Japan examples (Kuroda, 1983). They may also vent from elongate graben fractures in the sea floor as is proposed for the West Shasta district, California (Lindberg, 1985), or they may issue from arcuate cauldron fractures as proposed for some of the Kuroko, Japan deposits (Ohmoto and Takahishi, 1983) and for the United Verde deposit (Lindberg, In press). In the Delta district of Alaska massive sulfide deposits formed in rifted tuff successions with no obvious lava or vent breccia associations (Clynt Nauman, pers. commun.).

There are certain terms, purely relative in nature, that often prove to be very useful in understanding the environment associated with volcanogenic massive sulfide deposits and their associated alteration zones. For example, Meyer (1972, pers. commun. and private company reports) applied the concept of "Lower" and "Upper Succession" to distinguish between altered, ore-associated host rocks of the Jerome district with post-ore cover rocks that are relatively unaltered. These informal terms can often prove helpful in determining stratigraphic tops by the "one-sidedness" of the alteration state at a mineralized contact. In addition, the terms "proximal" and "distal" provide the relative sense of whether the sulfide deposit is close to, or away from, an altered vent site.

NOMENCLATURE IN THE JEROME DISTRICT

Anderson and Creasey (1958) classified the volcanic and sedimentary rocks of the Jerome district as belonging to the Ash Creek group of the Precambrian Yavapai series. A uranium-lead date of 1,820±10 m.y. old was obtained from zircons contained within the "quartz porphyry facies in the upper part of the Deception Rhyolite" (Anderson, et al., 1971, p. C12).

Post-1971 detailed mapping in the Jerome district discloses that the published stratigraphic nomenclature of Anderson and Creasey (1958) and Anderson and Nash (1972) is in need of severe revision. There are two main reasons for the problems in terminology. In the first place, not all of the effects of folding were taken into account before names were applied to the rock units. Along the Jerome anticline, for example, (Lindberg and Jacobson, 1974) Deception Rhyolite and Shea Basalt interfinger with one another. In the present paper the author has applied the informal names "lower Shea Basalt, lower Deception Rhyolite, upper Shea Basalt, and upper Deception Rhyolite" to the succession seen in Deception Gulch south of Jerome. The second reason for terminology confusion rests with the interpretation of how the "Cleopatra quartz porphyry" of Fearing (1926) fits the stratigraphic succession.

It is beyond the scope of this paper to present all of the evidence and reasons for proposing formal changes in the geologic nomenclature for the Jerome region. The informal stratigraphic succession presented in this paper is compatible with the necessary constraints on the system required by the volcanogenic model. A thorough review of the origin and structural history of the Jerome massive sulfide deposits and proposed nomenclature revisions is currently being prepared by the author (Lindberg, In prep.).

INFORMAL STRATIGRAPHIC SECTION FOR JEROME

The following table presents a simplified stratigraphic section for the northern portion of the Jerome district. Map and cross section rock symbols are also shown as used by the author in Figures 1, 2, 4 and 5. This informal usage is subject to further refinement. Wherever possible the terminology initiated by Anderson and Creasey (1958) has been retained, but it is now clear that major revisions in their nomenclature is required.

Tertiary:	
Thv	Mid.-Late Miocene; Hickey Basalt and included sediments
Tmrg	Eocene(?)-Mid. Miocene; Mogollon Rim Gravels
∿∿∿	(Major Unconformity)
Paleozoic:	
Pz	Paleozoic sediments, undifferentiated; Also includes Ꞓt=Tapeats Sandstone, Ꞓcv=Chino Valley formation, Dm=Martin Dolomite, PPs=Supai Sandstone
∿∿∿	(Major Unconformity)
Proterozoic:	
gb	Intrusive gabbro sills
gg	Grapevine Gulch formation; ggs=volcaniclastic sediments and turbidites, ggaf=andesitic flows and breccias, ggah=andesitic hyaloclastites, ggbf=pillow basalt flows, ggclt=crystal lithic tuffs (rhyolite)
usr	Upper Succession Rhyolite; flows, breccias, tuffs
ms	Massive sulfide (United Verde Horizon)
exh	Bedded exhalites; lateral equivalent to ms above and contained in United Verde Horizon
uvs	Minor non-exhalitive sediments contained along United Verde Horizon
bs	"Black schist" footwall alteration to ms (Mg-chlorite)
cct	Cleopatra Crystal Tuff; cctb=internal autobreccia layers, cctc=chloritic alteration, but not to the intensity of black schist
ms	Massive to semi-massive sulfides (Verde Central Horizon)
dru	Upper Deception Rhyolite; flows and breccias
sbu	Upper Shea Basalt; flows and breccias
drl	Lower Deception Rhyolite; flows and breccias
sbl	Lower Shea Basalt; flows, some pillowed, and hyaloclastites (Not exposed below the northern portion of the Jerome district but projected into this position from abundant N.N.W.-plunging exposures southeast of Jerome)

EVOLUTIONARY MODEL FOR THE JEROME VOLCANIC PILE

Figure 2 shows a schematic pre-fold evolutionary model of a portion of the Jerome volcanic pile as seen in cross section. Most of the folds at this locality plunge toward the N.N.W. and there is a progressive younging of outcropping strata from the Copper Chief mine area toward the last Proterozoic exposures found at Jerome, nearly 4 miles to the northwest. In addition, the rhyolitic section thickens appreciably toward Jerome. The submarine basement upon which the Deception Rhyolite was laid is here defined as lower Shea Basalt, and the periodic build-up of rhyolite lava and breccia sheets created a submarine dome that was several thousand feet thick. Collectively, the lower and upper Deception Rhyolite appears to be thickest in the immediate Jerome area, but outcrop limitations and fold geometries do not allow the full areal extent of the unit to be determined toward the west, north, or northeast of Jerome.

Figures 1 and 2 show a northward-thinning wedge of upper Shea Basalt which outcrops between lower and upper Deception Rhyolite. Anderson and Creasey (1958) included this basalt within the Deception, but extensive field studies prove that this rock unit can be traced without interuption from Deception Gulch, just south of Jerome, to the main mass of outcropping Shea Basalt several miles to the southeast. During the recent mapping phase and study of the evolution of the volcanic pile it has become clear that rhyolite eruptions near Jerome interfinger with andesite/basalt emissions from a source located further to the south on the flank of the dome.

A temporary hiatus in volcanic activity occurred at the end of the systematic and slow build-up of the upper Deception Rhyolite. Jasper lenses, chemical exhalites, re-worked volcaniclastic sediments, and local thin conglomerates can be observed on this disconformable surface for some distance. Several prospect cuts have been dug along this prospective contact over the last century. The Verde Central orebody was discovered at this horizon. Rather than occurring at a random position on the topmost surface of the upper Deception Rhyolite, the alteration sites, prospects, and orebody lie on fractures that closely match the same locations where subsequent cauldron fractures of the next cycle of volcanism were about to occur.

Following the generation of the Verde Central ore deposit (and perhaps even during), a catastrophic set of events took place that radically changed the nature of the evolving volcanic dome. Tumescence, or swelling, of the large submarine dome by increasing deep-seated magma pressure triggered the formation of nested, arcuate fractures around the periphery of the volcanic high. Large cauldron subsidence faults formed within the Deception Rhyolite dome and the ruptures acted as feeder channels through which the Cleopatra Crystal Tuff was explosively erupted. Collapse of a central crater by magma withdrawal from a deep chamber was probably commensurate with the rapid surface accumulation of the tuff sheet.

The Cleopatra Crystal Tuff was extruded in massive surges onto the sea floor where thick sheets were accumulated. Irregularly distributed within the uniform sheets are autobreccia layers that exhibit indistinct boundaries, implying that the crystal tuff was consolidated enough between eruptive surges to permit local brecciation. The composition of the crystal tuff is virtually the same from bottom to top of a mass which is conservatively estimated to be 2000 feet thick in the Jerome area. Away from the pervasively altered Cleopatra in the footwall of ore zones the rhyolite exhibits abundant 2-3 mm quartz and feldspar phenocrysts set in a felsic matrix. When altered, the conspicuous and resistant quartz "eyes" remain in a fine-grained matrix often consisting of sericite, quartz, and some chlorite.

Cleopatra Crystal Tuff feeder dikes now occupy some of the cauldron subsidence fractures that cut the upper Deception Rhyolite. Offsets that have been studied on six cauldron faults and/or feeder dikes show consistent down-to-the-north motions, indicating that the collapsed dome lies somewhere to the north of Jerome. Where cauldron fractures are not filled by feeder dike material the original fault gouge has been completely healed by chlorite and other hydrothermal alteration minerals.

Mine exposures and exploration drilling have extended the limited outcrop range of the Cleopatra to a minimum of 5.5 miles in a north-south direction. Because of Phanerozoic cover rocks, complex folds, and the fault-buried northeastern portion, it is virtually impossible to assign an accurate volume to the original Cleopatra Crystal Tuff sheet. It is probable that it covered a diameter of at least 8 miles and had a central thickness of 2000 feet or more. A conservative estimate for the volume would be 6 cubic miles (25 cubic kilometers). This rapid eruption and mass would have been capable of generating an enormous "heat engine" which, along with the energy released from the buried magma chamber, was capable of driving the hydrothermal solutions responsible for massive sulfide generation.

Renewed cauldron fracturing cut the consolidated Cleopatra Crystal Tuff sheet along breaks that were subparallel to the feeder dikes. These late stage subsidence faults were not large, but they allowed the release of trapped hydrothermal fluids to escape to the sea floor along confined channelways. Figure 3 depicts a schematic view of how these hydrothermal solutions vented to the sea floor and deposited the United Verde massive sulfide ore deposit. Continued hydrothermal activity caused extensive high-grade replacement ores to form near the base of the earlier formed, syngenetic sulfide laminates and masses.

Coeval with proximal massive sulfide ore deposition may be distal deposition of bedded chemical exhalites and other minor sedimentary lenses. In the example cited in Figure 3, exhalites extend distally toward the east from the United Verde deposit, but did not breach the sea floor scarp on the western wall. The assymetry of deposition of fluids which escape along the sea floor from a vent area depends upon the irregularity of the volcanic seascape. In some parts of the Jerome district little, or none, of the hydrothermal fluids bled away from the vent site to produce bedded exhalites. They extended for long distances away from the Copper Chief orebody to the southeast, however, where the bedded exhalites are currently being studied by Johnson (In press) for their chemical signatures.

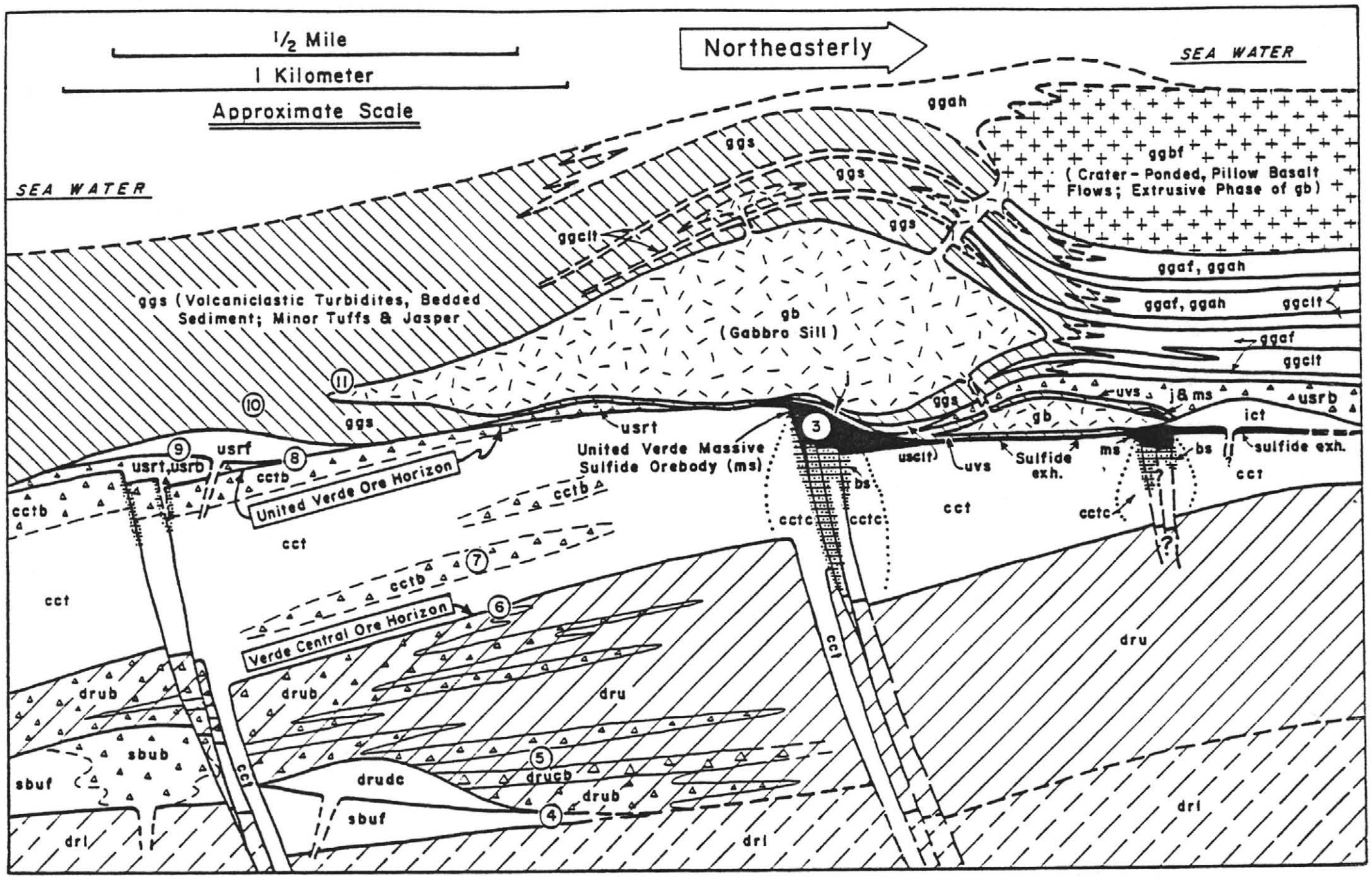

Figure 2. Schematic pre-fold model of the Jerome volcanic pile in cross section. Rock symbols are the same as shown in Figure 1 and the informal stratigraphic section listed in the text. In addition to rock formation names, for example gg for Grapevine Gulch formation, additional letters designate the specific subdivision of that formation. These include: f=flow, t=tuff, b=breccia, h=hyaloclastite, clt=crystal lithic tuff, j=jasper, s=sediment, and c=chloritized. Only a portion of the large Deception Rhyolite dome is shown in this figure. Following ore deposition along the Verde Central Horizon the rhyolite dome is disrupted by cauldron faulting and the explosive eruption of the Cleopatra Crystal Tuff. Post-consolidation cauldron subsidence faults break the tuff sheet and allow hydrothermal solutions to vent to sea floor traps where the massive sulfide bodies accumulated. In time the hydrothermal venting and ore formation subsided along the United Verde Ore Horizon where massive sulfide bodies, bedded exhalites, and other thin sediments mark the upper surface of the Cleopatra. Localized eruptions of Upper Succession Rhyolite lava domes, breccias, and tuffs were laid on top of the horizon. Toward the northeast renewed andesitic and basaltic volcanism, interspersed with thin rhyolitic crystal lithic tuffs, blanketed the high part of the volcanic dome and shed debris down the flank toward the southwest. All of these units are designated as part of the Grapevine Gulch formation. Where they are most readily observed in Hull Canyon along Highway 89A, the rocks are chiefly comprised of turbidites (ggs). Late stage, but pre-folding, gabbro sills cut the upper part of the succession and are probably co-equivalent to the crater-ponded pillow basalt flows shown in the upper right. Field trip stops are indicated by numbered circles. The Cleopatra crystal tuff (cct) is shown at approximately ½ the true thickness. All other strata approximate true thicknesses.

Following the hiatus in volcanism, and massive sulfide ore generation with widespread footwall rock alteration, localized and relatively small rhyolite domes, breccias, and tuffs were laid onto the United Verde Ore Horizon. The rocks are fresh and distinctly post-ore in age and have been given the informal name of Upper Succession Rhyolite.

Above the fresh rhyolites in Hull Canyon (Field Trip Stop No. 10) are a thick series of turbidite sheets (ggs) of the Grapevine Gulch formation. Toward the north, as seen in outcrop, mine workings, and extensive drill holes, these volcaniclastic sediments gradually change into hyaloclastites, breccias, and flows from the higher part of the dome. Interspersed within the abundant Hull Canyon turbidite exposures are bedded jasper horizons which must represent significant time intervals between turbidite surges. In other turbidite sheets there are basal rip-up clasts of tabular jasper laminae.

Gabbro sills intrude the bedded sediment portion of the Grapevine Gulch formation, and may be related to pillow basalt extrusions into the inferred crater region at the summit of the dome. Gabbro sills are pre-folding in age and part of the dome development.

STRATIGRAPHIC SECTION SEEN ON FIELD TRIP

Figures 1 and 2 show the field trip stop numbers in their true plan and idealized section position. Stops No. 4-11 will examine the stratigraphic section from upper Shea Basalt through to the Grapevine Gulch turbidites and intrusive gabbro sill as exposed along Highway 89A in Deception Gulch and Hull Canyon.

Stop No. 4 is situated on the axis of the Jerome anticline at the apex of the upper Shea Basalt amygdaloidal flow. Overlying this for the next 2500 feet to the west along the highway are intensely folded flow and breccia sheets of the upper Deception Rhyolite. The plane of the Verde fault lies a few hundred feet to the northeast.

Stop No. 5 is located at a distinctive marker unit within the upper Deception Rhyolite which helps define the tight folding in this region of the Jerome anticlinorium. Polygonal joints in this unusual flow are considered to be primary cooling fractures that have been distorted during subsequent folding. The rest of the upper Deception Rhyolite is made up of numerous flows with surficial flow rinds that were formerly glassy (now devitrified) and their associated flow breccias. Most of the breccias are composed of relatively small fragments in the range of one-three inches, but between Stops No. 4 and 5 there is a distinctive coarse breccia bed that can be traced through numerous fold closures for several thousand feet.

Stop No. 6 is located at the upper culmination of the monotonous series of flows and breccias that comprise the upper Deception Rhyolite. The distal end of the Verde Central ore horizon is well exposed in a large drag fold near creek level at the western end of Deception Gulch along the contact between the upper Deception Rhyolite and the overlying Cleopatra Crystal Tuff. The contact is marked by a thin layer of greenish-black Mg-chlorite alteration and associated jasper lenses that wax and wane along the prospective ore horizon. Mine tunnels from the Verde Central workings come close to this location and the mine dumps can be seen a short distance upstream. While the Deception Rhyolite is typically devoid of megascopic quartz phenocrysts, the overlying Cleopatra Crystal Tuff contains abundant 2-3 mm semi-rounded crystals set in a felsic matrix. At the base of the Cleopatra is a thin rip-up layer containing rounded jasper clasts and fragments of the Verde Central Ore Horizon sediments.

Stop No. 7, a short distance from the last stop and located along Highway 89A, illustrates the internal features of the Cleopatra Crystal Tuff. On the immediate north side of the highway, in a drainage culvert opening, there is a conformable contact between two possible cooling units formed during eruptive surges. Lying to the west of this location, and well exposed in a highway roadcut, is an autobreccia lens within the crystal tuff. Weathering enhances the fragmental nature of the rock but this feature is often difficult to see on freshly sawn or drilled rock surfaces.

Stop No. 8 is located at the extreme top of the Cleopatra Crystal Tuff at a roadcut in Highway 89A at a point approximately 5000 feet to the W.S.W. of the United Verde orebody. The top 10-50 feet of the Cleopatra is brecciated, with incipient fracturing extending deeper. Multiple folds along the contact exaggerate the thickness of the breccia. The top few feet of the breccia show matrix supported Cleopatra fragments bearing different alteration states as well as foreign jasper and re-worked volcaniclastic fragments caught up in a debris flow. The color of this distinctive horizon takes on a purplish hue from the interstitial hematite staining. Because the same color was seen adjacent to known orebodies in the district the old prospector's term "purple porphyry" was considered as an important exploration guide to ore. The hematite staining is thought to have resulted from deposition of weak hydrothermal fluids that percolated outward from the volcanic edifice and into the surrounding seascape. These rocks are anomalously devoid of sulfur, as are all of the rhyolites seen in Deception Gulch and Hull Canyon. The brick red color that is seen in the rhyolites of Deception Gulch is due to the weathering of chlorite.

From Stop No. 8 due south to creek level in Hull Canyon, the Cleopatra contact can be followed along the purplish color zone. Several excellent drag folds can be observed along the thin bedded sediments of the United Verde Ore Horizon. Just across the stream bed, on the southern side, can be seen some of the least altered Cleopatra Crystal Tuff known to the author.

Stop No. 9 is situated immediately to the west of the previous stop and is located within the Upper Succession Rhyolite. One prominent and unaltered flow exhibits large polygonal joints and is locally called the Bullseye rhyolite from the distinctive iron-stained rings which can be observed within the polygonal fractures. During a 1971 visit to this location Howel Williams referred to these localized rhyolite accumulations as "blister domes," (pers. commun.). The thickness of the Upper Succession Rhyolite varies greatly along strike. It is absent over the western part of the United Verde orebody but thickens considerably in the hangingwall rocks above the U.V.X. mine. They may reach their greatest thickness in the Copper Chief mine area to the southeast.

Stop No. 10 examines scores of stacked turbidite sheets that range from a few feet to more than 40 feet in thickness. These rocks can either be seen in the weathered outcrops along Highway 89A or to better advantage in the nearby parallel drainage to the south. They form classic Bouma cycles which exhibit coarse, graded volcanic fragments at the base to fine-grained pelites at the top (Bouma, 1962). A few of the pelitic tops show delicate load casts caused by the weight of a subsequent overlying turbidite sheet. Fragments within the turbidites may vary from rhyolitic crystal tuff to andesite and the individual sheets appear to become progressively finer grained upward and more andesitic as the beds become younger. The turbidites are believed to emanate from the summit area of the volcanic dome located somewhere north of Jerome. Submarine erosion, perhaps close to wave level, has removed material from the dome and deposited the thick turbidite accumulations on the southwest flank. These rocks are included in the Grapevine Gulch formation of Anderson and Creasey (1958).

Stop No. 11 is located near the ruins of the Walnut Springs swimming pool. Bedded and tightly folded chert horizons are exposed within pelitic sediments of the Grapevine Gulch formation. Just north of this site is a highway roadcut which exposes the southern tip of a large gabbro sill that extends to the hanging-wall of the United Verde ore deposit. The Warrior fault lies just west of this location and marks the end of Proterozoic outcrops in Hull Canyon.

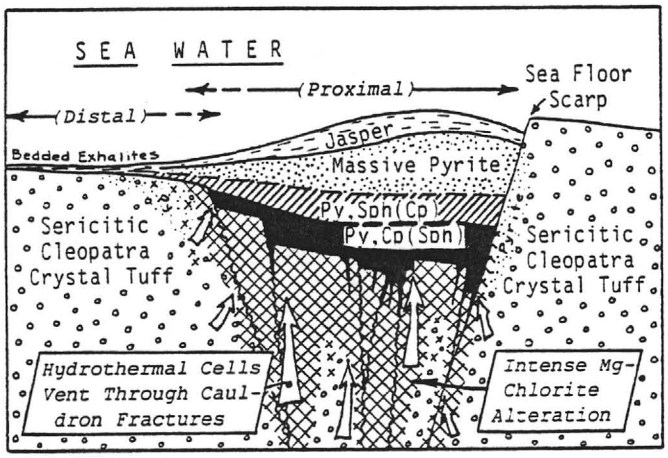

Figure 3. Schematic pre-fold cross section through the United Verde deposit. The view is southerly as one would observe the south open pit wall. Massive sulfides were emplaced over cauldron subsidence faults and lap against a sea floor scarp, giving assymetric distributions. The Cleopatra Crystal Tuff has been intensely altered by Mg-chlorite (Black Schist) in the footwall of the orebody. At depth within the mine the sea floor scarp appears to diminish to zero and the sulfide lenses overlap the fractures. The distal bedded exhalites on the eastern side are now highly folded but persist as thin chemical sediments that extend toward the U.V.X. deposit for several thousand feet.

UNITED VERDE OPEN PIT

Stop No. 3 will be at the United Verde open pit. Except for a small lease operation in the mid-1970's to salvage some footwall stringer ore (chalcopyrite in black schist), the mine has been inactive since 1953. The massive sulfide body is located on patented claims owned by the Phelps Dodge Corporation.

The original small surface cuts, shafts, and very early smelter sites were located well above the large flat bench that now leads into the pit area. This bench was cut into the hill on the United Verde 300 mine level (i.e., 300 feet below the original ore discovery point). The open pit portion of the mine was begun in 1917 but it was not until 1922 that ore was produced. One of the reasons for digging the pit was to remove burning massive sulfide ore that was hindering underground production. After a hiatus during the Depression years the pit continued to produce ore until 1940. The orebody was eventually mined to the 4500 level along the N.N.W.-plunging orebody, or to a depth of 4200 feet below the bench level.

The open pit operation has removed most of the sulfide mass, but the upper barren pyritic massive sulfides can still be seen in the northwestern pit wall. This is overlain by a tightly folded jasper capping and remnants of Grapevine Gulch sediments. The northwestern open pit wall above the sediments has been cut into the gabbro sill. The entire ore system (footwall alteration, massive sulfide ore and barren pyrite, and jasper capping) has a N.N.W. plunge at an average of about 60 degrees. When standing outside the fenced-off pit area, from a vantage point near the old Phelps Dodge office, a view toward the southwest into the pit shows the distinct plunge on the south pit wall where the dark colored chloritic footwall remains beneath the mined away sulfide zone.

The conspicuous high ridge just west of Jerome and immediately south of the pit is Cleopatra Hill. This erosion-resistant hill marks a silica-chlorite alteration zone. Cauldron faults which helped to localize the venting of hydrothermal solutions can be traced from the southwest corner of the pit up and over the high southern ridge, where the heavily chloritized fracture zones pass over the ridge just to the west of the highest part of Cleopatra Hill.

The entire southern wall of the 300 level bench area and open pit is composed of Cleopatra Crystal Tuff, with the exception of two tight synclines of bedded exhalites and post-ore rhyolites just southwest of the shaft. The bedded exhalites are composed of banded cherts and jaspers with sulfide laminates and disseminations. They represent the lateral, or distal, equivalent to the main massive sulfide body to the west as is shown in the pre-fold reconstruction of Figure 3. At this excellent exposure the three dimensional effects of the polyphase folding can be seen in detail. These folds can be traced down plunge to the deepest levels of the United Verde mine workings as well as to the southeast through Deception Gulch and on into Mescal Gulch.

The principal, or primary, folds trend N.N.W. and their axial planes dip steeply to the E.N.E. The secondary cross folds trend east-northeasterly and also exhibit steep axial planes. The interference patterns created by the two superimposed fold effects create the classic "egg crate" pattern seen in outcrop. In the United Verde pit area the primary folds plunge at 60° to the depths of the mine and there the plunge reverses as the system passes through the east-trending Haynes cross syncline. The resultant of polyphase folding generated near-vertical high grade ore shoots where chalcopyrite migrated into the steep axial plane intersection of primary and secondary anticlines.

The tour will examine the south pit wall in some detail to observe the distal and proximal footwall alteration effects in the Cleopatra Crystal Tuff. The pit ramp road along the south wall is an ideal location to observe the effects drawn in Figure 3. To the east of the orebody the thin exhalite strata extend distally away from the chloritic-altered vent area and override the sericitic-altered crystal tuff adjacent to that vent. Dark colored, greenish-black Mg-chlorite alteration formed in the immediate ore footwall. It can be seen in fractures cutting the crystal tuff and replacing the rock.

The miner's term "black schist" was applied the intensely chloritized footwall alteration of the United Verde orebody. Mg-chlorite alteration ranges in intensity from complete replacement of the crystal tuff to a permeation of the rock with indistinct outer boundaries. The strongest concentrations of chlorite occur within the old feeder fractures which channeled large quantities of hydrothermal solution toward the original sea floor. Between major fracture zones are brecciated areas where chlorite envelops and partially bypasses large blocks of lesser chloritized crystal tuff.

Pyrite is not abundant in the footwall rocks of the immediate vent area, but is displaced to the sides of the most strongly chloritic zone where it is associated with abundant sericite. Directly below the massive sulfide body were high grade stringer veins composed of chalcopyrite and intensely chloritic crystal tuff. This constituted a major source of ore produced during the mining operation.

Just west of the main chloritic fracture zone, a prominent pit wall of Cleopatra Crystal Tuff shows strong sericite alteration and pyritic stockworks of a type identical with that seen to the east of the orebody below the bedded exhalites. Chlorite is virtually absent in this zone which is in sharp contrast to the nearby chloritized vent zone. The wall is interpreted by the author to be near the sea floor scarp depicted in Figure 3. It was just off the main point of hydrothermal venting, which accounts for the lack of Mg-chlorite, but was involved within the widespread sericite alteration envelope. There is no evidence that massive sulfide deposition ever breached this sea floor scarp at this point in space. Cauldron faulting formed an effective sea floor ore trap.

In the bottom levels of the pit massive pyrite outcrops beyond the rubble left by mining operations. Delicate primary depositional banding can be seen in the massive pyrite, along with primary chert lenses that become more common upward. Replacement textures are rare to absent this high up on the massive sulfide pile and the economic values are nil. Only the overlying jasper was somewhat recrystallized and partially bleached by the adjacent gabbro sill intrusion. A small amount of pyrite was formed in the chert at the expense of the hematite.

PROTEROZOIC FOLDING

Polyphase folding is seen throughout the Jerome district within the Proterozoic rocks. The dominant folds trend N.N.W. and approach isoclinal conditions in some areas. Drill-indicated primary fold amplitudes of at least 6000 vertical feet are inferred, while secondary cross folds of lesser amplitude are revealed by F_1 plunge reversals seen throughout the district. The principal exposed fold in the Jerome area is the Jerome anticline as shown in Figures 1, 4, and 5. In reality this is axis of an anticlinorium that is about 5000 feet wide. Correlation studies over the last decade and a half of old mine records and new diamond drill data indicate that additional major anticlines and synclines are concealed beneath Paleozoic and Tertiary cover rocks to the northeast of the Verde, Bessie, Valley, and other faults within the Verde Graben. Fold limb attitudes in the Jerome area are steep and trend north-northwest.

Cross folds of lesser amplitude than the primary folds trend irregularly along east-northeast axes, and a few of them are shown in the southeastern portion of Figure 1. Interference patterns between the complex fold sets cause numerous fold plunge reversals and result in "Christmas tree" contact patterns. Both stages of folding are caused by a single deformational event from uniform compressional stress being applied sub-horizontally along an E.N.E. axis. The earlier folds (F_1, N.N.W.) result from initial crustal foreshortening, while the cross folds (F_2, E.-N.E.) result from differential vertical extension and thickening of the crust.

PROTEROZOIC FAULTING

Proterozoic faulting was confined to cauldron-type features that are often arcuate, steep, and are associated with growth features inherent within the development of the volcanic pile. These pre-fold fault zones were healed by hydrothermal solutions that converted fault gouge into alteration minerals such as chlorite and silica. These steep features remain steep and retain their cross-cutting contact relationships during the folding stage because the axes of the folds are also steep. A circular fracture zone with primary steep attitudes will foreshorten in the direction of compression and distort it into an oval shape during the formation of F_1 folds. In the same example the oval-shaped fracture will be distorted again during vertical ductility to flatten the oval even more, and tend to make the fracture zones even steeper during the formation of F_2 folds.

Ransome (1932) maintained that movement must have occurred along the Verde fault in Precambrian time. He believed that the United Verde Extension orebody was the faulted-off apex of the United Verde body, and he was not alone in this belief during the life of the mines. Ransome's concept is illustrated in Bateman (1950, p. 501). A number of other geologists over the years opposed this view for the origin of the U.V.X. deposit as outlined in Anderson and Creasey (1958, p. 7-8).

Exploration programs over the past 4 decades have added a great deal of new information that was not available at the time of the Anderson and Creasey (1958) report. Correlation work by the author on U.V.X. and United Verde mine records show an almost exact fit across the Verde fault plane when displacements are removed. No evidence for a Precambrian age of fault offset could be found, or was necessary. The United Verde and U.V.X. massive sulfide bodies are simply independent and separate deposits that are now located on opposite-facing limbs of the Jerome anticline (Lindberg and Jacobson, 1974; Handverger, 1975). It is equally clear that the extreme supergene enrichment of the U.V.X. body does not date from Precambrian time as proposed by Ransome (1932), simply because normal supergene effects rarely exceed 200 feet below the Paleozoic cover level (The U.V.X. has 450 feet of gossan above it).

PHANEROZOIC FAULTING

Phanerozoic faulting in the Jerome area is restricted to two distinct and separate events. The first involved high-angle reverse faulting associated with the Laramide Uplift of Southwestern Arizona in

Late Cretaceous to Eocene time. The second involved normal faulting that began in Late Miocene time.

High-angle Laramide reverse faulting was widespread in the Jerome area (Lindberg, 1983), in the Grand Canyon region (Huntoon, 1974), and along portions of the Mogollon Rim. Nations, et al. (1982) place the timing of the Laramide Orogeny in Late Cretaceous to Eocene time. The reverse faults seen in the Jerome area accompanied compressional uplift of Southwestern Arizona. Figure 4 depicts a geologic cross section reconstruction of the Jerome mine area just following the Laramide Uplift, reverse faulting, and northeast tilting of the strata on the Verde monocline (Lindberg, Verde Graben abs. in press). Several local gravity slides of detatched Paleozoic strata occurred northeast of Jerome where large blocks de-coupled and slid eastward at a low angle along shaly beds of the Chino Valley formation. Although the mile-wide slab moved only a few hundred feet, the ensuing "pull-away" zone that overlay the U.V.X. orebody adjacent to the Ancestral Verde fault was to become a major factor in the generation of the bonanza ore grades that were about to develop in the deposit. From the time of the Laramide Uplift to Middle Miocene time the eroding, northeast-draining peneplain partially removed the tilted Paleozoic strata from the Jerome area but bared the Precambrian basement in the Mayer-Prescott region to the southwest. Rim Gravels were deposited toward the northeast continuously from Mingus Mountain to the present Colorado Plateau, uninhibited by any intervening valleys or grabens.

Erosion on the northeast-draining peneplain may have lasted for 40-50 million years and resulted in a mature landscape with well defined drainage channels. One such mature channel developed in the "pull-away" zone overlying the U.V.X. deposit. A conglomerate-filled channel, 400 feet deep and 2000 feet wide was carved into the landscape in pre-Hickey Basalt time. Precambrian cobbles, thought to show a Mayer-Prescott area provenance (including several varieties of granitic rocks which are unknown in the Jerome area) were carried toward the plateau in these channels. Hickey Basalt was laid on top of the gravel channels in the Mingus Mountain-Mayer area 14.6 to 10.1 m.y. ago (McKee and Anderson, 1971). Identical gravel-filled channels, buried by 8 m.y. old Slide Rock Basalt, are seen in the eastern wall of Oak Creek Canyon, 30 miles to the northeast (McKee and McKee, 1972). They also occur south of Sedona beneath Hickey age basalt flows and are thought by the author to represent down-faulted gravels and basalt within the Verde Graben (Lindberg, 1983).

The first known normal faulting along the Verde fault system in the Jerome area took place is post-Hickey time, or less than 10.1 m.y. ago. McKee and McKee (1972) believed that 10 m.y. old basalt clasts were still being carried onto the plateau in the vicinity of Oak Creek Canyon. This gives credence to the idea that an important drainage reversal could not have occurred in the Jerome-Verde Valley area, at least before that time. The author concurs in this belief and proposes that the Verde Graben could not have formed before 10 m.y. ago.

Figure 5 shows the geology of the Jerome area following normal faulting associated with the formation of the Verde Graben, beginning about 10 m.y. ago. This section also shows the modern erosional surface along United Verde mine coordinates Zero to 400 North. Field Trip Stop No. 2 presents the surface portion of the cross section to a viewer situated at a Jerome viewpoint on Highway 89A near the old Mingus Union High School (See Figure 1).

THEORIES OF ORIGIN OF U.V.X. OREBODY

The role of faulting was a controversial subject in the Jerome district when it came to searching for additional hidden orebodies. A popular theory early in this century held that the apex of the outcropping United Verde "ore pipe" could have been faulted off and remain hidden below Tertiary and Paleozoic rocks on the northeastern side of the Verde fault (See Anderson and Creasey, 1958, p. 87-89 and 145-149).

Costly attempts to locate a buried orebody by underground searching in the expected location nearly ended in failure when a small pod of 45% copper ore was discovered in late 1914. This, of course, led to the famous discovery of the main bodies of the U.V.X. bonanza-grade Cu-Ag-Au ores. Because the discovery was close to the predicted location for the "faulted-off United Verde apex" theory, it became an accepted model by some (Ransome, 1932).

This concept, however, had its problems when seen in retrospective. The theory demanded a Precambrian age of offset prior to Paleozoic deposition, and another normal offset in Tertiary time along the Verde fault of another 1500 feet. The Precambrian age of movement is no longer regarded as valid, but the Tertiary offsets are well documented. G. W. H. Norman (in: Anderson and Creasey, 1958 and Norman, 1977) has struggled with a U.V.X. fault solution for a long time.

Handverger (1975) and the author conclude that the U.V.X. is a separate and distinct orebody from the United Verde deposit. The two bodies lie on the opposite limbs of the Jerome anticline and each has distinctive footwall and hanging-wall assemblages. While the primary massive sulfides of the U.V.X. were Proterozoic in age, they were largely converted to high grade chalcoite ore during the Tertiary supergene enrichment period and formed at the expense of a much larger orebody.

GENERATION OF THE VERDE GRABEN

The Jerome area marks the southwestern margin of the Verde Graben which involves faulting of the Hickey Basalt that is as young as 10.1 m.y. old. Collective normal offsets on the Verde, Bessie, Valley, and other un-named faults amount to 6100 vertical feet in the area between the Copper Chief mine and the Mingus Union High School south of Cottonwood, Arizona. It is likely that the deepest portion of the graben underlies the present course of the Verde River, but drill holes have not penetrated that deep.

Until recently the role played by the Laramide high-angle reverse faults was not understood. The author has located numerous fault slices of preserved Laramide age offsets, and this ancestral stage nearly always failed again during the Late Miocene tensional regime with its normal faulting.

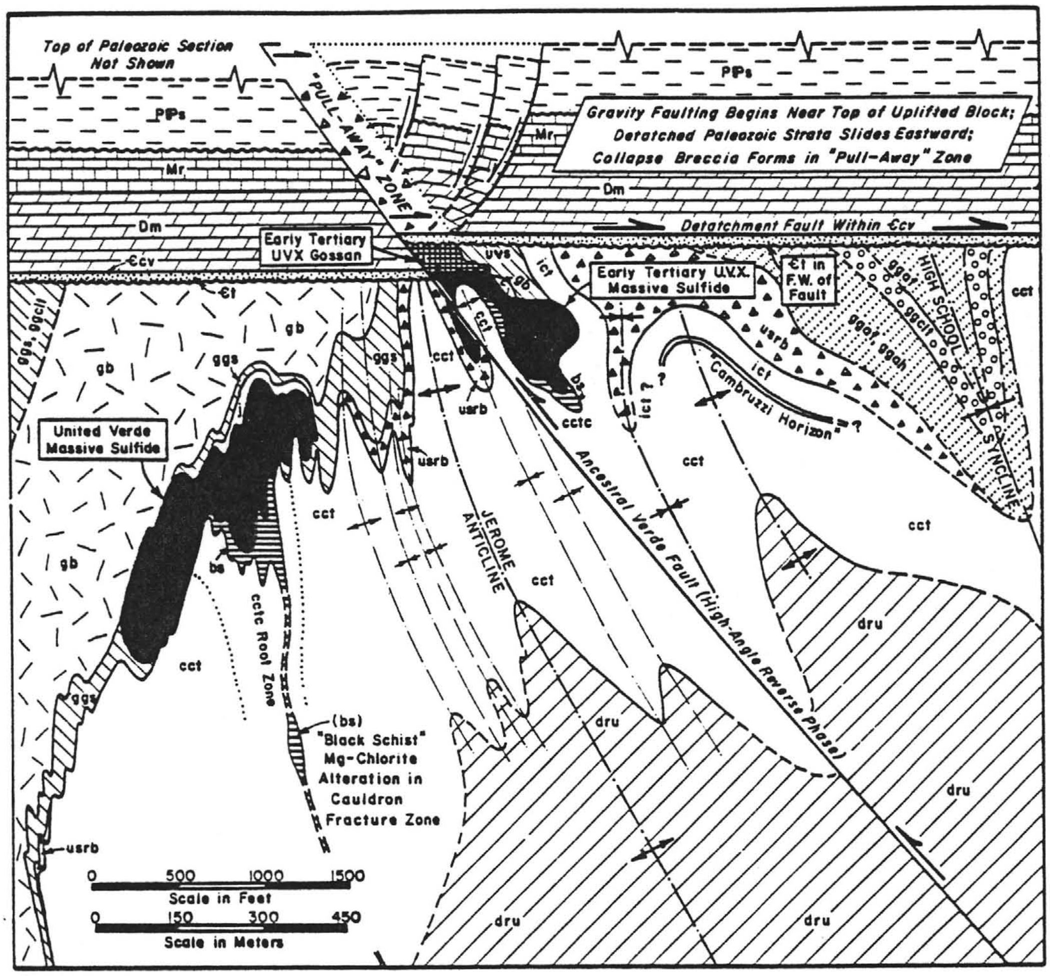

Figure 4. East-west composite cross section through the United Verde (Mine Section 400 North) and U.V.X. (Mine Section Zero North) orebodies as their positions have been reconstructed following the Laramide Uplift and high-angle reverse faulting on the Ancestral Verde fault. The view is looking due North. A "pull-away" zone is created along the fault trace when a large block of Paleozoic strata detatches from the underlying Tapeats Sandstone and slides toward the east on uplifted and gently dipping strata. The Jerome anticline forms the central axis of an anticlinorium that is nearly 5000 feet across. Deep level exploration of the overturned western limb of the anticline was carried out from the United Verde mine to elevations below that shown in this figure. The chloritic root zone below the United Verde orebody follows cauldron fractures that extend through the entire Cleopatra Crystal Tuff (cct). Rock symbols are as shown in Figure 1 and as described in the text. Note the size of the gossan over the U.V.X. orebody. It is expected to not have exceeded more than 200 feet in depth below the Paleozoic strata.

The Laramide and Late Miocene faults are always parallel to the limbs of the primary folds in the Proterozoic basement. The Precambrian influence on the location and dip of Tertiary fault planes in the Jerome district is unmistakable.

The recent understanding that most faults in the Jerome district had a dual history, first compressional and then tensional, has led to a whole new understanding of the complex geometries of the fault blocks in this region. For example, as the Verde fault is traced northward the down-to-the-east motion gradually diminishes to zero and then further on it begins to develop a reverse sense. Britt (1972) discovered that two ages of faulting had taken place and it was not just a simple scissor fault. The first reverse phase (Laramide) affected the entire fault trace from Jerome northward to beyond the Verde River. The later tensional stage (Late Miocene) affected only the southeastern segment of the fault which was re-activated during the generation of the Verde Graben (Lindberg, in press).

The Verde fault forms a clear boundary along the southwestern portion of the graben, but in the vicinity of Jerome additional fault steps along the Bessie (Field Trip Stop No. 1), Valley, and other un-named faults create ever-greater cumulative displacements toward the southeast. The northeastern boundary probably extends into the Sedona area.

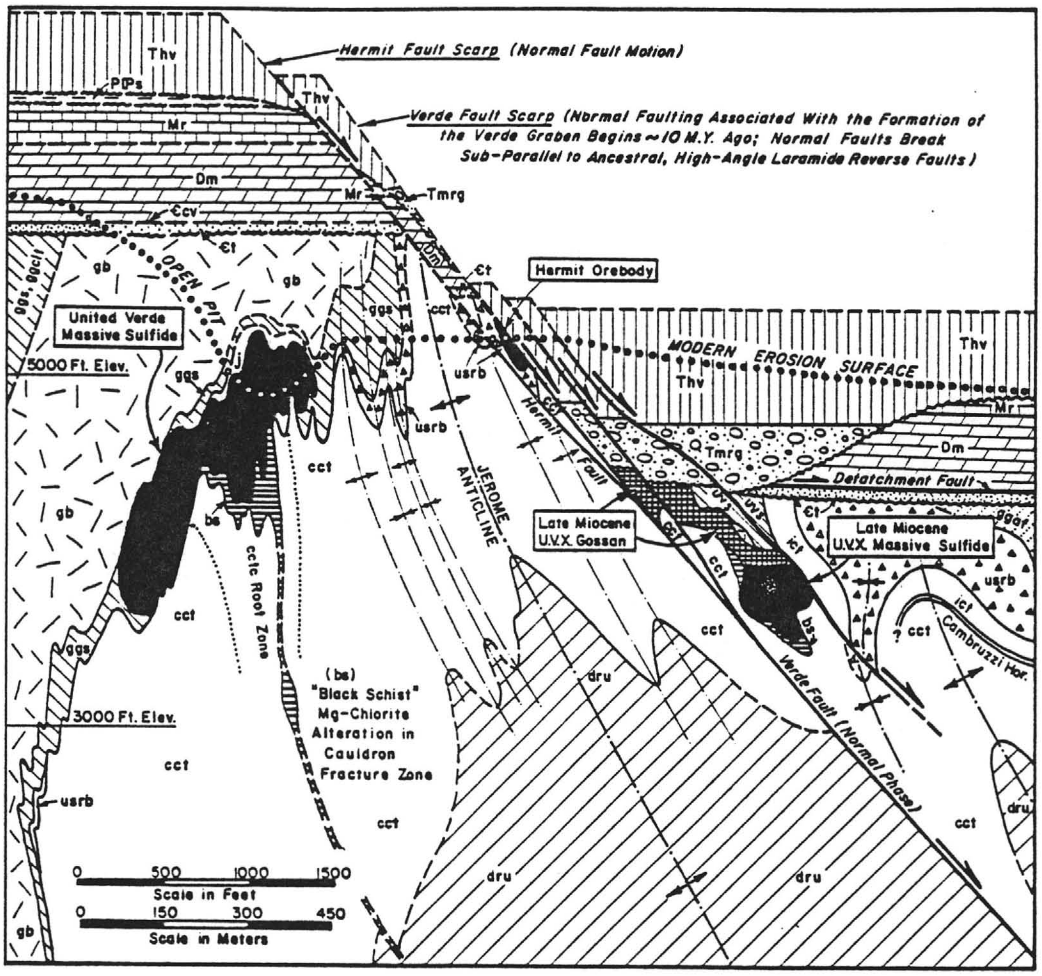

Figure 5. East-west composite cross section through the United Verde and U.V.X. orebodies as their positions have been reconstructed following the period of normal faulting associated with the generation of the Verde Graben approximately 10 m.y. ago. The view is looking due North. A post-Laramide Uplift erosional surface has cut deeply into the Paleozoic surface and left a mature, deep, gravel-filled channel directly overlying the U.V.X. orebody (Compare with Figure 4). The dotted line shows the approximate modern erosional surface across this section. Field Trip Stop No. 2 will view the surface trace of this section from a vantage point along Highway 89A. Using the Tapeats Sandstone as a marker horizon, the Laramide reverse fault stage had lifted the eastern side (Ancestral Verde stage) no more than 400 feet. Then, in Late Miocene time, normal faulting of approximately 1900 feet took place along the Verde fault. The net offset is about 1500 feet. Note the development of basalt lava flows (14.6 to 10.1 m.y. old) that overlie the mature channels filled with Rim Gravels. The normal faulting that accompanied the generation of the Verde Graben has to post-date these lava flows.

The graben gradually diminishes in amplitude toward the northwest, but individual small graben blocks can be seen as far as the entrance to Sycamore Canyon. The graben appears to have attained greatest offset along the former Verde monocline, remnants of which can be seen north of the Phoenix Cement plant near Clarkdale. The Mingus Mountain block is a segment of the Colorado Plateau which the author infers has been detatched during recent crustal extension, with the intervening Verde Graben having been formed as that portion of the plateau floundered. The post-Laramide peneplain affords an excellent marker horizon to measure the amount of graben displacement.

ACKNOWLEDGMENTS

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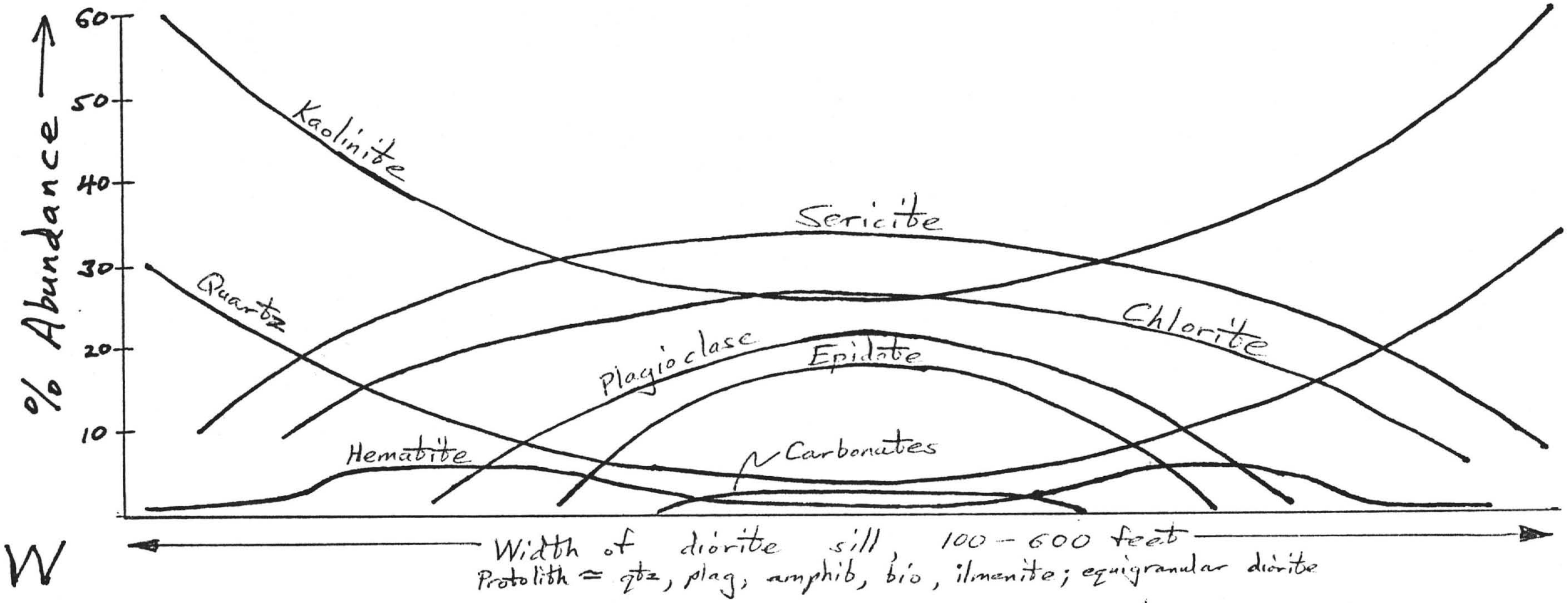
PARTIAL CHRONOLOGICAL LISTING OF U.V./U.V.X. PERSONNEL

1916-30's	James S. Douglas	Pres., U.V.X. Mining Company
1916 +	F. A. Provot	Geologist, U.V.X.
1918 +	J. R. Finlay	Geologist, U.V.X.
1918-30's	R. W. Hart	Geologist, later mine mgr., U.V.X.
1920's	L. E. Reber, Jr.	Geologist. U.V,X.
1920's	George Kingdon	Mine Manager, U.V.X.
1920's	F. W. Lowery	Geologist, U.V.X.
1920's-30's	R. Louis D'Arcy	Chief Mine Engineer, later Mine Superintendant and Manager, U.V.X.
1924-25	J. L. Fearing, Jr.	Geologist, U.V.X.
1926	Waldemar Lindgren	Geologist, U.V.X. (consultant)
1927-28	F. L. Ransome	Geologist, U.V.X. (consultant)
1920's-49	P. C. Benedict	Geologist, U.V.X. & later Mingus Mt. Mining Company
1930 +	Mayer G. Hansen	Geologist, U.V.
1931 +	Fred Searles, Jr.	Geologist, U.V.X.
1947 +	D.D. Donald	Geologist, Mingus Mtn. Mining Co.
1947-70's	G.W.H. Norman	Geologist, Mingus Mountain Mining Co.
1958-70's	C. A. Anderson	Geologist, U.S. G.S.
1958-70's	S. C. Creasy	Geologist, U.S.G.S.
1958-70's	J. T. Nash	Geologist, U.S.G.S.
1960's-80's	Paul A. Handverger	Geologist, Verde Exploration
1970's	Ira Jeroloman	Geologist, Copper Range
1970's	Norm Duke	Geologist, Callahan
1970's-80's	Paul Lindberg	Geologist, Anaconda, Coca Mines, & Indep.
1983 - 87	Robert Rivera	Geologist, V.P. Explor., Coca Mines

DCW.
May, 1985



Protolith = qtz, plag, amphib, bio, ilmenite; equigranular diorite

Verde Area Cherts | Intrusive breccia

Silicic	Argillic	Propyllitic (Core of diorite sill)	Argillic 20'-160' thick	Silicic 20'-40' thick
Kaolinite (40-60) quartz (20-30) ± sericite, chlorite, hematite	Kaolinite (30-50) sericite (20-30) chlorite (10-20) quartz, leucoxene, feldspar with some hematite ± native copper and malachite	Kaolinite (20-40%) chlorite (15-25%) epidote (15-25%) plagioclase (15-25%) leucoxene (~5%) ± quartz, hematite, carbonate (calcite, dolomite)		
		Clear relict textures	Some relict textures	Few or no relict textures
"Heavily bleached + clay-alt'd dt"	"Red blocky schist"	"Massive diorite" ± CO_3		

Intrusive breccia | Gold Stope Cherts

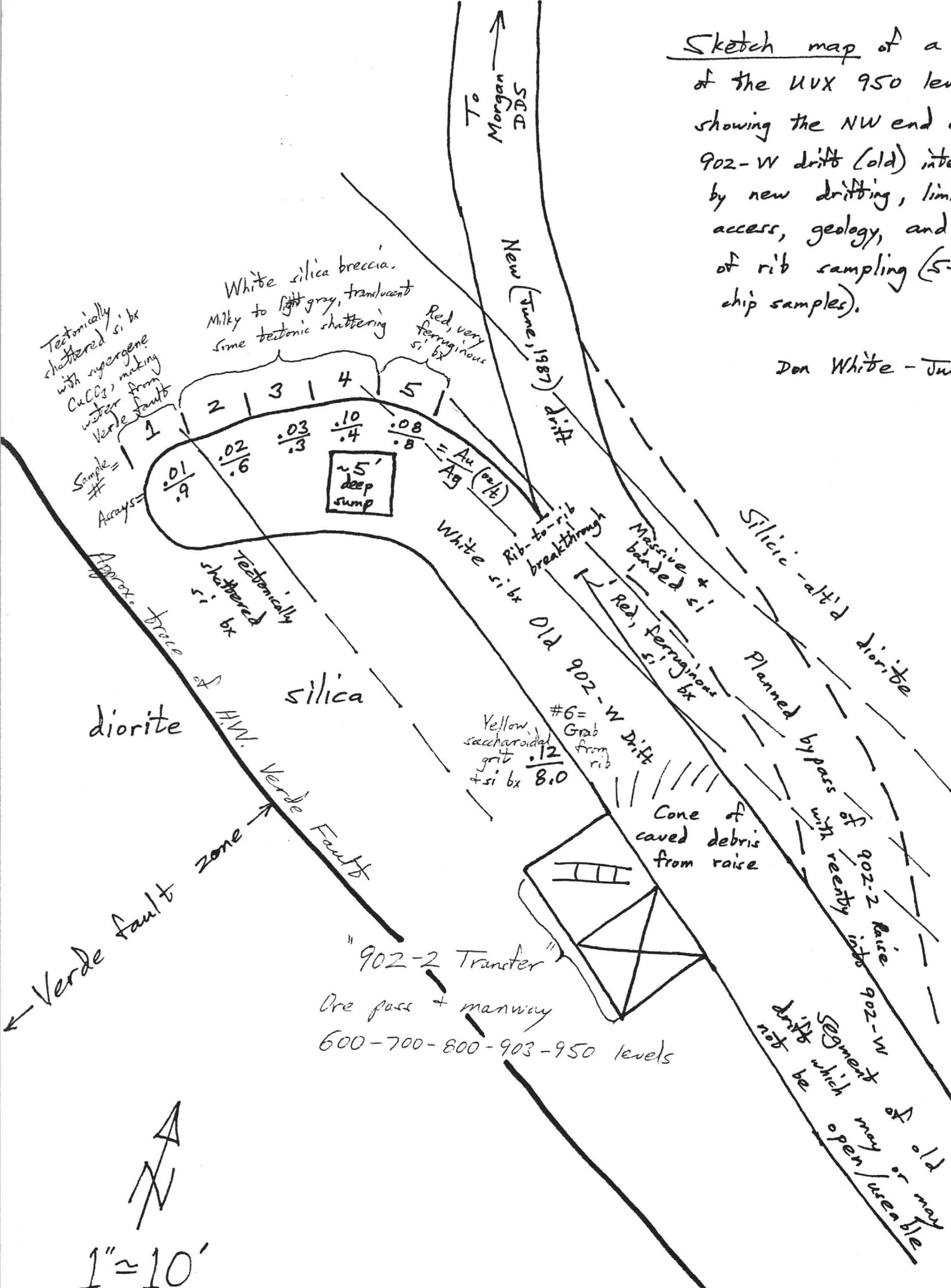
Diagrammatic section of U.V.X. diorite sill alteration assemblages

as defined by S.G. Harding, 1987

Don White
May 3, 1987

Sketch map of a portion of the UVX 950 level (~11,400 N, ~7,100 E) showing the NW end of the 902-W drift (old) intersected by new drifting, limits of access, geology, and results of rib sampling (5-ft cont. chip samples).

Don White - June, 1987

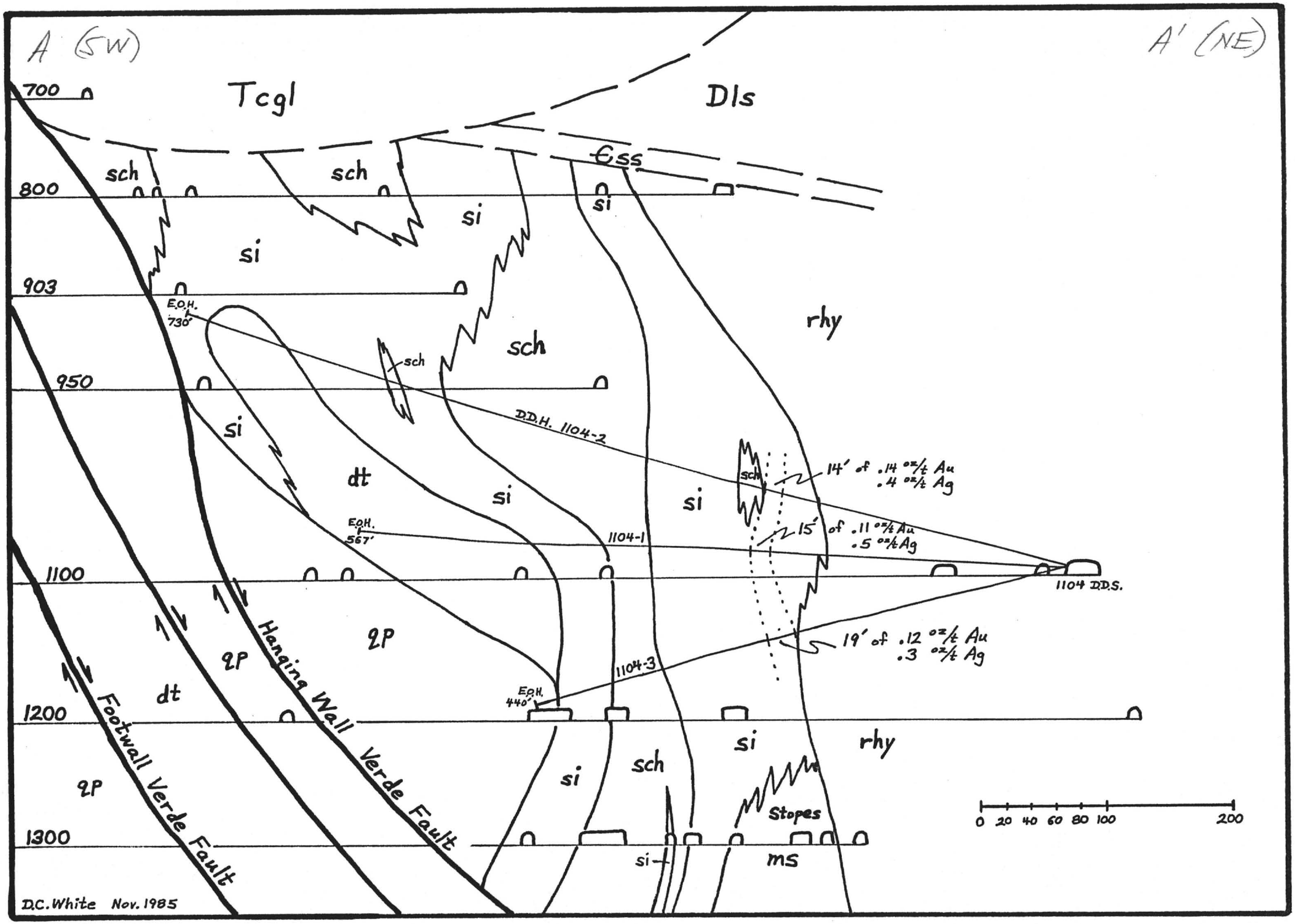


U.V.X. Precious Metal Assays by Stope

Karl Budge + Don White - May, 1985

Stope		Average grade (oz/t) Au	Ag	Ratio Au/Ag	Maximum grade (oz/t) Au	Ag	# Precious metal assays	Remarks
728		.01	1.1	.01	.05	2.5	35	
819		.01	0.4	.02	.18	4.9	38	
821		.02	1.5	.02	.02	3.2	51	
824		.04	2.3	.02	.60	19.1	65	
826		.03	1.4	.02	.05	2.3	7	
828		.04	2.0	.02	.04	2.0	1	
901	Upper N end Gold stope	~.50	~3.0	~.17	2.32	7.2	~30	
903		.12	1.8	.07	2.08	6.3	72	
905	Upper third Gold stope	~.30	~2.5	~.12	1.36	8.4	~200	
906		.03	2.1	.01	.48	10.2	160	
911		.06	2.1	.03	.09	4.8	14	
956		.02	2.1	<.01	.10	3.0	44	
1102		.01	0.8	.01	.12	1.5	38	
1105	Lower No. end Gold stope	~.50	~3.0	~.17	1.22	3.2	~30	
1107		.01	2.0	<.01	.04	2.8	16	
1112	Upper Maintop	.02	1.0	.02	.02	1.0	3	
1119		.01	0.7	<.01	.02	1.4	24	
1125	Main Gold stope	~.70	~3.0	~.23	5.82	7.1	~700	
1202	Maintop	.02	0.8	.02	.04	1.1	25	
1204		<.01	0.6	—	<.01	1.0	6	
1205	'Veins'	.03	1.0	.03	.12	1.4	19	
1206	N of Gold stope	.10	1.0	.10	.72	1.9	34	
1207		.03	1.6	.02	.16	3.2	17	
1210	Maintop	.13	2.8	.05	.17	5.6	11	
1244		.01	1.3	<.01	.02	1.6	8	
1246		.01	1.0	.01	.01	1.2	14	
1303		.02	0.9	.02	.02	1.0	25	
1307		.03	0.6	.05	?	?	6	
1307-A		.12	0.8	.15	?	?	9	
[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	

1206	Gold stope	.10	1.0	.10	.12	1.9	34
1207		.03	1.6	.02	.16	3.2	17
1210	Maintop	.13	2.8	.05	.17	5.6	11
1244		.01	1.3	<.01	.02	1.6	8
1246		.01	1.0	.01	.01	1.2	14
1303		.02	0.9	.02	.02	1.0	25
1307		.03	0.6	.05	?	?	6
1307-A		.12	0.8	.15	?	?	9
1308		.04	5.4	<.01	.22	15.8	109
1309		.02	1.0	.02	.02	1.1	16
1312		.05	~100.	<.01	.26	~1235.	105
1316		.03	17.2	<.01	.40	~86.	45
1317		.03	6.8	<.01	.06	15.1	14
1320		.02	11.8	<.01	.12	~120.	98
1321		.05	1.4	.04	.40	3.3	11
1323		.03	4.4	<.01	.03	4.4	1
1325		<.01	<0.1	—	<.01	0.2	6
1326		.07	~52.	<.01	.36	~620.	47
1344		.02	1.6	.01	.24	2.6	61
1353		.05	7.0	<.01	.38	~49.	54
1405		.01	3.3	<.01	.14	~54.	42
1413		.02	1.1	.02	.03	1.5	49
1414		.02	1.5	.01	.04	5.0	49
1417		<.01	1.0	—	.01	1.8	18
1420		.01	0.8	.01	.03	4.6	100
1425		.01	0.5	.02	.02	0.8	26
1426		~1.00	~20.	~.05	2.80	~56.	3
1427		.01	0.9	.01	.02	1.1	3
1428		.02	1.1	.02	.03	1.4	46
1429		.02	1.9	.01	.26	~22.	36
1430		<.01	2.1	—	<.01	2.1	1
1432		.02	1.4	.02	.03	2.3	30
1440		<.01	0.7	<.01	<.01	0.9	5
1444		.04	2.0	.02	.04	2.0	5
1508		.06	0.4	.15	?	?	11
Σ 56 Stopes	Arithmetic averages only =	~.08	~5.2	~.02	~5.82	~1235.	~2700



A (SW)
A' (NE)
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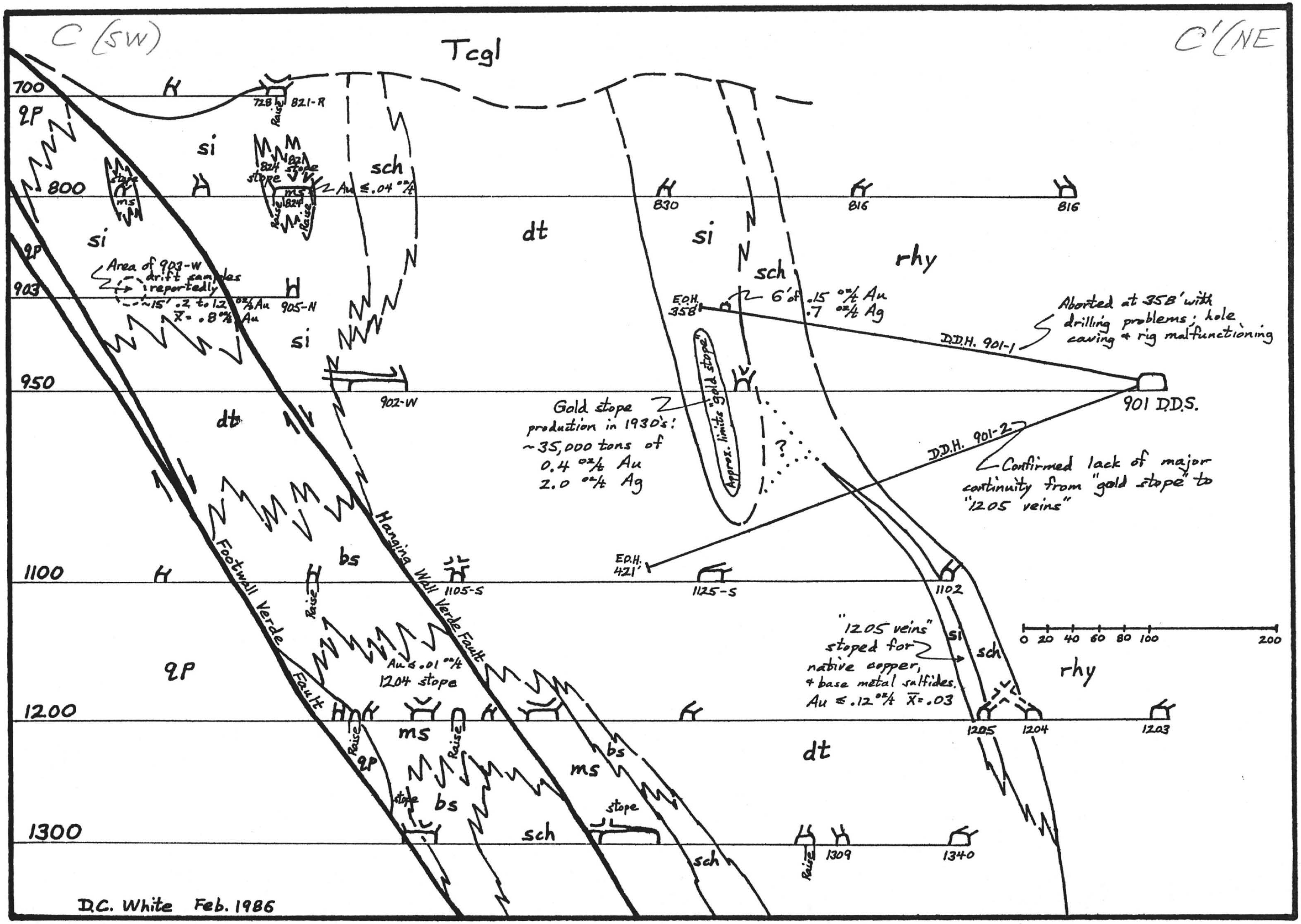
qP
ms
Stopes
E.O.H. 730'
E.O.H. 567'
E.O.H. 440'
D.D.H. 1104-2
1104-1
1104-3
1104 D.D.S.
14' of .14 oz/t Au .4 oz/t Ag
15' of .11 oz/t Au .5 oz/t Ag
19' of .12 oz/t Au .3 oz/t Ag
Hanging Wall Verde Fault
Footwall Verde Fault
0 20 40 60 80 100 200
D.C. White Nov. 1985



C (SW)
C' (NE)
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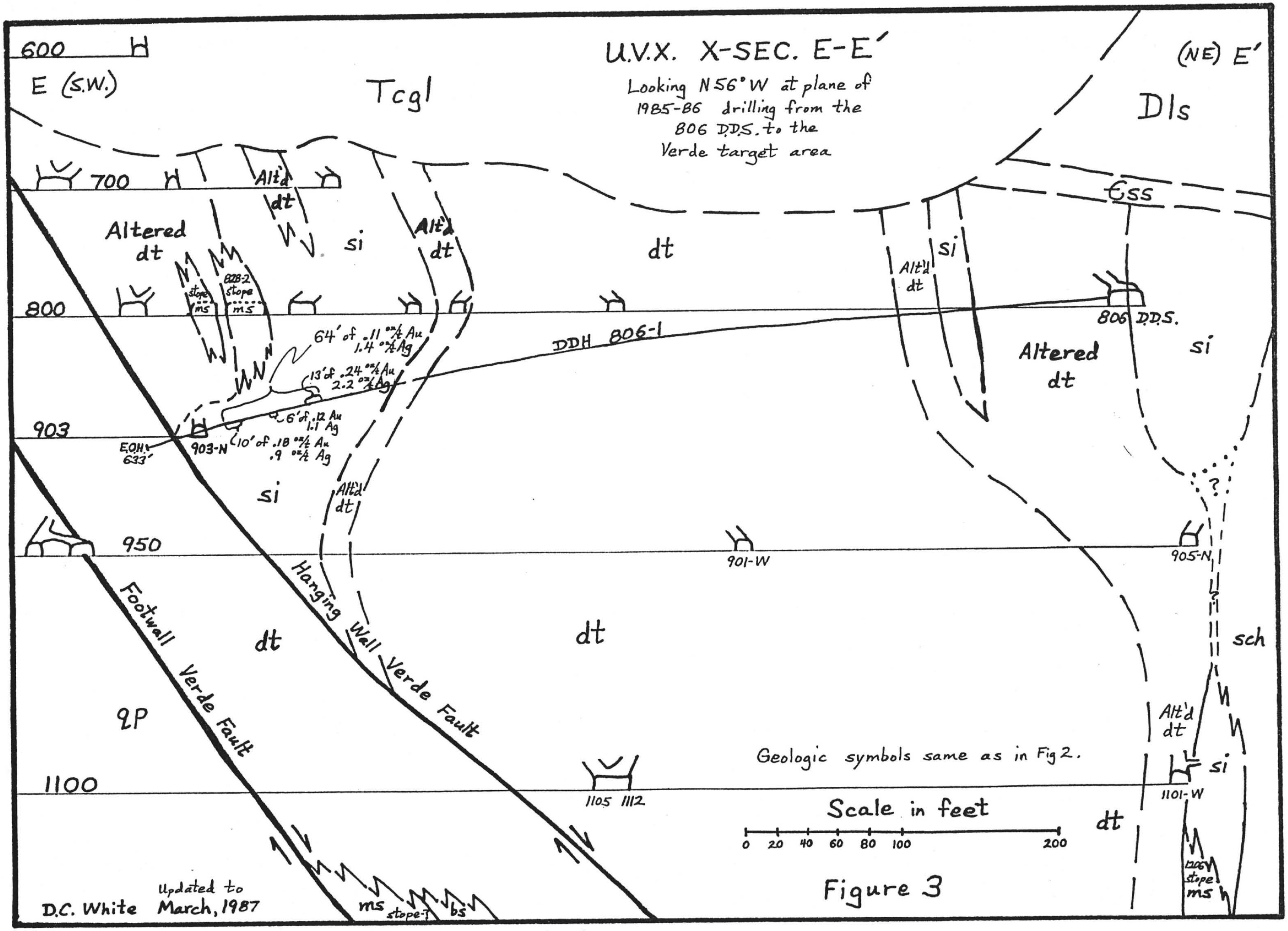
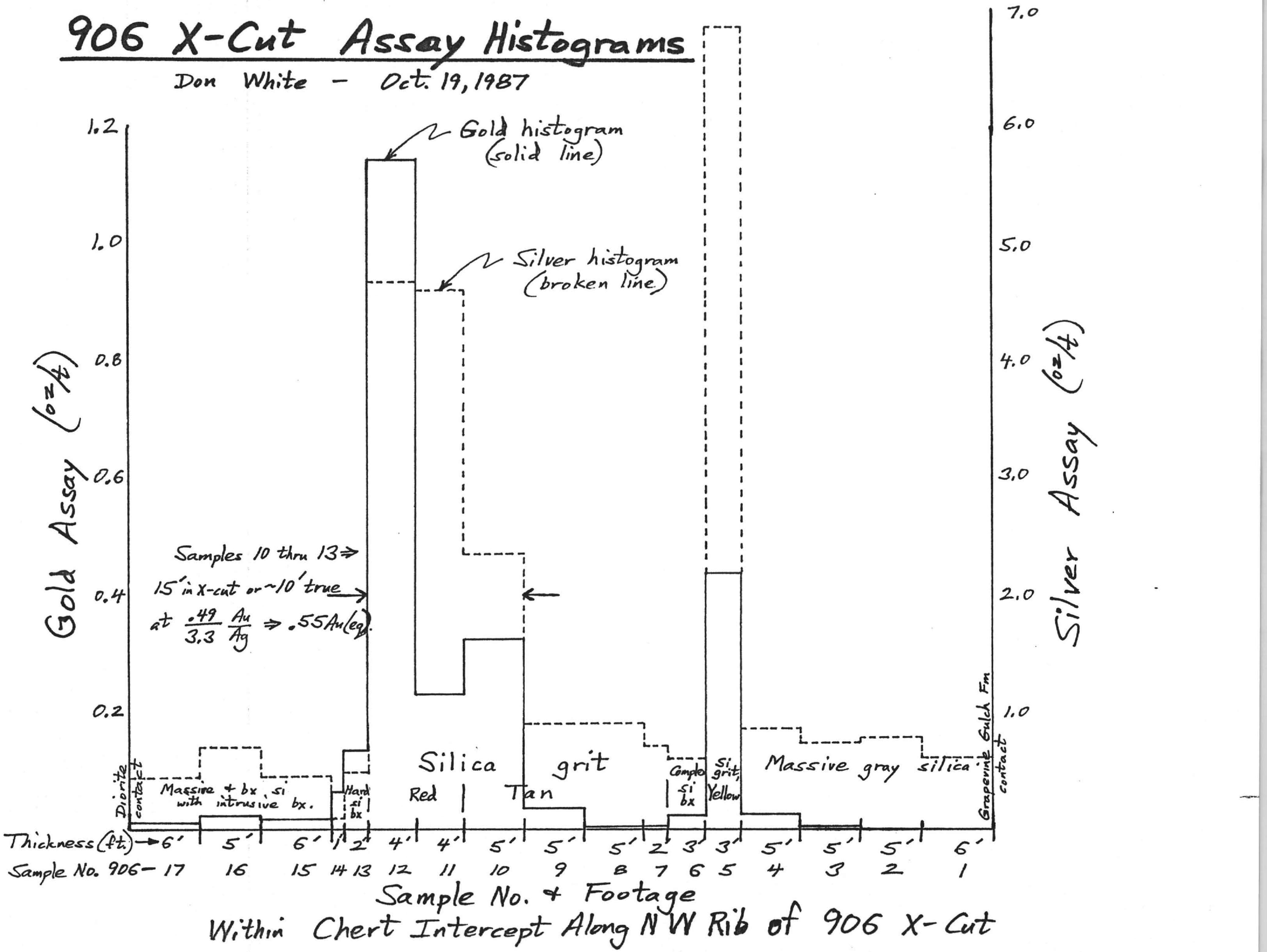
ms
728 Raise 821-R
824 stope
821 stope
Au ≤ .04 oz/t
830
816
816
Area of 903-W drift samples reportedly ~15' .2 to 1.2 oz/t Au $\bar{x}$ = .8 oz/t Au
905-N
902-W
E.O.H. 358'
6' of .15 oz/t Au .7 oz/t Ag
Aborted at 358' with drilling problems; hole caving + rig malfunctioning
D.D.H. 901-1
901 D.D.S.
D.D.H. 901-2
Gold stope production in 1930's: ~35,000 tons of 0.4 oz/t Au 2.0 oz/t Ag
Approx. limits "gold stope"
Confirmed lack of major continuity from "gold stope" to "1205 veins"
E.O.H. 421'
1105-S
1125-S
1102
Footwall Verde Fault
Hanging Wall Verde Fault
Raise
0 20 40 60 80 100 200
"1205 veins" stoped for native copper, + base metal sulfides. Au ≤ .12 oz/t $\bar{x}$ = .03
Au ≤ .01 oz/t 1204 stope
1205
1204
1203
stope
1309
1340
D.C. White Feb. 1986


U.V.X. X-SEC. E-E'
Looking N56°W at plane of 1985-86 drilling from the 806 D.D.S. to the Verde target area
E (S.W.)
(NE) E'
600
700
800
903
950
1100
Tcgl
Dls
Ꞓss
Alt'd dt
Altered dt
si
dt
stope ms
828-2 stope ms
DDH 806-1
806 D.D.S.
64' of .11 oz/t Au 1.4 oz/t Ag
13' of .24 oz/t Au 2.2 oz/t Ag
6' of .12 Au 1.1 Ag
10' of .18 oz/t Au .9 oz/t Ag
E.O.H. 633'
903-N
901-W
905-N
1105 1112
1101-W
Hanging Wall Verde Fault
Footwall Verde Fault
sch
qP
Geologic symbols same as in Fig 2.
Scale in feet
0 20 40 60 80 100 200
1206 stope ms
ms stope-? bs
Updated to March, 1987
D.C. White
Figure 3



906 X-Cut Assay Histograms
Don White - Oct. 19, 1987
Gold histogram (solid line)
Silver histogram (broken line)
Gold Assay (oz/t)
Silver Assay (oz/t)
1.2
1.0
0.8
0.6
0.4
0.2
7.0
6.0
5.0
4.0
3.0
2.0
1.0
Samples 10 thru 13 ⇒
15' in X-cut or ~10' true
at .49/3.3 Au/Ag ⇒ .55 Au(eq).
Diorite contact
Massive + bx si with intrusive bx.
Hard si bx
Silica grit
Red
Tan
Complex si bx
Si grit, Yellow
Massive gray silica
Grapevine Gulch Fm contact
Thickness (ft.) → 6' 5' 6' 1' 2' 4' 4' 5' 5' 5' 2' 3' 3' 5' 5' 5' 6'
Sample No. 906– 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1
Sample No. + Footage
Within Chert Intercept Along NW Rib of 906 X-Cut

Don White
521 East Willis St.
Prescott, AZ 86301
602/778-3140

June 16, 1987

Tim Brand
Facilities Planning and Development Mgr.
Arizona State Parks
800 West Washington, Suite 415
Phoenix, AZ 85007

Dear Tim,

We met over two months ago when you attended a public review session regarding the U.V.X. Mine Road improvements in Jerome. I am the geologist involved with the ongoing mineral exploration there, on behalf of A.F. Budge (Mining) Ltd., lessee from Verde Exploration, Ltd.

Neither my client nor the lessor has heard anything more from you or the D.O.T. regarding easements or road design criteria. We trust that does not mean we're being left out of the planning!

The attached memo from April 1, 1987 summarizes our concerns and wishes. I hope you will review it with the D.O.T. personnel involved and approach us with respect to the easement, turning radii, and load bearing issues.

I wish to pass on another observation. It relates to the parking problem and the very rationale for the road improvements. Right now the state park parking for buses, campers, and trailers is limited to our mine yard area on a "permissive use" agreement. That area is increasingly being used by our own employees, now numbering about eight cars per shift. If our exploration is as successful as is expected, we will have more personnel using that area and the already tight parking will have no space remaining for tourists with oversize units. On popular days even now I often witness traffic snarls in that lot when campers and buses and normal cars clash. The obvious questions is "why upgrade the access road for buses and trailers if there's no place for them to go?"

May I suggest that you deal seriously with Paul Handverger of Verde Exploration for acquisition of parking area east of the museum, away from our mine area, before the road improvements and before we grow to need all the parking west of the museum.

I trust we will be hearing from you.

Sincerely,

Don White

Don White
Geologist, C.P.G.

DW:sk
cc: Carole A. O'Brien, A.F. Budge (Mining) Ltd.
David J. Mellgren, AZ DOT
Paul A. Handverger, Verde Explor., Ltd.

M E M O

TO: Carole A. O'Brien

FROM: Don White

DATE: June 16, 1987

SUBJECT: Handverger's "lease" of specimen rights southeast of U.V.X.

It seems Paul Handverger has leased someone rights to collect azurite and malachite in Bitter Creek gulch just SE of Budge's lease boundary at the U.V.X. Whitey heard a couple blasts down there last week so I investigated.

The access road is being used (grass is worn down) and a locked cable is strung across the access road near its junction with the U.V.X. Mine Road south of our lease. New signs are posted along the road in the gulch bottom, due south of the state museum and the old waste glory hole. They say:

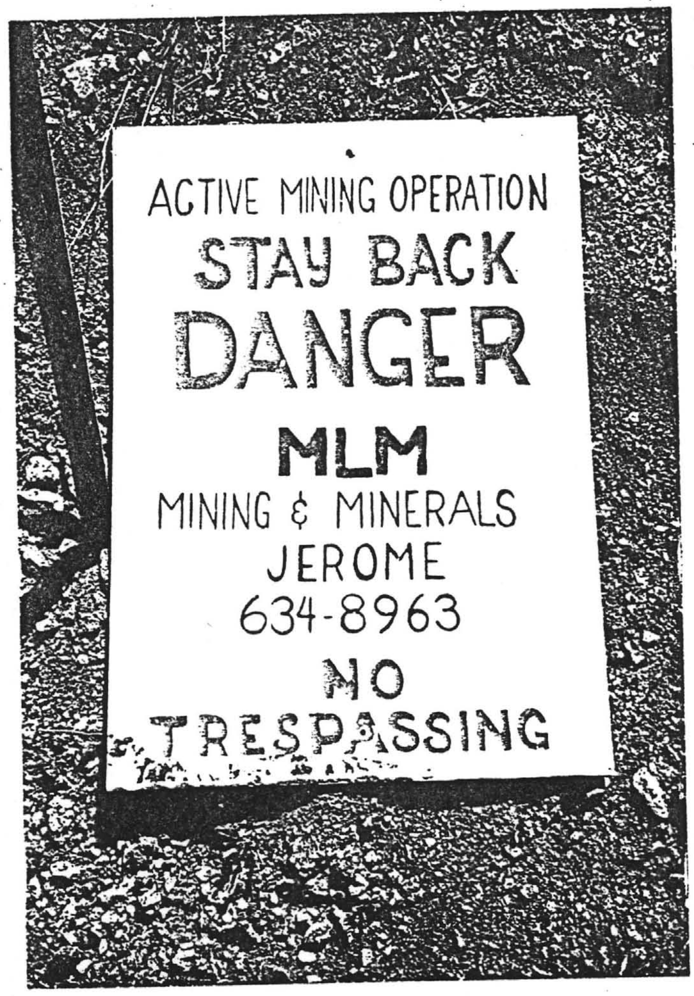
Active Mining Operation
MLM Mining and Minerals
Jerome, 634-8963
No Trespassing

I phoned the number posted and learned from Mimi Courier that "we were given a lease by Paul Handverger to collect specimens to a depth of 25 feet." That apparently was worked out in the weeks just before he left for Alaska last month. Neither Carole nor Pete nor I knew anything about it. It certainly seems rude of Handverger to do that unannounced when the complaints for surface blasting noise are going to come to us, when misunderstandings with the state park folks are likely, and when Verde's financial gain is certainly most minimal but their liability risks are heightened.

DW:sk

Politician's home hit in drug raid

Prescott Sun 6-17-87



[redacted]

M E M O

TO: C.A. O'Brien, A.F. Budge

FROM: Don White

DATE: August 1, 1987

SUBJECT: Data on the Jerome slippage/subsidence history

Accompanying is one full set (to C.A. O'B.) of copies of the Jerome slippage information collected to date. It is a combination of data from our own search of the U.V.X. vault, from published sources, and, most recently from a chance meeting with Bob Rivera of COCA Mines. As Bob was clearing out COCA's Jerome office yesterday I spotted a file on Jerome subsidence. I recognized none of the contents and soon learned why. Bob copied it all from data Paul Handverger keeps at his house and has never indexed, mentioned, or otherwise made known to anyone. Bob Rivera only found it by renting Handverger's home for a year with allowance to use "very voluminous" files on the U.V.X. housed there.

Anyway, what I have copied from Rivera's file is mostly engineering information and testimony in the 1937-38 case, ultimately arbitrated by Joralemon, some of whose correspondence is included. Attached is a list of what has been copied from Rivera's (Handverger's) file.

Other data, less text and more map-based survey data, is included on large rolled maps at the top of the U.V.X. geology vault. None of them are reproduceables.

Early in July I photographed the more prominent cracks and damage to walls, roads, and buildings in Jerome just for the record. I will caption the prints and get you a set for the file.

DW:sk

Attachment

Jerome Slippage/Subsidence References

Anonymous, 1930. Memorandum on separation of slippage issue into fault versus landslide components. April 30, 1938. 1½ pages, typed.

Anonymous, 1938. Graph (cumulative curve) of percentage of total movement thru time from 1921 thru 1937, for UVX mine levels and surface. 8½"x11" graph.

Anonymous, 1938. Miscellaneous sketched cross sections of the Jerome land slide area. 8½"x11" captioned sketches.

Anonymous, 1938. Weather conditions and happenings, February 2__(?)th to March 5th, 1938. 1¼ page typed, dictated notes.

Anonymous, undated. Maps. 1) Town of Jerome and vicinity with drainage notes and topography and culture. 2) Nancy claim landslide, 1" = 50'.

Carr (?), A.B., 1937. Memorandum regarding conference with Mr. Leisk, Nov. 13, 1937. Mr. Carr is attorney (in Prescott) for U.V.X. 4 type-written pages.

Colvocoresses, George M., 1937. Letter reports to J.S. Douglas on "Jerome slippage." 1) April 16, 1937 - 4½ pages, typed. 2) May 13, 1937 - 21 pages, typed. 3) June 1, 1937 - 12 pages, typed. 4) Jan. 14, 1938 - 7 pages, typed.

Douglas (?), J.S., 1938. Letters to Colvocoresses and Leisk, Jan. 15, 1938. Handwritten. 1 p. to "Colvo". 3 p. to "Leisk".

D'Arcy (?), R.L., 1939. "Notes on United Verde Extension Mine", particularly concerning backfilling, subsidence and surveys. 1½ pages, typed.

Elsing, W.T., 1939. Testimony of witnesses, Small versus U.V.X. 46 pages of type-written personal notes of the witnesses statements and cross examinations.

Handverger (?), Paul A., 1971. Draft report on the UVX slippage history. Labelled "Appendix A", no date or identification except for P.A.H. initials and Jan., 1971 date on a sketch cross section. 14 pages, typed plus hand written notes and revisions.

Joralemon, Ira B., 1938. Miscellaneous correspondence to and from U.V.X. and P.D. regarding arbitration of slippage issue. March, April, May, 1938. 12 pages, typed.

Joralemon, Ira B., 1976. Adventure Beacons. p. 353-355 on the Jerome, UV, UVX arbitration case.

Leisk, R.D., 1937. Letter to J.S. Douglas, March 6, 1937 concerning town slippage observations and causes. 2½ pages, typed.

Waara, J. William, 1935. Statement of J. William Waara regarding Small Building, examined Sept. 13-14, 1935. Typed report. 15 pages plus 1 page notarization.

Waara, J. William, 1937. "High spots": by Waara. Summary of observations made upon P.D. data presentation (?) labelled "Jerome, April 16, 1937". 1½ pages, typed.

convince prospective clients that my head was more important than my weakening legs.

World War II made the transition more complete. After it there was less frequent adventure but the occasional journeys were even more exciting than before.

Joralemon, Ira B; 1976; Adventure Beacons

Valuation and Arbitration

The new sort of work that came first was valuation of mining properties, for purchase or as a basis for taxation. Few engineers had specialized in this branch of engineering before the war. I gradually worked my way into it through valuations for companies for which I was regularly employed. Then other companies hired me for important valuations. The most important of these commissions was valuation for tax purposes of all the branches of Phelps Dodge Corp. in 1934 to 1939. This was to support requests by the company for reduction in the value on which taxes were computed. The catastrophic drop in the price of copper during the Depression made relief imperative. The determining factor that would govern the value was the price of copper that might fairly be expected in the 10 or 15 years after the date of valuation. Because of cumulative interest the price and profit more than 15 years in the future had little bearing on the value. It took several years to prepare the suits for trial in Arizona courts. During this period valuations of the various great mines were more than cut in half after negotiations with the tax commissions.

The Phelps Dodge tax suits finally came to trial in Tucson in 1937 and 1938. It was evident that the value depended on the future copper price. C.K. Leith, one of the leading educators and engineers in the country, and I estimated the 15-year average price, beginning in 1933, as 10½¢ per lb. Engineers for the State Tax Commission thought it would be 12 or 13¢. The average 1933 price was 7.02¢. Wartime preparations caused a temporary copper shortage and a 13.1¢ average price in 1937 but then government price-fixing made the price drop to an average of 11¢ from 1938 through 1945. Leith and I did not have to be ashamed of our estimate. But the decision by the Arizona judge was that the Tax Commission could not be expected to foresee in 1933 the long dry spell for copper. Therefore the 12 or 13¢ average claimed by the state was not unreasonable, so we lost the final round in the contest. But we had already gained a big

decrease in taxes that made possible a profit during the prewar years.

I was later employed by Kennecott Copper to represent their Ray and Chino branches in tax suits. Both got good reductions.

Jerome

subsidence case

An important arbitration case concerned a landslide that had wrecked a large part of the center of the city of Jerome, Ariz. United Verde Extension had mined a great ore body down the steep mountain below the area wrecked by the slide and the United Verde branch of Phelps Dodge—an independent company when the slide started—had mined millions of tons of ore and waste from the mountainside above the slide. The situation was complicated by the fact that the great Verde fault outcropped just above the caved area and unusual rainfall had been accompanied by smaller slides below the fault, far from any mining. While the owners of the buildings wrecked by the Jerome slide would have a hard time proving that the mines were entirely responsible, the directors of United Verde Extension and Phelps Dodge agreed that as Jerome depended entirely on the mines that were nearing their end, it would not be fair to let property owners be ruined by the slide. Because of a large "slump" of the surface just above the Verde Extension stopes and down the mountain from the disastrous slide it seemed obvious that Verde Extension was at least partly responsible. Therefore it was agreed that Verde Extension would reimburse the owners of the wrecked buildings, but that without any publicity the companies would employ an arbitrator to decide the division of responsibility between the companies, and the decision of the arbitrator would be final. And they agreed on me as arbitrator.

I accepted the assignment on condition that my decision need not depend exclusively on testimony of the eminent geological experts employed by both parties, but that I might also take into account geological ideas of my own. This turned out to be fortunate. I spent weeks listening to the testimony of some of the best experts on geology in the country, and in visiting the mines and studying the surface. It was a lonely job because no one outside a few employees of the companies had any idea why the great battery of technical men had been brought together. If it had become known that both companies were accepting responsibility, the demands of the property owners would have been doubled. And in the interest of fairness I could not eat or associate in any way with friends on either side, seeing them only when several representatives of both sides were present. After the hearings were over I spent more weeks in my San Francisco office, studying the evidence and making a chart that showed all the events that had accompanied the years of the slide. It showed rainfall day by day for years, exact measurements of ground movement at many test points all around the slide area, monthly tonnages of ore mined by Verde Extension, monthly tonnages of ore and waste mined by United Verde in its open pit, and tonnages placed on waste dumps above and below the Verde fault, and all the other data I thought might be pertinent. I don't think there was ever as much information on one sheet of paper. Oh yes, the dates of all the big blasts in the United Verde open pit were also recorded.

When it was done we all, including expert witnesses, gathered again in Jerome. I gave each party a copy of my chart. The most important thing it showed, which neither party had noticed, was that there had been motion on the Verde Fault in the slide area at the time of the slide. And I concluded that if the motion had been due to events in the United Verde open pit, the motion must have continued a mile north of the damaged area in Jerome, to a point opposite the main part of the open pit and the big waste dumps the United Verde had placed on the hanging wall of the Verde fault. The comparatively recent Hopewell haulage tunnel crossed the fault in this area. If there had been fairly widespread movement on the fault at the time of the slide, there ought to be a considerable movement apparent on the fault in the Hopewell Tunnel.

United Verde engineers said they had never noticed any offset in this area. A trip underground would quickly settle the question. I could see that both parties were skeptical, but we loaded the whole group into a couple of cars, drove to the portal of the Hopewell Tunnel, and got into the train of man cars that was waiting for us. It took only a few minutes to ride to the projected position of the fault, which was marked by shattered rock. I got off the train, stood up on an ore car until my eyes were on a level with the bottoms of the horizontal timber caps, and sighted along the caps toward the fault. I had an engineer from each party hold a light just below the successive caps. For 200 ft the light stayed in sight, in line with the caps near me. Then, as the lights moved from cap to cap, they disappeared. A few feet further in, beyond the crushed area of the fault, I had the engineers drop their lights until they were in line with the bottom of the caps near me. The evidence was conclusive that there had been a downward movement of 14 in. on the east side of the fault after the timbers had been put in. A survey made later that day showed that the rails also had been gradually raised 14 in. as they crossed the fault. The

movement of timbers and rails had been made a little at a time by repair crews, without the knowledge of the management.

The movement of the Verde fault at the time of the Jerome slide and of United Verde activity in the open pit made it evident that Phelps Dodge should pay for at least part of the damage. Less important observations had suggested this, but not as conclusively. United Verde extension responsibility due to the fact that the slide ran right down into the area of subsidence over Verde Extension stoping was greater and more evident. After the Hopewell Tunnel expedition we adjourned the hearings and I went home to write my decision. It assessed two-thirds of the losses due to the slide to United Verde Extension and one-third to Phelps Dodge.

Within a couple of days after my formal decision reached New York I received a friendly wire from Louis Cates, president of Phelps Dodge, saying that my discovery of the recent movement on the Verde fault had convinced Phelps Dodge that they were partly responsible. They thought my decision was fair, and thanked me for the care with which I had studied the case. A couple of days later I received a rather peremptory wire from Jim Douglas, president of United Verde Extension saying that the recent motion on the fault changed the whole question of responsibility, and that therefore I should reopen the entire inquiry to give their experts a chance to show that all the damage should be paid for by Phelps Dodge. Of course I said I could not do this. I was a bit irritated because without my deduction that the fault had moved Verde Extension would have had almost no case at all. I felt much better when, a couple of days later, as I was starting with my family on a vacation trip through Europe, another wire came from Jim Douglas wishing us a happy tour and saying they accepted my decision. This was characteristic of my good but sometimes demanding friend Jim Douglas.

Vacation in Ireland and Europe

We were happy to have a trip to Europe. It would mark the end of our close relation with the young, before Molly started work at Radcliffe and Peter at Phillips Andover for a year before Yale. And we had been working hard, Dorothy on constructions for the 1939 Exposition at Treasure Island, and I with the Jerome arbitration.

A fortunate offer added to the enjoyment. A wealthy Bostonian,

M E M O

TO: Carole A. O'Brien, A.F. Budge

FROM: Don White

DATE: September 21, 1987

SUBJECT: Status of J.V. Proposal to Phelps Dodge for exploration at the U.V. Mine, Jerome.

I phoned Bob Ludden, the P.D. Western Exploration Mgr. in Tucson and querried him as to what he knows of our proposal's status. He responded that there has been "no decision" and that the mood is "certainly not negative."

Apparently Jon DuHamel is slated to look over the old data they have related to the chert distribution and precious metal grades. He hasn't been able to get to that, but may do so in October. Bob suggests that Paul Lindberg will likely be called upon for advice too. Then the geologic recommendation will be passed along from Bob Ludden to Don Ranta and Pat Ryan and more administrative sorts for a decision on the corporate policy toward a lease or joint venture of their own property, a definite break from tradition.

The basis of their consideration of any lease or J.V. is the smallness of the target relative to their aspirations or corporate needs, a point I used to get our shoe in the door when they visited June 5th. They have let four months elapse without even a reply to my last letter and so I pointed out to Bob that within a few more months we shall be substantially along on the U.V.X. drilling and that only 1 to 2 years need elapse before the higher grade areas could be mined out and Budge gone from the camp. He acknowledged that a decision too late on their part may be useless, and promised to bring it up again with Don Ranta and to let us know when anything is decided. But decisions will only come after Jon DuHamel's and Paul Lindberg's review. So I'll bug them later in the year to see how that stands.

DW:sk

MEMORANDUM

TO: Carole A. O'Brien

FROM: R.W. Hodder and D.C. White

DATE: October 31, 1987

SUBJECT: Review of current memoranda, drill holes 809-8 and 809-9, plus 902-1 and 902-2.

Introduction

Since our last joint review memorandum of September 3, 1987, 2 of 3 recommended holes in the 809 zone have been drilled and 2 of 11 recommended holes have been drilled in the 902 zone. The drive on the 950 level to the 911 drill station has penetrated chert with gold in the south part of the 1205/Gold Stope zone and is 20 feet north of the planned location of the 911 drill station. In addition M. Janeck has commented on direct mining costs and because this comment contains some misconceptions of previous work we begin with it.

1) M. Janeck memorandum of October 2, 1987.

Page 1, 5th paragraph, line 3, Mr. Janeck states "Reserves are considered as drill indicated." This may be his consideration but it is not implied in our statements to date except for the M-3 zone where we felt the density of drilling and the construction of plans and vertical cross sections provided the control for such a calculation. We have been careful to call estimates of tonnage and grade in zones other than M-3, "estimates of potential" as in Table 2, our memo of September 3, 1987.

Also in the 5th paragraph, lines 6 through 9, Mr. Janeck notes an apparent discrepency between a total potential of 468,000 tons of 0.22 ounces of gold equivalent per ton in Table 2 and 532,000 tons of 0.21 ounces of gold equivalent per ton in Table 3. There is no discrepency. Table 2 is titled "Comparison of Successive Estimates of Potential in Verde Area" and the derivation of the 468,000 tons is explained as a potential for the Verde Area only. Table 3 is titled "Gold reserve totals for the UVX project, updated to September 3, 1987" and the derivation of the 532,000 tons is shown as Verde area potential plus that of the 1205/Gold Stope and the Florencia areas.

Page 2, 2nd paragraph, raises the problem of fire underground becuase of the combustability of massive sulfide. There is an inference here that past operations of UVX had fires or fire hazards. This was certainly so at the United Verde where the main orebody was massive sulfide. Fire did not occur at the UVX where percautions were taken within the main copper orebody and where there is virtually no sulfide mineral content in the silica-rich areas under current exploration. We are distrubed to see this non-issue raised at a time when the real issues of defining potential warrant full attention.

Page 2, 4th paragraph, line 2, "ore bodies in the vicinity of 11,600N; 6,900E are rather flat...." Actually in this southeast part of the 809 zone dips are steep.

Although it is not our place to comment on direct mining issues, they are important in the definition of ore which is a joint exploration and engineering function. Hence, we are concerned that Mr. Janeck's memo does not fully appreciate what can go down or come up the existing shaft, as he suggests (page 2, last paragraph) using stope jumbus and load-haul dumps which would be a problem to get underground and (page 3, paragraph 7) that present plant capacity is 30 to

50 tons per 24 hours. This tonnage is currently hoisted in just a few hours. Consideration of a new shaft throws a new light on potential at UVX and would require a much expanded exploration target. We would like to see the definition of ore refined on the basis of the type of material, its size, shape, and grade, so that we can reasonably estimate reserves as the data are gathered. For this, direct negotiations with smelter customers must be recommended.

We do echo Mr. Janeck's concern for the problem with accurate location of present headings underground relative to old workings and do press for a reconciliation of surveys as soon as possible so that proper plans and sections will be ready when reserve calculations are to be done.

2) Drill holes 809-8 and 809-9.

Hole 809-8 was drilled at +33° from the 809 station to test the updip extension of intersections in hole 809-2 which was drilled at +23° from the 809 station. (fig. 1, RWH & DCW, Sept. 3, '87)

Hole 809-2 had the following intersections

Block 1, 19' true width, 0.33 oz/t Au, 1.4 oz/t Ag, 0.35 oz/t Au(eq), 2% Fe
Block 3, 12' true width, 0.07 oz/t Au, 2.0 oz/t Ag, 0.10 oz/t Au(eq), 4% Fe

Hole 809-8 had the following intersections

Block 1, 5' true width, 0.21 oz/t Au, 1.6 oz/t Ag, 0.24 oz/t Au(eq), 3% Fe
Block 3, 4' true width, 0.15 oz/t Au, 5.6 oz/t Ag, 0.24 oz/t Au(eq), 3% Fe

Hence, hole 809-8 diminishes width and grade of Block 1 and the width of Block 3, but increases grade of Block 3. In Block 1, grade x width for hole 809-2 is 6.6 and in 809-8 it is 1.2. In Block 3, grade x width for hole 809-2 is 1.2, and for hole 809-8 it is 1.0. A revision of the estimate of potential and calculation of a drill indicated reserve will follow reconciliation of surveys and construction of plans and vertical sections.

In hole 809-8 gold in excess of 0.10 oz/t occurs in and adjacent to a beige massive and banded chert breccia. As noted previously (Sept. 3) this rock type is typically barren.

Hole 809-9 was drilled at -5° and directed 20° south easterly of hole 809-3 from the 809 drill station. Hole 809-3 was not used in the September 3rd estimate of potential in the 809 zone as its 2 gold-bearing intersections are en echelon to the north and east and not contiguous with intersections in hole 809-2, the closest of the holes which define the 809 zone.

Hole 809-3 has the following intersections

7' true width of 0.21 oz/t Au, 0.4 oz/t Ag, 0.22 oz/t Au(eq), 3% Fe
5' true width of 0.15 oz/t Au, 1.5 oz/t Ag, 0.18 oz/t Au(eq), 5% Fe

Hole 809-9 had the following intersections

28' true width of 0.21 oz/t Au, 0.09 oz/t Ag, 0.21 oz/t Au(eq), 2% Fe
26' true width of 0.19 oz/t Au, 1.2 oz/t Ag, 0.21 oz/t Au(eq), 3% Fe
These are contiguous intersections and together are
54' true width of 0.20 oz/t Au, 1.0 oz/t Ag, 0.22 oz/t Au(eq), 2.5% Fe

The current interpretation is that these 2 holes may indicate a separate, en echelon part of the 809 zone, or that it may be an up plunge extension of the north end of the M-3 zone. We will be looking at these possibilities during map construction after reconciliation of underground surveys. The configuration of the diorite is critical in this area but from the present data compilation does permit continuity of the M-3 zone through holes 809-3 and 809-9 into the 809-zone.

3) Drill holes 902-1 and 902-2.

Hole 902-1, drilled S5°E and +40° is the first test of the 902 chert zone. It is collared in diorite at the 902 drill station, cut 165' of chert, and ended in the 824 stope. Most of this is the grey chert breccia, which, next to gritty chert breccia has been the most auriferous material encountered. However, in 902-1 there are only 3 assays intervals with more than 0.10 oz/t Au:

91-93,	0.199 oz/t Au,	7.82 oz/t Ag,	3% Fe
93-96,	0.11 oz/t Au,	1.68 oz/t Ag,	10% Fe
and 207-209,	0.102 oz/t Au,	2.65 oz/t Ag,	10% Fe

The visual inspection of the core from this hole is much more encouraging that the assays. There are significant assays in old working within 40 feet of the 207-209 interval in hole 902-1 and the impression is that a hole slightly more easterly and at a lesser inclination would intersect these permissive rocks with a greater gold content. We have seen this several times in the drilling program, most recently in the reverse sense where hole 809-8 has less gold in 2 separate intervals than the previously drilled, less inclined hole 809-2. The point is, we do not understand the gold distribution and cannot count on empirical relationships to hold over short distances. We will be looking into the similarities and differences in the chert breccias of holes 809-2 and 809-8.

Hole 902-2 has just terminated in tectonicly brecciated chert between hanging and footwall strands of the Verde fault and was to be the test of the area between fault strands. Assays are not yet in hand. There is approximately 15' of good looking gritty chert east of the hanging wall strand of the fault but none between fault strands where the hole terminated.

4) The 991 crosscut toward the 911 drill station.

The 906 crosscut has been reopened on the 950 level and sampled where it crosses that breccia on the south extension of the 1205/Gold Stope zone. These samples are reported in the DCW figure of October 19, 1987 in which the most significant are is 10' true width of 0.49 oz/t Au, 3.3 oz/t Ag for 0.55 oz/t Au(eq) in gritty chert breccia.

The new drive has left the old 906 at the west contact of hanging wall chert with diorite and is proceeding southeasterly as the 991 crosscut, totally within chert breccia. Assays have not yet been received for samples of the 991 crosscut. One striking feature of chert breccia in this new drive is the preponderance of beige massive and banded chert breccia in a hematite-rich matrix, and the increasing matrix support and vugginess of the breccia as are proceeds south. The openess of the breccia may reflect proximity to the Florencia fault, or something more primary.

Recommendations

1. Clearly the surveying has to be done now to resolve location of drill statons and new and old workings. We need to construct a new base at 1" to 40', or preferably 1" to 20' for reserve calculation in the near future and right now for location of drill holes relative to old workings and target zones. If other work precludes this work by staff then we would recommend it be done by contractors available as close as Mayer or Prescott.

2. Base map preparation which will be the foundation of planning and reserve calculation needs to be underway as soon as the survey grids are reconciled. It is recommended that DCW hire a draftsperson to make level plans at 1" to 40' of mine workings and drill holes with assay intervals as soon as possible. Otherwise we foresee a bottleneck upon completion of current drilling. DCW does not have the time to prepare the base maps while drilling is in progress.

3. Reserve calculations will benefit from an economic definition of ore, a definition which will extend the consideration of the natural cutoff in grade we have used to date in estimating and projecting potential. It would be of great help to have discussed the reasonableness of the smelter flux product originally envisaged versus a a multiproduct concept or a gold-only operation. The alternative is to do a reserve statement expressing the various options of products but it would help to guide this with a realistic look at what might be profitably marketed.

M E M O

TO: Carole A. O'Brien, A.F. Budge, A.J. Fernandez

FROM: Don White

DATE: May 11, 1987

SUBJECT: Suggestions made by Herb Welhener and other thoughts related to U.V.X. mining

Herbert E. Welhener and associate, Jack Riddle, both mining engineers, met with Joe and me at the UVX on Thursday, May 7, 1987. The main purpose of their visit was familiarization with the M-3 zone, its access, geometry and dimensions, internal and wall rock characteristics, and other factors affecting its mining. They have been asked to recommend a mining plan for the M-3 zone.

A number of other issues had to be touched on in the course of discussion. In so doing, Herb made a number of recommendations of merit:

1) Rock density measurements - The M-3 zone includes low density silica grit (perhaps 16 ft^3/s.t. because of its porosity) and high density ferruginous chert (maybe only 10 ft^3/s.t.) ore types. Some quantification of this is in order. It will refine our reserve calculations and improve mine planning.

2) Rock quality determination - RQD logging should be integrated into my core logging routine as an aide to mining studies. Herb promised to send me forms and instructions to facilitate RQD logging.

3) Strength tests - Unsplit drill core from key rock types in future holes should be sent out for strength tests. Sheared samples can be returned if assays are needed upon the same material.

4) Subsidence documentation - The whole issue of mining near the Verde fault and beneath the town of Jerome was pivotal to the day's meeting. Our mining will be miniscule compared to that of immediately adjacent silica ore stopes, but we could easily be used as scapegoats for any damages at the surface. For that reason Herb's points are well taken in that we should document, both by surveys and photographs, all that we can related to subsidence. This should include underground surveys, surface surveys in the mine area and town, and photographs of the fault traces and foundation damage now in evidence. Such documentation will at least clear us of responsibility for those damages that precede our mining.

   Attached are two extracts pertinent to subsidence and surveys. The one by Joralemon refers to the 1939 legal precedent established by out-of-court settlement between the town of Jerome and the P.D./U.V.X. companies. The other by D'Arcy discusses

U.V.X. backfilling procedures, their effectiveness, and monitoring of subsidence.

5) Backfill sources - We will produce some waste as part of development efforts. Where practical, this can be utilized underground, even if it means hoisting from the 950 to 800 level, to avoid more cumbersome surface handling and shaft transfer.

The P.D.-owned tailings from the United Verde/Clarkdale mill might well be considered. Those tailings are a subject of current concern to environmentalists critical of P.D.'s land trade proposed wherein Copper Basin BLM lands would be consolidated by P.D. in exchange for, amongst other parcels, the tailings adjacent to Tuzigoot National Monument. The tails are viewed as a chemical "hazard" (same type as being ground up and acidified by Ironite at the Iron King Mine and sold as lawn and garden fertilizer) and dust source and hence may be available free of charge (or even at "negative cost" if someone dislikes the tails enough; e.g., P.D., towns of Clarkdale/ Cottonwood, state of Arizona). Perhaps some sampling of the tails for grain size and chemical analyses should be initiated and, if appropriate, negotiations with P.D. started.

6) Possible leach pad available - Pete Flores, in the course of checking out rail sidings and haulage routes, noted the concrete leach pads near the Hopewell tunnel portal. They are P.D.-owned, former copper leach pads, unused since at least the early fifties. They are not too far away and in a rather remote canyon, ideally suited to a gold leaching site. If tests reveal we should plan toward our own leaching of certain ore types, we may well want to approach P.D. about this.

7) Need for down-the-hole survey instrument - As exploration drilling advances we may find increasing need for more accurately surveying our drill holes. M-10 and M-11 are examples of holes where accurate locations would help geologic and reserve interpretations.

On the 806-1 hole in January, 1986 we borrowed the Stan West Corp. single-shot camera survey instrument. That performed well. Their office could not be reached when needed during the M-10 or M-11 drilling. Rentals require considerable lead time and are expensive. We might will consider owning our own instrument for this and other projects.

DW:sk

MEMO

TO: C.A. O'Brien, P. Flores

FROM: Don White

DATE: May 6, 1988

SUBJECT: John Bruno of Jerome

Over the course of three years work at U.V.X. I have come to know "Giovanni", the nickname for an approximately 55-year old artist in Jerome. He takes walks early morning and late afternoon every day, taking him past the U.V.X. where he habitually visits if I am splitting or logging core.

Giovanni is having a hard time supporting himself on art alone and inquired about watchman/security work and/or gopher-type jobs.

I suspect he is quite reliable and trustworthy as I have had him do several favors for me and he has always come through with promises. He has been in Jerome many years and Sedona for a decade or so before that. He offered references if needed.

While I see no present need for a guard between shifts or on weekends, should it become necessary, I believe Giovanni would be a good one. I recommend this letter be kept in the personnel file as a reminder of his availability. He says he'd work for about $5-$6./hour. Giovanni is:

John Bruno
Box 987
Jerome, AZ 86331
(634-7060)

DW:sk

M E M O

TO: Carole A. O'Brien, Anthony F. Budge

FROM: Don White

DATE: November 15, 1987

SUBJECT: Visit to the U.V.X. by Dan Maxwell

Dan Maxwell of Southwest Exploration, Inc., Silver City, NM, visited the U.V.X. for better than half a day, Nov. 12, 1987. At Carole's request I gave him a complete tour and listened to any comments he had. Some reactions he had are worth passing along.

1) The timbering now being done in areas of bad back is not proper. He feels the using of 2"x8/10" and 3"x8/10" on their broad sides is overly costly and not as strong in the event of heavy ground. He says lagging should not be used for timbering high backs, rather he recommends 4"x6" or 4"x8" timbers resting on their narrow sides to minimize timber cost and maximize strength.

2) His impression of the track work is poor. He says the turns and switches in particular are not suitable for production haulage. Indeed my own experience is difficulty in negotiating many spots with light rolling-stock and I notice drill steel (pry-bars) at many sites, indicative of frequent derailments. I have also noticed several locomotive derailments at key places, both time consuming and hazardous. Pete's crews are clearly hired from drifting backgrounds and lay rail only for lack of anyone else to do so. Improvements in the rail system will be required as production nears.

3) Rail grade control has been almost non-existent. There is still no system for laying rail at predetermined gradients as required for linkages of tunnels being worked on from opposite ends to form a circuit (as on the 902-W, 950 level).

4) Blast-hole drilling in chert is going to be a major cost/time factor in overall mining costs/plans. Caving of the holes upon withdrawal of the drill steel, or even inability to withdraw the drilled steel, is now costing much time, broken steel, etc. The sooner systems are worked out to handle chert drilling the better. Many parameters may be varied. Bit type (button vs. chisel vs. knockoff cross-type) water usage, hole diameter (fewer, larger blast-holes may be advantageous) and possible use of sleeves, disposable or reuseable, are all to be considered.

5) Dan suspects that heap leaching may be a viable alternative for that portion of UVX reserves amenable to leaching (mainly the silica grit; no crushing or grinding needed, high recoveries probable - one bottle roll thus far suggests 93% recovery of Au in first 24 hours). He suggests costing this alternative (his estimate about $5./s.t. including plant and operating costs) and consideration of the Martin Limestone terraces just NE of the UVX (below Bell's houses, on Verde property) as sites within 0.1 mile of gentle downgrade haulage with intrinsic safety in that the limestone would neutralize any HCN leakage.

6) We talked about the smelter flux market and the chemical characteristics of flux that are deleterious. In that context our iron content was covered, and I was referred onward to Mr. Eric Partelpoeg, Asst. Supt. of P.D.'s Hidalgo, NM Smelter (505-436-2211). Mr. Partelpoeg confirms that indeed iron in any form, sulfide or oxide, is deleterious in that it consumes energy and increases the mass of slag. However, our iron oxides will not aggravate any SO_2 emissions problem. Our nearly alumina-free, high silica, high gold and high silver values have sufficient appeal that the standard smelter flux contract (all we have looked at thus far) is not sacred. Mr. Don Farquhar of P.D.'s Morenci office (602-865-4521) who apparently would head up any flux contract negotiations for P.D., would probably consent to an increased iron allowance in light of the chemical characteristics and quantity of UVX flux available. This needs to be investigated.

DW:sk

DCW

Don White
521 E. Willis St.
Prescott, AZ 86301
602-778-3140

November 30, 1987

Daniel L. Maxwell
SOUTHWEST EXPLORATION, INC.
P.O. Box 3026
Silver City, NM 88062

Dear Dan,

I enjoyed meeting you at the U.V.X. in Jerome. I hope the information over the phone was adequate for your proposal to inspect the old workings of the Josephine. As I dug further in the vault it seemed there was enough to warrant a record for everyone's convenience. Hence the attached memo and sketches.

Do not hesitate to call me in Prescott or Jerome if I may be of any further help on this or other issues. I look forward to our working on something in common one day.

Sincerely,

Don White

Don White
Geologist, C.P.G.

DW:sk

cc: Carole A. O'Brien

Don WAIDE

NOTES ON THE UNITED VERDE EXTENSION MINE — Probably by Mr. R.L. D'Arcy
~ 1939 UVX Chief Mine Engineer

The United Verde Extension Ore Zone occupies an area in the hanging wall of the Verde fault about 1500 ft. along the strike of the fault by 600 ft. across. The ore is located in an area of Precambrian schists.

Ore has been mined from the 1900 level to above the 800 level in the schist areas, the bulk coming from between the 1600 and 1100 levels. Some ore has also been mined from the 700 to 300 level in a conglomerate formation in the north end of the ore zone. Producing levels

The mine has produced 4,110,000 wet(?) tons of ore. The main orebody produced 2,100,000 tons, in round numbers; the 819 orebody, in the quartz area above the main orebody, produced 200,000 tons. North of the main orebody, the 1507 veins produced 350,000 tons, the 1207 country 475,000 tons. The remainder, some 475,000 ore tons come from smaller orebodies scattered thruout the mine. Production ~75%! 819- 1507-Vein 1207

Mining in the main orebody began in 1916. Stopes were started in the central portion of the orebody and also near the west edge. Later stopes were started in the east end of the orebody. From then on mining consisted in whitling slices off the ore mass until it was mined out. The mining was carried in steps, so the operations of the different levels did not interfere. The result was that the 1300 level was mined slightly ahead of the 1400, the 1400 ahead of the 1500, and so on. Mining methods

The ore was mined by the ordinary square set method, with a Mitchell slice used in mining some of the pillars.

Over a period of years it was established that 90% of the square sets mined were filled; and that better than 90% of each set was filled [12 to 13 - 17 cu.ft. cars per set]. The fill may be assumed to compact 20%. The amount of compacted fill then is .9 x .9 x .8 = .648 or 65% of original volume. The timber left in the stopes will run from 8 to 9% by volume. Assuming 50% of the timber rots out, there remains 4% as fill. This leaves voids of 31% of the excavation. Backfilling

The fill was obtained from the usual development work consisting of drifts raises and shafts, and a surface glory hole. Considerable waste was also sorted out in the stopes, in the outside orebodies.

The excavation made thru mining is very nearly 36,000,000 cu.ft. or 1,333,000 cu. yds. A figure of 9 cu.ft. was used in estimating ore reserves. In estimating ore production a figure of 30 tons per square set of 247 cu.ft. was used. This method was used over a period of many years, and production figures checked very closely with shipments to smelter. This gives 8.25 cu. ft. per ton. Allowances for a certain amount of overbreak in mining raises this figure to 8.7 or 8.8. Volumes & density

After mining operations had been carried on for a few years a cave developed in the quartz area above the main orebody. This cave extended up thru the quartz and finally checked itself in the schist areas which it encountered from the 1100 level up. The mining of the smaller orebodies did not develope caves, except of very local character. Caving

30 tons per square set in sulfide ore

The effect of mining operations has been to cause a sag in the overlying rock formations with the greatest sag directly over the main orebody, diminishing from this point in all directions. Subsidence

In the fall of 1921 the U.V.X. began the development of two new levels, the 950 and 550. These levels were driven for prospecting purposes. Both of these levels passed over the Main Orebody area. A level record dated March, 1918 of a frog at 816/817 in this area gives the elevation as 4340.33. The next record, dated September, 1921, gives 4340.19, a difference of .14 ft. in a 3½ year period. This marks the beginning of sagging of the formations. The next record, dated January, 1924, gives the elevation as 4339.29, a difference of .90 ft. over the 2 year, 4 month period. Sometime during 1923, a dislocation of the hanging wall of the fault was noticed at the old U.V. hospital, at a point 800 ft. above the described area on the 800 level. This is the first recorded instance of movement of the hanging wall block, to our knowledge.

The hanging wall block involved in the sag has settled slowly and very evenly. On the Bitter Creek Tunnel elevation the drop on the fault is about 2.5 ft. on the footwall proper and about 1 ft. on the hanging wall slip. On the east side there has developed a more or less vertical fracture, extending from below the 1300 to above the 550 level. To the south there is no discernible break on any level. The formations here simply sagged. This is also the case on the north end, with the exception of the 950 level, where some cracks have appeared in a quartz area in that end. The area involved is roughly 800 ft. x 1100 ft. on the 950 level. On the surface it comprises the area between School Gulch to the south, Bitter Creek to the east and north and the Verde fault to the west. The greatest amount of sag on the 950 level of which we have record is 14 ft. This amount is carried up past the 800 level. On the 550 and Bitter Creek elevations the sag amounts to about 12 ft.

During the years that the movement of the hanging wall block has been in progress extensive development work and mining has been carried on in the block.

It necessitated raising track and backs of drifts from time to time. But the movement has been so even and gradual that the rock structure within the block is still virtually undisturbed in the Precambrian from the 950 level up, and but very little disturbance is shown in the conglomerate and lava above. This condition also persists on the surface along the Daisy road and in the hillside above.

I. C. 6250

February, 1930

DEPARTMENT OF COMMERCE

UNITED STATES BUREAU OF MINES
SCOTT TURNER, DIRECTOR

INFORMATION CIRCULAR

MINING PRACTICE AND METHODS AT THE UNITED VERDE EXTENSION MINING COMPANY, JEROME, ARIZ.

BY

RICHARD L. D'ARCY

I.C.6250.
February, 1930.

INFORMATION CIRCULAR

DEPARTMENT OF COMMERCE - BUREAU OF MINES

MINING PRACTICE AND METHODS AT THE UNITED VERDE EXTENSION MINING COMPANY, JEROME, ARIZ.[1]

By Richard L. D'Arcy[2]

INTRODUCTION

This paper describing the mining practice and methods at the United Verde Extension mine, Jerome, Ariz., is one of a series of papers in preparation by the Bureau of Mines presenting the mining methods used in various mining districts of the United States.

The United Verde Extension mine is a massive, high-grade deposit of copper sulphide containing some gold and silver and is mined almost exclusively by the conventional square-set method with some local modifications.

About 450 men are employed underground and 1200 tons of direct smelting ore is produced per day. Figure 1 is a surface map of the Jerome district.

ACKNOWLEDGMENTS

The author acknowledges the assistance of Olaf Hondrum, chief engineer, and Roy H. Marks, efficiency engineer, United Verde Extension Mining Co., and also that of E. D. Gardner, supervising engineer, and C. H. Johnson, assistant mining engineer, U. S. Bureau of Mines, Tucson, Ariz.

HISTORY OF DISTRICT

The development of the Jerome mining district as an important source of copper, gold, and silver dates from the development of the mine of the United Verde Copper Co. This mine was located in 1876 and worked in a small way at shallow depth for its gold-silver values until purchased in 1889 by Senator W. A. Clark of Montana. Production from this mine increased steadily, especially after 1894, when the narrow-gauge railroad from Jerome Junction was built. From 1900 to 1918, inclusive, the mine produced slightly over 7 million

1 - The Bureau of Mines will welcome reprinting of this paper, provided the following footnote acknowledgment is used: "Reprinted from U. S. Bureau of Mines Information Circular 6250."

2 - One of the consulting engineers, U. S. Bureau of Mines, General Superintendent, United Verde Extension Mining Co.

tons of ore containing 750,000,000 pounds of copper, 12,374,000 ounces of silver, and 403,000 ounces of gold. Recovery per ton for this period was about 100 pounds of copper, 1.75 ounces of silver, and 0.057 ounces of gold. From 1918 to date the United Verde has been one of the most important mines in Arizona, and the total metal value of its product probably has been greater than that of any other mine in the State.

The success of this mine encouraged capitalists to attempt to find other important ore bodies in the district; this led to the development of the United Verde Extension, the second large mine of the district.

The United Verde Extension mine was brought to successful production through the efforts of James S. Douglas and associates, who assumed the financing of the property from the time when it was a small prospect. Their efforts were rewarded in December, 1914, by the discovery of a small high-grade vein of chalcocite. Finally in January, 1916, a big lens of high-grade chalcocite was opened up on the 1400 level. This lens, when fully outlined on this level, proved to be oval, with a maximum length of 500 feet and a maximum width of 300 feet. Virtually all of the lens was clean, high-grade ore. From then on the mine rapidly became an important producer.

Production started in 1915 and has been maintained ever since. From 1915 to 1928, inclusive, the mine produced slightly over 2,000,000 tons of ore containing approximately 535,000,000 pounds of copper, 4,100,000 ounces of silver, and 76,000 ounces of gold, with a gross metal value of approximately $98,000,000. 2.05 oz/t 0.038 oz/t

GEOLOGY

The geology of the Jerome district has been described in detail by L. E. Reber, jr.[3] The Verde fault is perhaps the most striking structural feature of the district. This fault strikes about N. 40° W. and can be traced on the surface for miles. The dip is about 59° to the northeast. It is a normal fault, and has a known vertical downthrow of approximately 1,600 feet.

The United Verde mine is immediately west of the fault; that is to say, it is located in the footwall, while the United Verde Extension mine is close to the fault in the hanging wall.

The fault is directly responsible for the discovery of the United Verde mine. It cut through the mineralized zone, dropping the section to the east 1,600 feet, as has been stated, leaving the greater portion of the zone in the footwall but exposing it in the newly-formed hillside.

The geologic section (fig. 2) at right angles to the fault shows the sequence of the geological formations. The United Verde Extension shafts go through lava, conglomerate,

3 - Reber, L.E., Jr., Geology and Ore Deposits of the Jerome District: Min. and Met., May, 1920.

limestone, and sandstone before encountering the pre-Cambrian rocks about 600 feet below the surface. The general distribution of the pre-Cambrian formations is shown in Figure 3, a plan of the 1400 level. The principal types of rock are diorite, quartz porphyry, greenstone, and schist. Greenstone is a name given to a variety of complex rocks, from fine-grained greenish black basic rocks, to light-colored rocks resembling rhyolites. Probably the schist is mainly altered quartz porphyry and altered greenstones of the more acid types. It is in the schist that most of the ore in the district is found.

METHODS OF DEVELOPMENT AND MINING

Development

The mine is operated through two vertical 3-compartment shafts and a large cross-section haulage adit connecting both shafts on the 1300 level. Both shafts are of concrete, located about 200 feet apart and 1,000 feet north of the main ore-bearing zone. This location has been very satisfactory because the shafts have been in firm rock from collar to bottom; conditions have been ideal for the rather elaborate system of ore and waste pockets, skip-dump pockets, transfer raises, and tunnel-loading pockets immediately adjoining the shafts.

The layout of ore pockets at the Audrey shaft is shown in Figure 4. Ore from below the tunnel level is hoisted in 3-ton skips running in counterbalance to a point above the 1100 level; the skip is dumped by movable guides which show red lights in front of the hoisting engineer when in dumping position and green lights when the shaft is clear. The ore passes from the dumping point to an air-operated deflecting door on the 1100 level, which turns the ore one way or the other as desired. Three converging pockets meet just below this deflector, two for sulphide ore and one for silica converter ore. From these pockets the ore is loaded into trains of standard-gauge cars in the main haulage adit on the 1300 level. Control at this point is by means of finger gates made from bent 70-pound rails operated by air cylinders.

The main tunnel is 2-1/4 miles long and approximately 10 by 10 feet in cross section. Some sections of the tunnel are of solid-concrete arch construction, and others are timbered with 12 by 12 inch sets on 5-foot centers. About 4,000 feet is rock section with gunite coating, and the remainder is unsupported rock section.

From the portal of the tunnel a standard-gauge railroad connects with the smelter at Clemenceau about 5 miles distant (fig. 1). Haulage through the tunnel is with a 25-ton electric motor handling trains of eight 30-ton cars, which are made into trains of 16 cars each at the portal and taken to the smelter by a steam locomotive.

Levels are run on the 550, 800, 950, and 1100 foot elevations and on 100-foot intervals from 1100 to 1900 feet, inclusive. These elevations refer to distances below the collar of the Daisy, an old prospect shaft. The actual depth of each level below the collars of the Edith and Audrey main shafts is about 200 feet less than indicated. The main producing levels in the big ore lens are the 1300, 1400, 1500, and 1600. Production from outlying smaller ore bodies extends from the 550 to the 1700 levels.

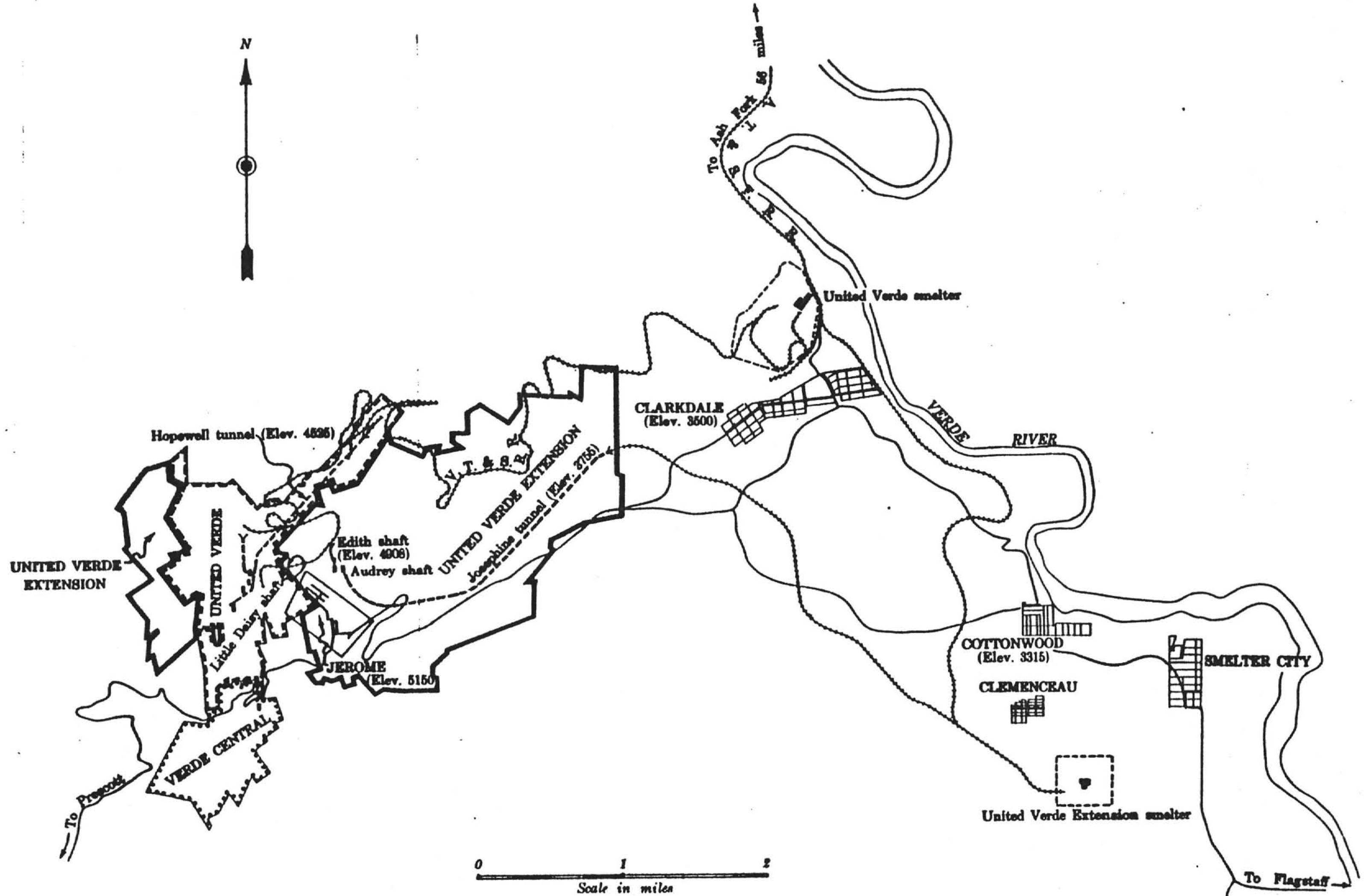


Figure 1.– Map of Jerome district

Development details

Shafts

As stated before, both main shafts, known as the Audrey and Edith, are of solid concrete. The Audrey is the ore-hoisting shaft, while the Edith is used for handling men and supplies and development waste. The Audrey is operated one shift and the Edith three shifts per 24 hours. The Audrey shaft was equipped after the ore was found and was concreted immediately, but the Edith was sunk for prospecting purposes and was at first timbered. Later, it was concreted, and Figure 5 shows a cross section of the completed concrete. The changing of this shaft from timber to concrete was done partly on a cost-plus basis with a contractor in charge of the job, and partly by a picked mine crew working under a bonus agreement. A comparison of these two methods is rather instructive and is favorable to the bonus work, where each man participated in the benefits. Shaft-sinking has since been done under a similar agreement, with very satisfactory results.

Following are details of the shaft concreting costs:

Edith shaft concreting

Three-compartment shaft (2 hoisting compartments 4 feet by 5 feet 6 inches, and 1 manway and pipe compartment 5 feet 2 inches by 5 feet 6 inches), shaft wall containing 6 pipes in sizes varying from 2 to 8 inches.

Shaft concreted from 1400 level to surface, a distance of 1205 feet, including 7 stations.

Work started February 1, 1921; completed July 25, 1921.

Work was done in two sections; first section from 800 to surface, 575 feet on contract basis, second section, 1400 level to 800 level, 630 feet, was done on bonus basis on footage made per day.

The actual cost of mixing and placing the concrete in each section, not considering the preliminary cost of installing the crushing plant, removing old pipe lines, and placing guides and chairs in the concreted sections, was in each instance as follows:

1st section

575 feet, including 2 stations.
Work started February 1, 1921; finished
April 21, 80 days.
Average advance, 7.19 feet per day.

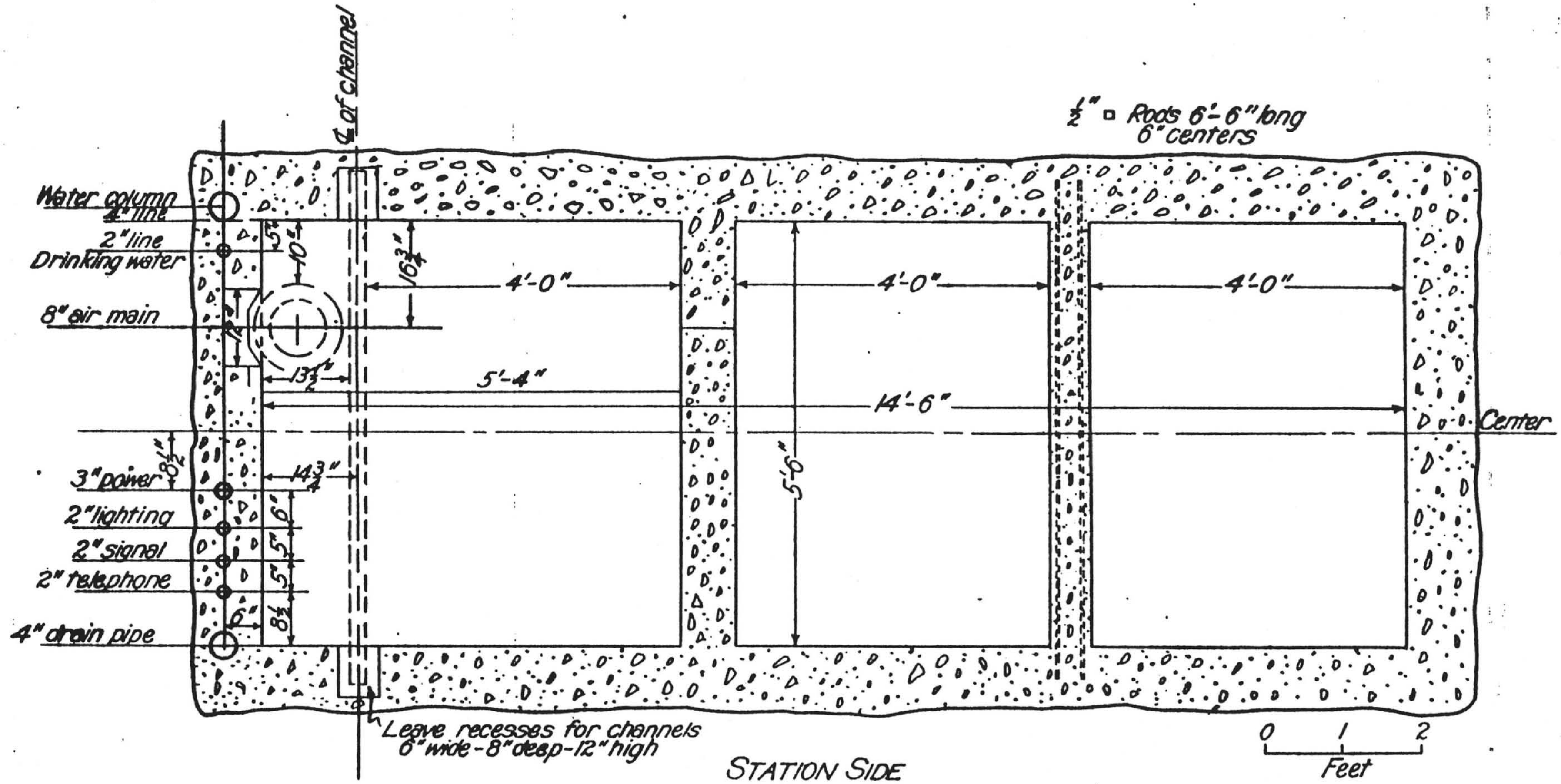
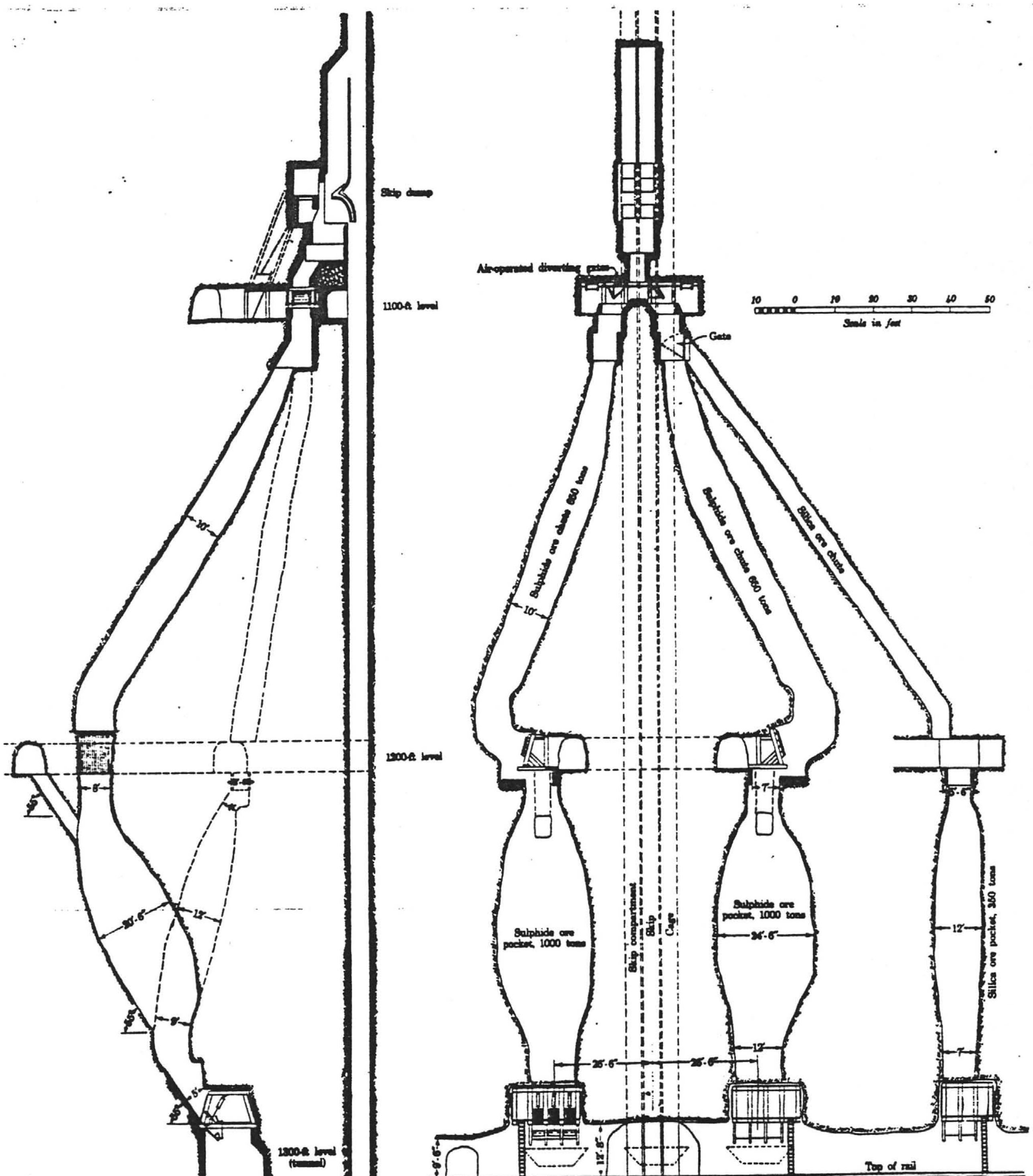


Figure 5.-Section of concrete, Edith Shaft



PROJECTION LOOKING SOUTH

PROJECTION LOOKING WEST

Figure 4.– Loading pockets at Andrey shaft

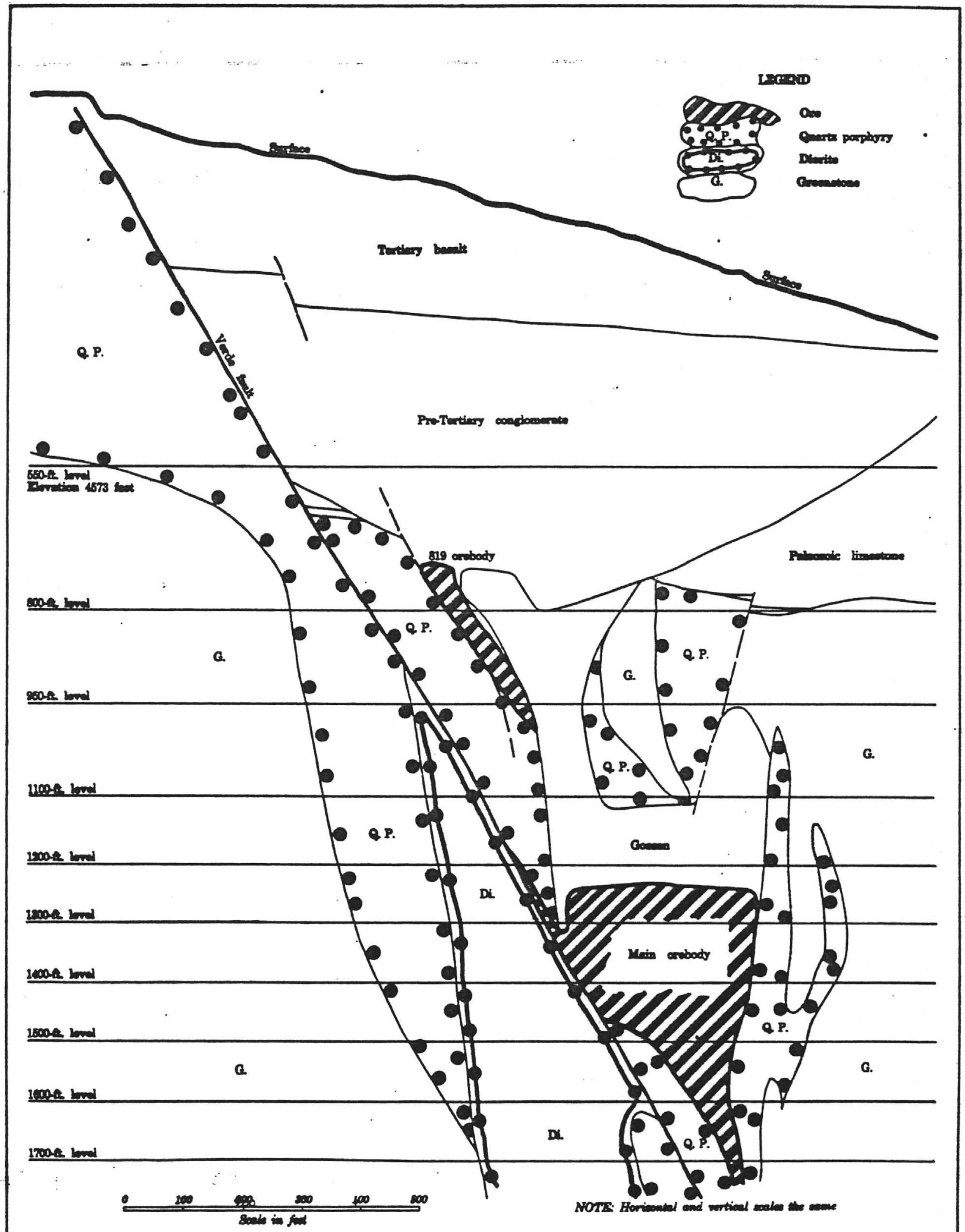
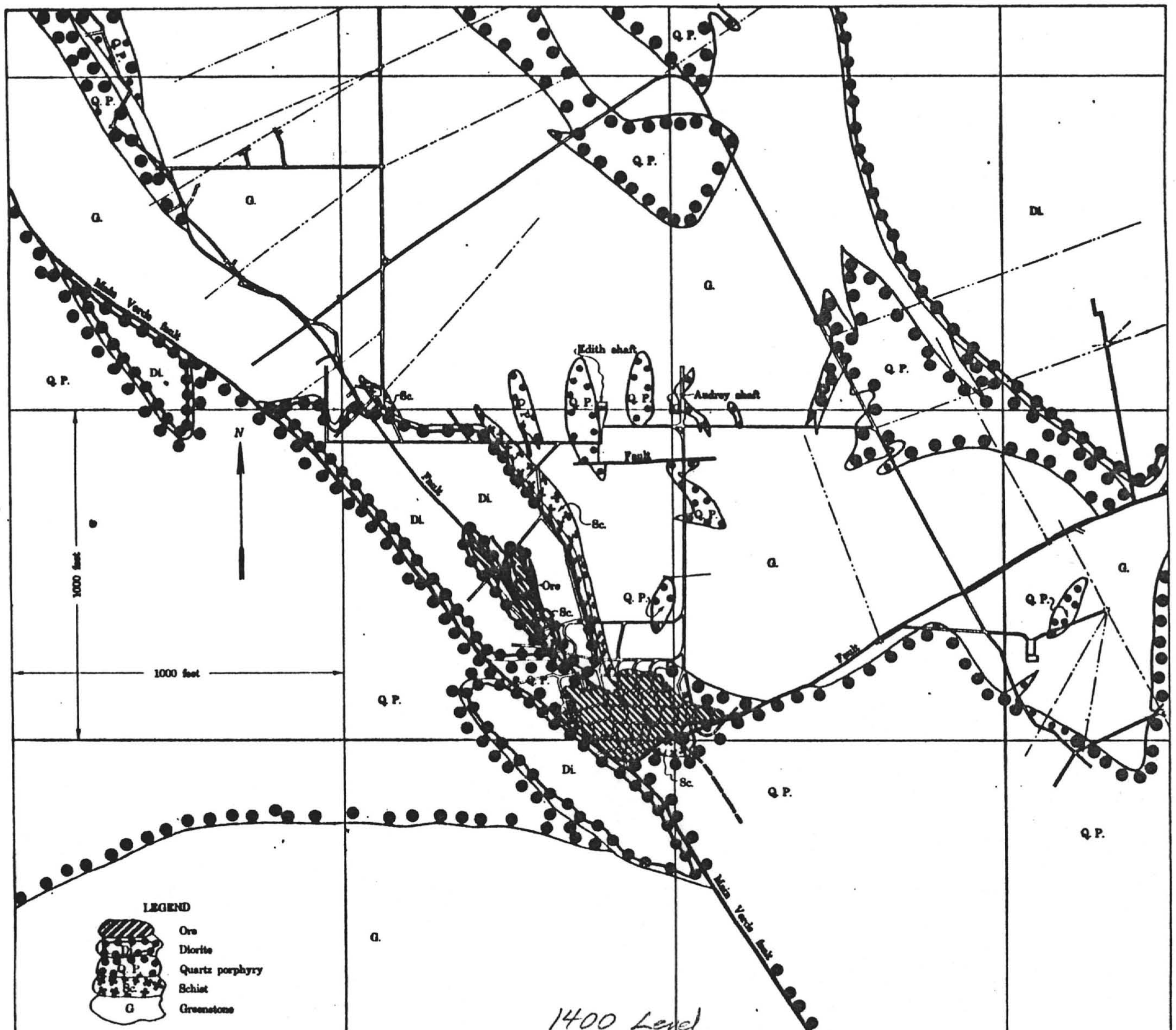


Figure 2. – Vertical geologic section (N. 45° E.) through main orebody



1400 Level

Figure 3. – Geologic plan of typical haulage level

Costs

Labor (including supervision at $10 per day)	$8,827.20
Cement (6,564 sacks at $1.10 per sack)	7,220.40
Sand and gravel, (1,498.1 yds. at $2.50 per yd.)	3,745.25
Power used hoisting and crushing (25,380 kw. h. at 2¢ per kw. h.)	507.60
Reinforcing iron, 10 lb. per ft. of shaft at 10¢ per lb.	575.00
Form lumber $1.50 per foot shaft	862.50
Bonus paid	3,075.00
Total cost for 575 feet	$24,812.95
Cost per foot	$43.14

2d section

Distance concreted, 630 feet, including 5 stations.
Work started May 1, 1921; finished July 25, 1921, 86 days.
Actual time of concreting this section of shaft, after deducting the time lost in cutting new stations, was 69 days, or an average per day of 9.13 feet.

Costs

Labor (including supervision at $225 per mo.)	$5,068.50
Cement used (6,256 sacks at $1.10 per sack)	6,881.60
Sand and gravel (1,434.5 yds. at $2.50 per yd.)	3,586.25
Power used hoisting and crushing (29,310 kw.h. at 2¢ per kw.h.).	586.20
Reinforcing iron, 10 lb. per ft. of shaft, at 10¢ per lb.	630.00
Form lumber (640 ft. of shaft at $1.50 per ft.)	945.00
Bonus paid	2,056.50
Total cost of completing section	$19,754.05
Cost per foot	$31.35

Mixture used was 1 part cement, 2 parts sand, 5 parts crushed rock, or 5-1/3 sacks of cement, 10 cubic feet fines, and 23 cubic feet crushed rock per yard of concrete in place.

Drifts

Many different rock conditions are found in the mine, varying from very hard quartz gossan to extremely heavy swelling ground. To meet these conditions several kinds of standard drift timbering are in use. Figure 6 (a), (b), and (c) show the various sets used for (a) a small prospect drift, (b) an ordinary hand-tramming drift, and (c) a motor drift;

also (d) shows the use of old rails or pipe in place of lagging in ground that is very soft and inclined to swell. It has been found that by using rail lagging in swelling ground the soft ground squeezes through between the rails, and very little pressure develops on the set itself. Figure 6 (e) shows a method of timbering in soft ground which is not bad enough to require spilling and still needs some support overhead. This is provided by carrying sliding booms over the sets which are pushed ahead as needed.

In the main haulage tunnel several different types of support were used, two of which are shown in Figures 7 (a) and (b).

Guniting

Guniting was used very successfully in a section of the main tunnel 4,000 feet long. This part of the tunnel was through an old recemented river-channel conglomerate, which was comparatively hard when first broken but after exposure to air and moisture tended to slack and slough. Had this not been gunited it would have needed timbering through the entire section. The gunite has now held for over 10 years. If this section had been supported by timber it would have needed at least one complete renewal of the timber. Gunite has been applied in other sections of the mine with little success, due to slight ground movements, that break the gunite and render it useless in a very short time.

A record of the cost of guniting this 4,000-foot section of the main tunnel follows.

Size of tunnel	10 by 10 feet
Footage gunited	4,098
Mixture used	1 cement to 3 sand
Applications	2 coats

Costs

Labor	$2,581.29
Cement (2,056 sacks at $1.10 per sack)	2,250.60
Sand (263 yds. at $2.50 per yd.)	657.50
Machinery repairs and supplies	282.84
Total cost	$5,772.23
Cost per linear foot of tunnel	1.40
Cost per sq. ft., approximately	.046

Bulkhead drift sets

A system of holding extremely heavy gangways through the pillars in the main ore body is shown in Figure 8. It has been found that solid timber bulkhead built as shown, using the waste ends of timber that accumulate in a mine of this kind, will hold a ground pressure that would break ordinary heavy timber sets several times a year. In fact, on one level a section of this kind of bulkheading put in on one side of a drift opposite a solid

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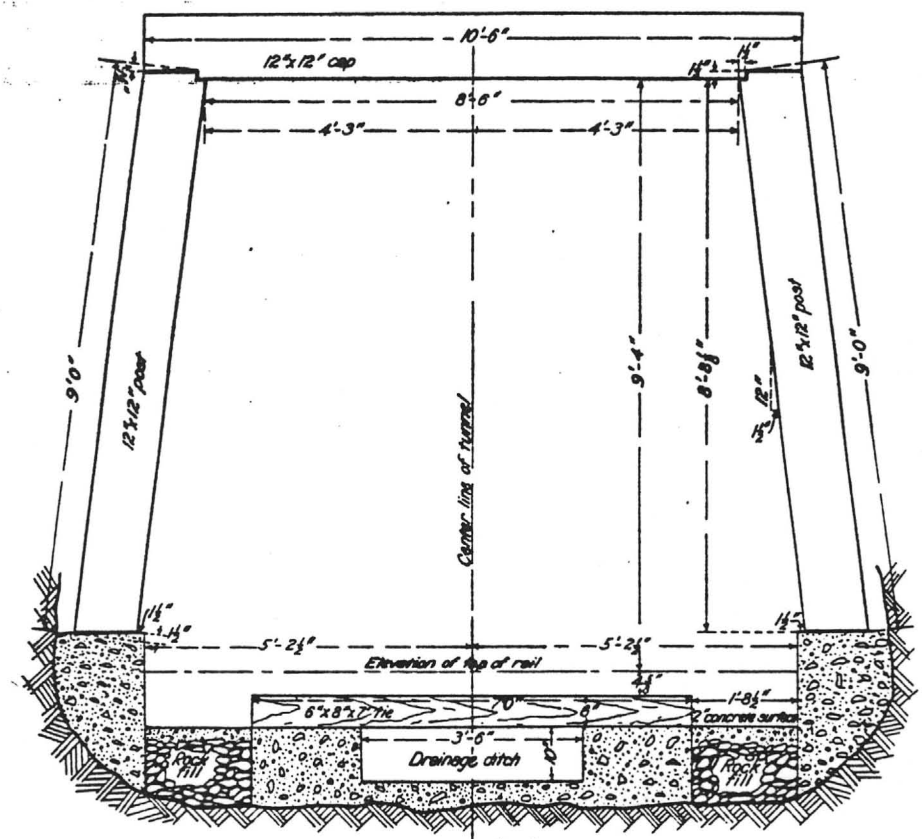


Figure 7-A.-Standard 12"x12" Tunnel Timber

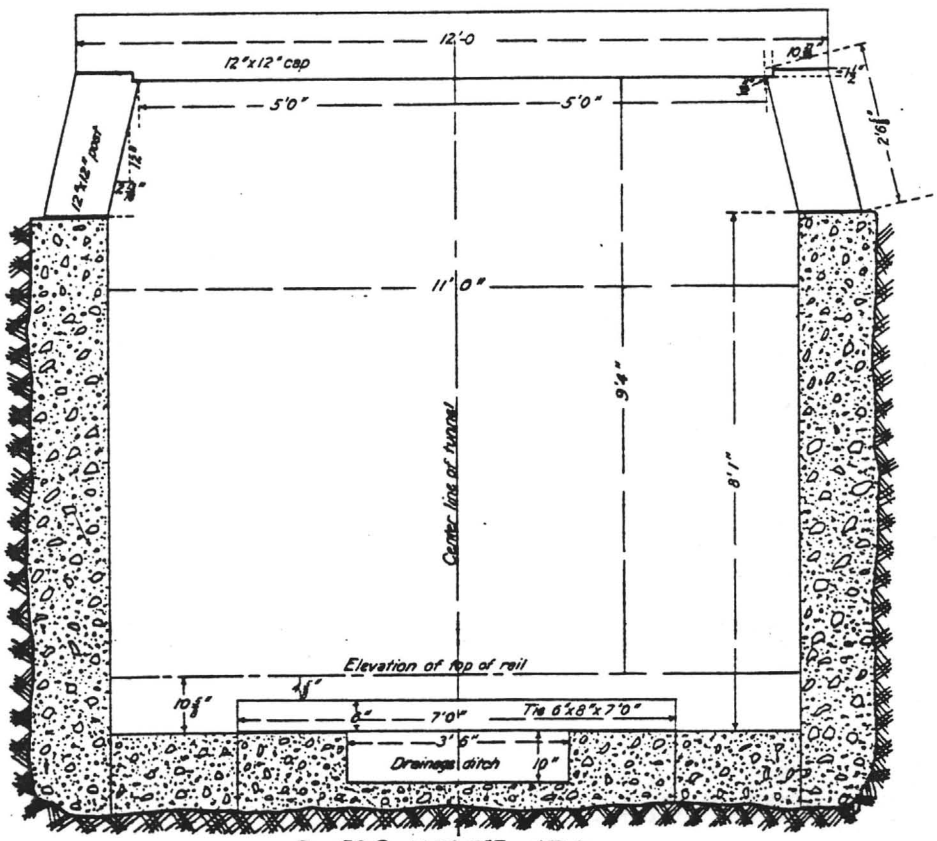
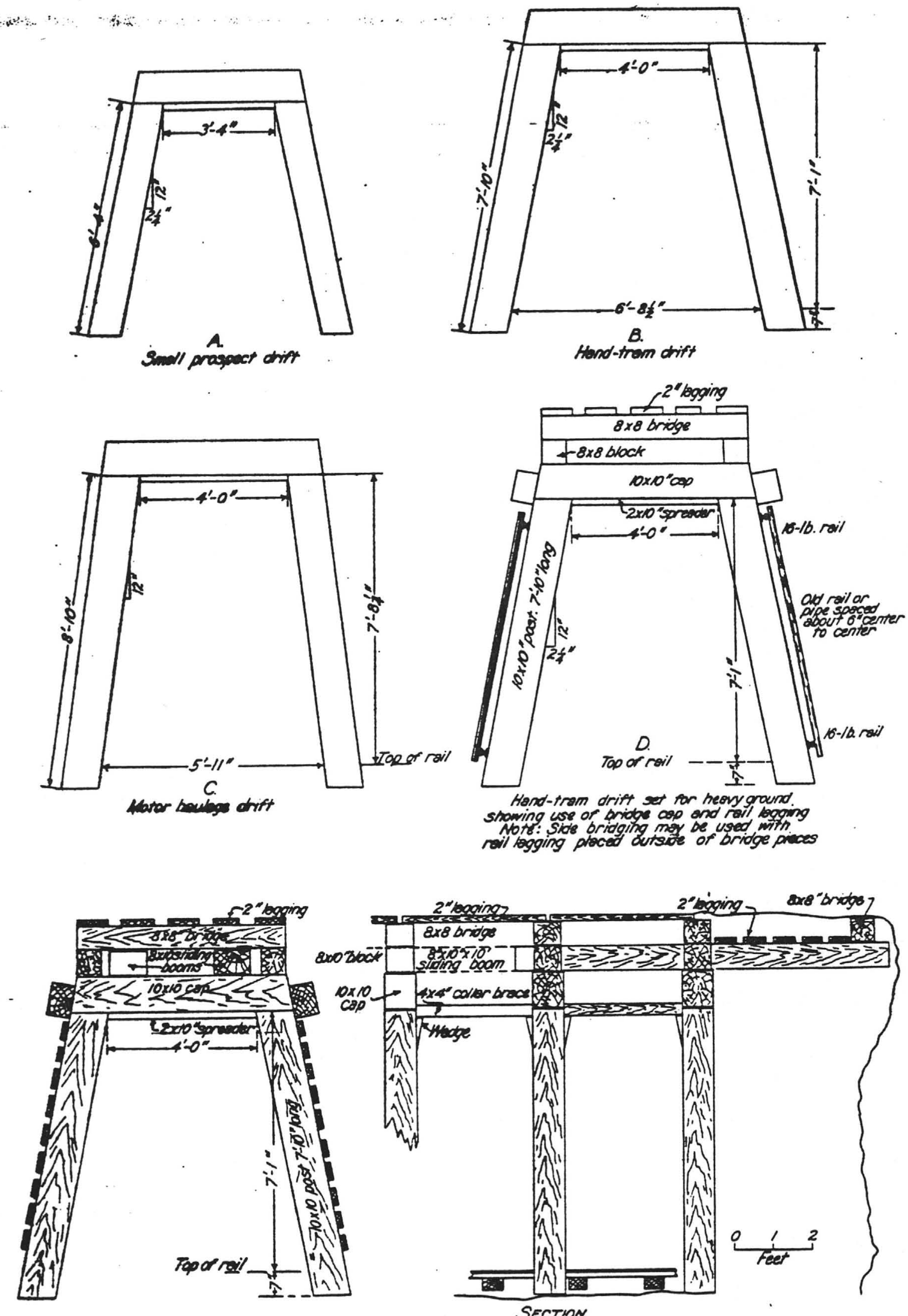


Figure 7-B-Special 12"x12" Tunnel Timber



E: Sketch of sliding booms used over top of drift sets in heavy ground

Figure 6.-Drift Timbers

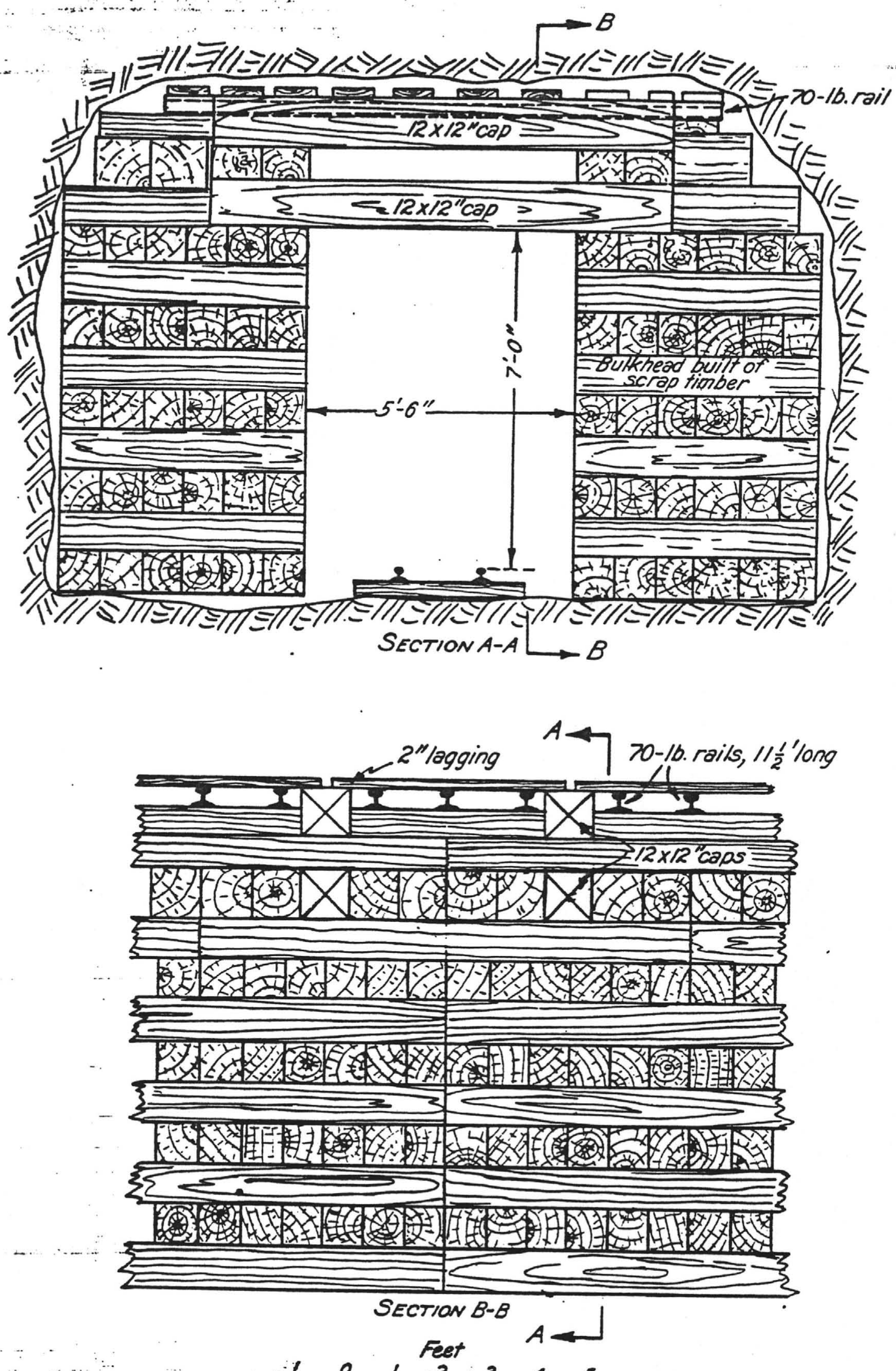


Figure 8.-Timber Bulkhead

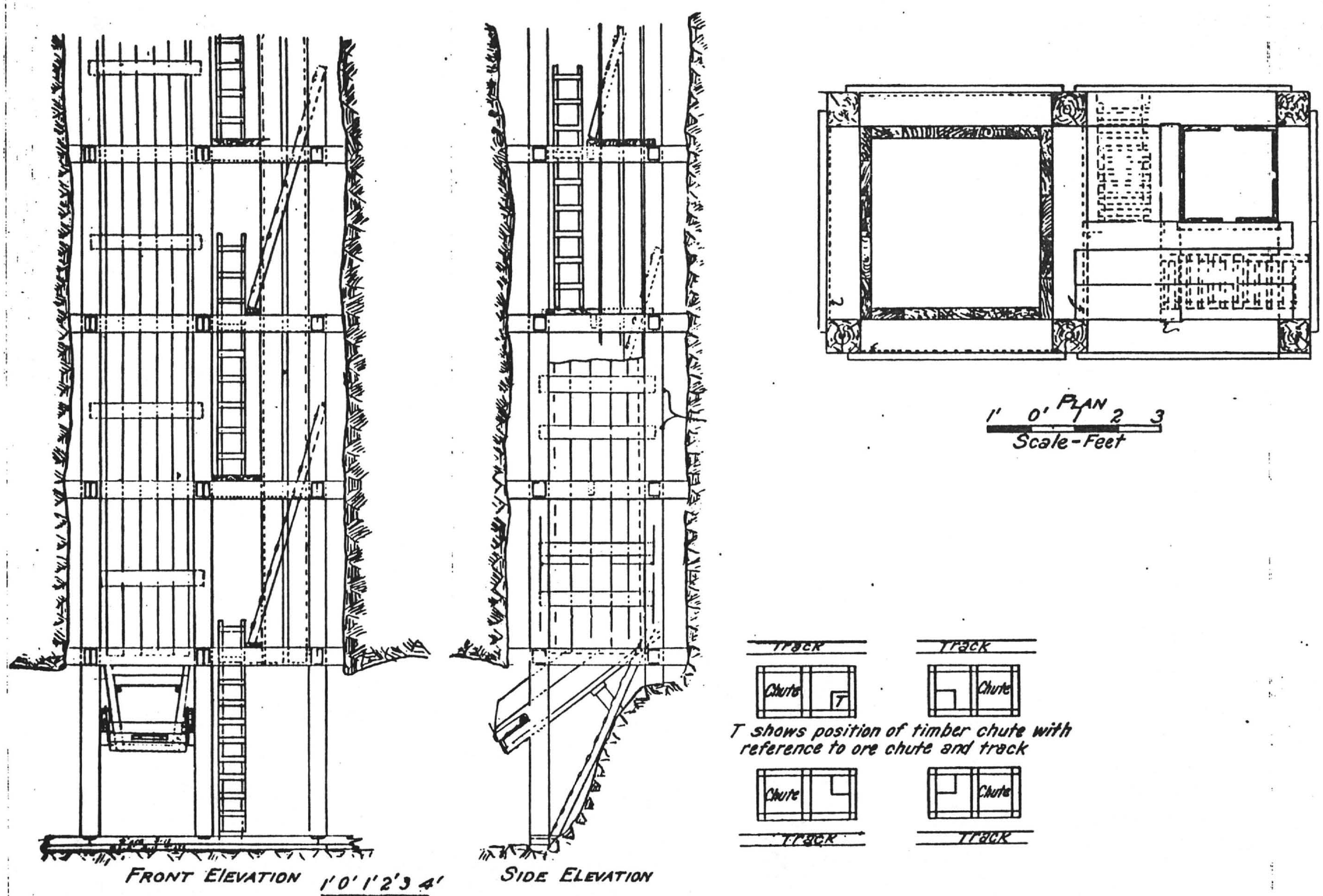
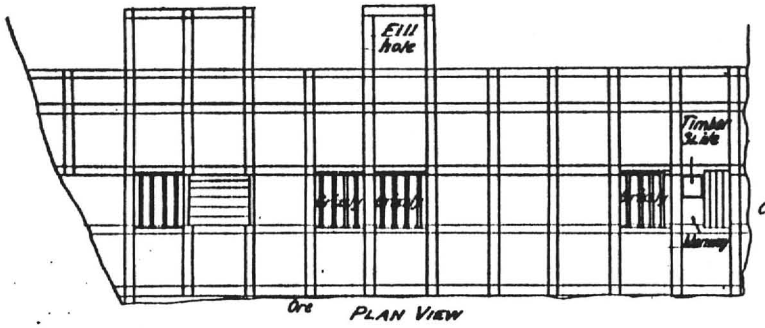


Figure 9. – Standard six post squares raise with safety manway



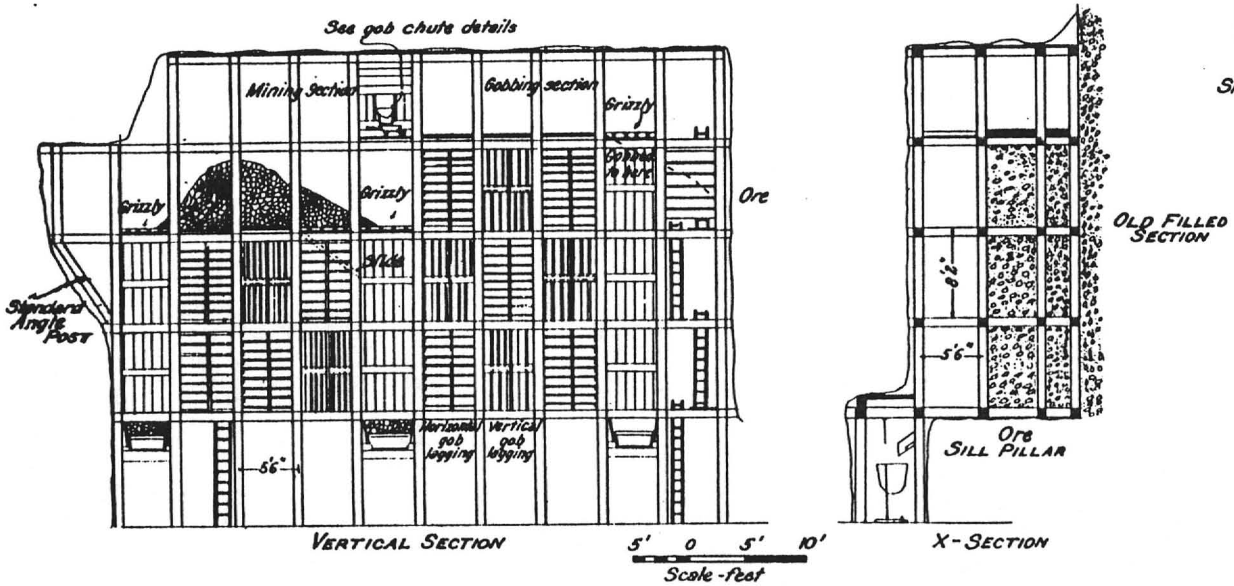


Figure 10-A: Typical Square Set Stoping Method

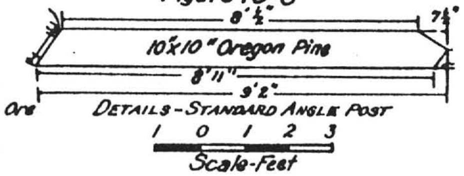


Figure 10-C

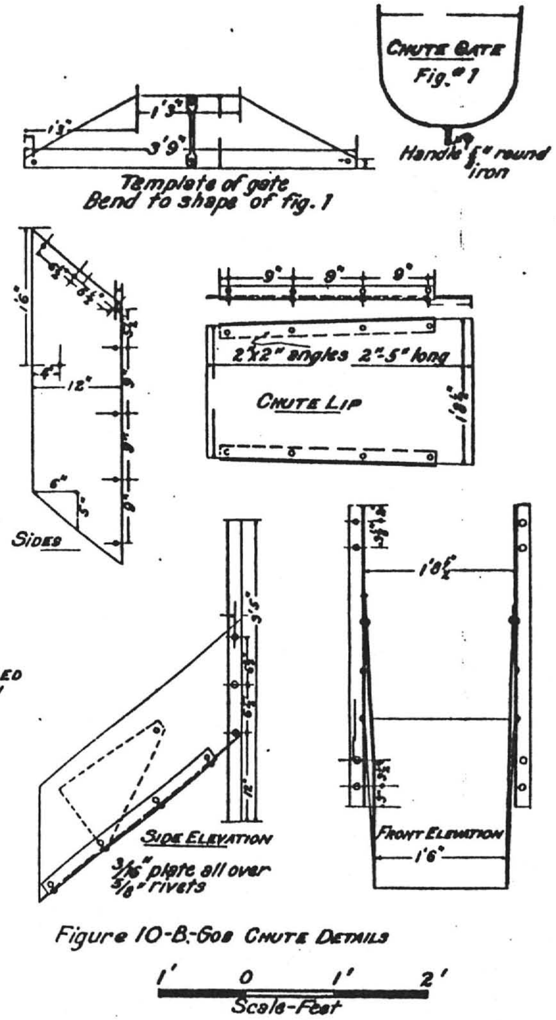


Figure 10-B - Gob Chute Details

reinforced concrete bulkhead 5 feet thick has stood the strain very well, while the concrete has been forced out of place and cracked and has had to be blasted away to make clearance for gangways.

Raises

Three kinds of timbered raises are run in the mine. Wherever the work is to be followed by square-set stoping the standard 2-compartment square-set raise shown in Figure 9 is used. The chute compartment is lined with 2 or 3 inch Oregon fir lining, depending upon the service expected. The manway provides a timber slide in one corner and has landing platforms on each floor. In addition to the square-set raise two kinds of cribbed raises are in use. The smaller raise is timbered with 3-inch Oregon fir cribbing, giving two compartments 3-1/2 by 3-1/2 feet in the clear. For heavier use cribbing is made of 6 by 8 inch material and compartments are 4 by 4 feet in the clear.

Stoping

Because of the heavy massive nature of the main ore body, the richness of the ore, and the necessity for mining in such a way that no blocks of sulphide ore are allowed to move and generate heat only the square-set system of mining with stopes tightly filled with waste has ever been used in the main sulphide lens. By using the square-set system of mining with stopes tightly filled with waste complete extraction of the main ore body has been possible with practically no dilution. Moreover, this system has allowed careful prospecting of the walls, which has resulted in finding many small rich lenses of ore that would otherwise have been missed.

A typical stope is shown in plan and section in Figure 10 (a). The stope sections are usually 3 sets wide in fairly solid ore and 2 sets wide in the heavier ground. If the ore is very badly broken it is sometimes removed in slices a single set in width. Slices are taken 100 feet high, as that is the interval between levels throughout the mine. The length of the slice may be anything to suit the conditions, usually being from 10 to 20 sets. Ore chutes are placed in about every fourth set, and alternate chutes have manways beside them. By spacing chutes in this manner and leaving slides with grizzlies in adjoining sets as shown the shoveling of ore into chutes is virtually eliminated. If no weight develops on the timbers after one floor is removed another is removed and sometimes several more before filling with waste. This reduces the cost of mining, as most of the ore rolls to the chutes, and a large part of the fill can be run into place by gravity. When several floors are mined before filling the timber is protected from the fall of the blasted ore by placing grizzlies of 70-pound rails, 6 feet long, held in metal holders, immediately below the mining floor. By using metal holders the grizzlies are moved very readily and placed where needed. After one section is finished it is filled entirely, except the chutes and manways needed for entrance to and mining of the next slice. The chutes also serve for fill holes for running waste into the new section. By having a fill hole in about every sixth set and mining several floors before filling there is very little shoveling of waste fill. If conditions are such that the waste will not spread a light metal gob chute is placed in the fill hole and the waste spread with a car or wheelbarrow. Figure 10 (b) shows the details of the chute gate.

All timber used in stoping is standardized (fig. 11). Figure 10 (c) shows a standard angle post for offsetting a set. In the heavier sulphide stopes nearly all timber is 10 by 10 Oregon fir, but in the lighter ground much 8 by 8 Oregon fir is used. In the heaviest sill-floor gangways all timber is of 12 by 12 dimensions.

Although the general method of mining used is the well-known square-set system several modifications have been developed locally to apply to conditions existing in this particular ore body. A general technique of mining under this system has been developed, which has an all-important bearing upon the efficiency and safety of the mining, especially in holding the unmined pillars so that there is no movement of ore, with resultant heat and danger of fire.

A system of mining badly broken pillars by stoping up through the center with small square-set cuts, then tying across the top with timber stringers and slicing the sides downward, has been quite successfully used. This method is shown in Figure 12. On most of the producing levels in the main ore body the mining has been done in such a way that pillars usually about six sets wide have been left over the main extraction gangways, extending vertically from level to level. These pillars have been standing for many years while the ore on both sides and on the level above has been removed. Resultant movement has in many instances thoroughly broken these pillars so that they would be very difficult to mine by ordinary square-setting from the bottom upward. Moreover, the gob lining between the pillars and old stope sections is often found to be rotten and broken. By taking a small square-set slice up through the middle of the pillar, using as a cutting point the old chute and manway in the section previously mined and filled, then tying across the top under the old filled level above and coming down with a series of 10 by 10 timber stringers from pilot sets to the old gob line, it has been found that these pillars can be removed very effectively. Quite often this ore between the sets and the old gob can be taken down by the use of a bar alone, without using explosives at all. If the old gob line is broken or rotten it is braced back by stulls between the stringers and new cross lagging. After one-half is finished it is filled with waste dumped in from the level above and the other half mined the same way. After all the mining is completed everything is filled except a chute and manway on the advancing side to be used as a cutting point for the next slice.

Underground transportation

Main haulage levels in the main ore body are maintained on the 1400 and 1600 levels, and the ore from the levels above is passed through a series of transfer raises. Haulage on these levels is done with 5-ton trolley locomotives running on tracks with 30-pound rails and minimum curves of 25-foot radius. The car used in this haulage is the 30 cubic foot side-dump car shown in Figure 13. Cars of this type have been in continuous operation for 12 years and have proved satisfactory. Chute doors used throughout the mine are illustrated in Figure 14. This type of chute door was copied from one used in the United Verde mine. The same type of door, operated by an air cylinder, is in use on most of the main haulage transfer chutes. A 16-cubic foot car used for hand tramming is also shown in Figure 14.

On other levels where the tonnage produced is much less and where the working

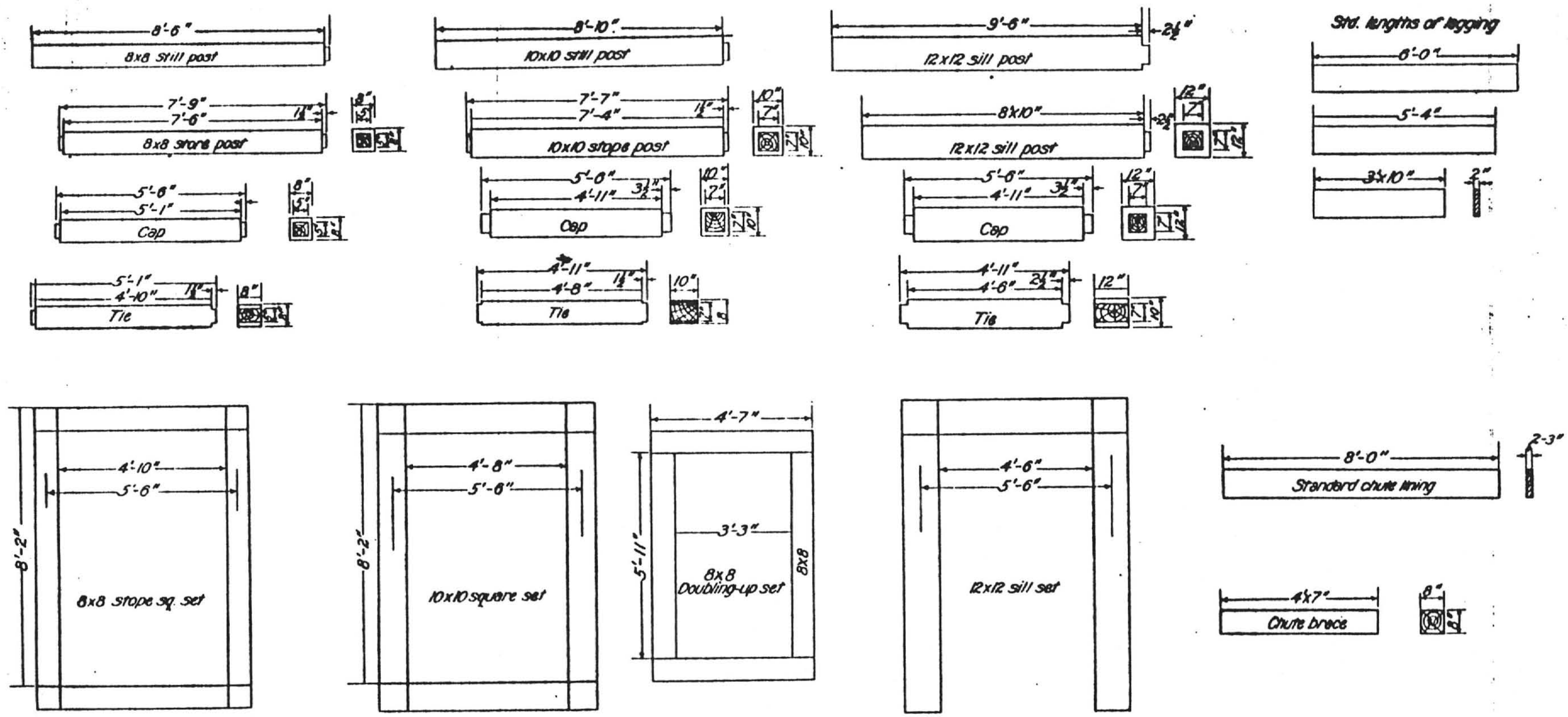


Figure II. - Standard Stope Timber

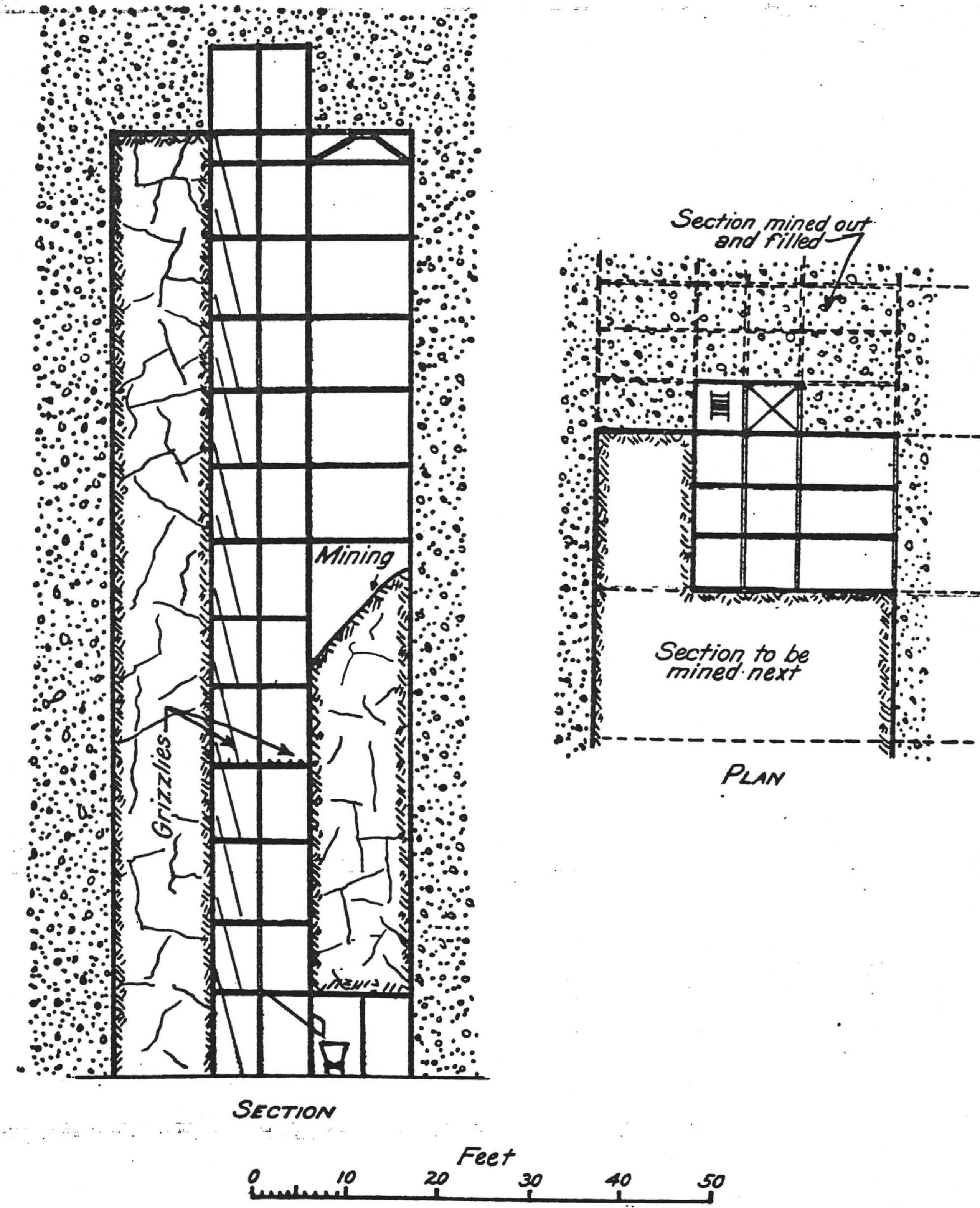


Figure 12.- Modified Mitchell slice used for mining pillars

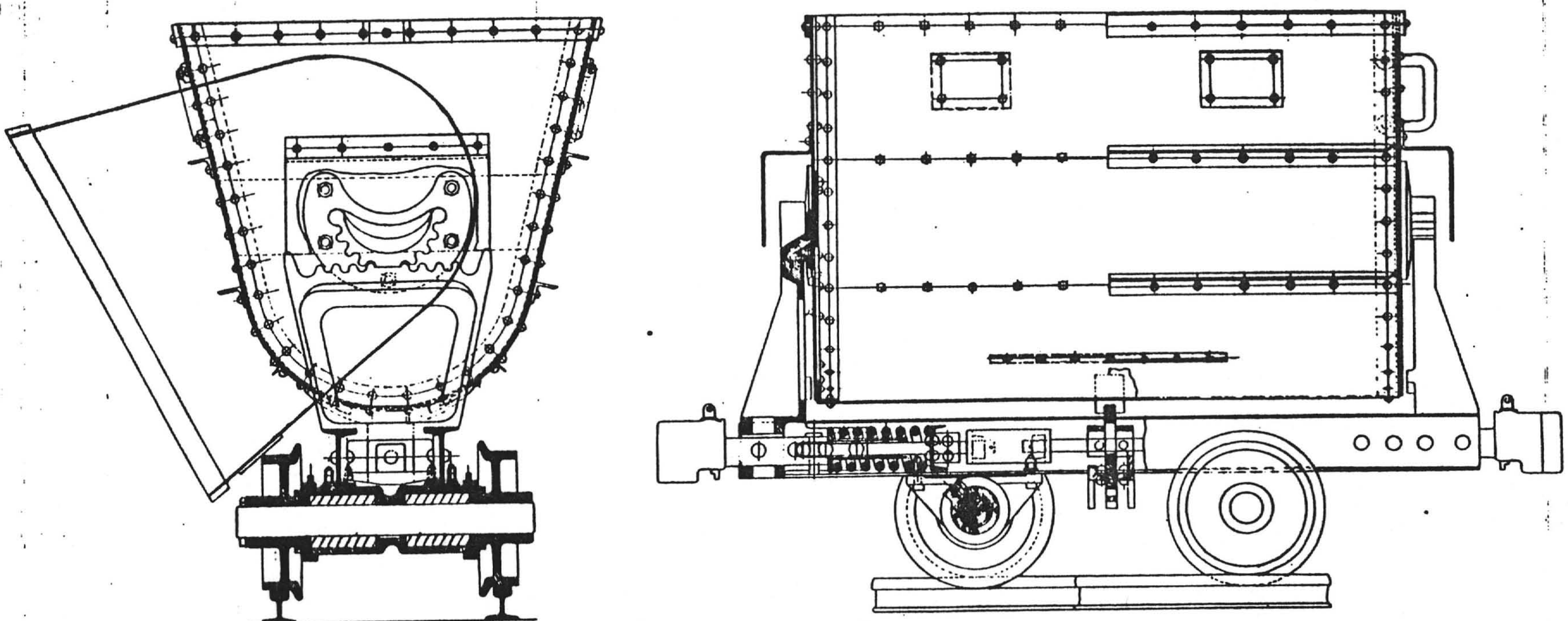


Figure 13.- 30-Cu. Ft. Mine car

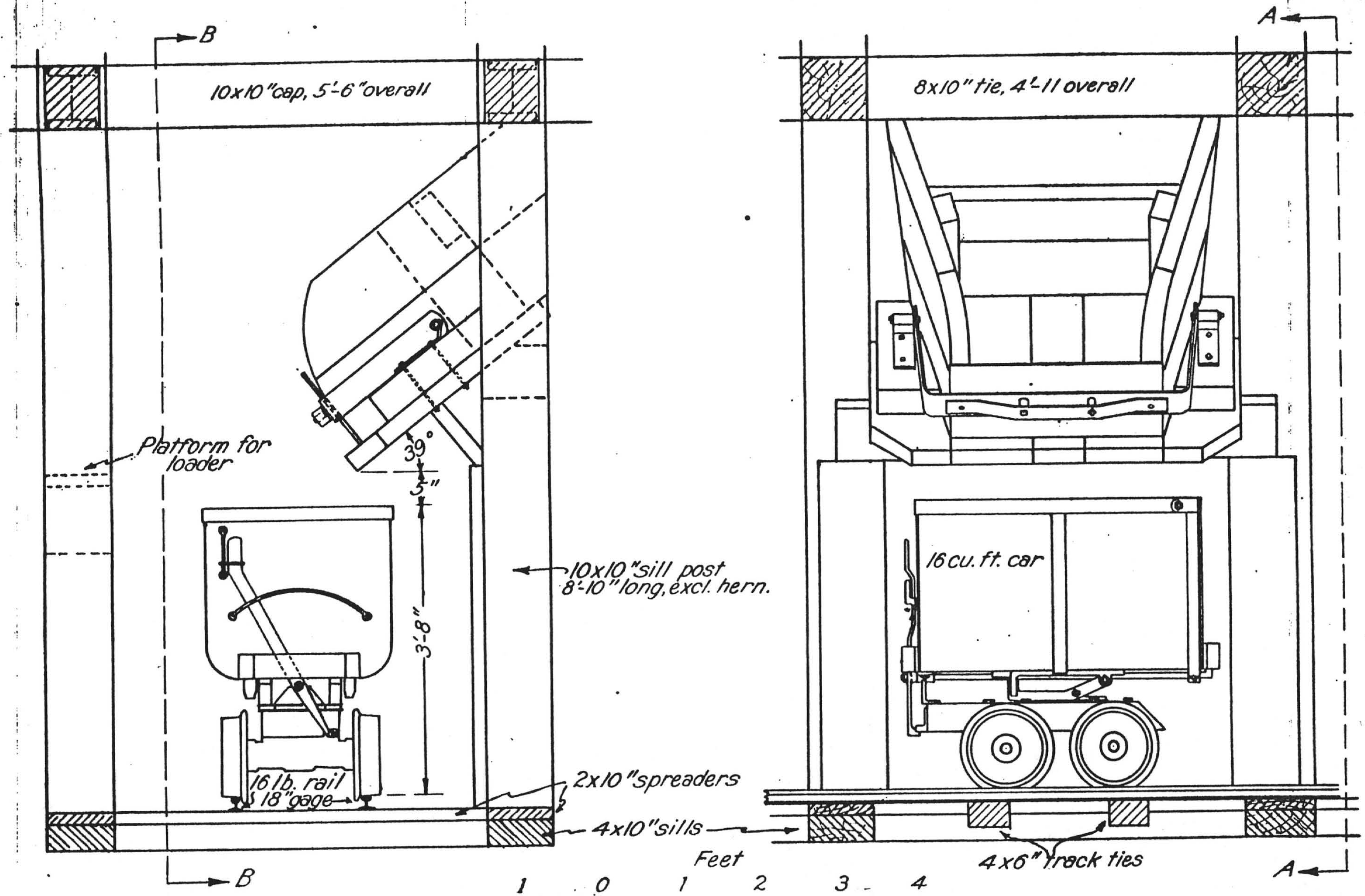


Figure 14. - United Verde Chute Gate and 16-Cu. Ft. Car

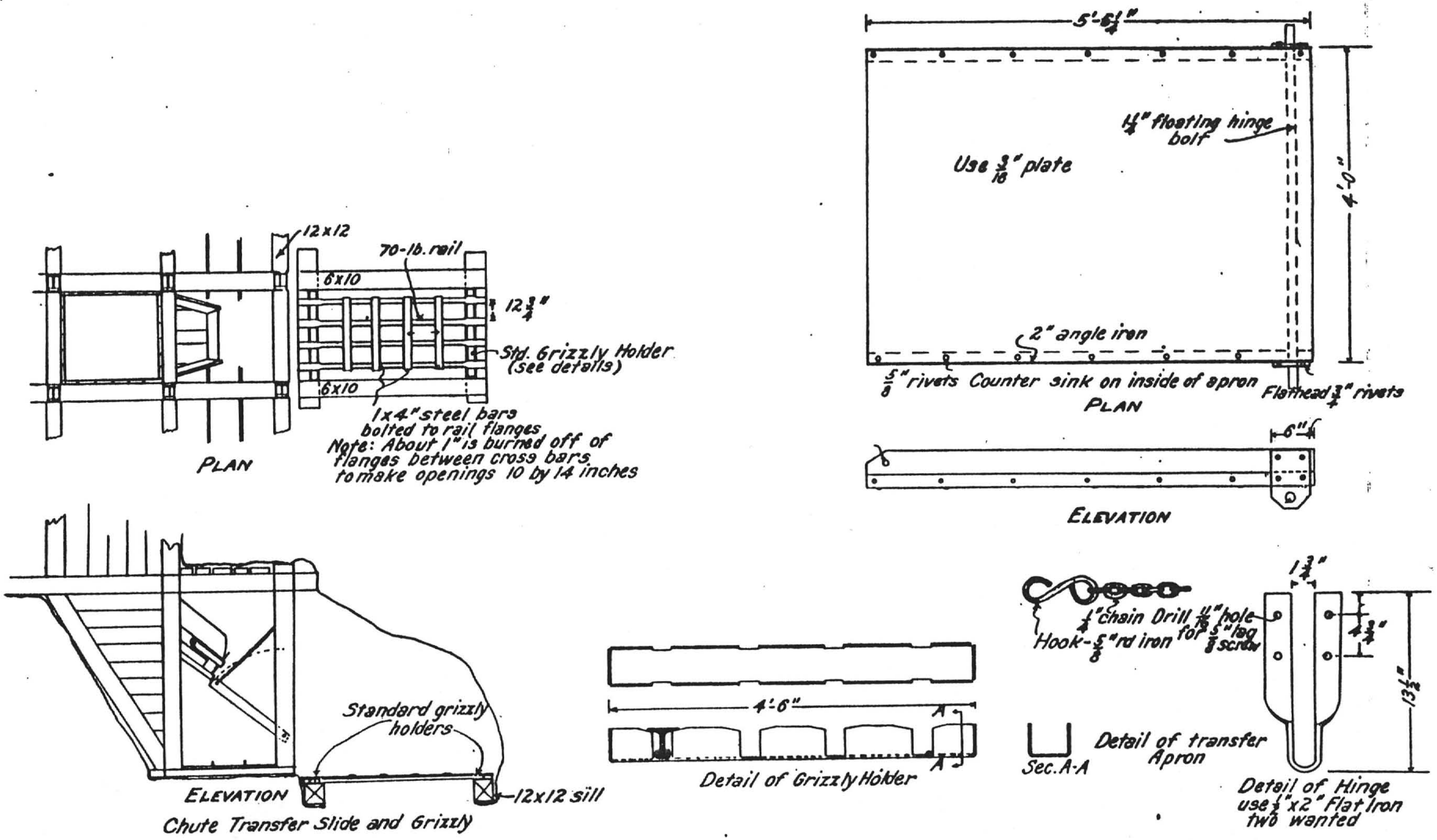


Figure 15.- Chute Transfer Slide and Grizzly

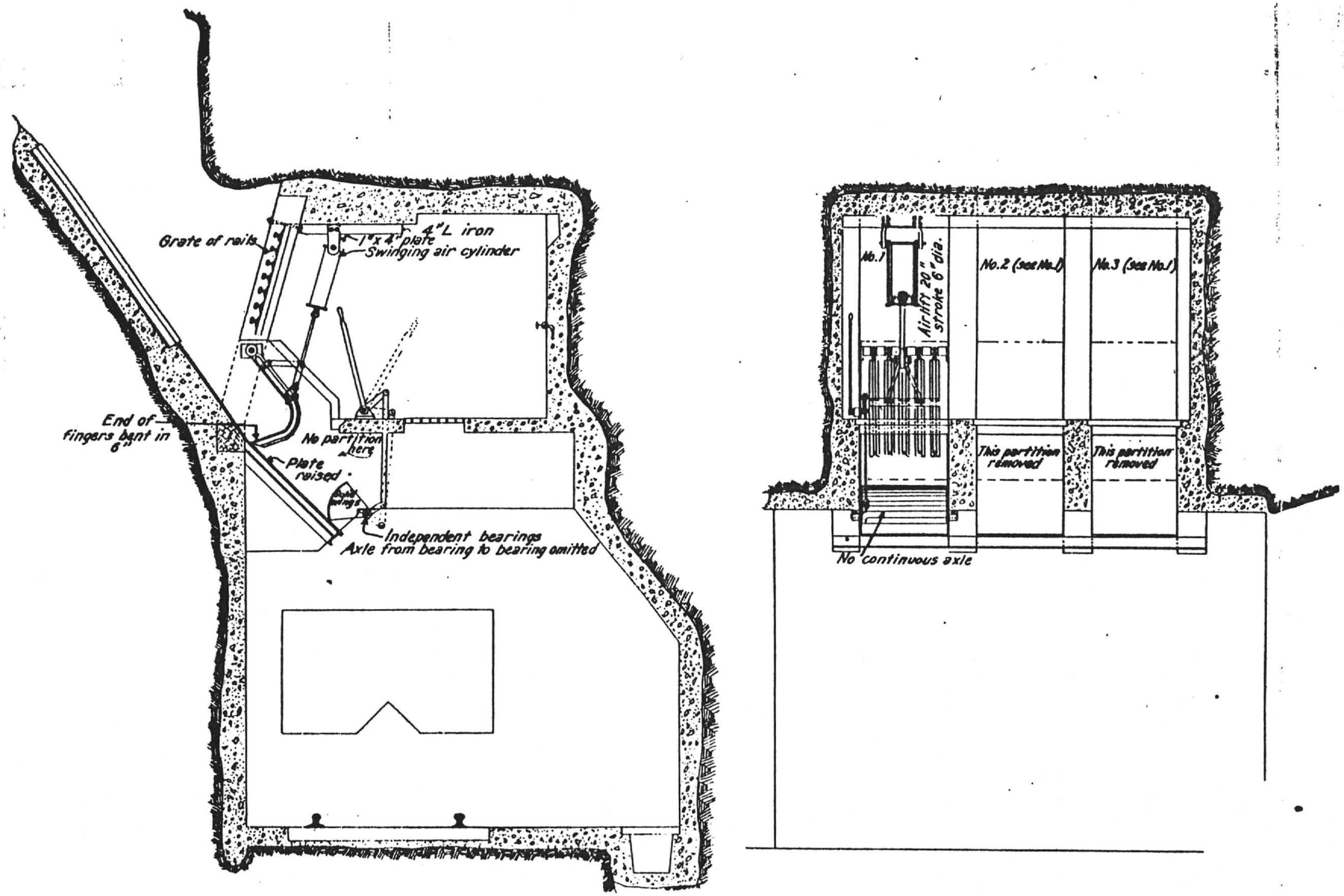


Figure 16.- Loading gates Main Ore Pocket

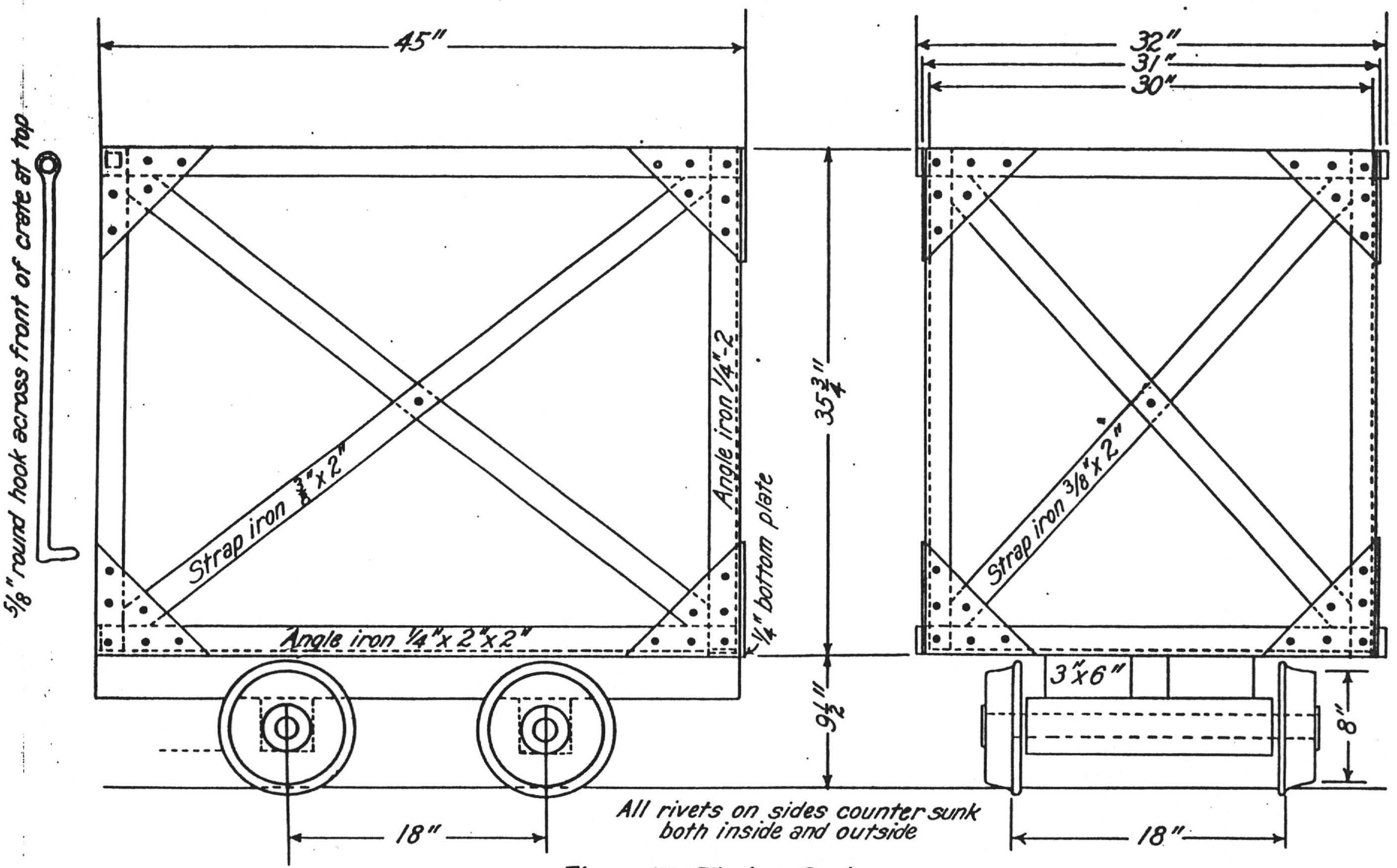


Figure 17.- Timber Crate

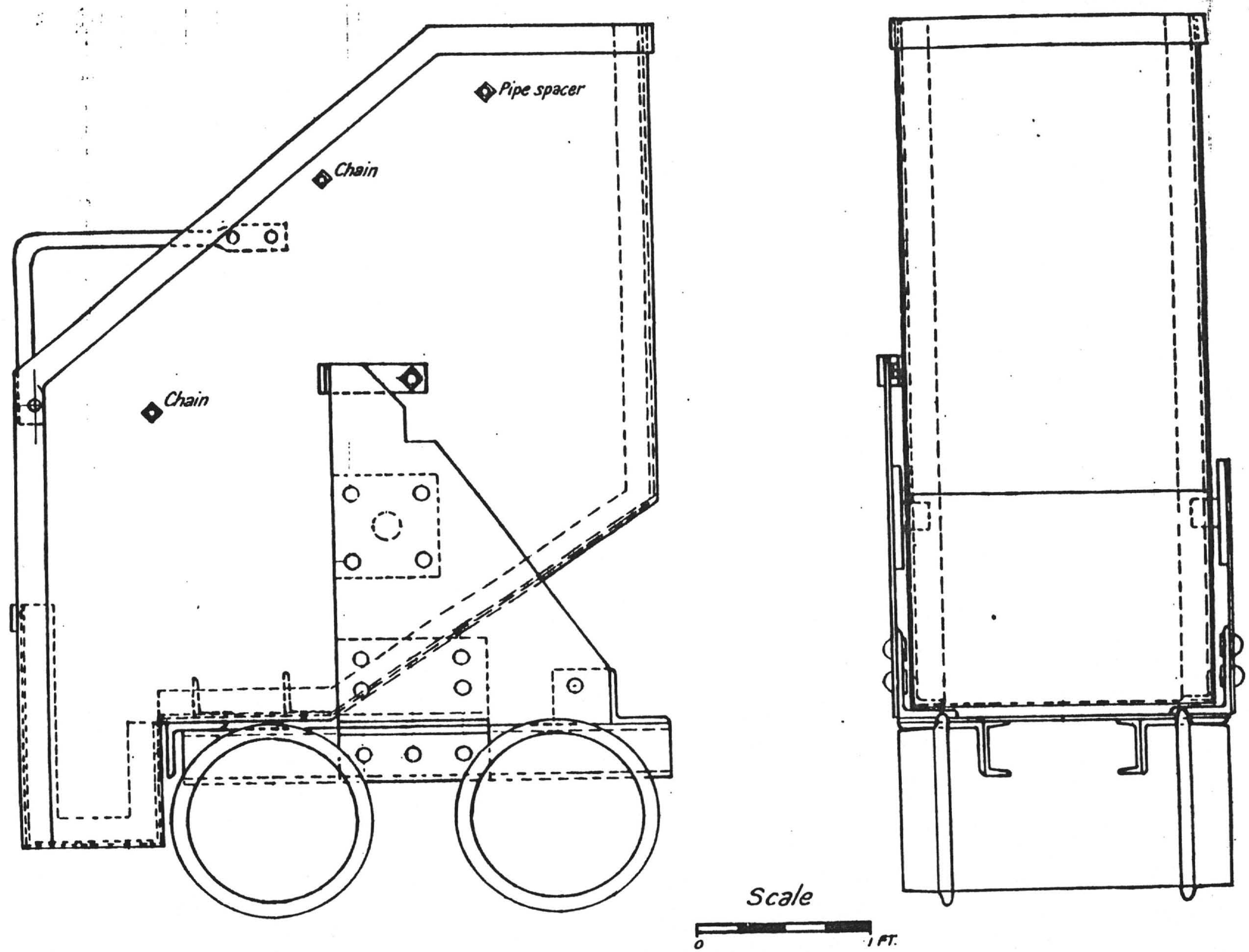


Figure 18.-Car for drill steel

places are widely separated much of the tramming is done with small storage-battery motors. Six of these are in use in various sections of the mine. They have proved satisfactory for moving small tonnages of ore from scattered workings and for handling development waste from long prospect headings.

Figure 15 shows the transfer apron and grizzly used on a level for transferring ore directly from a chute into an ore pass.

Figure 16 shows the loading gates of the main ore pocket on the 1300 level.

Figure 17 shows the timber crate used for handling timber in the cages and Figure 18 the details of the car for handling drill steel in the mine.

CONTRACTS

In an effort to obtain better progress and more efficiency drifting and raising are generally done on contract. All contracts are let directly through the superintendent's office. In a raise the contract specifies the footage to drive to the next level. In drifting the footage is generally limited to 100 feet, although contracts have been let for more. The contract stipulates the price per foot, the price per set of timber, the size of opening required, and, in a raise, the kind of timbering. The contractor pays for all explosives used. The contractor gets his regular day-pay check on pay days, and settlement on his contract is deferred until the first of the month. Settlement is then made according to the engineer's measurement and payment made on the 15th of the month.

Drifting contracts may run for months. When a contract is completed the contractor obtains settlement immediately, if he so requests.

Bonus work was tried out some years ago. In the stopes it resulted in hurried and consequently poor mining. The saving effected was not considered enough to compensate for this disadvantage. In drifting and raising difficulty was experienced in setting rates. The straight contract system was decided upon as being more acceptable to the workmen.

VENTILATION

The mine is ventilated mechanically by a surface exhaust fan installed at the top of a return-air system extending to the 1200 level. Rock temperatures are not very high, but a considerable amount of heat is generated by oxidation and timber decay, and the system is predicated entirely upon providing comfortable working conditions and control in case of a mine fire.

A multivane, forward-curved blade, single-inlet, single-width, centrifugal fan is used, with a 78-1/2-inch rotor operated at 346 r.p.m. by belt drive from a 250-hp., 2,200-volt, 60-cycle, 3-phase, 585-r.p.m. slip-ring induction motor. It exhausts from a 6.33 by 15.0 foot raise through a 10-foot concrete duct on a 30-degree slope and 4.5 by 5.5 feet in section. This fan is at present exhausting 100,000 cubic feet per minute of air saturated at 70°.

A single-inlet, single-width, multivane, forward-curved blade centrifugal fan, with 52-3/8 inch rotor, is connected to the opposite end of the air raise by a similar concrete duct; this is an auxiliary installation and is installed to operate at 590 r.p.m. by belt drive from a 75-hp., 2,200-volt, 875-r.p.m. induction motor. Each fan duct has a winch-operated door hinged to the floor and held in place both by fan pressure and gravity.

All long development headings are ventilated by fan-pipe installations, using small air or electrically-operated blowers, with 10-inch galvanized-iron piping.

FIRE HAZARDS

On account of the heavy ground in the mine considerable timber is required. Due to this and to the fact that the main ore body carries a high sulphur content a fire menace is always present. Timber bulkheads are used to maintain haulage and extraction drifts in various parts of the stoping sections of the mine. To control any fire starting from the above conditions fire hydrants and standpipes are placed at all places where hazards exist.

A fire patrol is maintained on the graveyard shift, and all hazardous places are wet down two and three times a week. In addition, large independent fire lines are maintained on the main working levels. These lines are direct-connected to the pump columns where a large source of water would be available if needed. In addition to this, all air lines can be converted into water lines in a few minutes by the use of installed by-passes.

In the timbered section of the Edith shaft sprays are placed at 300-foot intervals, and the timbers in this shaft are wet down at least three times a week.

FIRE-FIGHTING EQUIPMENT

A complete mine rescue station is maintained with all the necessary fire-fighting equipment. Figure 19 illustrates a small portable disk fan. This type of fan has proved successful in other parts of the Southwest in fighting fires. The fan is equipped with a 110-volt, alternating-current, single-phase, 60-cycle, 850 revolutions per minute, General Electric repulsion motor. It is mounted on a mine truck with a reel carrying 1,000 feet of No. 14 duplex rubber cable that can be connected to the lighting circuit. The fan and reel are mounted on a turntable and can be locked in any position desired. Figure 20 shows an emergency tool truck for fire-fighting.

Sets of oxygen breathing apparatus and gas masks are kept on hand, and men have been trained in their use. Fifteen active rescue men are required to practice rescue and fire-fighting at least twice a month. These practices are followed by occasional maneuvers in which all apparatus men participate. Apparatus men practice on company time and are paid a bonus of $7.50 a month.

All shift bosses, jigger bosses, and tool nippers are trained in first aid, and first-aid stations or cabinets are maintained on all active levels. The training of apparatus and first-aid men is in charge of the safety engineer, who is also responsible for the maintenance of the rescue station.

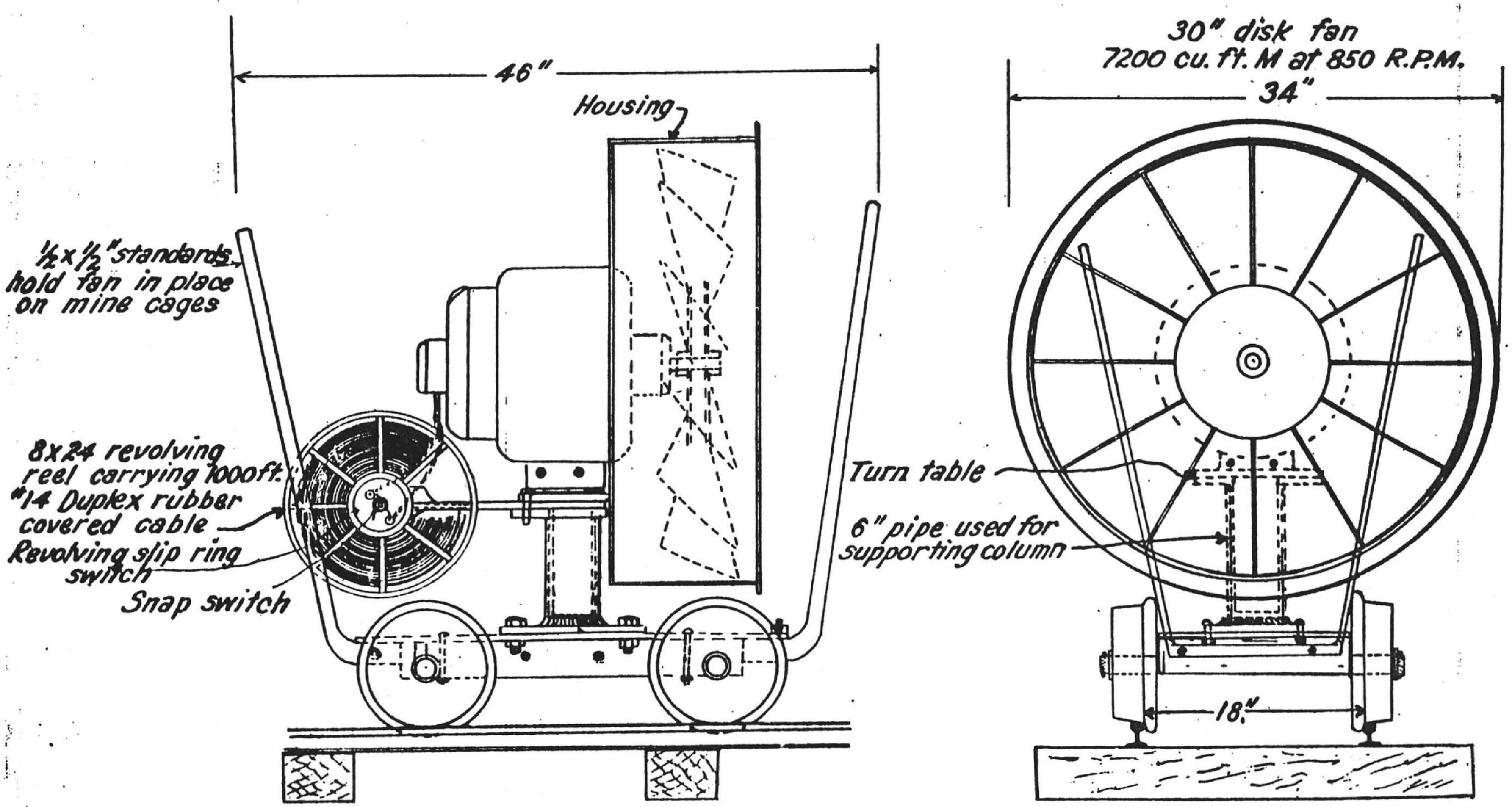


Figure 19 — Portable Ventilation Fan Used for Mine Fire Fighting

ACCIDENT PREVENTION

The safety engineer makes daily inspections and reports all unsafe conditions to the mine superintendent, mine foreman, and the shift boss on each run visited. Safety propaganda in the form of bulletins and individual talks by the safety engineer on inspection trips through the mine impresses the safety idea upon the men. Safety committees have been tried and abandoned in favor of the present method.

UNITED VERDE EXTENSION MINING COMPANY

EFFICIENCY DATA

YEAR 1928

Tons mined per man (stoping shifts)	4.84
Tons mined per man (underground shifts)	2.47
Tons mined per man (total shifts)	2.00
Feet advanced per man (development shifts)	1.17
Mine timbers and handling cost (per 1000 board feet)	36.24
Mine timbers and handling cost per ton	.67
Mine timbers (board feet per ton)	16.82
Total board feet used per ton	18.53
Pounds power per foot advanced	6.14
Feet fuse per foot advanced	19.10
Number caps per foot advanced	3.29
Pounds carbide per underground shift	.85
Pounds powder in stope per ton	.39
Feet fuse in stope per ton	1.93
Number caps in stope per ton	.35

UNITED VERDE EXTENSION MINING COMPANY

MINING COSTS

YEAR 1928

Tons shipped during period: 275,212

	Cost per ton
Prospecting and development	$0.611
Extraction	1.710
Repairs and maintenance	.260
Ventilation	.068
Haulage	.357
Hoisting	.151
Pumping and drainage	.039
Underground miscellaneous	.107
Rock drills	.152
Compressed air	.092
Waste pit	.005
Office and general	.738
TOTAL COST PER TON	$4.286

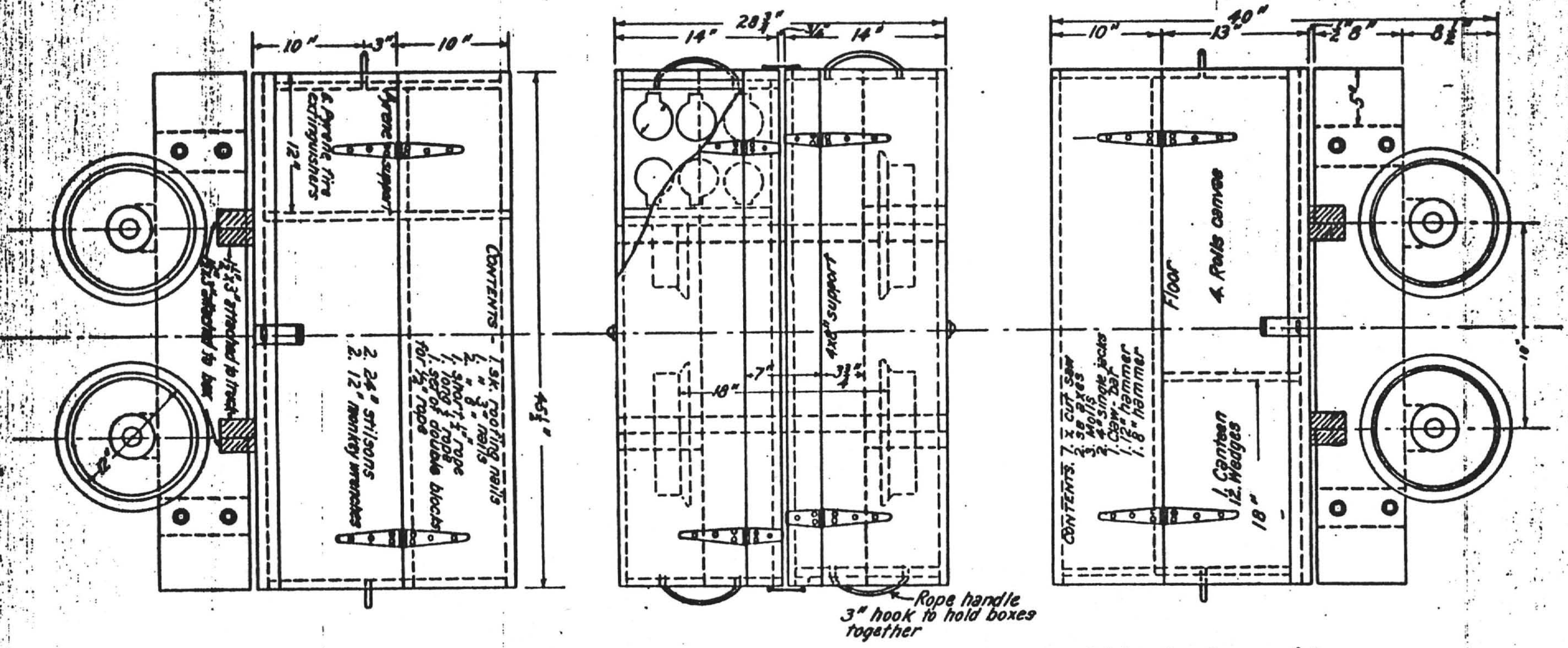


Figure 20.- Emergency Tool Truck for Helmet Teams United Verde Extension Mining Co. Jerome, Ariz.

I. C. 6250

February, 1930

DEPARTMENT OF COMMERCE

UNITED STATES BUREAU OF MINES
SCOTT TURNER, DIRECTOR

INFORMATION CIRCULAR

MINING PRACTICE AND METHODS AT THE UNITED VERDE EXTENSION MINING COMPANY, JEROME, ARIZ.

BY

RICHARD L. D'ARCY

I.C.6250.
February, 1930.

INFORMATION CIRCULAR

DEPARTMENT OF COMMERCE - BUREAU OF MINES

MINING PRACTICE AND METHODS AT THE UNITED VERDE EXTENSION MINING COMPANY, JEROME, ARIZ.[1]

By Richard L. D'Arcy[2]

INTRODUCTION

This paper describing the mining practice and methods at the United Verde Extension mine, Jerome, Ariz., is one of a series of papers in preparation by the Bureau of Mines presenting the mining methods used in various mining districts of the United States.

The United Verde Extension mine is a massive, high-grade deposit of copper sulphide containing some gold and silver and is mined almost exclusively by the conventional square-set method with some local modifications.

About 450 men are employed underground and 1200 tons of direct smelting ore is produced per day. Figure 1 is a surface map of the Jerome district.

ACKNOWLEDGMENTS

The author acknowledges the assistance of Olaf Hondrum, chief engineer, and Roy H. Marks, efficiency engineer, United Verde Extension Mining Co., and also that of E. D. Gardner, supervising engineer, and C. H. Johnson, assistant mining engineer, U. S. Bureau of Mines, Tucson, Ariz.

HISTORY OF DISTRICT

The development of the Jerome mining district as an important source of copper, gold, and silver dates from the development of the mine of the United Verde Copper Co. This mine was located in 1876 and worked in a small way at shallow depth for its gold-silver values until purchased in 1889 by Senator W. A. Clark of Montana. Production from this mine increased steadily, especially after 1894, when the narrow-gauge railroad from Jerome Junction was built. From 1900 to 1918, inclusive, the mine produced slightly over 7 million

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1. The Bureau of Mines will welcome reprinting of this paper, provided the following footnote acknowledgment is used: "Reprinted from U. S. Bureau of Mines Information Circular 6250."

2 - One of the consulting engineers, U. S. Bureau of Mines, General Superintendent, United Verde Extension Mining Co.

5/5 Cu

tons of ore containing 750,000,000 pounds of copper, 12,374,000 ounces of silver, and 403,000 ounces of gold. Recovery per ton for this period was about 100 pounds of copper, 1.75 ounces of silver, and 0.057 ounces of gold. From 1918 to date the United Verde has been one of the most important mines in Arizona, and the total metal value of its product probably has been greater than that of any other mine in the State.

The success of this mine encouraged capitalists to attempt to find other important ore bodies in the district; this led to the development of the United Verde Extension, the second large mine of the district.

The United Verde Extension mine was brought to successful production through the efforts of James S. Douglas and associates, who assumed the financing of the property from the time when it was a small prospect. Their efforts were rewarded in December, 1914, by the discovery of a small high-grade vein of chalcocite. Finally in January, 1916, a big lens of high-grade chalcocite was opened up on the 1400 level. This lens, when fully outlined on this level, proved to be oval, with a maximum length of 500 feet and a maximum width of 300 feet. Virtually all of the lens was clean, high-grade ore. From then on the mine rapidly became an important producer.

Production started in 1915 and has been maintained ever since. From 1915 to 1928, inclusive, the mine produced slightly over 2,000,000 tons of ore containing approximately 535,000,000 pounds of copper, 4,100,000 ounces of silver, and 76,000 ounces of gold, with a gross metal value of approximately $98,000,000.

GEOLOGY

The geology of the Jerome district has been described in detail by L. E. Reber, jr.[3] The Verde fault is perhaps the most striking structural feature of the district. This fault strikes about N. 40° W. and can be traced on the surface for miles. The dip is about 59° to the northeast. It is a normal fault, and has a known vertical downthrow of approximately 1,600 feet.

The United Verde mine is immediately west of the fault; that is to say, it is located in the footwall, while the United Verde Extension mine is close to the fault in the hanging wall.

The fault is directly responsible for the discovery of the United Verde mine. It cut through the mineralized zone, dropping the section to the east 1,600 feet, as has been stated, leaving the greater portion of the zone in the footwall but exposing it in the newly-formed hillside.

The geologic section (fig. 2) at right angles to the fault shows the sequence of the geological formations. The United Verde Extension shafts go through lava, conglomerate,

3 - Reber, L.E., Jr., Geology and Ore Deposits of the Jerome District: Min. and Met., May, 1920.

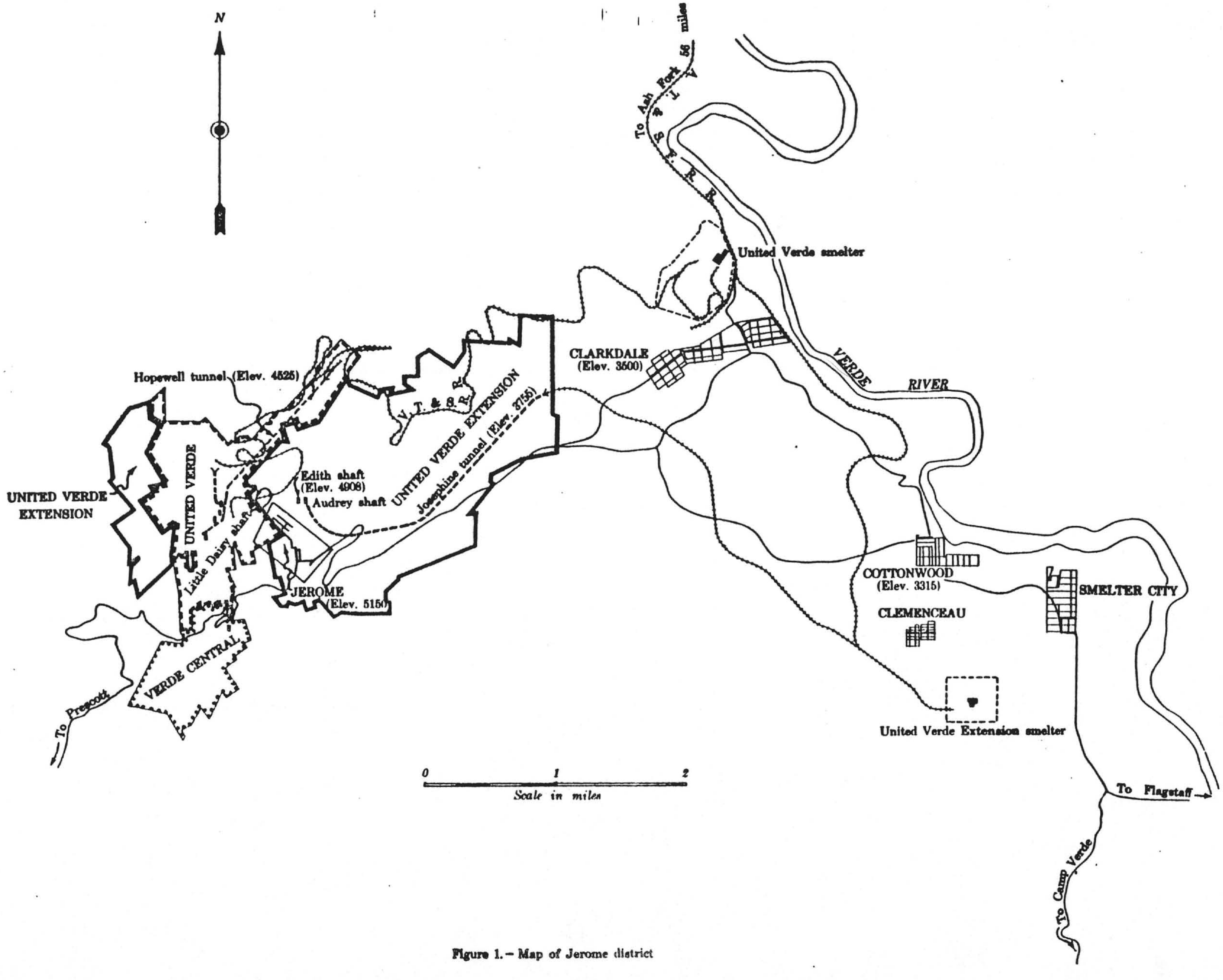


Figure 1.- Map of Jerome district

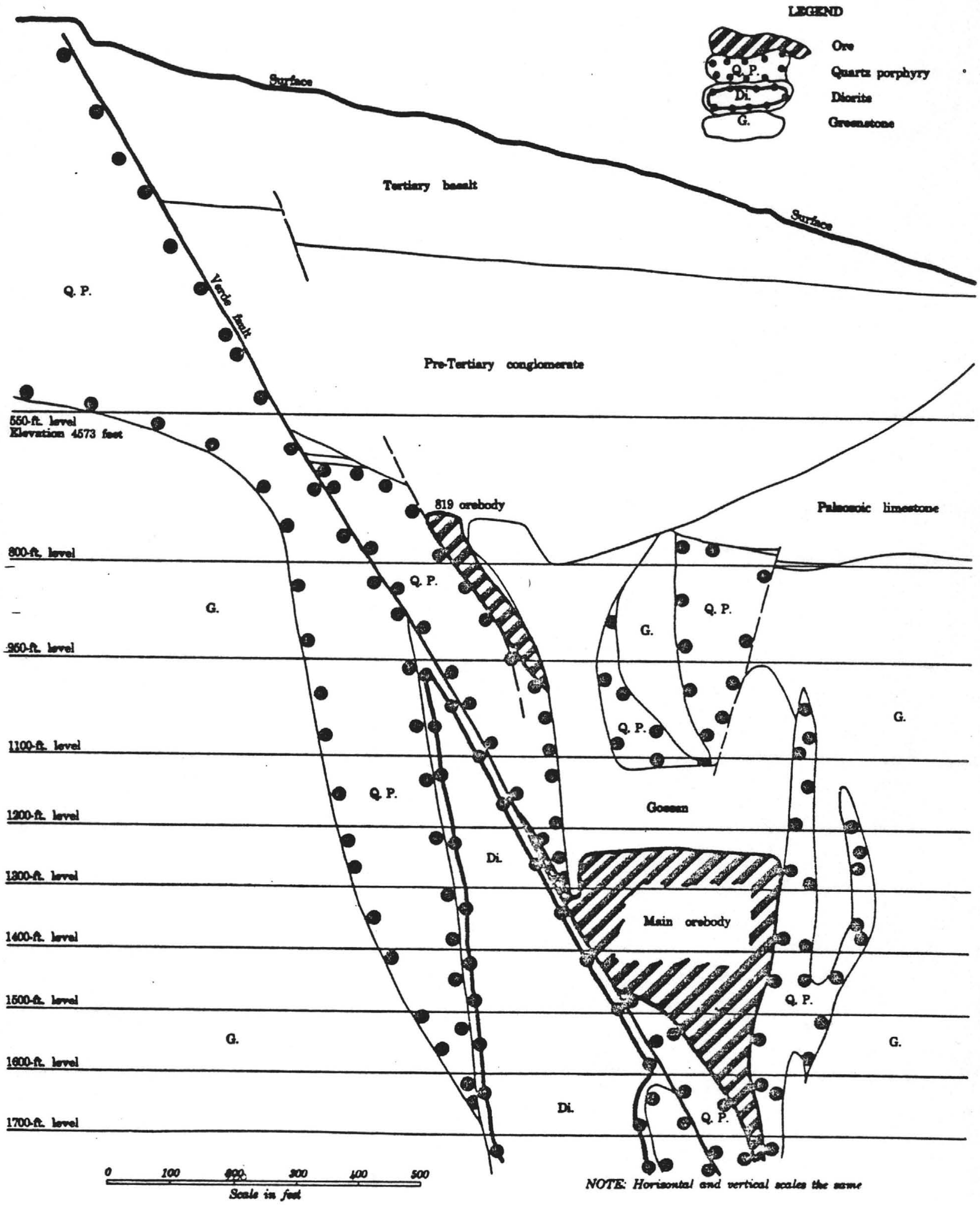


Figure 2. – Vertical geologic section (N. 45° E.) through main orebody

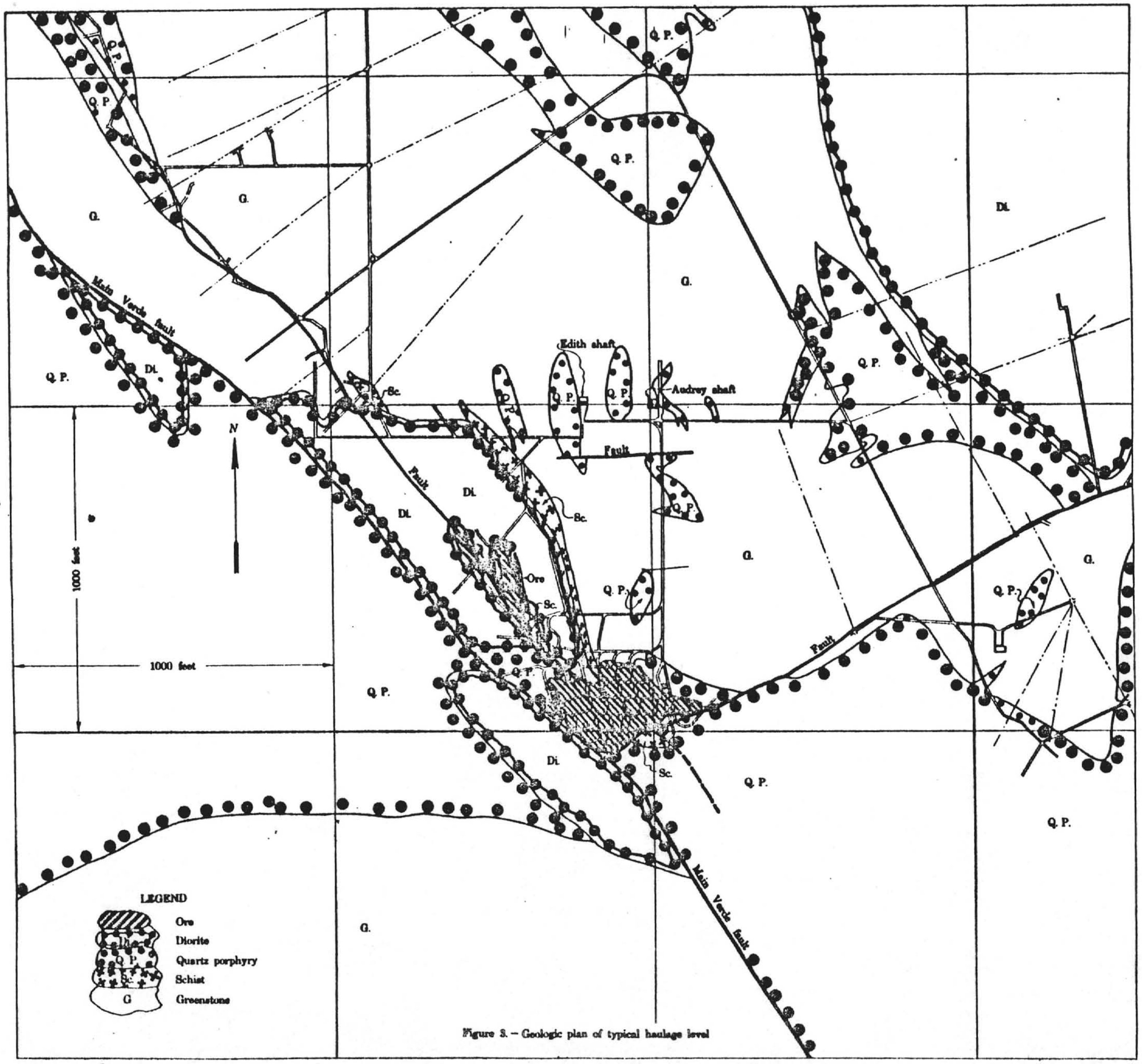


Figure 3. – Geologic plan of typical haulage level

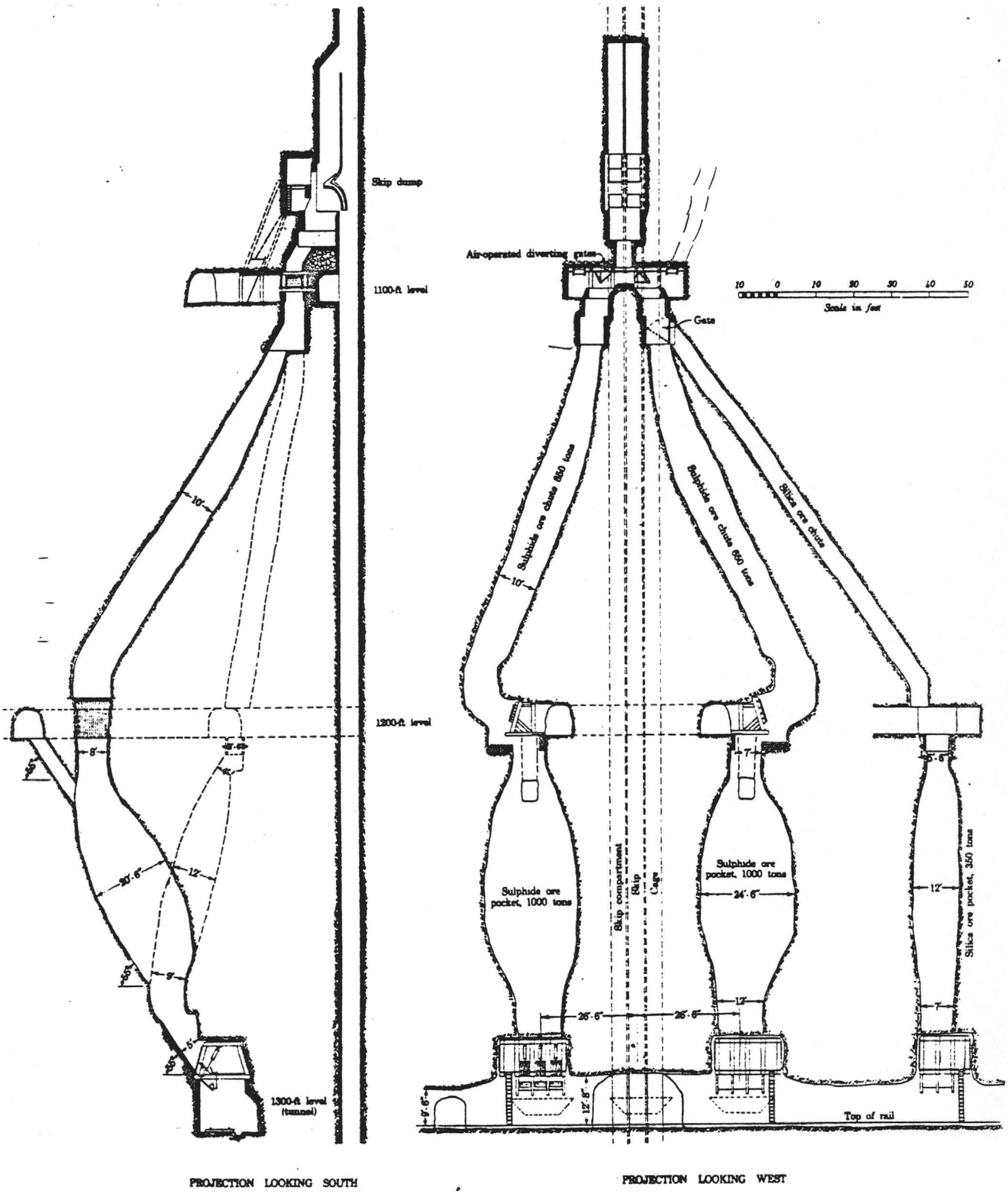


Figure 4. – Loading pockets at Audrey shaft

limestone, and sandstone before encountering the pre-Cambrian rocks about 600 feet below the surface. The general distribution of the pre-Cambrian formations is shown in Figure 3, a plan of the 1400 level. The principal types of rock are diorite, quartz porphyry, greenstone, and schist. Greenstone is a name given to a variety of complex rocks, from fine-grained greenish black basic rocks, to light-colored rocks resembling rhyolites. Probably the schist is mainly altered quartz porphyry and altered greenstones of the more acid types. It is in the schist that most of the ore in the district is found.

METHODS OF DEVELOPMENT AND MINING

Development

The mine is operated through two vertical 3-compartment shafts and a large cross-section haulage adit connecting both shafts on the 1300 level. Both shafts are of concrete, located about 200 feet apart and 1,000 feet north of the main ore-bearing zone. This location has been very satisfactory because the shafts have been in firm rock from collar to bottom; conditions have been ideal for the rather elaborate system of ore and waste pockets, skip-dump pockets, transfer raises, and tunnel-loading pockets immediately adjoining the shafts.

The layout of ore pockets at the Audrey shaft is shown in Figure 4. Ore from below the tunnel level is hoisted in 3-ton skips running in counterbalance to a point above the 1100 level; the skip is dumped by movable guides which show red lights in front of the hoisting engineer when in dumping position and green lights when the shaft is clear. The ore passes from the dumping point to an air-operated deflecting door on the 1100 level, which turns the ore one way or the other as desired. Three converging pockets meet just below this deflector, two for sulphide ore and one for silica converter ore. From these pockets the ore is loaded into trains of standard-gauge cars in the main haulage adit on the 1300 level. Control at this point is by means of finger gates made from bent 70-pound rails operated by air cylinders.

The main tunnel is 2-1/4 miles long and approximately 10 by 10 feet in cross section. Some sections of the tunnel are of solid-concrete arch construction, and others are timbered with 12 by 12 inch sets on 5-foot centers. About 4,000 feet is rock section with gunite coating, and the remainder is unsupported rock section.

From the portal of the tunnel a standard-gauge railroad connects with the smelter at Clemenceau about 5 miles distant (fig. 1). Haulage through the tunnel is with a 25-ton electric motor handling trains of eight 30-ton cars, which are made into trains of 16 cars each at the portal and taken to the smelter by a steam locomotive.

Levels are run on the 550, 800, 950, and 1100 foot elevations and on 100-foot intervals from 1100 to 1900 feet, inclusive. These elevations refer to distances below the collar of the Daisy, an old prospect shaft. The actual depth of each level below the collars of the Edith and Audrey main shafts is about 200 feet less than indicated. The main producing levels in the big ore lens are the 1300, 1400, 1500, and 1600. Production from outlying smaller ore bodies extends from the 550 to the 1700 levels.

Development details

Shafts

As stated before, both main shafts, known as the Audrey and Edith, are of solid concrete. The Audrey is the ore-hoisting shaft, while the Edith is used for handling men and supplies and development waste. The Audrey is operated one shift and the Edith three shifts per 24 hours. The Audrey shaft was equipped after the ore was found and was concreted immediately, but the Edith was sunk for prospecting purposes and was at first timbered. Later, it was concreted, and Figure 5 shows a cross section of the completed concrete. The changing of this shaft from timber to concrete was done partly on a cost-plus basis with a contractor in charge of the job, and partly by a picked mine crew working under a bonus agreement. A comparison of these two methods is rather instructive and is favorable to the bonus work, where each man participated in the benefits. Shaft-sinking has since been done under a similar agreement, with very satisfactory results.

Following are details of the shaft concreting costs:

Edith shaft concreting

Three-compartment shaft (2 hoisting compartments 4 feet by 5 feet 6 inches, and 1 manway and pipe compartment 5 feet 2 inches by 5 feet 6 inches), shaft wall containing 6 pipes in sizes varying from 2 to 8 inches.

Shaft concreted from 1400 level to surface, a distance of 1205 feet, including 7 stations.

Work started February 1, 1921; completed July 25, 1921.

Work was done in two sections; first section from 800 to surface, 575 feet on contract basis, second section, 1400 level to 800 level, 630 feet, was done on bonus basis on footage made per day.

The actual cost of mixing and placing the concrete in each section, not considering the preliminary cost of installing the crushing plant, removing old pipe lines, and placing guides and chairs in the concreted sections, was in each instance as follows:

1st section

575 feet, including 2 stations.
Work started February 1, 1921; finished
April 21, 80 days.
Average advance, 7.19 feet per day.

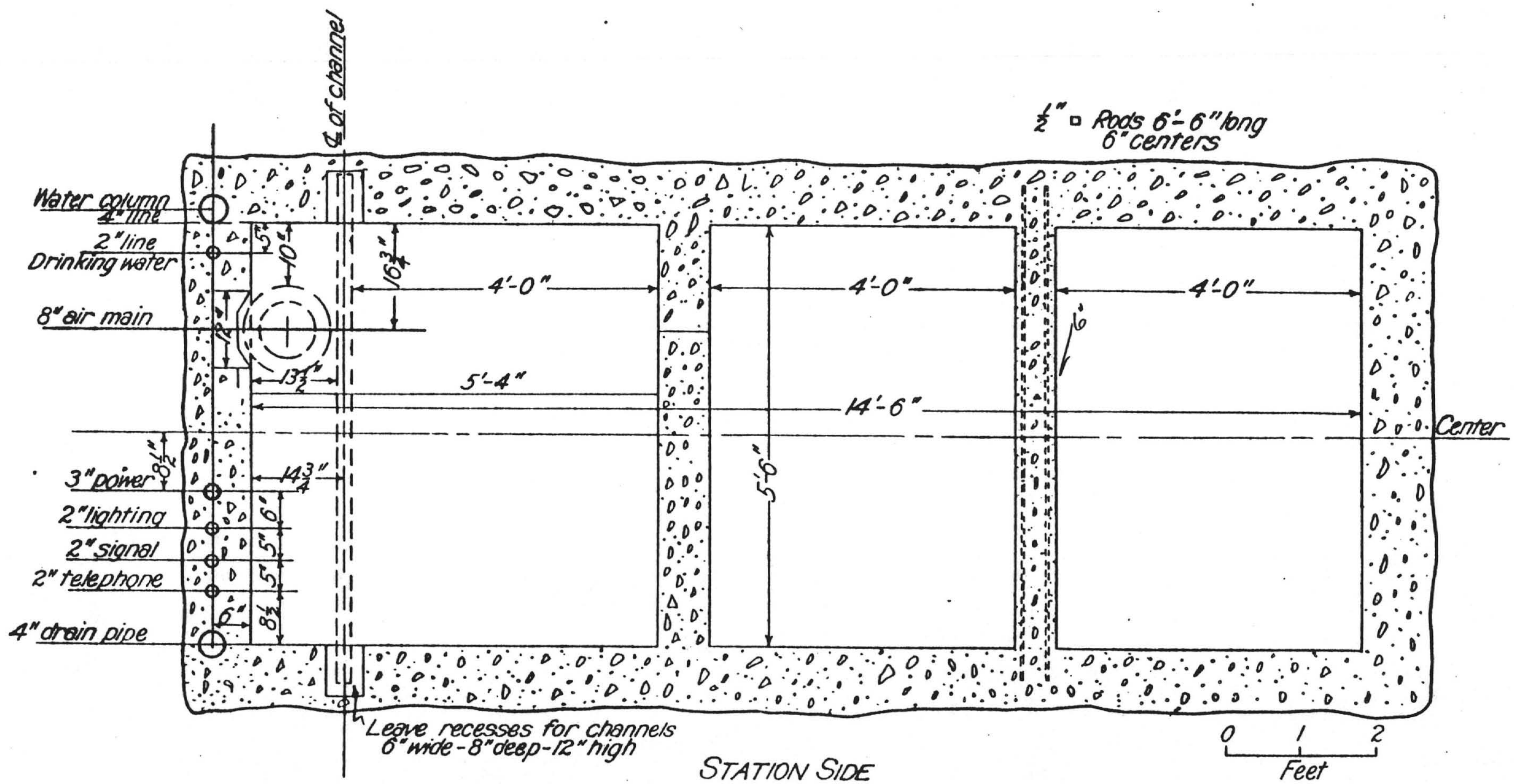
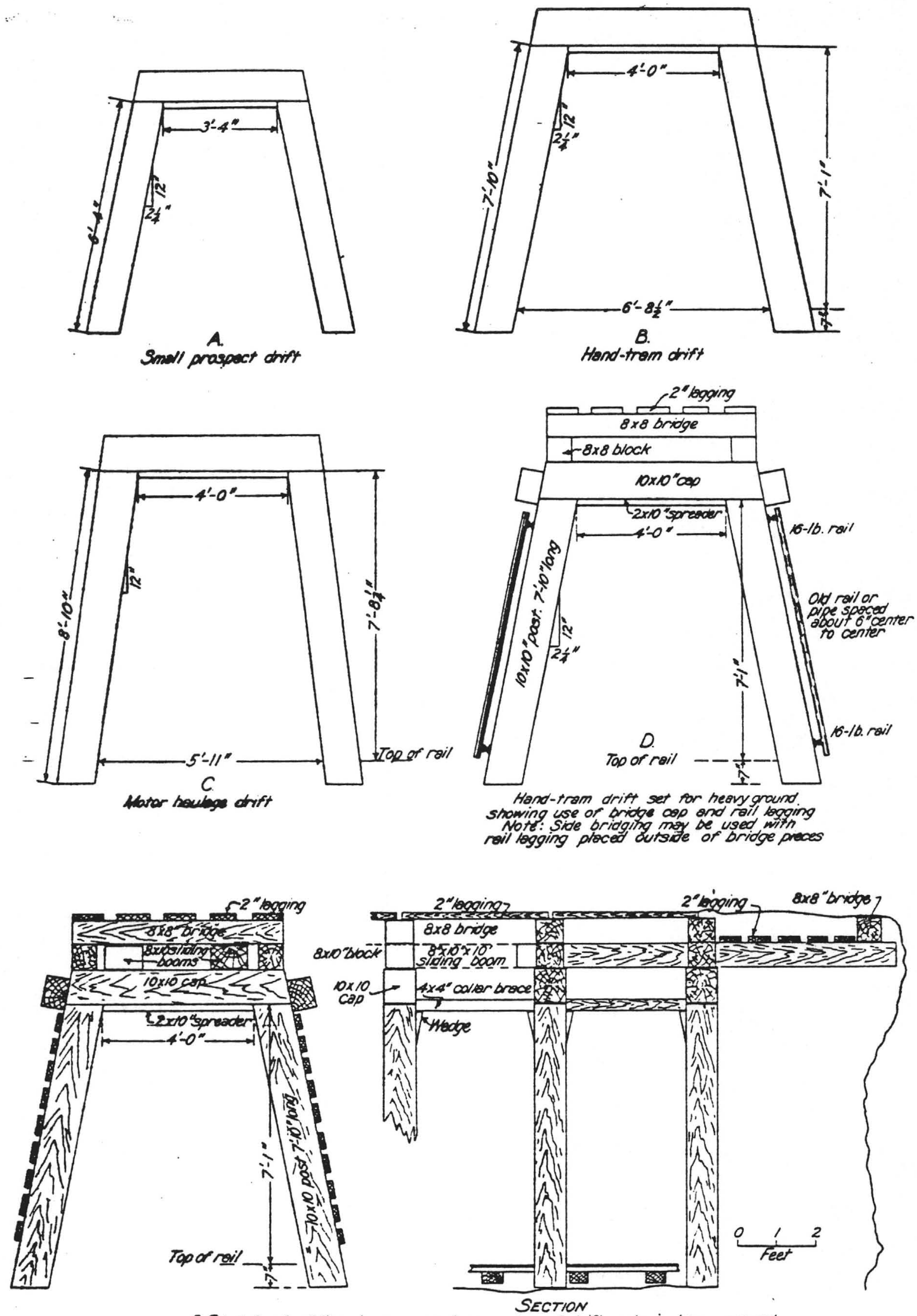


Figure 5.-Section of concrete, Edith Shaft



E: Sketch of sliding booms used over top of drift sets in heavy ground

Figure 6.-Drift Timbers

Costs

Labor (including supervision at $10 per day)	$8,827.20
Cement (6,564 sacks at $1.10 per sack)	7,220.40
Sand and gravel, (1,498.1 yds. at $2.50 per yd.)	3,745.25
Power used hoisting and crushing (25,380 kw. h. at 2¢ per kw. h.)	507.60
Reinforcing iron, 10 lb. per ft. of shaft at 10¢ per lb.	575.00
Form lumber $1.50 per foot shaft	862.50
Bonus paid	3,075.00
Total cost for 575 feet	$24,812.95
Cost per foot	$43.14

2d section

Distance concreted, 630 feet, including 5 stations.
Work started May 1, 1921; finished July 25, 1921, 86 days.
Actual time of concreting this section of shaft, after deducting the time lost in cutting new stations, was 69 days, or an average per day of 9.13 feet.

Costs

Labor (including supervision at $225 per mo.)	$5,068.50
Cement used (6,256 sacks at $1.10 per sack)	6,881.60
Sand and gravel (1,434.5 yds. at $2.50 per yd.)	3,586.25
Power used hoisting and crushing (29,310 kw.h. at 2¢ per kw.h.).	586.20
Reinforcing iron, 10 lb. per ft. of shaft, at 10¢ per lb.	630.00
Form lumber (640 ft. of shaft at $1.50 per ft.)	945.00
Bonus paid	2,056.50
Total cost of completing section	$19,754.05
Cost per foot	$31.35

Mixture used was 1 part cement, 2 parts sand, 5 parts crushed rock, or 5-1/3 sacks of cement, 10 cubic feet fines, and 23 cubic feet crushed rock per yard of concrete in place.

Drifts

Many different rock conditions are found in the mine, varying from very hard quartz gossan to extremely heavy swelling ground. To meet these conditions several kinds of standard drift timbering are in use. Figure 6 (a), (b), and (c) show the various sets used for (a) a small prospect drift, (b) an ordinary hand-tramming drift, and (c) a motor drift;

also (d) shows the use of old rails or pipe in place of lagging in ground that is very soft and inclined to swell. It has been found that by using rail lagging in swelling ground the soft ground squeezes through between the rails, and very little pressure develops on the set itself. Figure 6 (e) shows a method of timbering in soft ground which is not bad enough to require spilling and still needs some support overhead. This is provided by carrying sliding booms over the sets which are pushed ahead as needed.

In the main haulage tunnel several different types of support were used, two of which are shown in Figures 7 (a) and (b).

Guniting

Guniting was used very successfully in a section of the main tunnel 4,000 feet long. This part of the tunnel was through an old recemented river-channel conglomerate, which was comparatively hard when first broken but after exposure to air and moisture tended to slack and slough. Had this not been gunited it would have needed timbering through the entire section. The gunite has now held for over 10 years. If this section had been supported by timber it would have needed at least one complete renewal of the timber. Gunite has been applied in other sections of the mine with little success, due to slight ground movements, that break the gunite and render it useless in a very short time.

A record of the cost of guniting this 4,000-foot section of the main tunnel follows.

Size of tunnel	10 by 10 feet
Footage gunited	4,098
Mixture used	1 cement to 3 sand
Applications	2 coats

Costs

Labor	$2,581.29
Cement (2,056 sacks at $1.10 per sack)	2,250.60
Sand (263 yds. at $2.50 per yd.)	657.50
Machinery repairs and supplies	282.84
Total cost	$5,772.23
Cost per linear foot of tunnel	1.40
Cost per sq. ft., approximately	.046

Bulkhead drift sets

A system of holding extremely heavy gangways through the pillars in the main ore body is shown in Figure 8. It has been found that solid timber bulkhead built as shown, using the waste ends of timber that accumulate in a mine of this kind, will hold a ground pressure that would break ordinary heavy timber sets several times a year. In fact, on one level a section of this kind of bulkheading put in on one side of a drift opposite a solid

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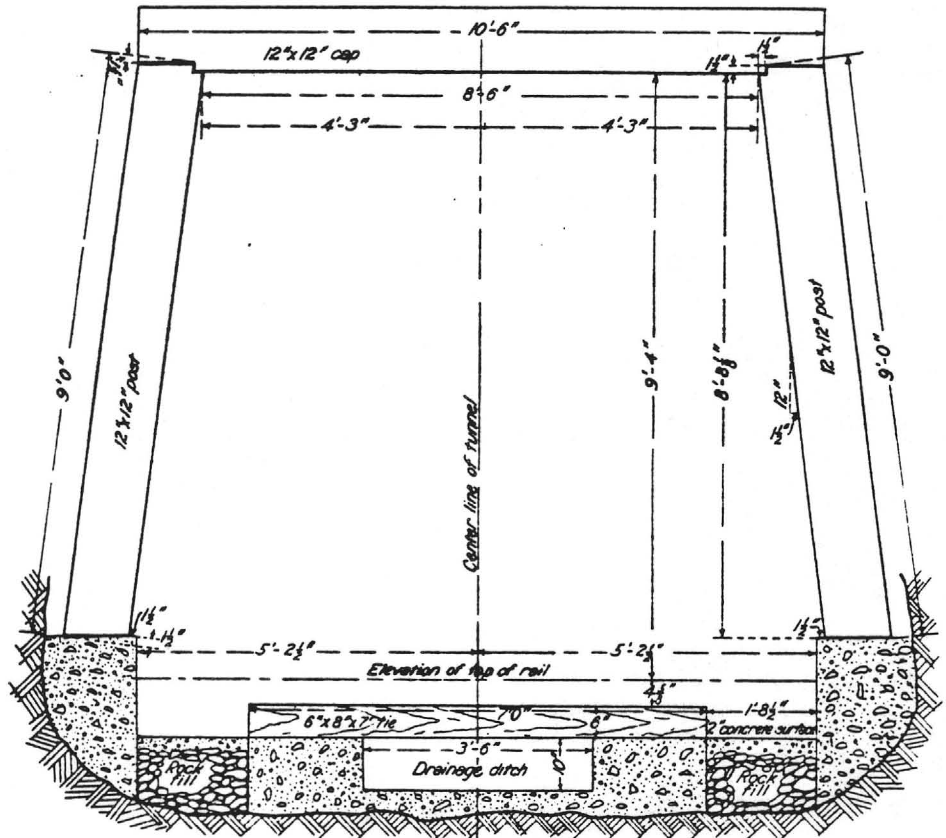

Figure 7-A.-Standard 12"x12" Tunnel Timber

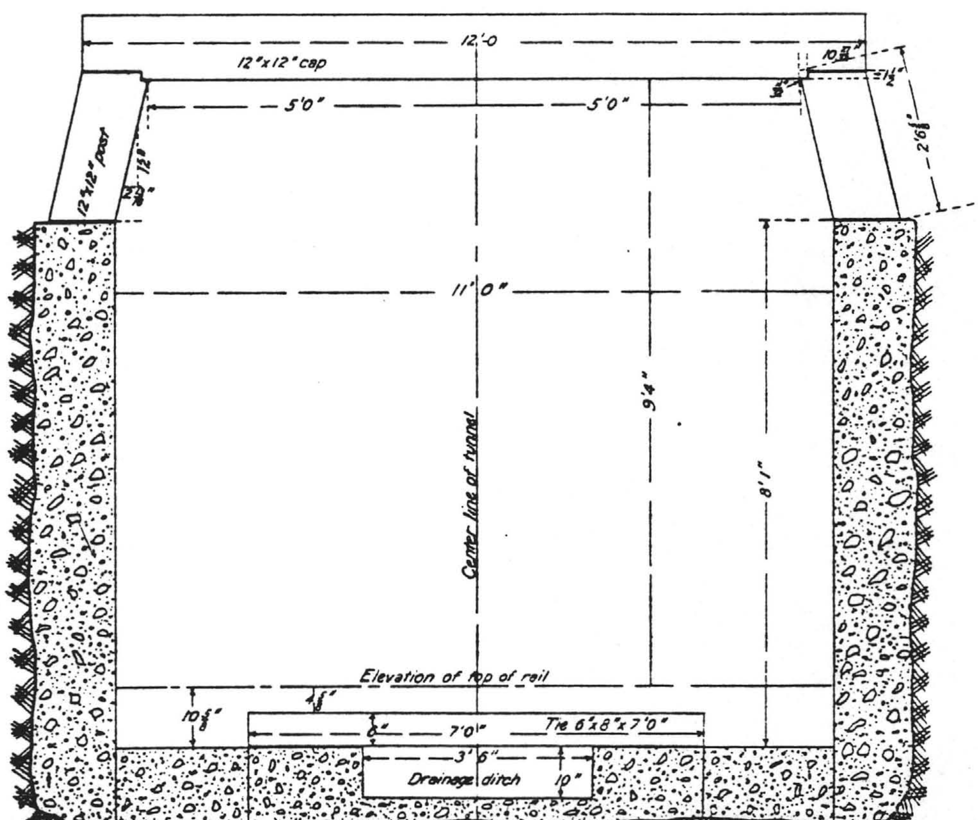

Figure 7-B-Special 12"x12" Tunnel Timber

ain ore
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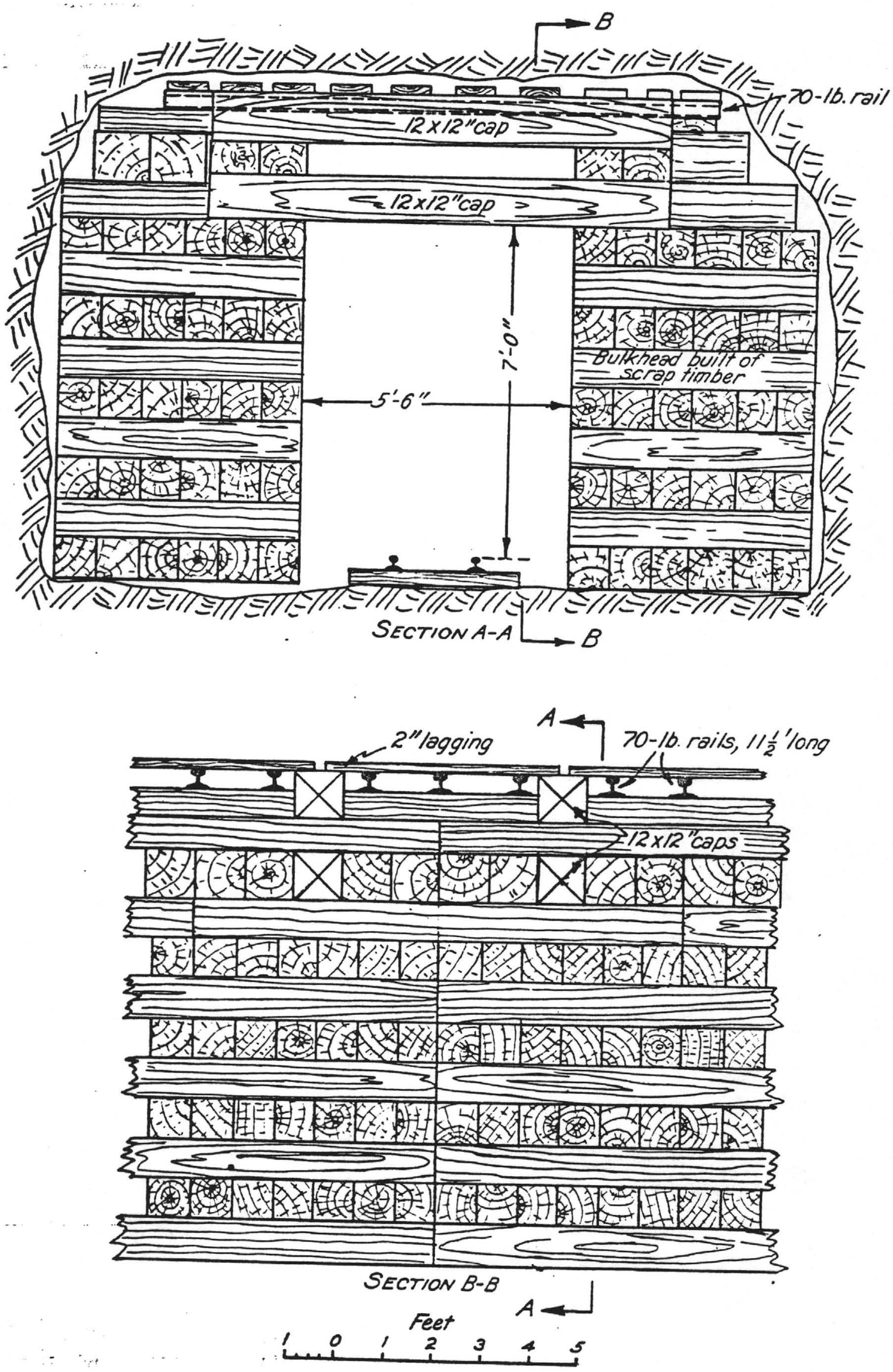


Figure 8.-Timber Bulkhead

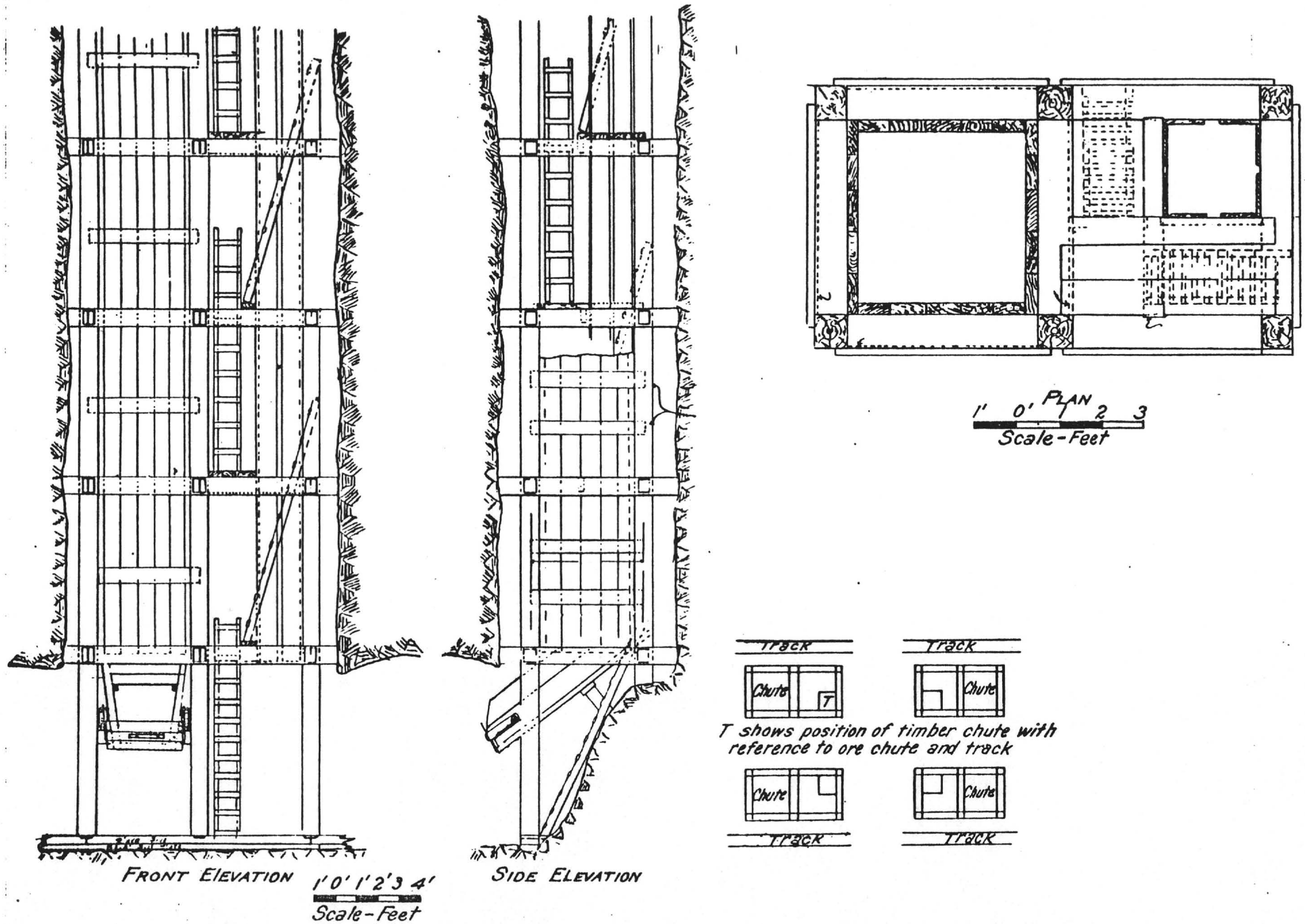


Figure 9. – Standard six post squares raise with safety manway

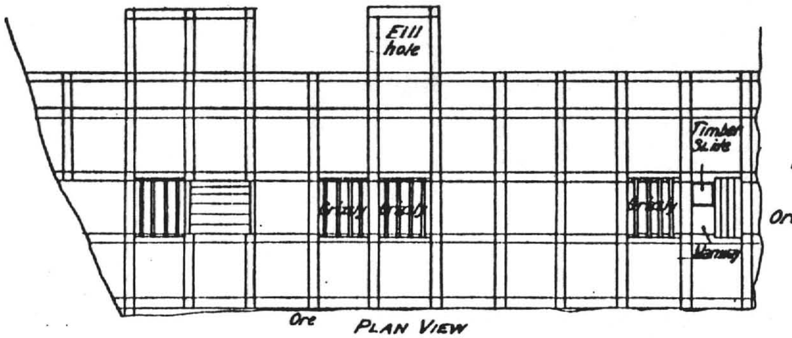
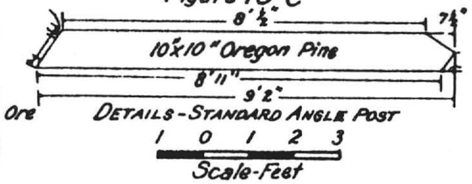


Figure 10-C



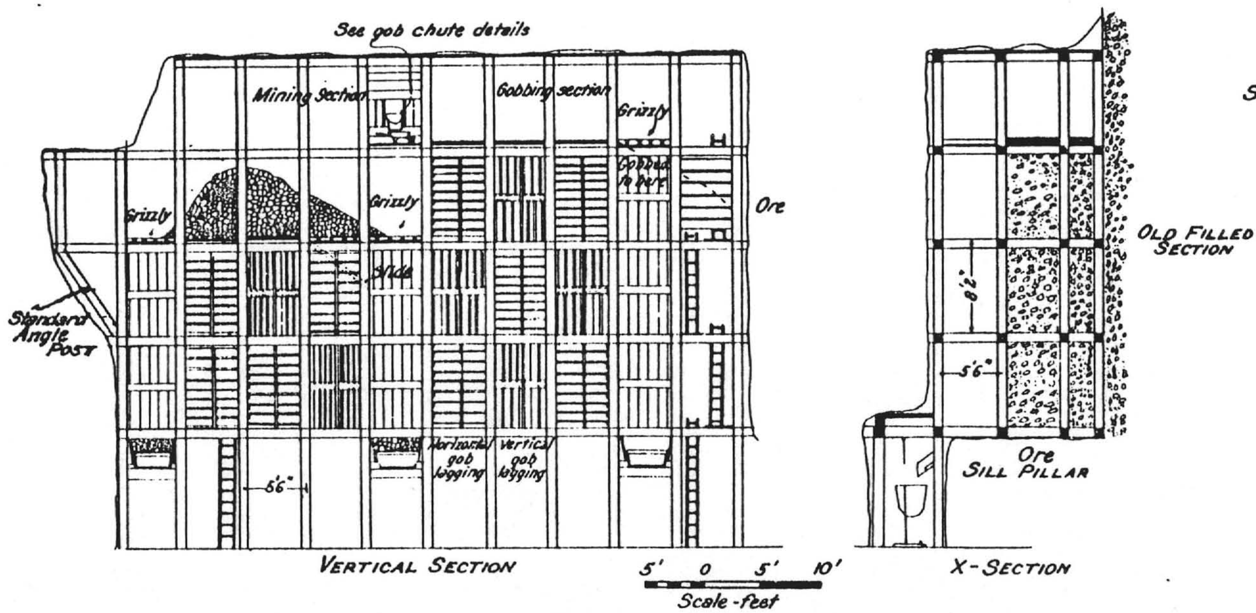


Figure 10-A: Typical Square Set Stoping Method

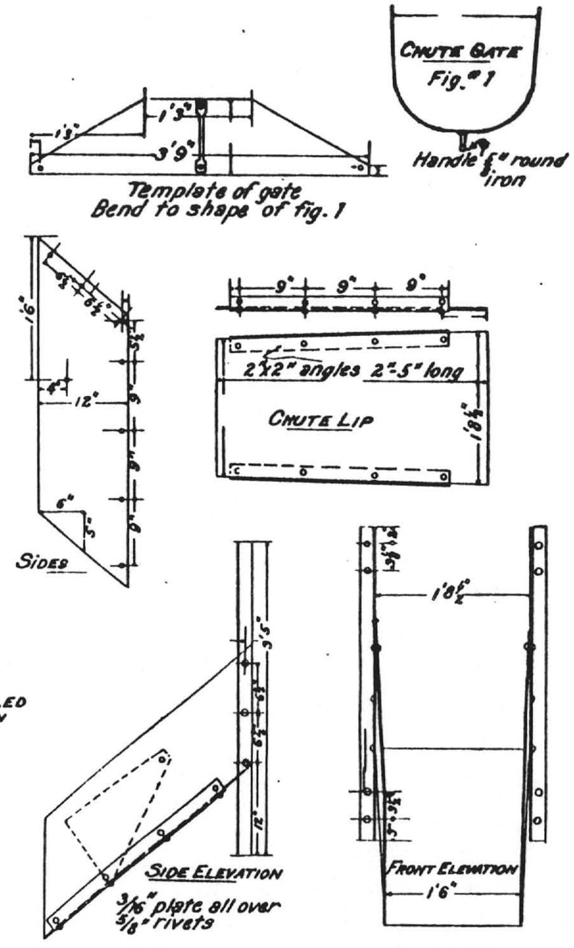


Figure 10-B-Gob Chute Details

1' 0 1' 2'

Scale-Feet

reinforced concrete bulkhead 5 feet thick has stood the strain very well, while the concrete has been forced out of place and cracked and has had to be blasted away to make clearance for gangways.

Raises

Three kinds of timbered raises are run in the mine. Wherever the work is to be followed by square-set stoping the standard 2-compartment square-set raise shown in Figure 9 is used. The chute compartment is lined with 2 or 3 inch Oregon fir lining, depending upon the service expected. The manway provides a timber slide in one corner and has landing platforms on each floor. In addition to the square-set raise two kinds of cribbed raises are in use. The smaller raise is timbered with 3-inch Oregon fir cribbing, giving two compartments 3-1/2 by 3-1/2 feet in the clear. For heavier use cribbing is made of 6 by 8 inch material and compartments are 4 by 4 feet in the clear.

Stoping

Because of the heavy massive nature of the main ore body, the richness of the ore, and the necessity for mining in such a way that no blocks of sulphide ore are allowed to move and generate heat only the square-set system of mining with stopes tightly filled with waste has ever been used in the main sulphide lens. By using the square-set system of mining with stopes tightly filled with waste complete extraction of the main ore body has been possible with practically no dilution. Moreover, this system has allowed careful prospecting of the walls, which has resulted in finding many small rich lenses of ore that would otherwise have been missed.

A typical stope is shown in plan and section in Figure 10 (a). The stope sections are usually 3 sets wide in fairly solid ore and 2 sets wide in the heavier ground. If the ore is very badly broken it is sometimes removed in slices a single set in width. Slices are taken 100 feet high, as that is the interval between levels throughout the mine. The length of the slice may be anything to suit the conditions, usually being from 10 to 20 sets. Ore chutes are placed in about every fourth set, and alternate chutes have manways beside them. By spacing chutes in this manner and leaving slides with grizzlies in adjoining sets as shown the shoveling of ore into chutes is virtually eliminated. If no weight develops on the timbers after one floor is removed another is removed and sometimes several more before filling with waste. This reduces the cost of mining, as most of the ore rolls to the chutes, and a large part of the fill can be run into place by gravity. When several floors are mined before filling the timber is protected from the fall of the blasted ore by placing grizzlies of 70-pound rails, 6 feet long, held in metal holders, immediately below the mining floor. By using metal holders the grizzlies are moved very readily and placed where needed. After one section is finished it is filled entirely, except the chutes and manways needed for entrance to and mining of the next slice. The chutes also serve for fill holes for running waste into the new section. By having a fill hole in about every sixth set and mining several floors before filling there is very little shoveling of waste fill. If conditions are such that the waste will not spread a light metal gob chute is placed in the fill hole and the waste spread with a car or wheelbarrow. Figure 10 (b) shows the details of the chute gate.

All timber used in stoping is standardized (fig. 11). Figure 10 (c) shows a standard angle post for offsetting a set. In the heavier sulphide stopes nearly all timber is 10 by 10 Oregon fir, but in the lighter ground much 8 by 8 Oregon fir is used. In the heaviest sill-floor gangways all timber is of 12 by 12 dimensions.

Although the general method of mining used is the well-known square-set system several modifications have been developed locally to apply to conditions existing in this particular ore body. A general technique of mining under this system has been developed, which has an all-important bearing upon the efficiency and safety of the mining, especially in holding the unmined pillars so that there is no movement of ore, with resultant heat and danger of fire.

A system of mining badly broken pillars by stoping up through the center with small square-set cuts, then tying across the top with timber stringers and slicing the sides downward, has been quite successfully used. This method is shown in Figure 12. On most of the producing levels in the main ore body the mining has been done in such a way that pillars usually about six sets wide have been left over the main extraction gangways, extending vertically from level to level. These pillars have been standing for many years while the ore on both sides and on the level above has been removed. Resultant movement has in many instances thoroughly broken these pillars so that they would be very difficult to mine by ordinary square-setting from the bottom upward. Moreover, the gob lining between the pillars and old stope sections is often found to be rotten and broken. By taking a small square-set slice up through the middle of the pillar, using as a cutting point the old chute and manway in the section previously mined and filled, then tying across the top under the old filled level above and coming down with a series of 10 by 10 timber stringers from pilot sets to the old gob line, it has been found that these pillars can be removed very effectively. Quite often this ore between the sets and the old gob can be taken down by the use of a bar alone, without using explosives at all. If the old gob line is broken or rotten it is braced back by stulls between the stringers and new cross lagging. After one-half is finished it is filled with waste dumped in from the level above and the other half mined the same way. After all the mining is completed everything is filled except a chute and manway on the advancing side to be used as a cutting point for the next slice.

Underground transportation

Main haulage levels in the main ore body are maintained on the 1400 and 1600 levels, and the ore from the levels above is passed through a series of transfer raises. Haulage on these levels is done with 5-ton trolley locomotives running on tracks with 30-pound rails and minimum curves of 25-foot radius. The car used in this haulage is the 30 cubic foot side-dump car shown in Figure 13. Cars of this type have been in continuous operation for 12 years and have proved satisfactory. Chute doors used throughout the mine are illustrated in Figure 14. This type of chute door was copied from one used in the United Verde mine. The same type of door, operated by an air cylinder, is in use on most of the main haulage transfer chutes. A 16-cubic foot car used for hand tramming is also shown in Figure 14.

On other levels where the tonnage produced is much less and where the working

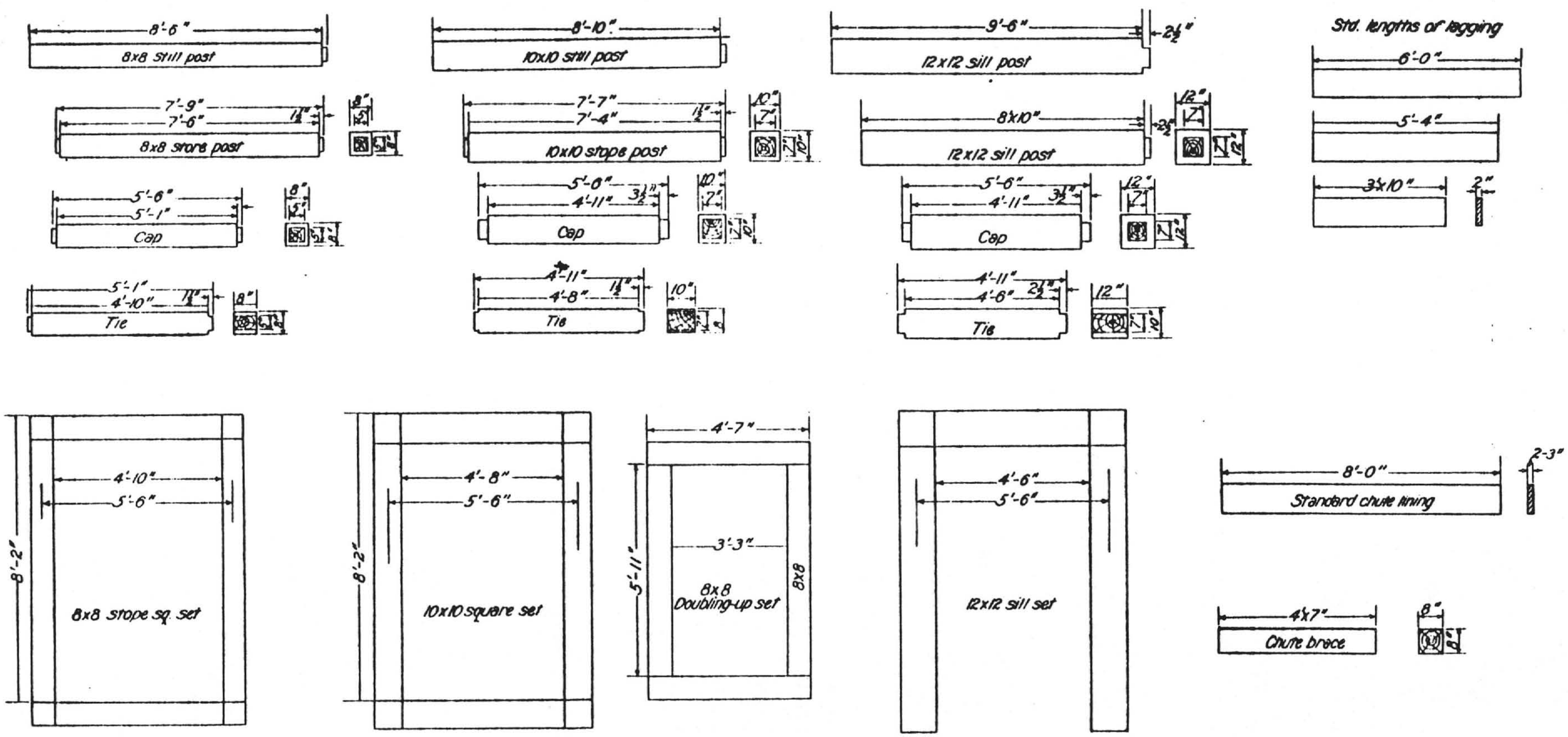


Figure 11.- Standard Stope Timber

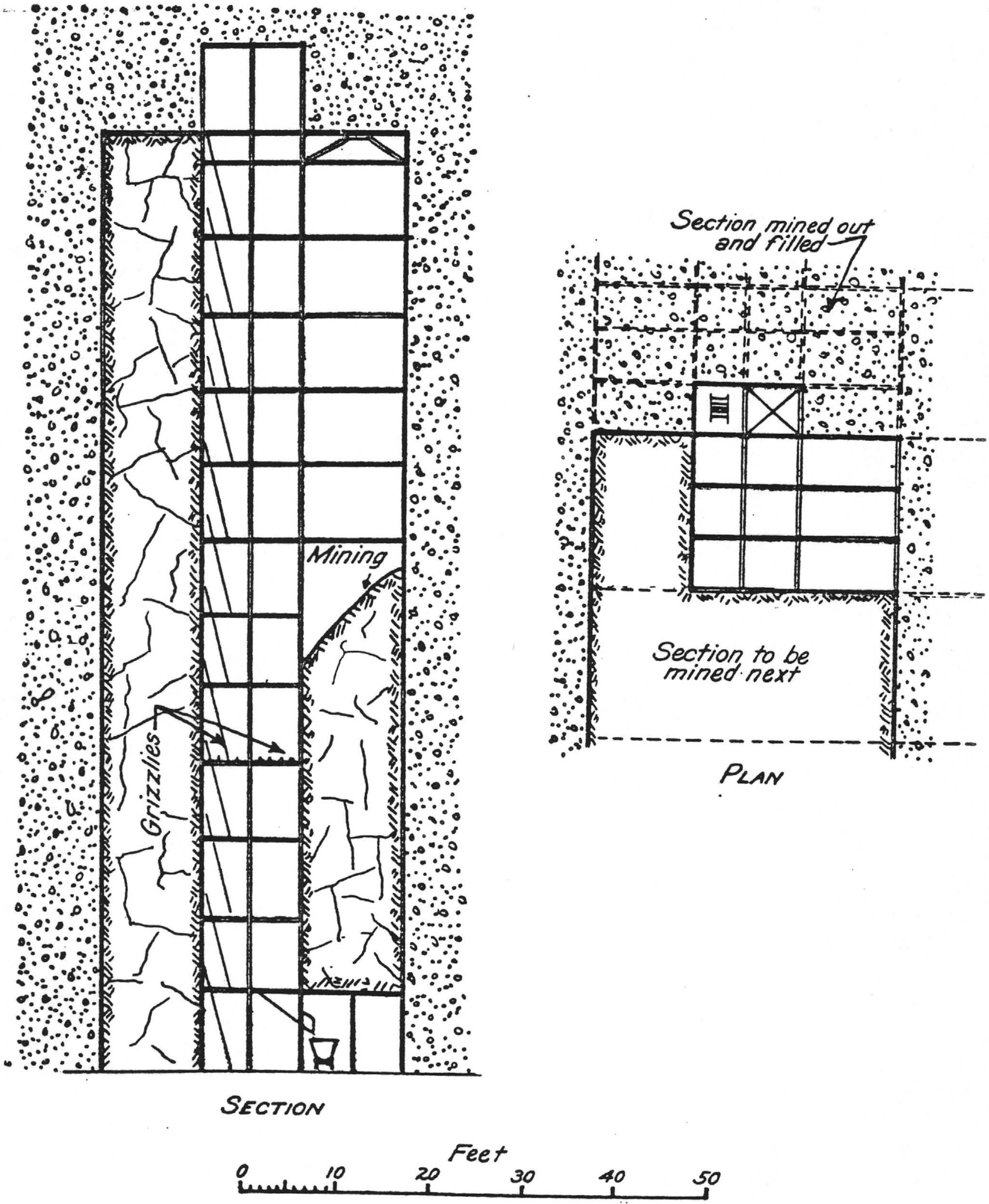


Figure 12.- Modified Mitchell slice used for mining pillars

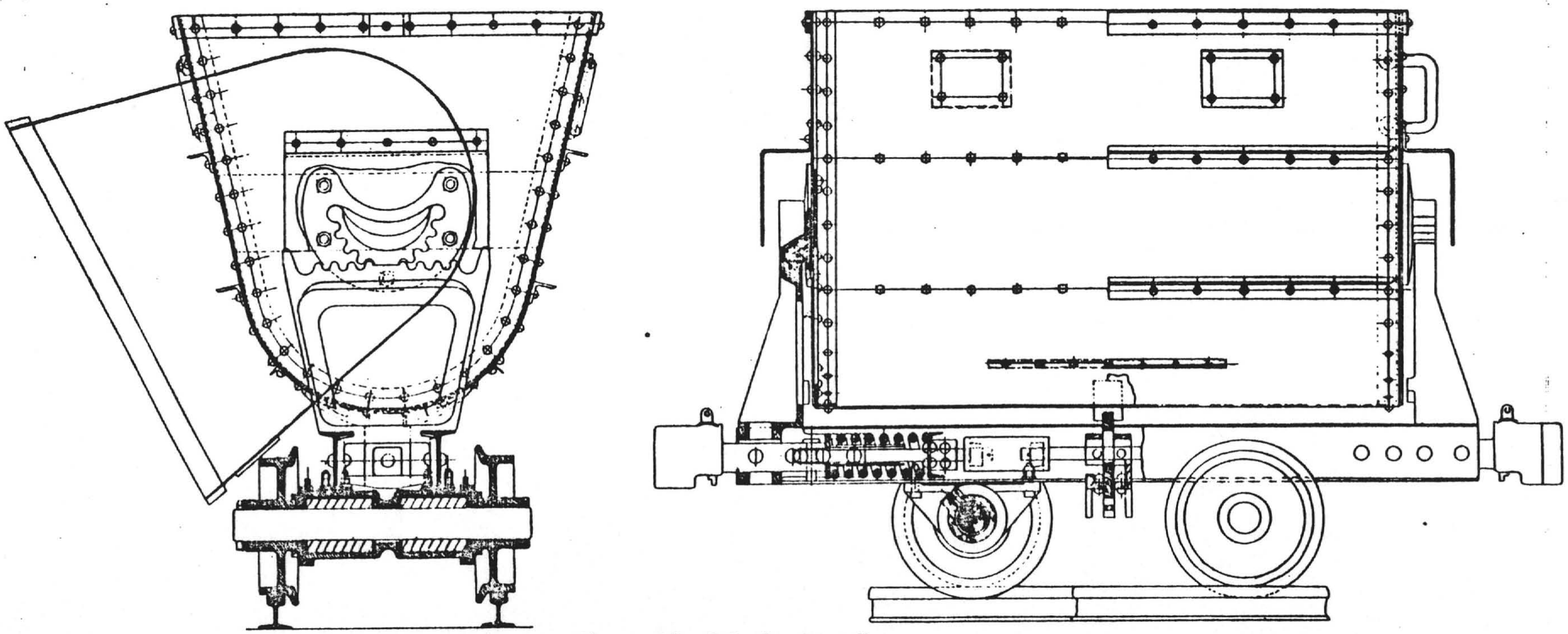


Figure 13.- 30-Cu.Ft. Mine car

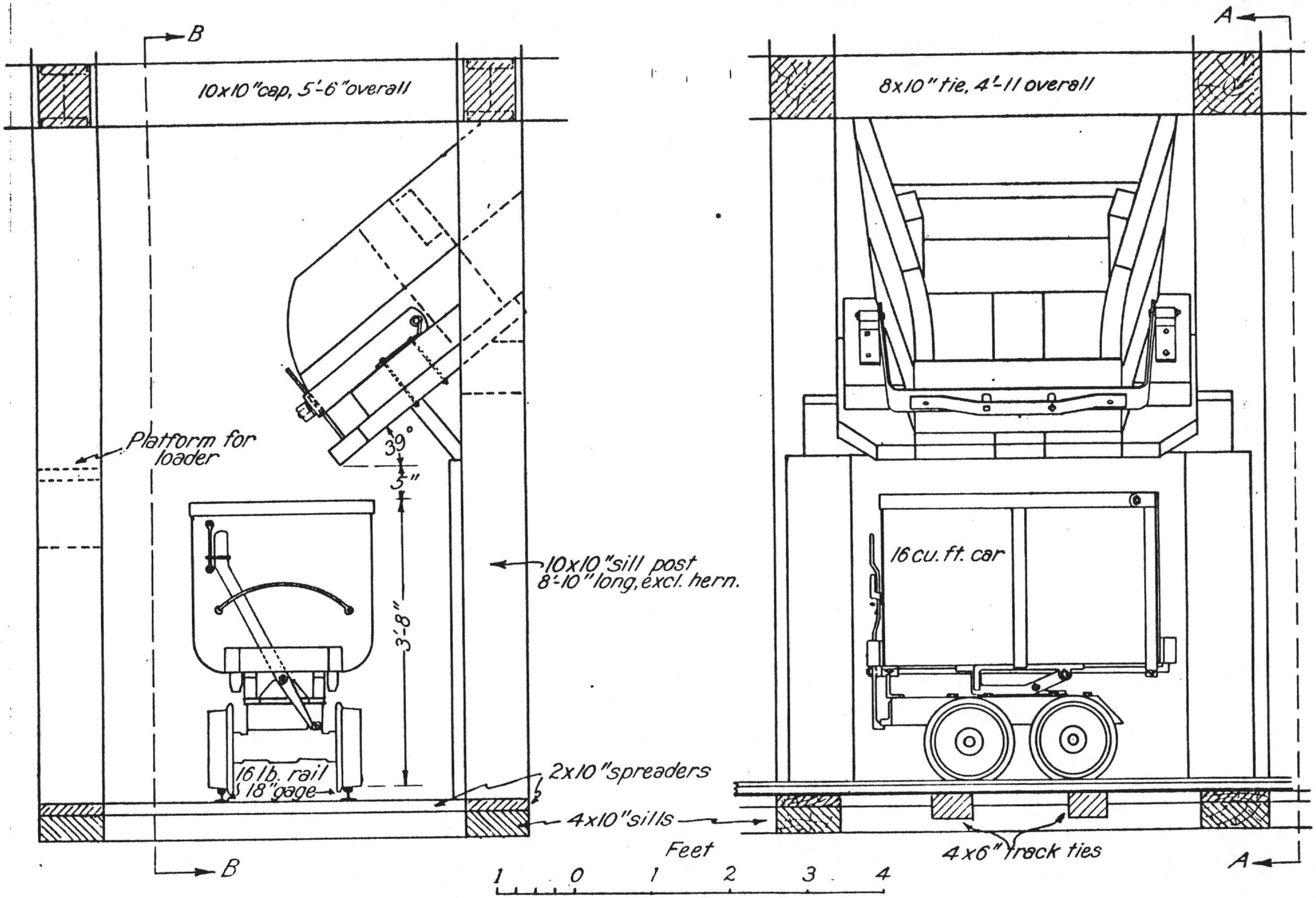


Figure 14. - United Verde Chute Gate and 16-Cu. Ft. Car

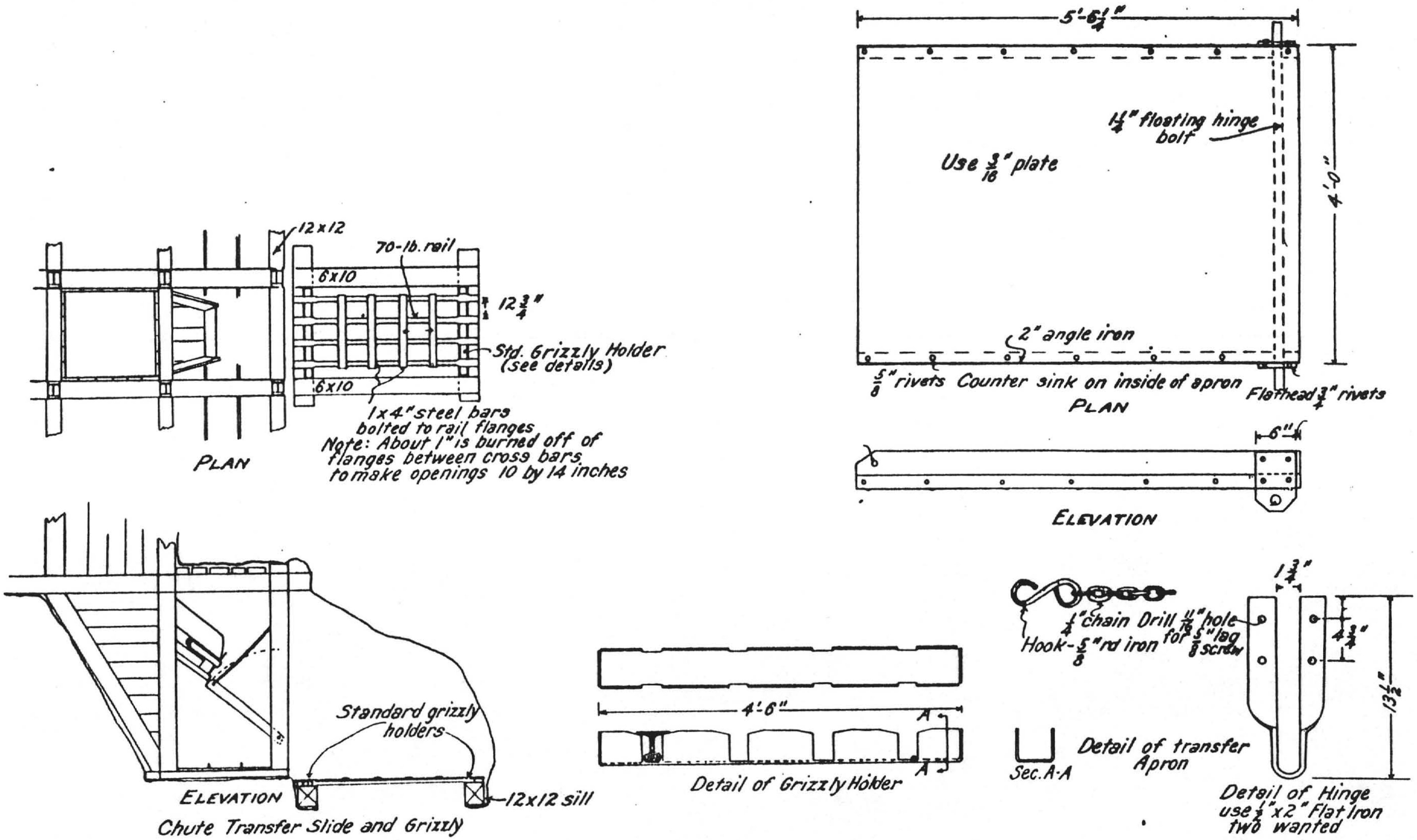


Figure 15.- Chute Transfer Slide and Grizzly

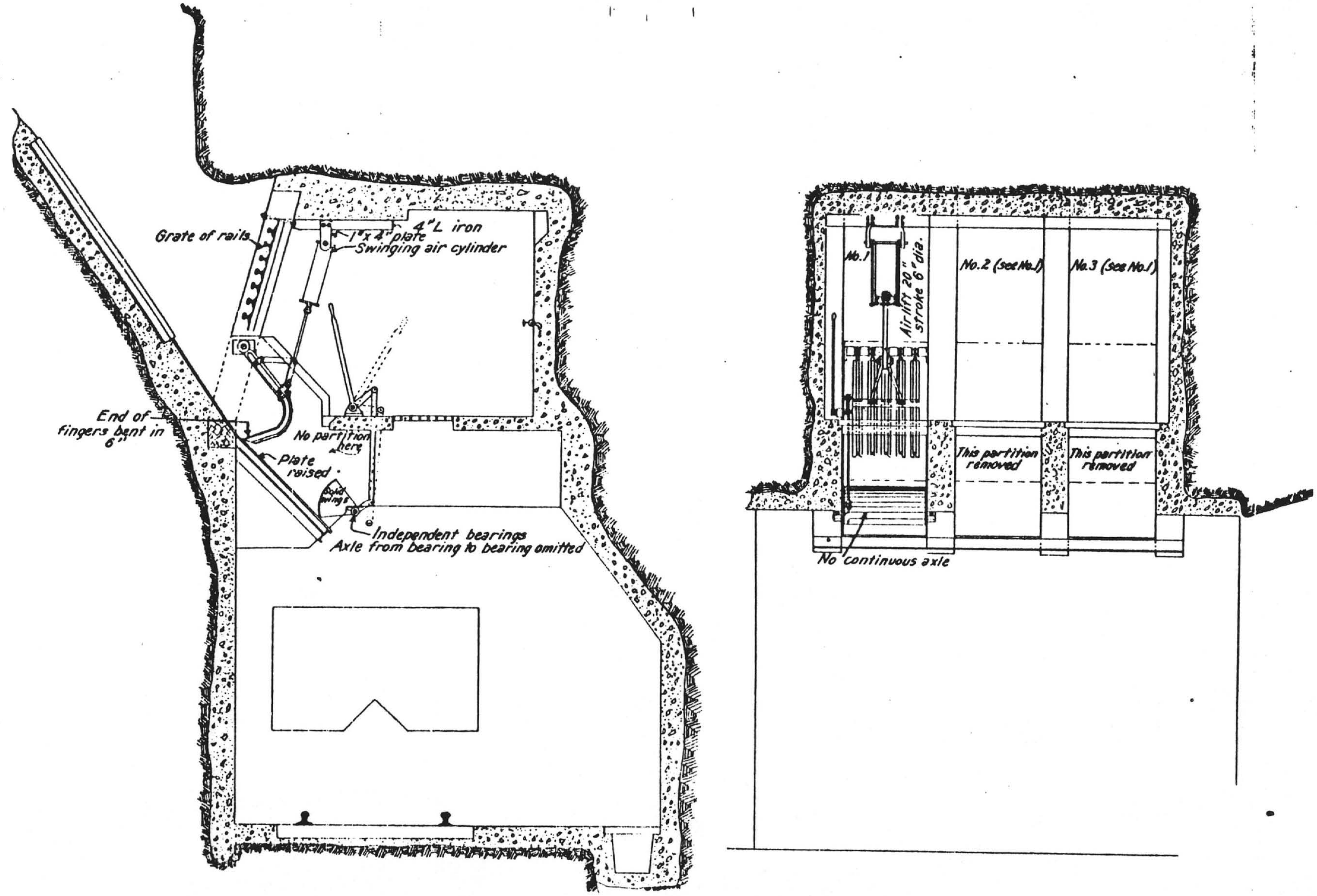


Figure 16.- Loading gates Main Ore Pocket

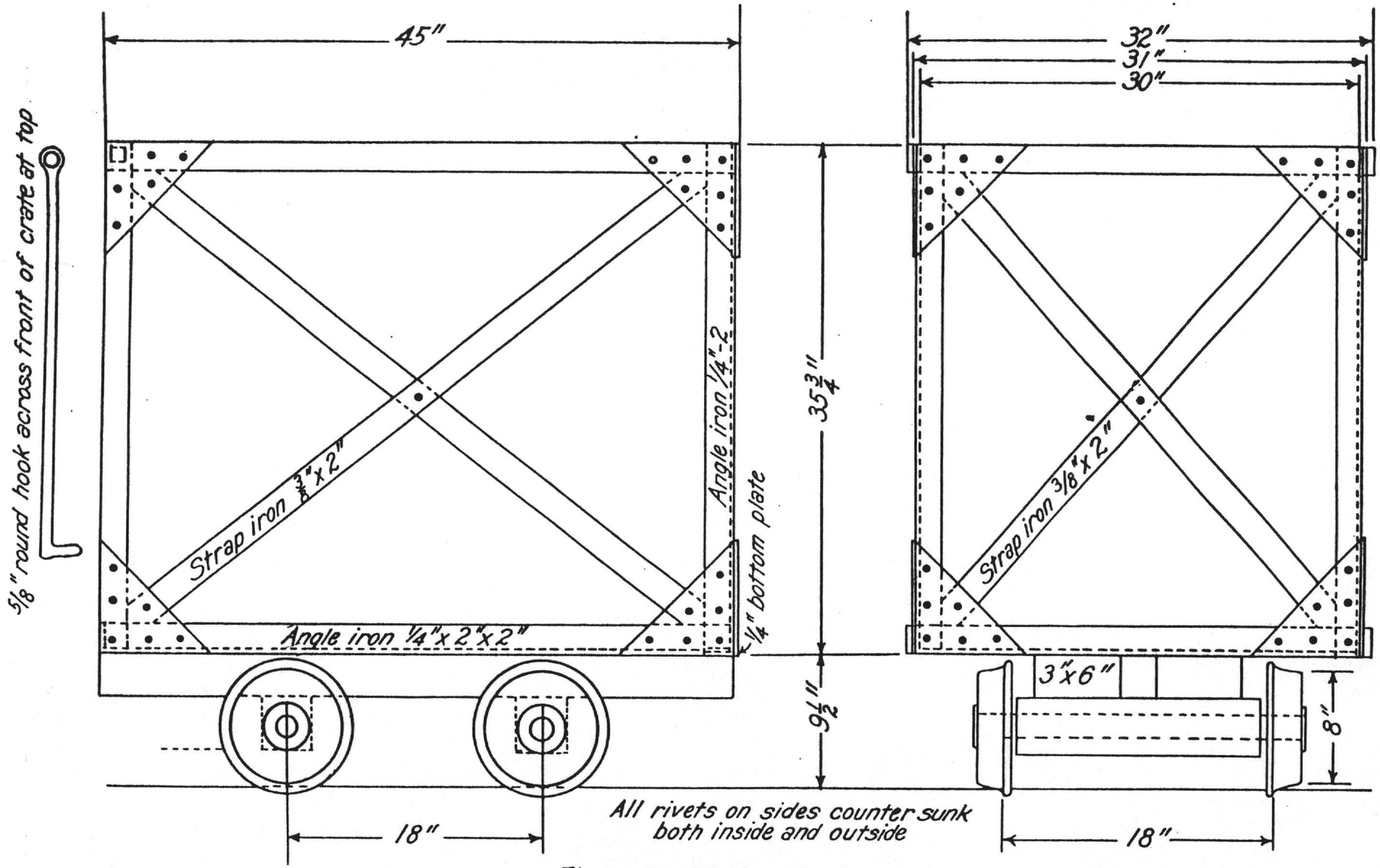


Figure 17.- Timber Crate

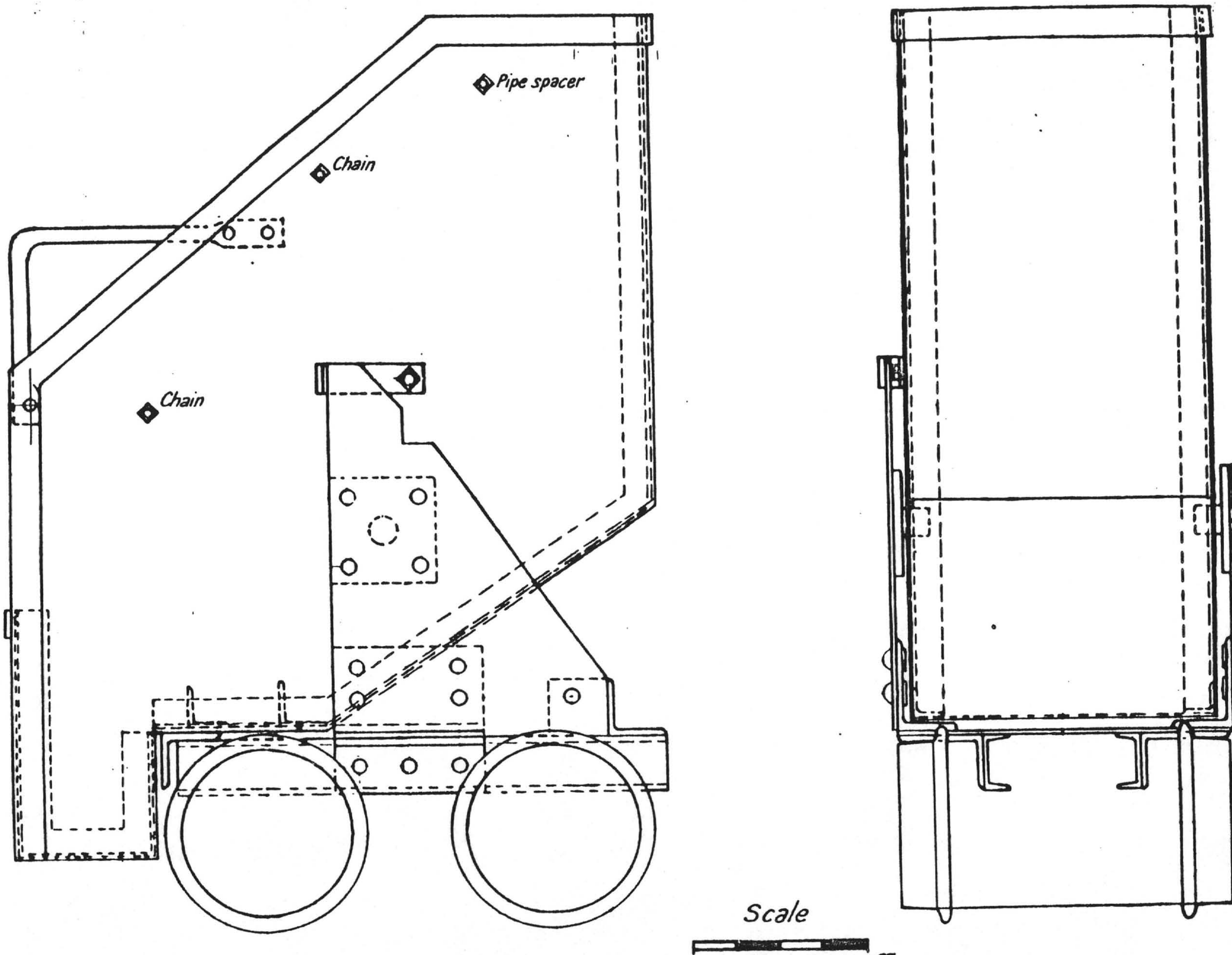


Figure 18.-Car for drill steel

places are widely separated much of the tramming is done with small storage-battery motors. Six of these are in use in various sections of the mine. They have proved satisfactory for moving small tonnages of ore from scattered workings and for handling development waste from long prospect headings.

Figure 15 shows the transfer apron and grizzly used on a level for transferring ore directly from a chute into an ore pass.

Figure 16 shows the loading gates of the main ore pocket on the 1300 level.

Figure 17 shows the timber crate used for handling timber in the cages and Figure 18 the details of the car for handling drill steel in the mine.

CONTRACTS

In an effort to obtain better progress and more efficiency drifting and raising are generally done on contract. All contracts are let directly through the superintendent's office. In a raise the contract specifies the footage to drive to the next level. In drifting the footage is generally limited to 100 feet, although contracts have been let for more. The contract stipulates the price per foot, the price per set of timber, the size of opening required, and, in a raise, the kind of timbering. The contractor pays for all explosives used. The contractor gets his regular day-pay check on pay days, and settlement on his contract is deferred until the first of the month. Settlement is then made according to the engineer's measurement and payment made on the 15th of the month.

Drifting contracts may run for months. When a contract is completed the contractor obtains settlement immediately, if he so requests.

Bonus work was tried out some years ago. In the stopes it resulted in hurried and consequently poor mining. The saving effected was not considered enough to compensate for this disadvantage. In drifting and raising difficulty was experienced in setting rates. The straight contract system was decided upon as being more acceptable to the workmen.

VENTILATION

The mine is ventilated mechanically by a surface exhaust fan installed at the top of a return-air system extending to the 1200 level. Rock temperatures are not very high, but a considerable amount of heat is generated by oxidation and timber decay, and the system is predicated entirely upon providing comfortable working conditions and control in case of a mine fire.

A multivane, forward-curved blade, single-inlet, single-width, centrifugal fan is used, with a 78-1/2-inch rotor operated at 346 r.p.m. by belt drive from a 250-hp., 2,200-volt, 60-cycle, 3-phase, 585-r.p.m. slip-ring induction motor. It exhausts from a 6.33 by 15.0 foot raise through a 10-foot concrete duct on a 30-degree slope and 4.5 by 5.5 feet in section. This fan is at present exhausting 100,000 cubic feet per minute of air saturated at 70°.

A single-inlet, single-width, multivane, forward-curved blade centrifugal fan, with 52-3/8 inch rotor, is connected to the opposite end of the air raise by a similar concrete duct; this is an auxiliary installation and is installed to operate at 590 r.p.m. by belt drive from a 75-hp., 2,200-volt, 875-r.p.m. induction motor. Each fan duct has a winch-operated door hinged to the floor and held in place both by fan pressure and gravity.

All long development headings are ventilated by fan-pipe installations, using small air or electrically-operated blowers, with 10-inch galvanized-iron piping.

FIRE HAZARDS

On account of the heavy ground in the mine considerable timber is required. Due to this and to the fact that the main ore body carries a high sulphur content a fire menace is always present. Timber bulkheads are used to maintain haulage and extraction drifts in various parts of the stoping sections of the mine. To control any fire starting from the above conditions fire hydrants and standpipes are placed at all places where hazards exist.

A fire patrol is maintained on the graveyard shift, and all hazardous places are wet down two and three times a week. In addition, large independent fire lines are maintained on the main working levels. These lines are direct-connected to the pump columns where a large source of water would be available if needed. In addition to this, all air lines can be converted into water lines in a few minutes by the use of installed by-passes.

In the timbered section of the Edith shaft sprays are placed at 300-foot intervals, and the timbers in this shaft are wet down at least three times a week.

FIRE-FIGHTING EQUIPMENT

A complete mine rescue station is maintained with all the necessary fire-fighting equipment. Figure 19 illustrates a small portable disk fan. This type of fan has proved successful in other parts of the Southwest in fighting fires. The fan is equipped with a 110-volt, alternating-current, single-phase, 60-cycle, 850 revolutions per minute, General Electric repulsion motor. It is mounted on a mine truck with a reel carrying 1,000 feet of No. 14 duplex rubber cable that can be connected to the lighting circuit. The fan and reel are mounted on a turntable and can be locked in any position desired. Figure 20 shows an emergency tool truck for fire-fighting.

Sets of oxygen breathing apparatus and gas masks are kept on hand, and men have been trained in their use. Fifteen active rescue men are required to practice rescue and fire-fighting at least twice a month. These practices are followed by occasional maneuvers in which all apparatus men participate. Apparatus men practice on company time and are paid a bonus of $7.50 a month.

All shift bosses, jigger bosses, and tool nippers are trained in first aid, and first-aid stations or cabinets are maintained on all active levels. The training of apparatus and first-aid men is in charge of the safety engineer, who is also responsible for the maintenance of the rescue station.

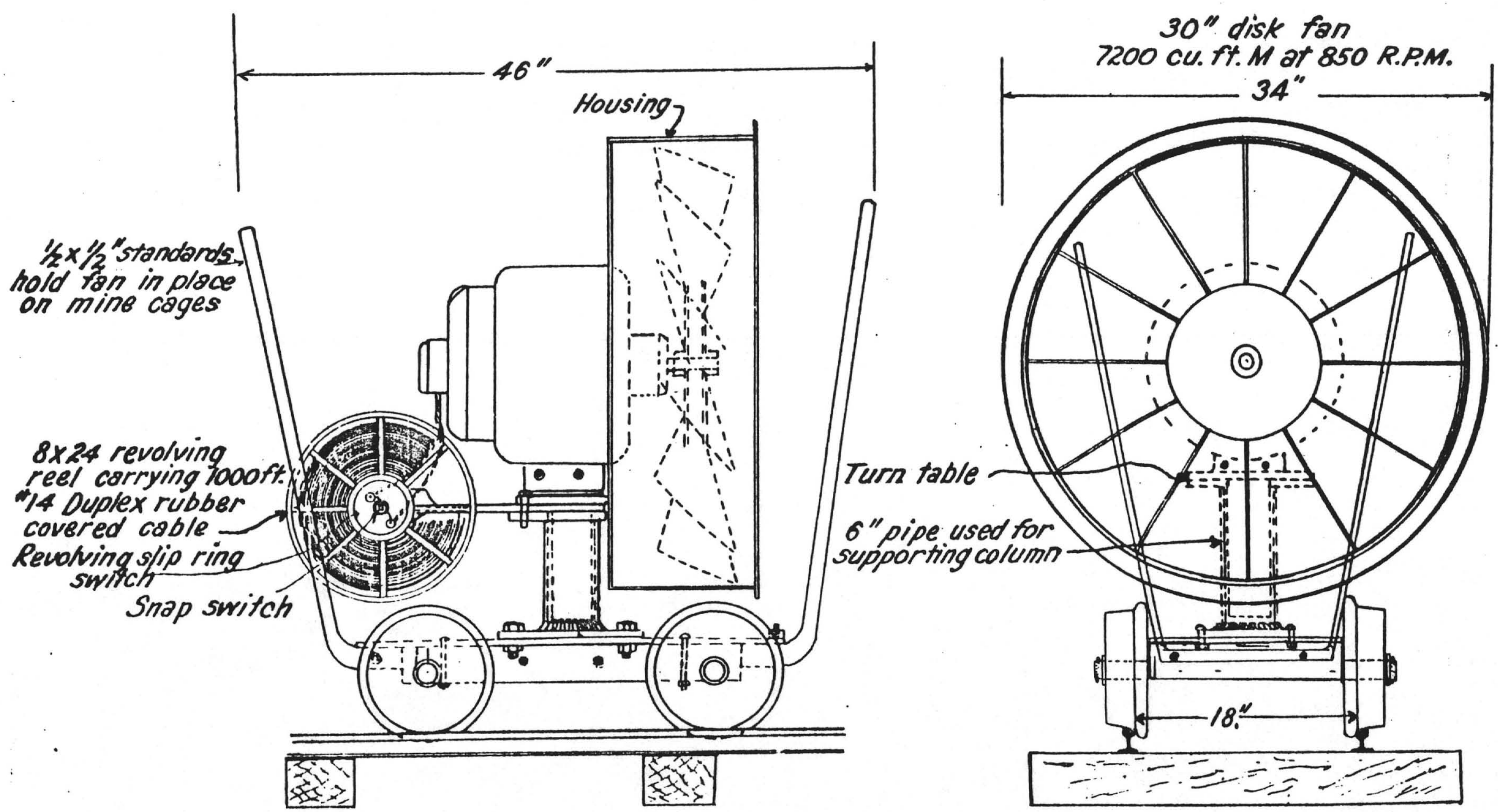


Figure 19 — Portable Ventilation Fan Used for Mine Fire Fighting

ACCIDENT PREVENTION

The safety engineer makes daily inspections and reports all unsafe conditions to the mine superintendent, mine foreman, and the shift boss on each run visited. Safety propaganda in the form of bulletins and individual talks by the safety engineer on inspection trips through the mine impresses the safety idea upon the men. Safety committees have been tried and abandoned in favor of the present method.

UNITED VERDE EXTENSION MINING COMPANY

EFFICIENCY DATA

YEAR 1928

Tons mined per man (stoping shifts)	4.84
Tons mined per man (underground shifts)	2.47
Tons mined per man (total shifts)	2.00
Feet advanced per man (development shifts)	1.17
Mine timbers and handling cost (per 1000 board feet)	36.24
Mine timbers and handling cost per ton	.67
Mine timbers (board feet per ton)	16.82
Total board feet used per ton	18.53
Pounds power per foot advanced	6.14
Feet fuse per foot advanced	19.10
Number caps per foot advanced	3.29
Pounds carbide per underground shift	.85
Pounds powder in stope per ton	.39
Feet fuse in stope per ton	1.93
Number caps in stope per ton	.35

UNITED VERDE EXTENSION MINING COMPANY

MINING COSTS

YEAR 1928

Tons shipped during period: 275,212

	Cost per ton
Prospecting and development	$0.611
Extraction	1.710
Repairs and maintenance	.260
Ventilation	.068
Haulage	.357
Hoisting	.151
Pumping and drainage	.039
Underground miscellaneous	.107
Rock drills	.152
Compressed air	.092
Waste pit	.005
Office and general	.738
TOTAL COST PER TON	$4.286

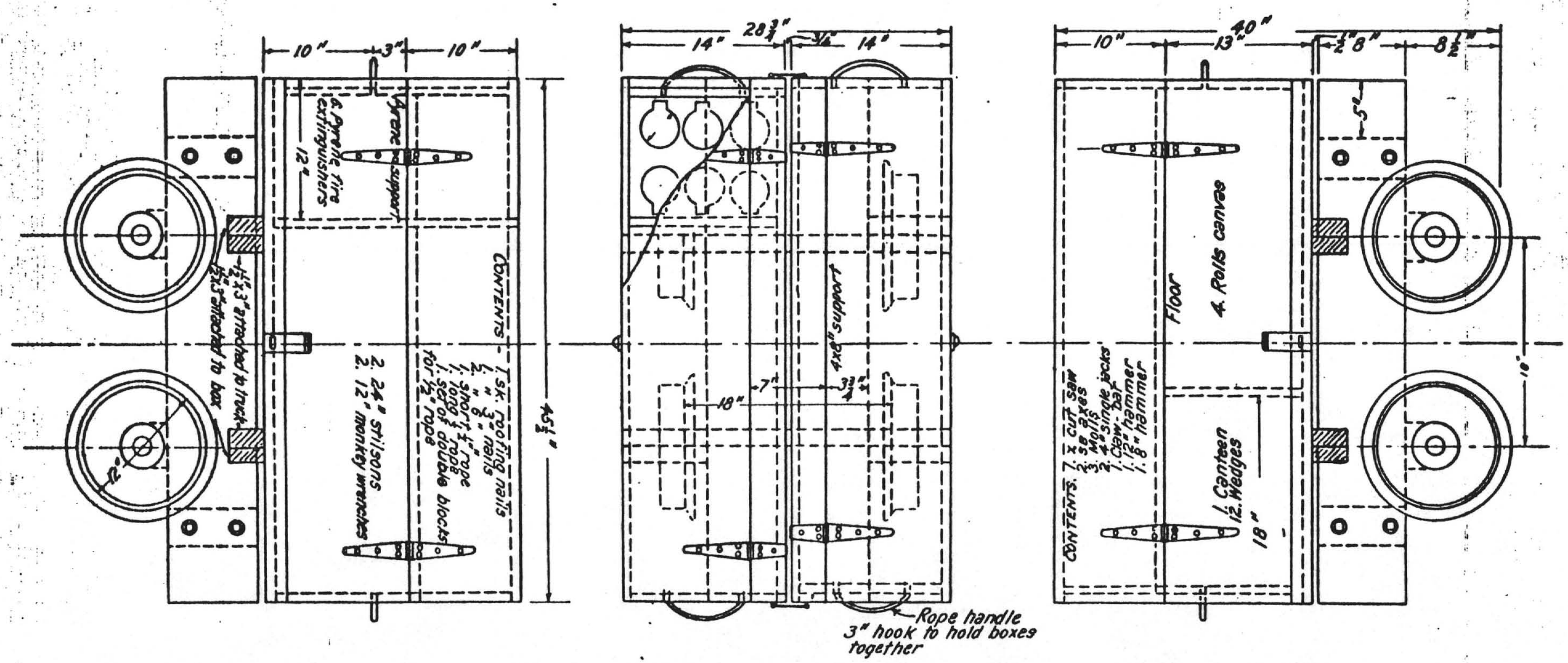


Figure 20.- Emergency Tool Truck for Helmet Teams United Verde Extension Mining Co. Jerome, Ariz.

Prescott, AZ

September 21, 1988

Dear Bob,

Posted separately a few days ago was a sample of peculiarly iron-rich (~ 45% Fe!) silica from the stratigraphic top (E edge) of the U.V.X. Morgan zone recently intersected by a raise from the 950 level. It occurs in that zone between the beige-banded silica and the low-iron silica grit. Because of that positioning and the areal continuity of the rock I have dubbed it the "iron front", thinking of it as iron emplaced by migrating thermal fluids from the adjacent diorite. It was discussion about that which led you to request the sample to see whether it couldn't be a relict iron formation or whether some study couldn't reveal more about its history.

I shall get you a plan with this sample located in context of others on the 925 sublevel (25 ft. above the 950 level) as soon as it's compiled.

Carole tells me the first gold pour of the Vulture tailings operation will be later today. I've been away on another tailings evaluation in the Cripple Creek district the last couple weeks.

Give me a call if any issues need discussion on the N.W.M.C. paper.

Sincerely,

Don

Don White
Geologist, C.P.G.

cc: Carole A. O'Brien
Ron R. Short
John McKenney

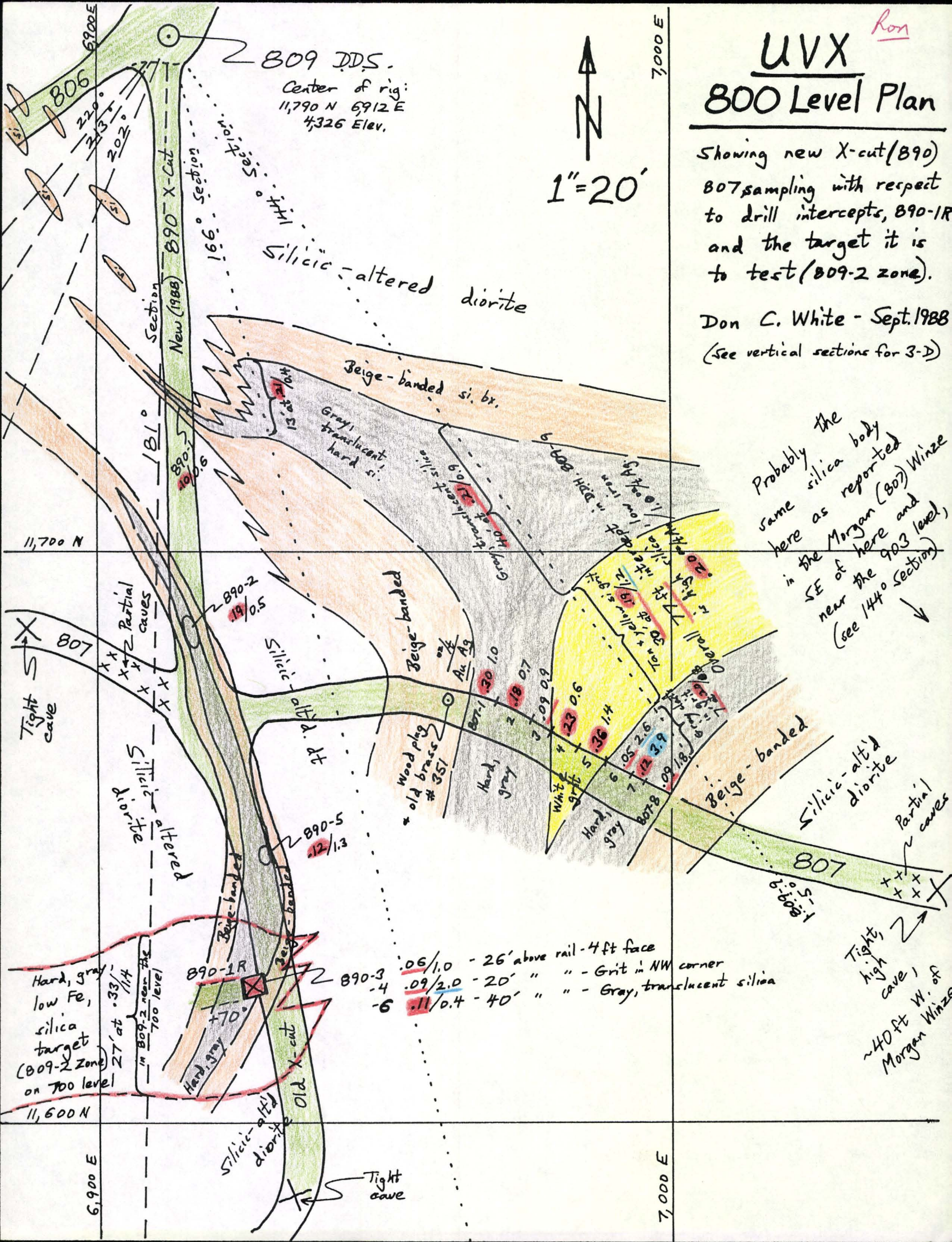
Ron

UVX
800 Level Plan

Showing new X-cut (890) 807 sampling with respect to drill intercepts, 890-1R and the target it is to test (809-2 zone).

Don C. White - Sept. 1988

(see vertical sections for 3-D)



M E M O

TO: Ron Short, Carole O'Brien, Anthony Budge
cc: John McKenney, Dale Allen

FROM: Don White, Robert Hodder

DATE: October 11, 1988

SUBJECT: Possibility of gold accidentally leaching from U.V.X. stockpiles

U.V.X. development ore is now being stockpiled on the ground within the mine yard. No plans have been consummated to get it on its way to a smelter. This is cause for concern because continued exposure to the weather may well diminish the precious metal content of the ore piles.

We are now fairly certain that the supergene role in concentrating precious metals at U.V.X. was quite profound. That is, meteoric waters channelled via the Verde Fault played an important part in transporting the metals to their present settings. The silica grit host is very porous and permeable. There is every reason to believe that merely wetting that material could redisolve some of the gold and silver and carry it away as runoff or into the ground beneath the piles.

We recommend against keeping stockpiles through a winter or even exposed to the January rains for risk that the grades will no longer match those of drilling, rib sampling, or car sampling. The best solution to the problem is to minimize holding time and get it to the smelters promptly. Failing that, or as a stopgap in bad weather, piles may be able to be covered with polyethylene sheets weighed down at their edges.

DW:sk

MEMO

TO: Carole A. O'Brien, A.F. Budge, Ron R. Short

FROM: Don White

DATE: November 3, 1988

SUBJECT: Eddie Basha's submittal, Mt. Union vicinity, Yavapai Co., AZ

INTRODUCTION: Carole O'Brien was provided several reports on a series of vein gold occurrences, some with historical production, on the west flank of Mt. Union about 14 miles south of Prescott, Arizona. The data was provided by Harvey Smith and was mainly Gerald Mathis' collections of historical data from published sources plus some metallurgical test results on dump samples and some recent assays.

The property is called variously the "B&C", Hassayampa Golden Girl, the EDG Mining Venture, the Wilson Property or by the various patent names and/or major vein names within the claim group. Patent names of import are the Alligator and Evergreen. Vein names from other records include the Crook vein (also called the Westerner) Premium vein, Storm Cloud vein, Vanderbilt vein, and the Ella Wick vein.

Having reviewed the file provided plus other published and unpublished information on the Hassayampa District veins, I spent one day traversing the claim block to inspect the old workings and outcrops. Because of the steep relief, heavy forest and undergrowth cover, and old age of the workings, this property is a case in which there is at least as much to be learned from the records as there is from on-site work. In fact, when it comes to assays, the old data is much more valuable than new surface or dump samples. Much sampling has already been done and my own coverage could not improve upon it without a major program. So no new samples were collected.

TYPE OF MINERALIZATION: All the mineralization is structurally controlled, NNE-trending fissure-filling veins (see accompanying map). The veins are quartz with or without calcite, pyrite, base-metal sulfides, gold, and silver. Thus they are very much like the McCabe Mine now in production at Humboldt and the Carter-Raymond and Gold Links-Sacramento Mines near Gunnison, Colorado, looked at on your behalf a couple years ago.

Veins are typically thin, up to about 6 feet in thickness but the "pay streak" in each is rarely over 2 feet thick. Of the large system of veins, the two most productive are northwest of Basha's claims. They are the Senator and Cash Mines. The Senator vein mineralization was up to 18 inches thick, the Cash up to 30 inches thick. Ore shoots plunge along the veins and average 200 feet wide and about 500 high. This gives 10,000 to 20,000 ton ore shoots.

Most of the value of the vein rock is in gold. Silver is far subordinate, as are copper, lead, and zinc for those sectors of veins carrying chalcopyrite, galena, and sphalerite respectively. The one main ore shoot of the Senator vein ran about one ounce gold per ton. Small sectors of each of the other veins ran about that as well, particularly in the oxide zone. Oxidation rarely extends more than 40 feet beneath the surface. Most of the historical mining activity was during the 1880's and 90's and developed only the oxide zone. Only at the Senator and Cash Mines were ore shoots found to be profitable into the sulfide zone.

The range of production grades for veins within Basha's claim block is about 0.2 to 0.5 oz/t Au. The average of many underground assays taken in the 1920's is reportedly 0.28 oz/t Au.

<u>LOGISTICS</u>: The claim area is very steep and rugged. While there are some access roads to adit portals, they are old wagon routes only. Others are just burro trails. Access for exploration drilling would necessarily involve bulldozed terrace-like roads through thick Ponderosa Pine forest and past bold outcrops requiring blasting. A track-mounted rig would probably be necessary.

Small tonnage deposits occurring as narrow veins could not possibly justify new shaft sinking at today's gold price ($400./oz). Thus one may only consider that potential approachable by adit from say 6,400 ft. elevation along the Senator "Highway" (rarely graded, one lane, Forest Service road) south of the claim block. This limits the height of potential finds to a maximum of about 500 feet at the northern edge of the claim block and much less than that closer to the portals.

Winter weather at about 7,000 feet in the Bradshaws is often quite snowy. Road access is cut off 2-3 months of the year and interrupted other times by fall and spring snows. A partial operating year would have to be planned on.

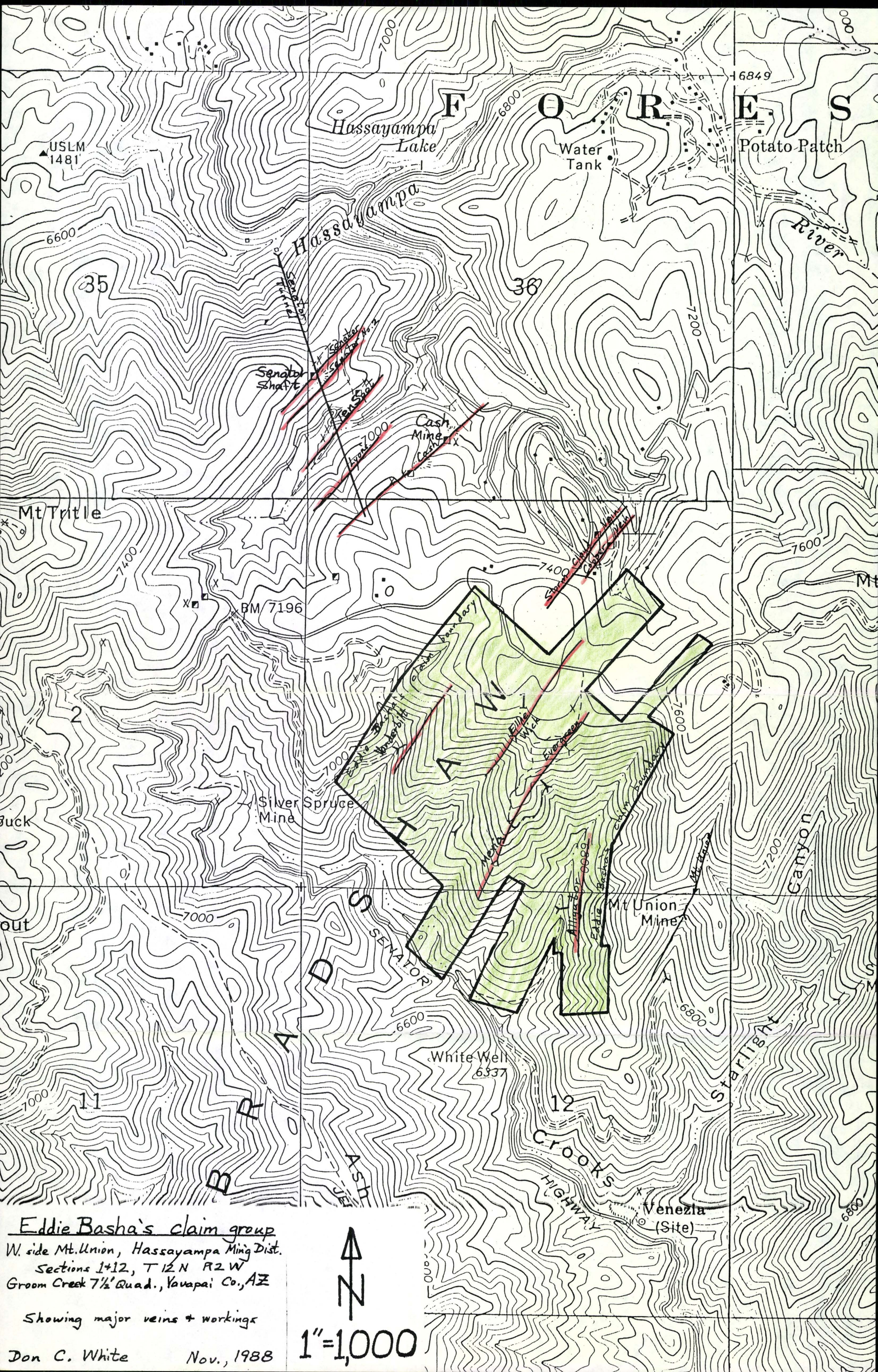
Because of the thinness of the pay streak in each vein, and the lack of disseminated mineralization in the wall rock, dilution would be a major problem. A 12-inch vein of, say optimistically 0.4 oz/t Au, diluted to a mere 4-foot mining width would yield 0.1 oz/t diluted grade. Thus split shooting and strict waste versus ore segregation would have to be the practice. Such techniques are costly.

The product of such mining would be a polymetallic sulfide and quartz ore. It would not likely be the best silica flux if very much aluminous wall rock is included. It may lend itself to flotation concentration and cyanidation as at McCabe but would have to be shipped. There would not be enough tonnage to justify a mill on site.

<u>CONCLUSIONS</u>: Basha's claims have potential for no more than about four ore shoots of average 15,000 short tons each from adit level to ground surface; say 60,000 tons total at the historical production grade of 0.28 oz/t Au. Such bodies would be thin and fraught with mining and dilution difficulties. They would be very difficult to locate by any but the most comprehensive exploration drilling program.

RECOMMENDATIONS: I do not see Basha's claim group as an attractive exploration target at the present time. If access is improved, mining technology is improved for narrow veins and/or ore segregation, and most critically, the gold price strengthens substantially, then it may be reconsidered. I believe at least $800./oz gold will be required to justify very serious expenditures there. Till then I do not recommend Budge's involvement.

DW:sk


F O R E S
Hassayampa Lake
USLM 1481
Water Tank
Potato Patch
6849
River
Hassayampa
35
36
Senator Tunnel
Senator Shaft
Cash Mine
Mt Tritle
BM 7196
2
Silver Spruce Mine
Buck
Mt Union Mine
B R A D S H A W
SENATOR
White Well 6337
11
12
Crooks
HIGHWAY
Venezia (Site)
Starlight
Canyon
Eddie Basha's claim boundary
Vanderbilt
Ellie
Mexia
Evergreen
Alligator
Mt Union
6600
7000
7200
7400
7600
Eddie Basha's claim group
W. side Mt. Union, Hassayampa Min'g Dist.
Sections 1+12, T12N R2W
Groom Creek 7½' Quad., Yavapai Co., AZ
Showing major veins + workings
N
1"=1,000
Don C. White
Nov., 1988

M E M O

TO: Ron Short, Carole O'Brien, Anthony Budge

FROM: Don White

DATE: February 16, 1989

SUBJECT: Ash Peak silver/silica exploration proposal.

SUMMARY The Ash Peak argetiferous silica flux mine is principally a vein-type occurrence. It has never been tested at very great depth nor along strike or on certain recognized splay veins. Some ore controls are recognized and targets for new exploration are defined on the basis of those controls.

Any one of the seven vein-type targets could lead to discovery of new bodies on the order of the historical production from the Commerce or Shamrock deposits. That is, a new body could measure up as 200,000 to 400,000 tons grading 8 oz/t Ag, 0.03 oz/t Au and at least 75% silica. Five vein targets are within the present claim block and could be tested with one hole each for about $125,000 drilling or $150,000 all-inclusive costs. Two of the vein targets are outside the claim block and require some land work. They could be tested for about $40,000 drilling or $50,000 all-inclusive, for a total of $200,000. Such a program would require about 2 months drilling, double-shift.

The manto-type target likelihood is best appraised after the vein drilling information is in hand. There is not much other useful data on the deep stratigraphy and that coming out of the proposed vein-target may well help define any manto target. Should one exist, it could well be at least 3,000 feet deep and each hole to that depth would cost $75,000 to $100,000. The deposit type at stake is very large and rich, and, if found, would support new shaft sinking, mill construction, plus the costly exploration.

All the proposed targets will require very careful work, top notch core recovery, down-the-hole survey control, and gleaning of all geologic information. Continuous, experienced, geologic supervision will be crucial.

INTRODUCTION Following a Nov. 14, 1988 mine visit, the tentative terms of an earn-in agreement for Budge's acquisition of a 50% interest in the Ash Peak Mine have been agreed upon. Budge's interests, according to Ron Short, are two-fold:

1) To find other Commerce/Shamrock size vein deposits; that is, 200,000 to 400,000 ton bodies grading 8. oz/t Ag and about 0.03 oz/t Au as minimum 75% silica for smelter flux;

2) To test for possible manto-type Pb-Zn-Ag mineralization at depth. Such a deposit would have to be large enough ($>$1 million tons) and rich enough (say 20% combined Pb-Zn and $>$ 10 oz/t Ag) to support new shaft sinking. It would not be flux but rather mill feed.

The purpose of this memo is to better identify and prioritize the vein-type targets and estimate the cost of drill testing them, and to explain why