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PRELIMINARY EVALUATION

OF

SILVER REEF MINE OPPORTUNITIES

near Chu Chui

Papago Indian Reservation.

South of Casa Grande, Arizona

INGARD M. CLAUSEN, CO-OWNER
8522 N. 48TH PLACE
SCOTTSDALE, ARIZONA 85253
BUSINESS PHONE: (602) 263-2801 ; HOME PHONE: (602) 948-3390

ROBERT L. CLAUSEN, CO-OWNER

DECEMBER 1, 1970

OUTLINE OF EVALUATION

- BACKGROUND ON THE SILVER REEF MINES

- OPPORTUNITY NO. 1 --

  -- THERE IS GOOD EVIDENCE SUGGESTING THAT THE SILVER REEF VEIN HAS BEEN SECONDARILY ENRICHED IN SILVER

- OPPORTUNITY NO. 2 --

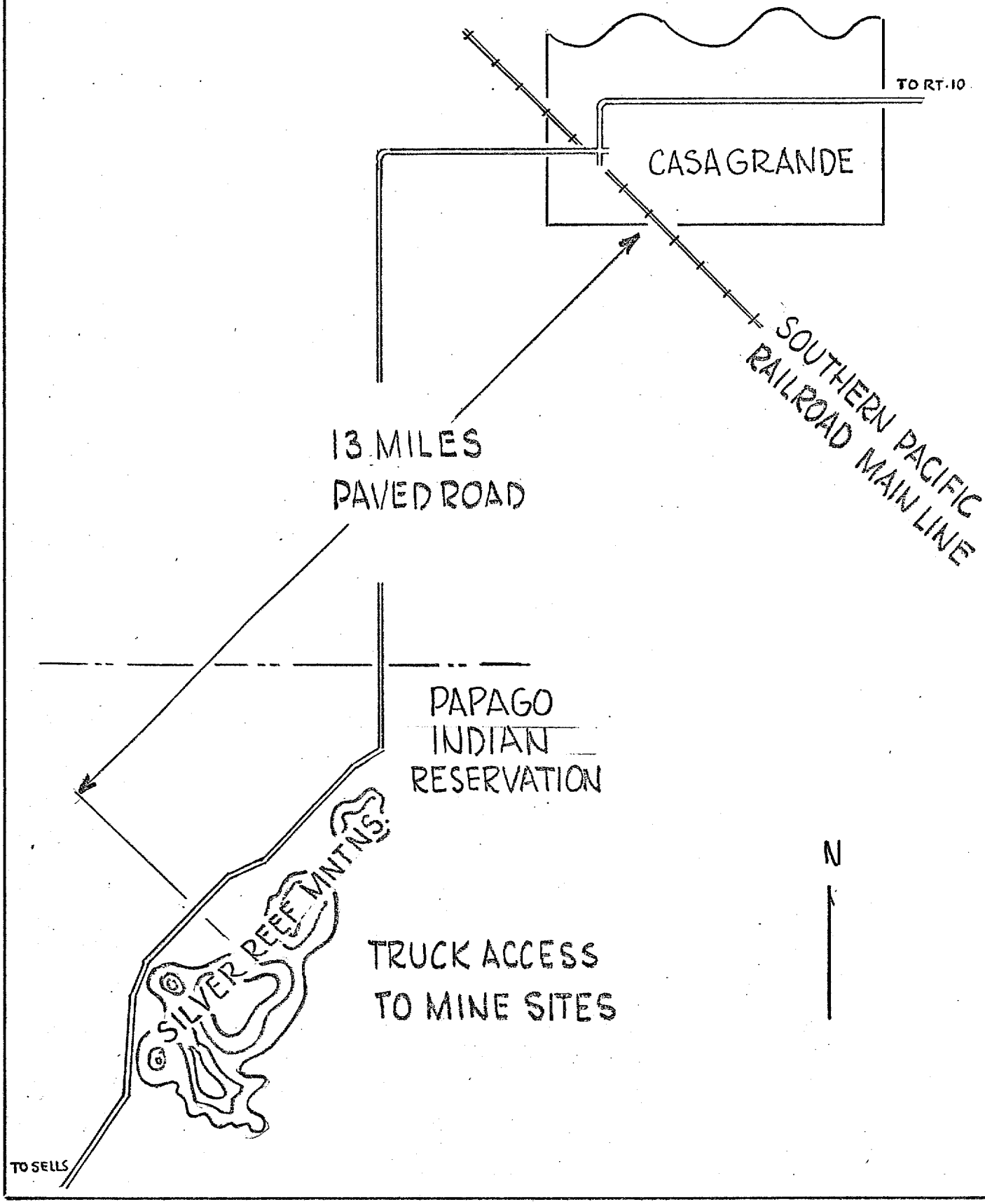
  -- THE SILVER REEF MINES MAY OFFER LARGE COPPER COMPANIES AN IMPORTANT WINDOW INTO PAPAGO COPPER

- OPPORTUNITY NO. 3 --

  -- THE CONTINUING INCREASE IN SILVER PRICES MAY MAKE IT NOW POSSIBLE TO RE-OPEN LOW-GRADE SILVER OPERATIONS IN THE UPPER WORKINGS OF THE SILVER NUGGET MINE

- APPENDIX -- COPIES OF SILVER REEF REPORTS

GENERAL LOCATION AND ACCESSIBILITY



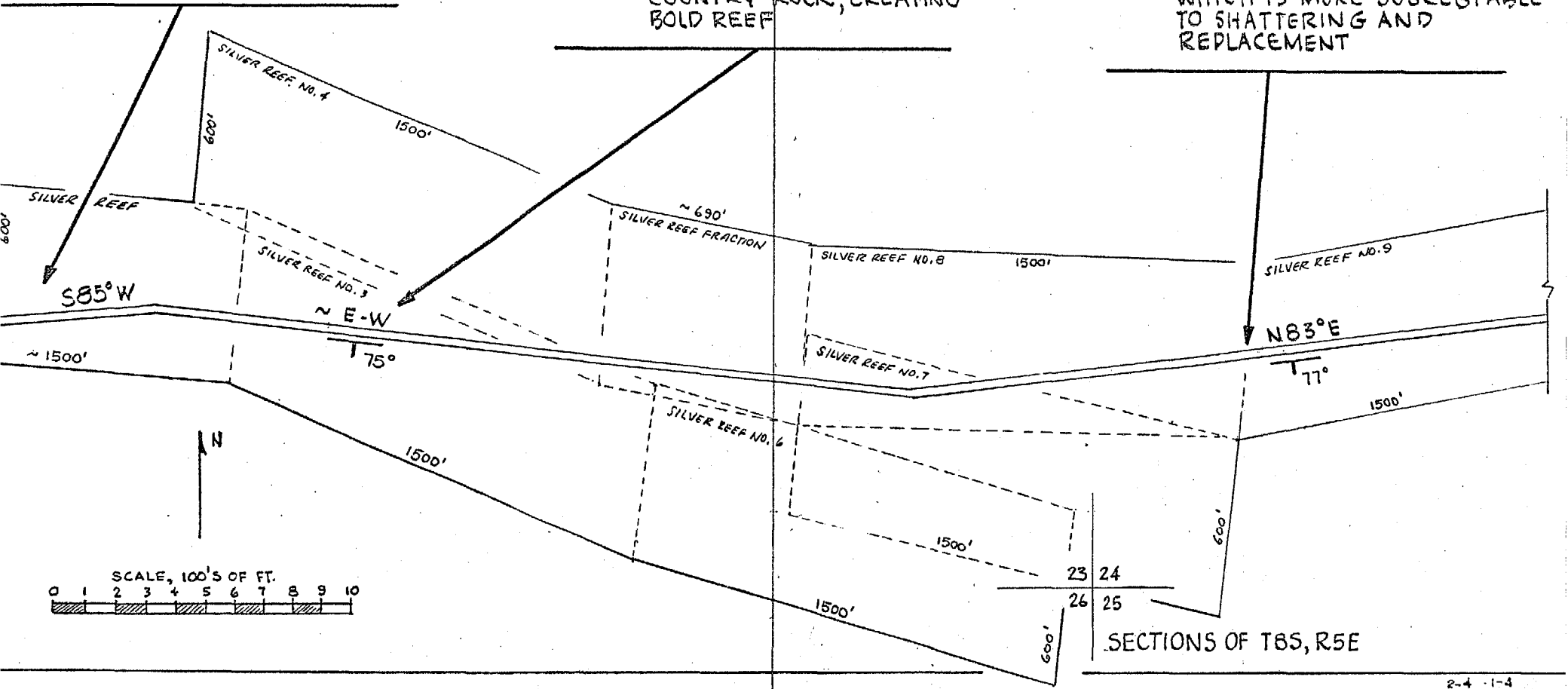
OVERVIEW OF THE SILVER REEF CLAIMS (6½ CLAIMS)

- MAIN VEIN STRUCTURE IS TRACEABLE FOR SOME 6000 FEET
- THE VEIN IS QUARTZ AND HAS STRONG WALLS WHOSE CONTINUITY HAS BEEN IRREGULARLY ESCHELONED BY POST-QUARTZ SHEARING
- METALLIZATION FOLLOWED THE SILICIFICATION AND LOCALLY EXTENDS OUT INTO THE GRANITE
- VEIN CHARACTERIZED BY TYPICAL BANDING AND VANANITE AND WULFENITE

- NARROWEST, LIGHTEST VEIN
- DIKE (TO EAST) MAY ACT AS CURTAILANT TO THE FLOW OF MINERALIZING SOLUTIONS

- VEIN 4 TO 7 FEET, MINERALIZATION 20 TO 25 FEET WIDE
- VEIN AND ACCOMPANYING BRECIATED ZONE ARE MORE RESISTANT THAN GRANITE COUNTRY ROCK, CREATING BOLD REEF

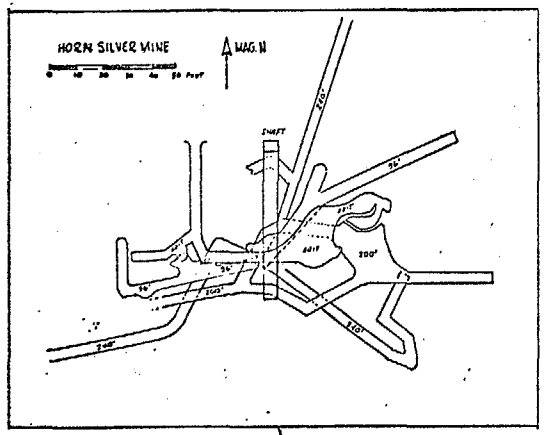
- MINERALIZATION STRONGEST, VEIN WIDEST (30 TO 50 FEET)
- MAY BE BECAUSE UPPER PORTIONS OF VEIN WERE IN ANDESITIC AGGLOMERATE (RHYOLITE) WHICH IS MORE SUSCEPTABLE TO SHATTERING AND REPLACEMENT



PRINCIPAL SILVER REEF WORKINGS

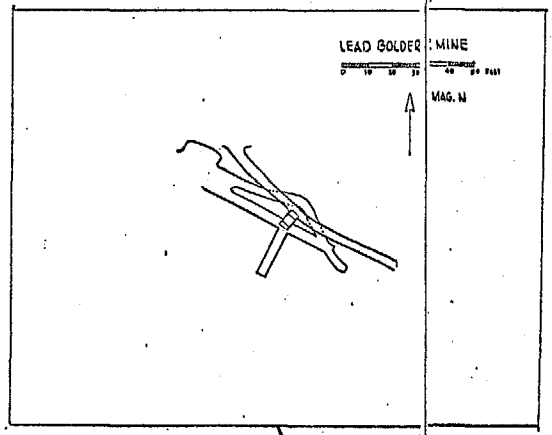
HORN SILVER MINE

EARLIEST, DEEPEST WORKINGS, WITH WATER AT 240 FEET. VALUES TOO LOW TO MINE NOW.



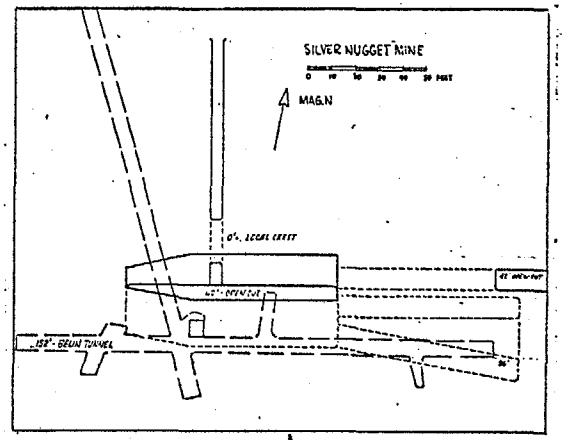
LEAD BOLDER MINE

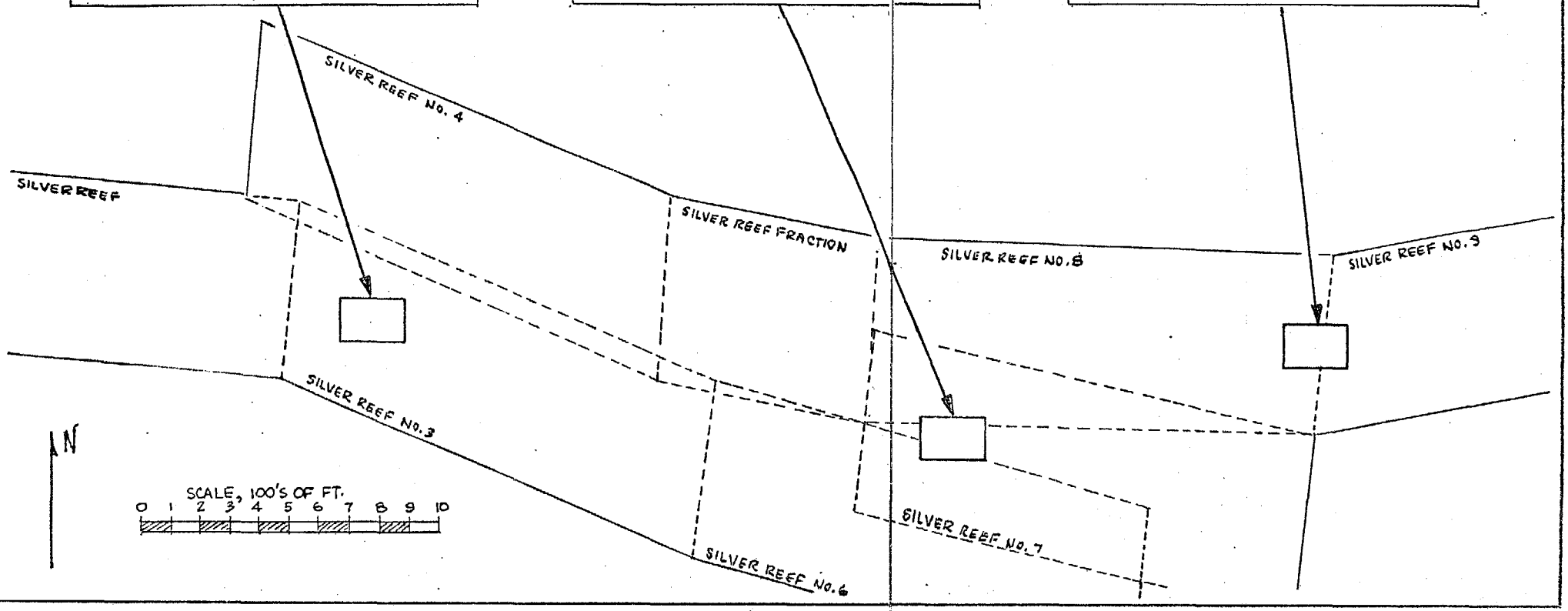
HIGHLY MINERALIZED, WITH LEAD, LOW SILVER. LEAST EXTENSIVE WORKINGS.

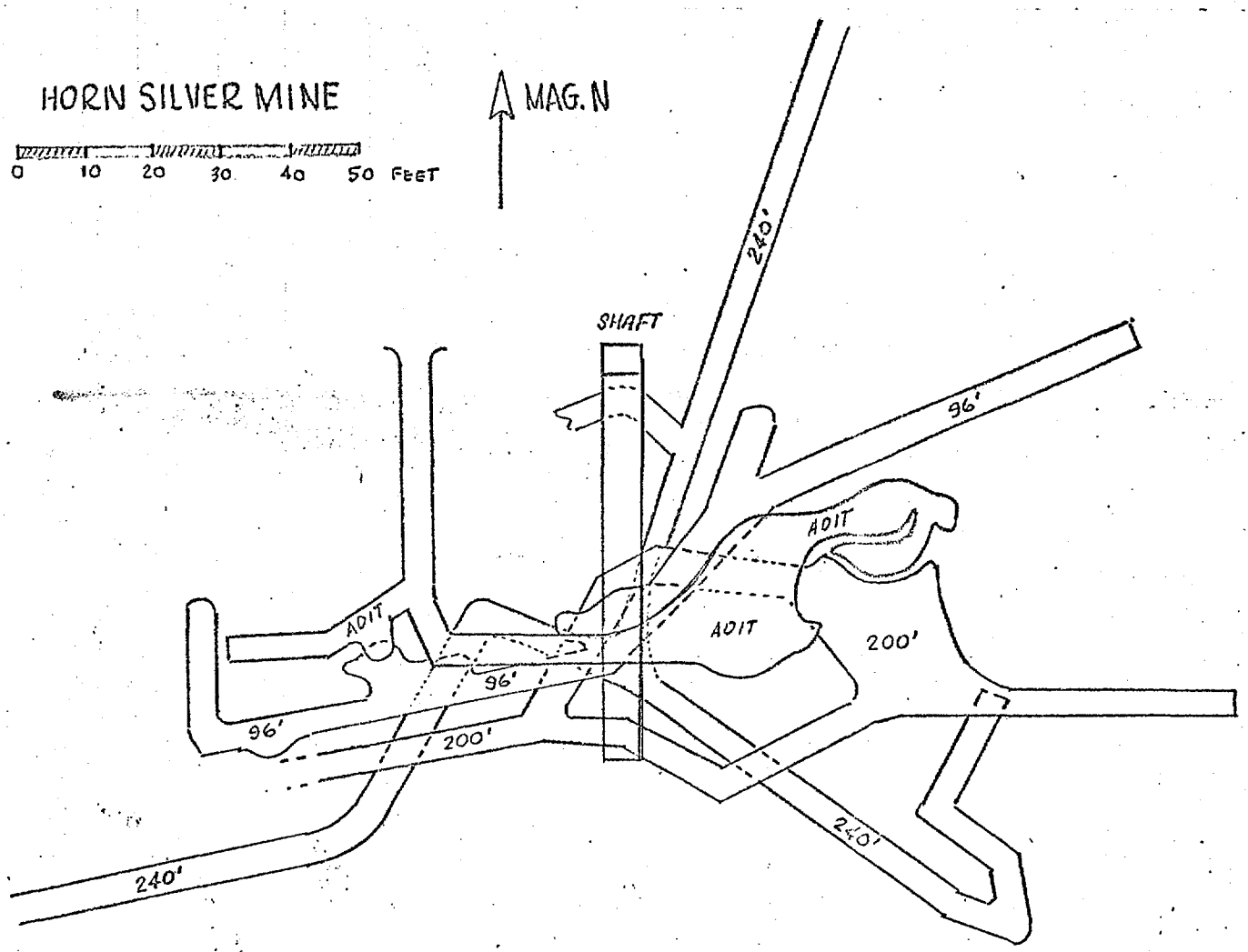


SILVER NUGGET MINE

RECOMMENDED FOR OPERATING AND FURTHER DEVELOPMENT NOW



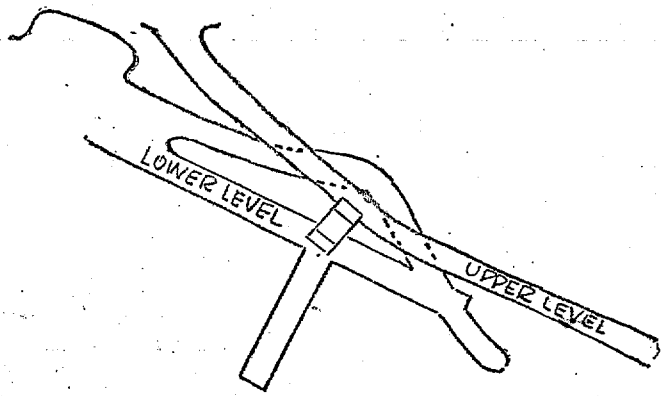


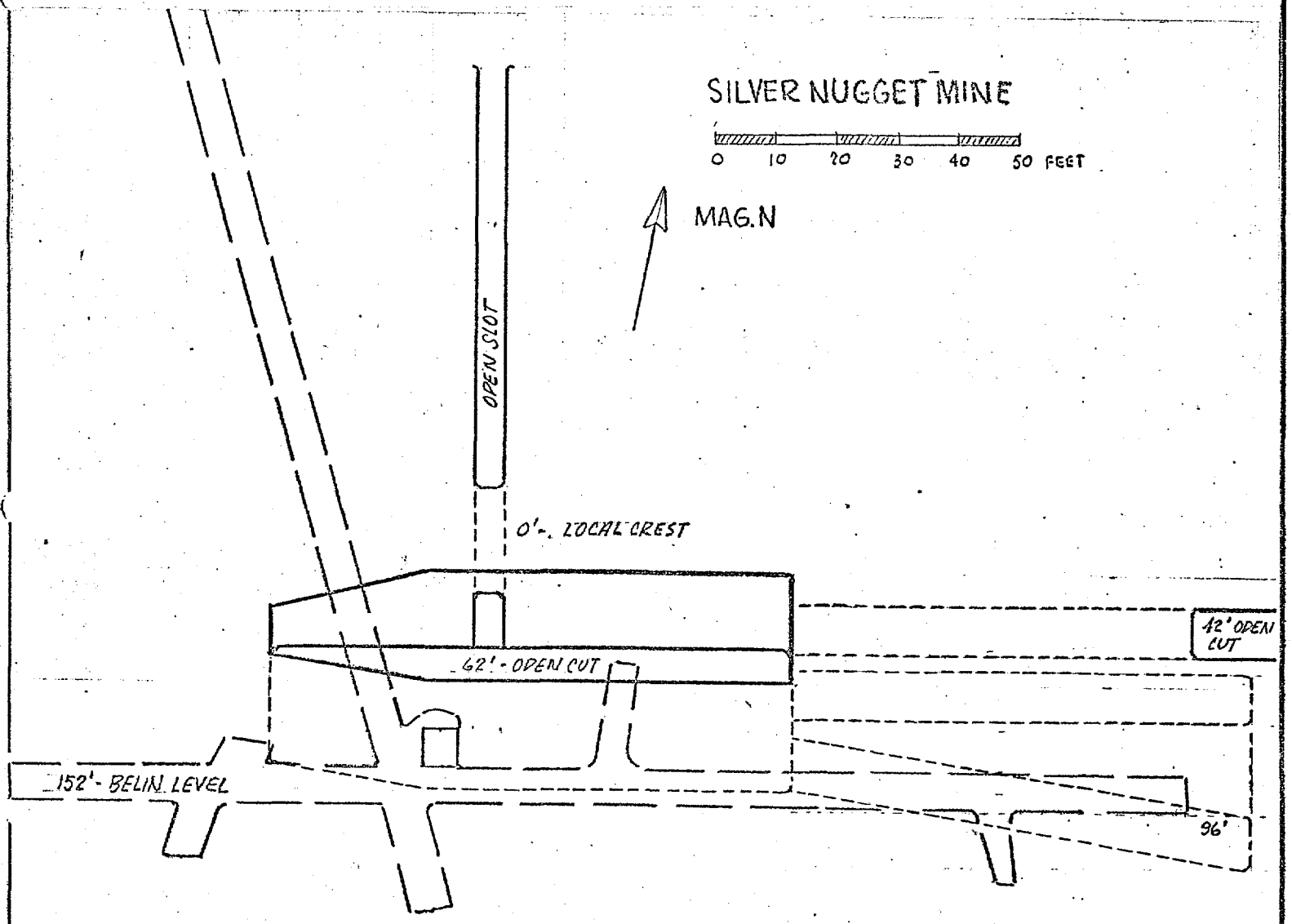

HORN SILVER MINE
MAG. N
0 10 20 30 40 50 FEET
240'
SHAFT
96'
ADIT
ADIT
ADIT
200'
96'
96'
200'
240'
240'

LEAD BOLDER MINE

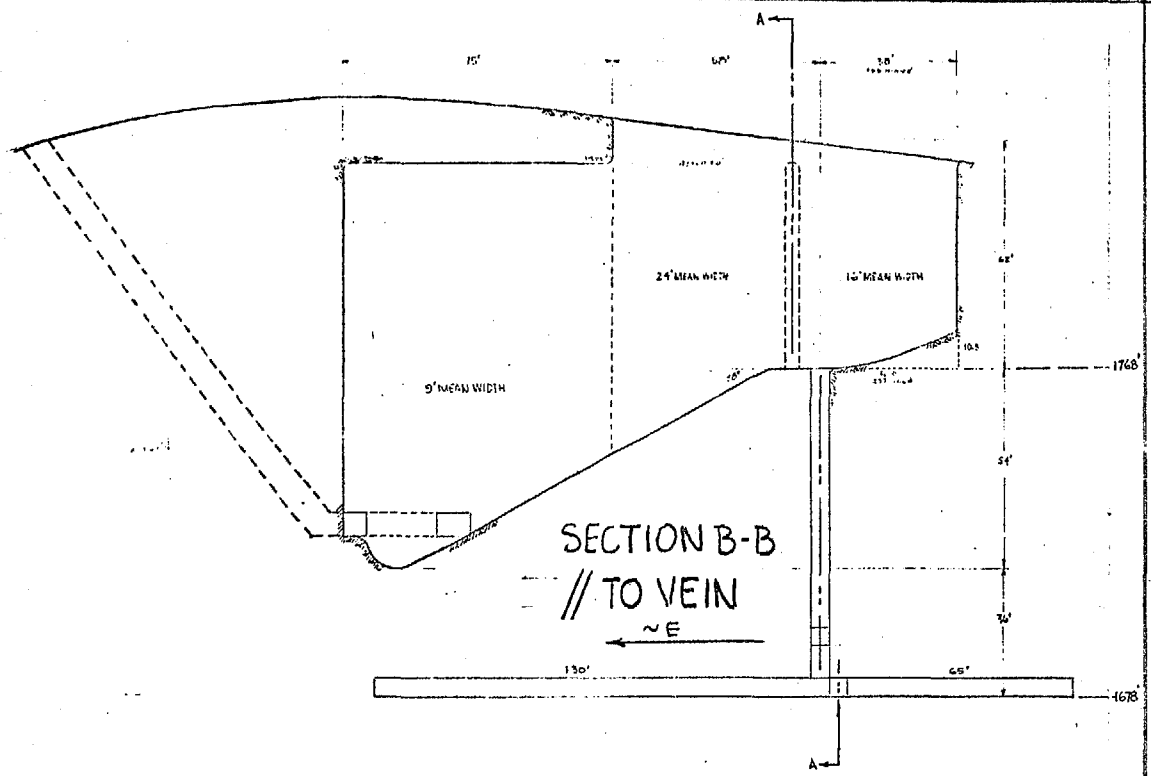
0 10 20 30 40 50 FEET

MAG. N

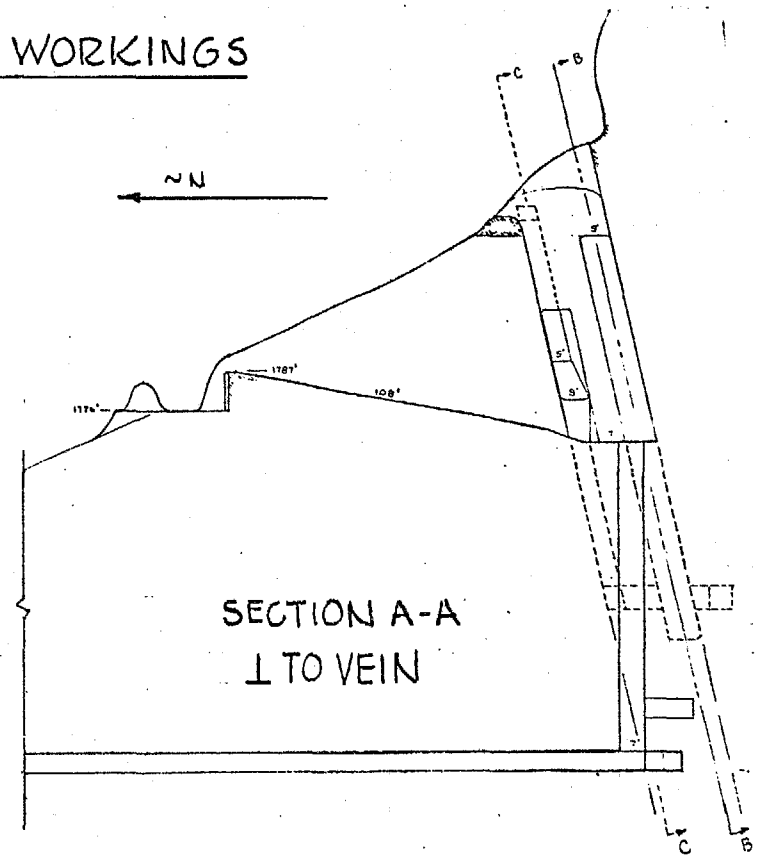



SILVER NUGGET MINE
0 10 20 30 40 50 FEET
MAG. N
OPEN SLOT
0'- LOCAL CREST
62'- OPEN CUT
42' OPEN CUT
152'- BELIN LEVEL
96'

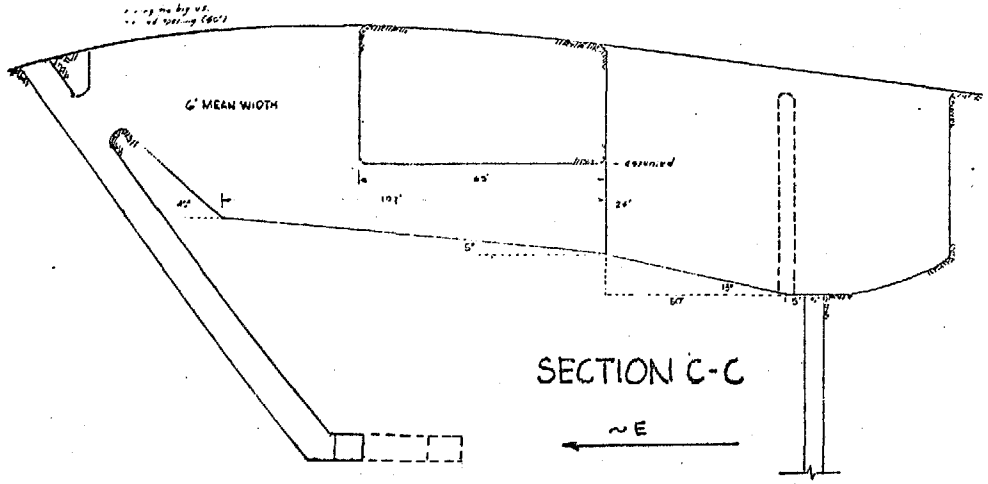
SILVER NUGGET MINE -- CURRENT WORKINGS



SECTION B-B
// TO VEIN
~E



SECTION A-A
⊥ TO VEIN



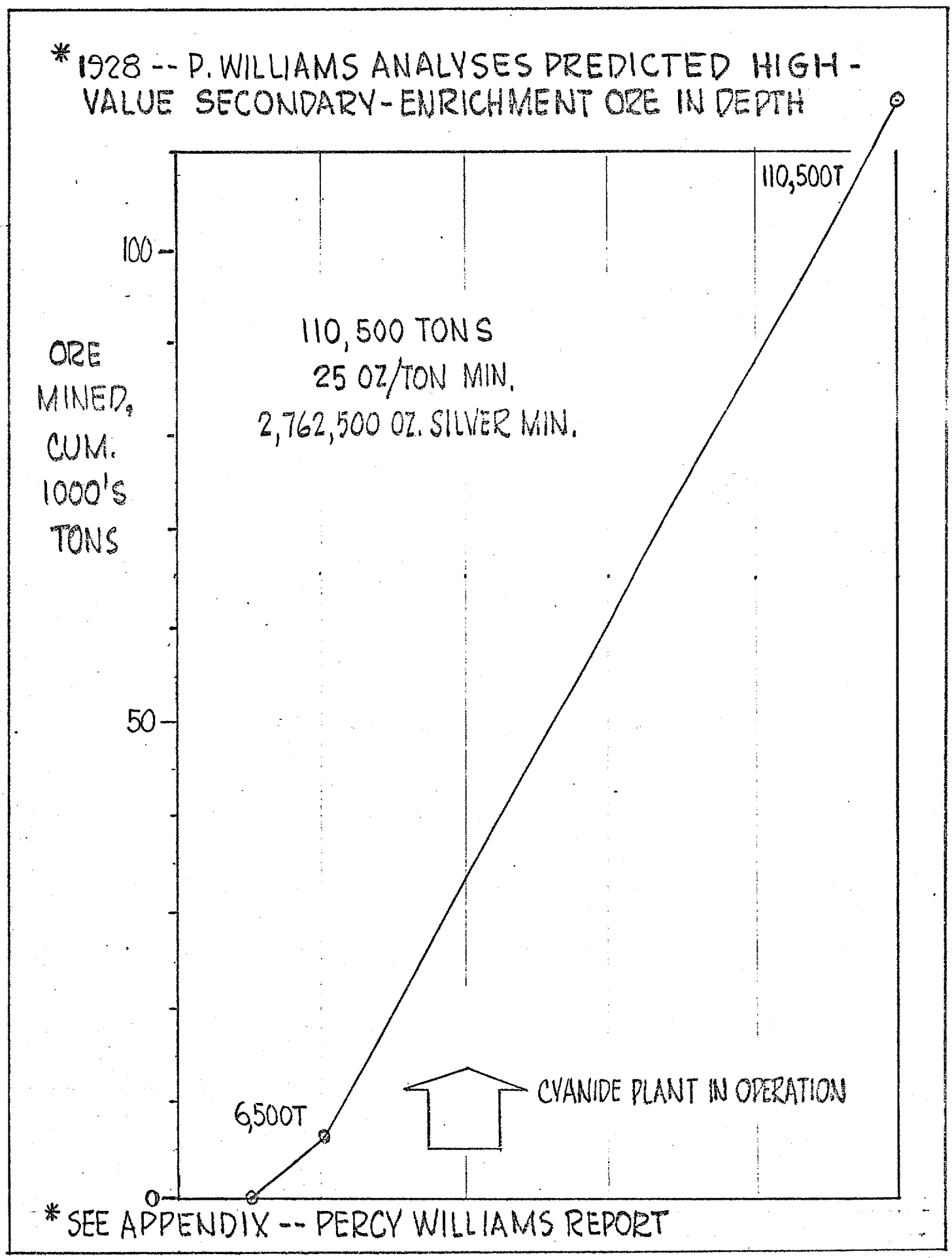
SECTION C-C
~E

SCALE IN FEET
0 10 20 30 40 50 60 70 80 90 100

PRELIMINARY EVALUATION OF SECONDARY-ENRICHMENT, HIGH-VALUE ORE IN DEPTH IN THE SILVER NUGGET MINE

CHRONOLOGICAL HISTORY OF THE SECONDARY-ENRICHMENT STUDIES AND DEVELOPMENT WORK TO DATE

PRO	CON
• 1928 -- P. WILLIAMS ANALYSES PREDICTED HIGH-VALUE SECONDARY-ENRICHMENT ORE	
• 1929 -- DR. G.M. BUTLER CONFIRMED CERTAIN POSITIVE EVIDENCE	BUT → DENIED POSSIBILITY BECAUSE OF UNFAVORABLE SILVER MIGRATION CHEMISTRY
• 1935 -- DR. G.M. BUTLER PUBLISHED PAPER REVERSING HIS 1929 POSITION	
	• 1949 -- CLAUSEN/OWENS DEEP-DRILLING DID NOT DISCOVER HIGH VALUES
• 1960 -- L.A. SMITH, ARIZ. DEPT. MINERAL RESOURCES, REPORTED ON POSITIVE EVIDENCE AND RECOMMENDED DEEPER EXPLORATION	
• 1970 -- ANALYSIS SHOWS CLAUSEN/OWENS DRILLED TOO SHALLOW	


*1928 -- P. WILLIAMS ANALYSES PREDICTED HIGH-VALUE SECONDARY-ENRICHMENT ORE IN DEPTH
110,500T
100
ORE MINED, CUM. 1000'S TONS
110,500 TONS
25 OZ/TON MIN.
2,762,500 OZ. SILVER MIN.
50
CYANIDE PLANT IN OPERATION
6,500T
0
*SEE APPENDIX -- PERCY WILLIAMS REPORT

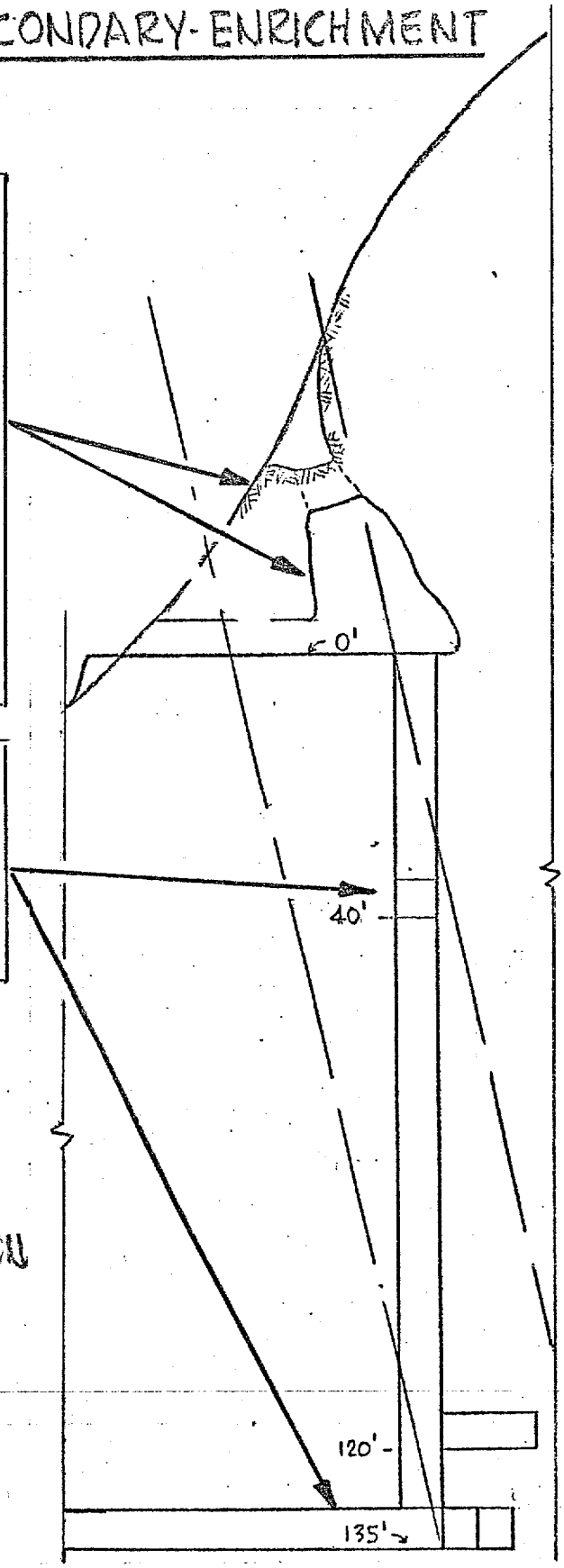
*1929 -- DR. G.M. BUTLER CONFIRMED CERTAIN POSITIVE EVIDENCES OF SECONDARY-ENRICHMENT

"IT IS TRUE THAT THERE ARE ABUNDANT EVIDENCES OF OXIDATION WHEREVER THE ORE IS EXPOSED."

"IT IS ALSO TRUE THAT CAVITIES IN THE ORE SUGGEST THAT SULPHIDE MINERALS HAVE BEEN OXIDIZED AND LEACHED THERE FROM."

"AND THAT A GREAT DEAL OF IRON OXIDE IS PRESENT ON THE 55-FT LEVEL ··· AND IN THE BELIN TUNNEL

"··· THESE ARE THE FACTORS THAT HAVE CAUSED MR. WILLIAMS TO BELIEVE THAT VALUABLE METAL HAS BEEN LEACHED FROM THE UPPER WORKINGS, CARRIED IN SOLUTION TO THE GROUND-WATER LEVEL, AND THERE DEPOSITED SO AS TO FORM A VALUABLE DEPOSIT OF SECONDARILY ENRICHED ORE



*SEE APPENDIX -- BUTLER LETTER TO BELIN, 12/4/29

1929 -- DR. G.M. BUTLER DENIED POSSIBILITY BECAUSE OF UNFAVORABLE SILVER MIGRATION CHEMISTRY

... [BUT] "HE [P. WILLIAMS] APPARENTLY NEGLECTED TO GIVE SUFFICIENT WEIGHT TO THE FACT THAT CALCITE (CALCIUM CARBONATE) FORMS A LARGE PORTION OF THE GANGUE THROUGHOUT THE VEIN MATERIAL EXCEPTING CLOSE TO THE FOOTWALL."

"THE PRESENCE OF ANY CONSIDERABLE AMOUNT OF CALCITE IN A VEIN PREVENTS THE GOING INTO SOLUTION OF ANY AMOUNT OF SILVER, AND SOLUTIONS CONTAINING SILVER IN SOLUTION WOULD BE FORCED TO DEPOSIT THIS METAL IF THEY CAME IN CONTACT WITH CALCITE."

* 1935 -- DR. G.M. BUTLER PUBLISHED PAPER REVERSING HIS POSITION ON UNFAVORABLE SILVER MIGRATION CHEMISTRY

"SOME FACTS ABOOT ORE DEPOSITS" AUG. 15, 1935; G.M. BUTLER, ARIZ. BUR. OF MINES GEOL. SERIES NO. 8, BULLETIN NO. 139

"IF ANY CONSIDERABLE AMOUNT OF CALCITE IS PRESENT IN THE GANGUE OF A SULPHIDE ORE BODY THROUGH WHICH WATER IS DESCENDING, ANY METAL EXCEPTING SILVER THAT MAY BE DISSOLVED WILL BE TRANSPORTED ONLY FAR ENOUGH TO BRING THE SOLUTION CONTAINING IT INTO CONTACT WITH THE CALCITE. THE METAL WILL THEN IMMEDIATELY BE DEPOSITED."

*SEE EXTRACT IN APPENDIX

* 1935 -- DR. G.M. BUTLER PUBLISHED PAPER REVERSING HIS POSITION ON UNFAVORABLE SILVER MIGRATION CHEMISTRY

LETTER, G.M. BUTLER TO MR. CHARLES BELIN ON THE SILVER NUGGET MINE, DATED DEC. 4, 1929

"THE PRESENCE OF ANY CONSIDERABLE AMOUNT OF CALCITE IN A VEIN PREVENTS THE GOING INTO SOLUTION OF ANY AMOUNT OF SILVER, AND SOLUTIONS CONTAINING SILVER IN SOLUTION WOULD BE FORCED TO DEPOSIT THIS METAL IF THEY CAME IN CONTACT WITH CALCITE.

"SOME FACTS ABOUT ORE DEPOSITS" AUG. 15, 1935; G.M. BUTLER, ARIZ. BUR. OF MINES GEOL. SERIES NO. 8, BULLETIN NO. 139

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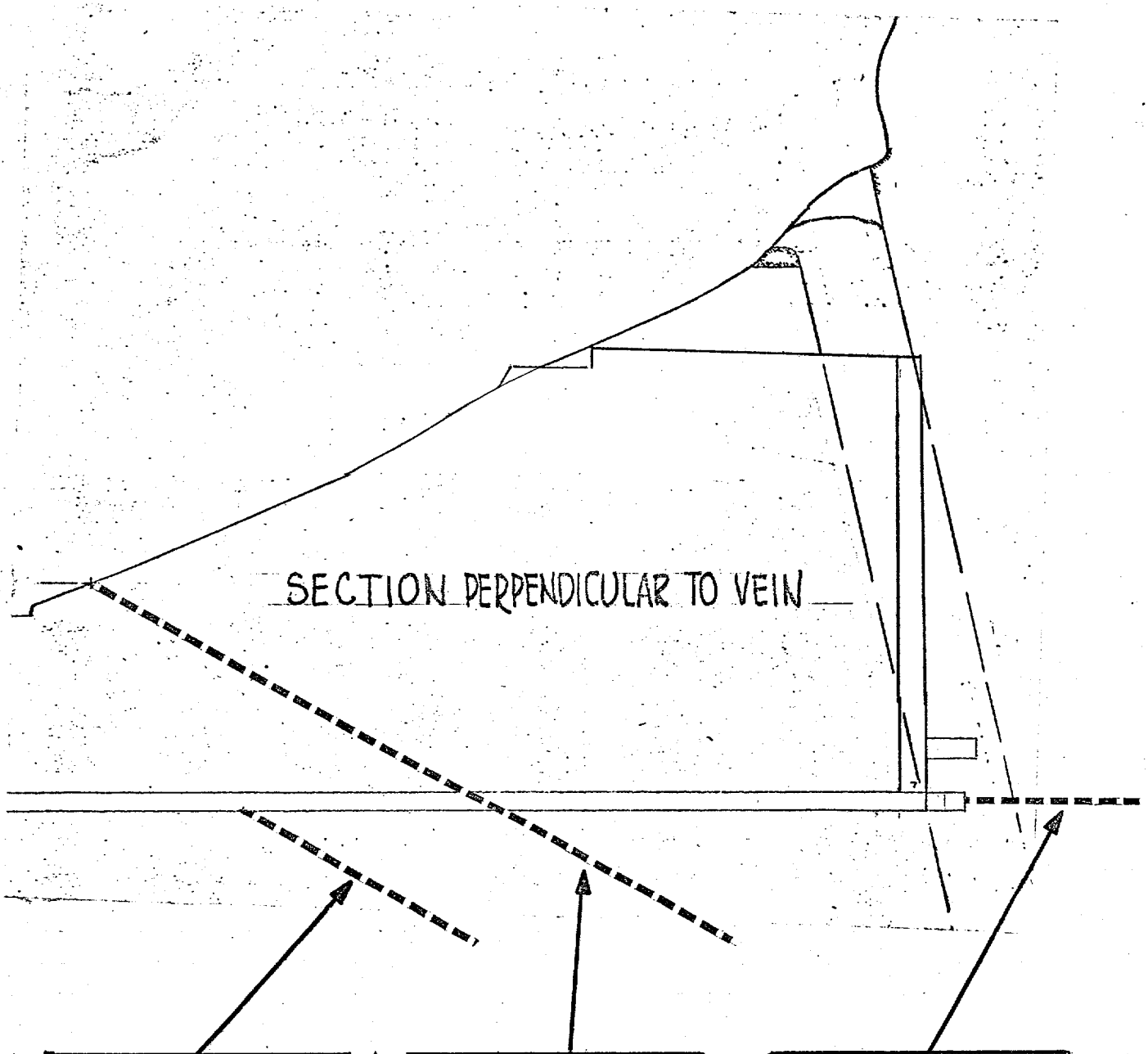
*SEE EXTRACT IN APPENDIX

1949 -- CLAUSEN/OWENS DEEP DRILLING DID NOT DISCOVER HIGH-VALUES

- JOINT CLAUSEN/OWENS AGREEMENT, MARCH 1948
  - -- ACCUMULATE $6000 DEVELOPMENT FUND
    - ... $3000 FROM LESSOR'S (CLAUSEN) FIRST ROYALTIES
    - ... MATCHING LESSEE'S (OWENS) PAYMENT
  - -- USE FOR EXPLORATORY WORK BELOW BELIN LEVEL
  - -- IF SUCCESSFUL, CLAUSEN/OWENS GO PARTNERS

- DIAMOND DRILL PROGRAM
  - -- FUND COMPLETE, JANUARY 1949
  - -- DRILLING INITIATED, MARCH 1949
  - -- 1123 FT., 5-HOLES COMPLETED, JUNE 1949
  - -- HIGH-VALUE DISCOVERIES NOT MADE
  - -- NO FURTHER STUDIES OR INVESTIGATIONS

CLAUSEN/OWENS DIAMOND DRILLING PLAN

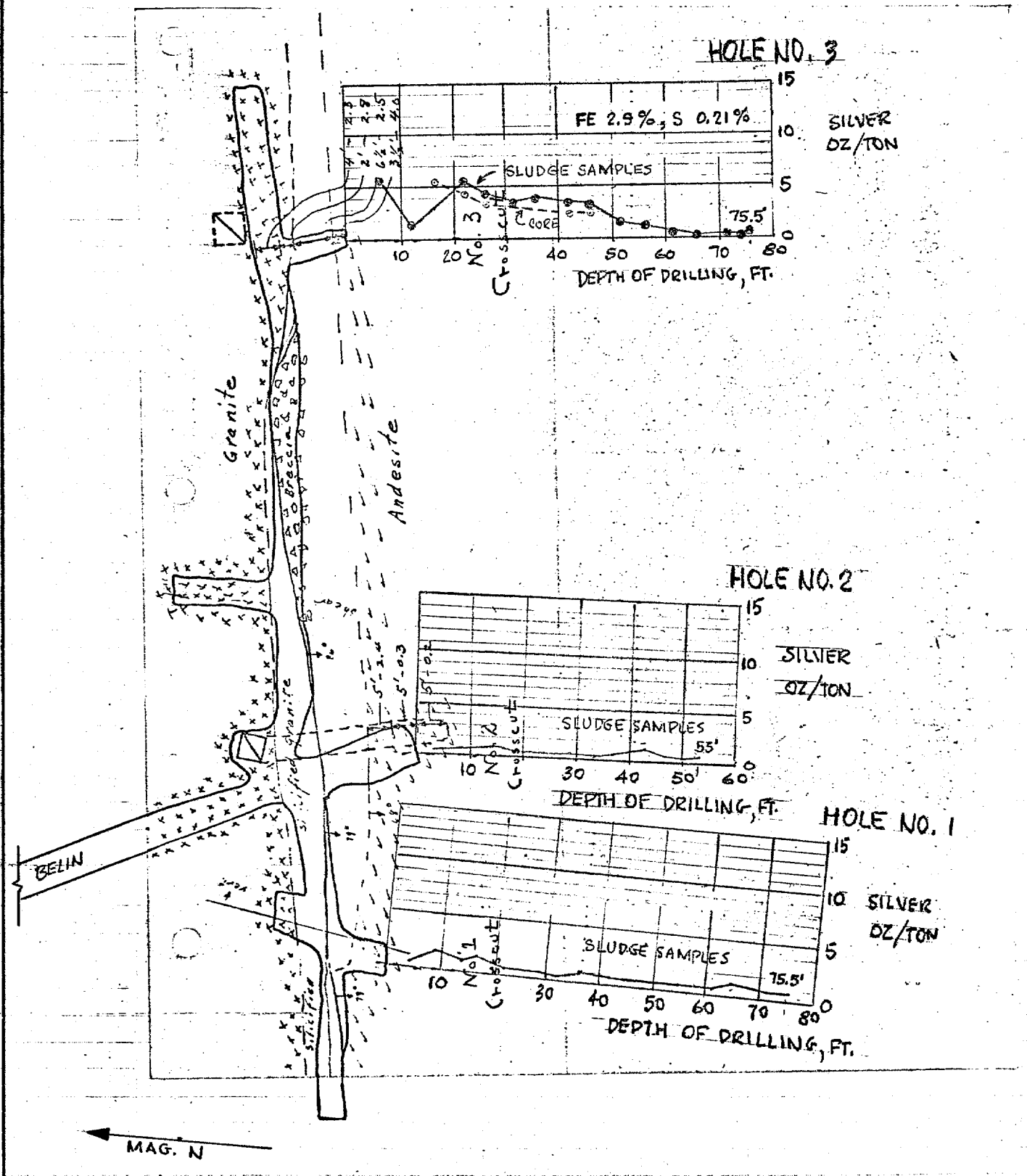


HOLE NO. 4
- 318 FT.
- 30° DIP IN PLANE OF BELIN
- LOCATED IN BELIN

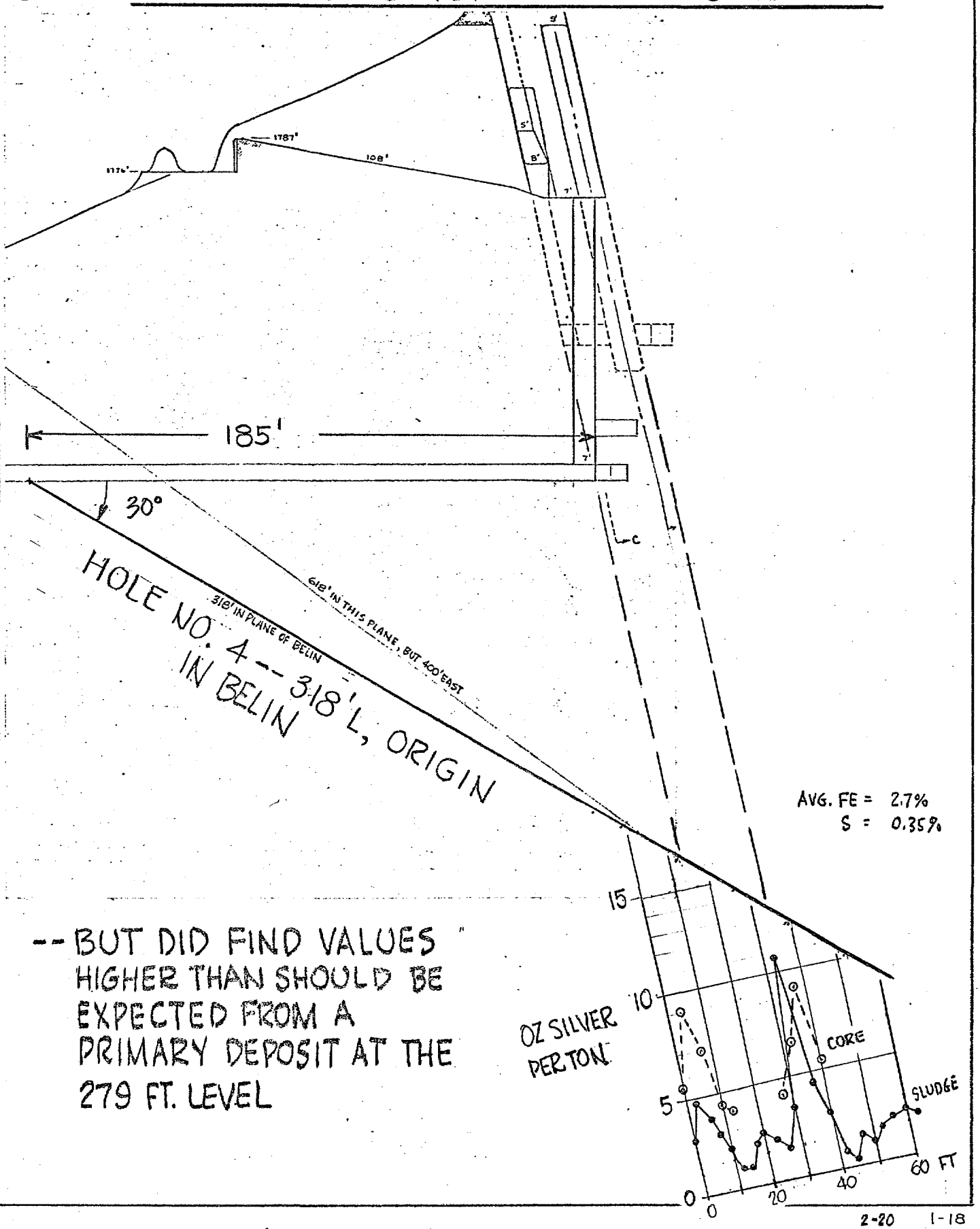
HOLE NO. 5
- 601 FT.
- 36° DIP IN N-S PLANE
- LOCATED 400' EAST

HOLES NO. 1, 2 & 3
- 50 TO 75 FT.
- 0° DIP IN N-S PLANE
- SPACED ALONG DRIFT

CLAUSEN/OWENS "DEEP DRILLING" DID NOT DISCOVER HIGH VALUES

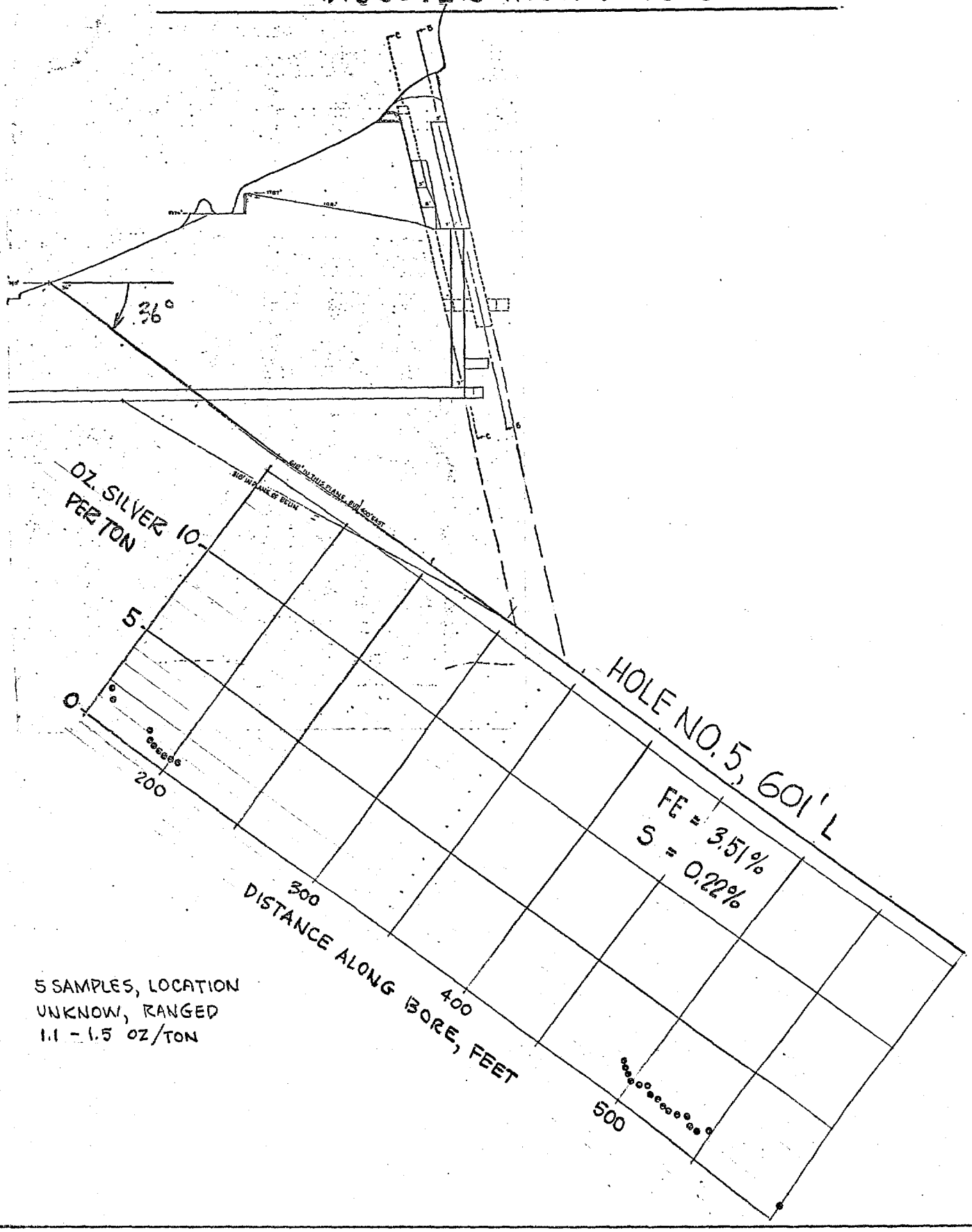


CLAUSEN/OWENS "DEEP DRILLING" DID NOT DISCOVER HIGH VALUES --

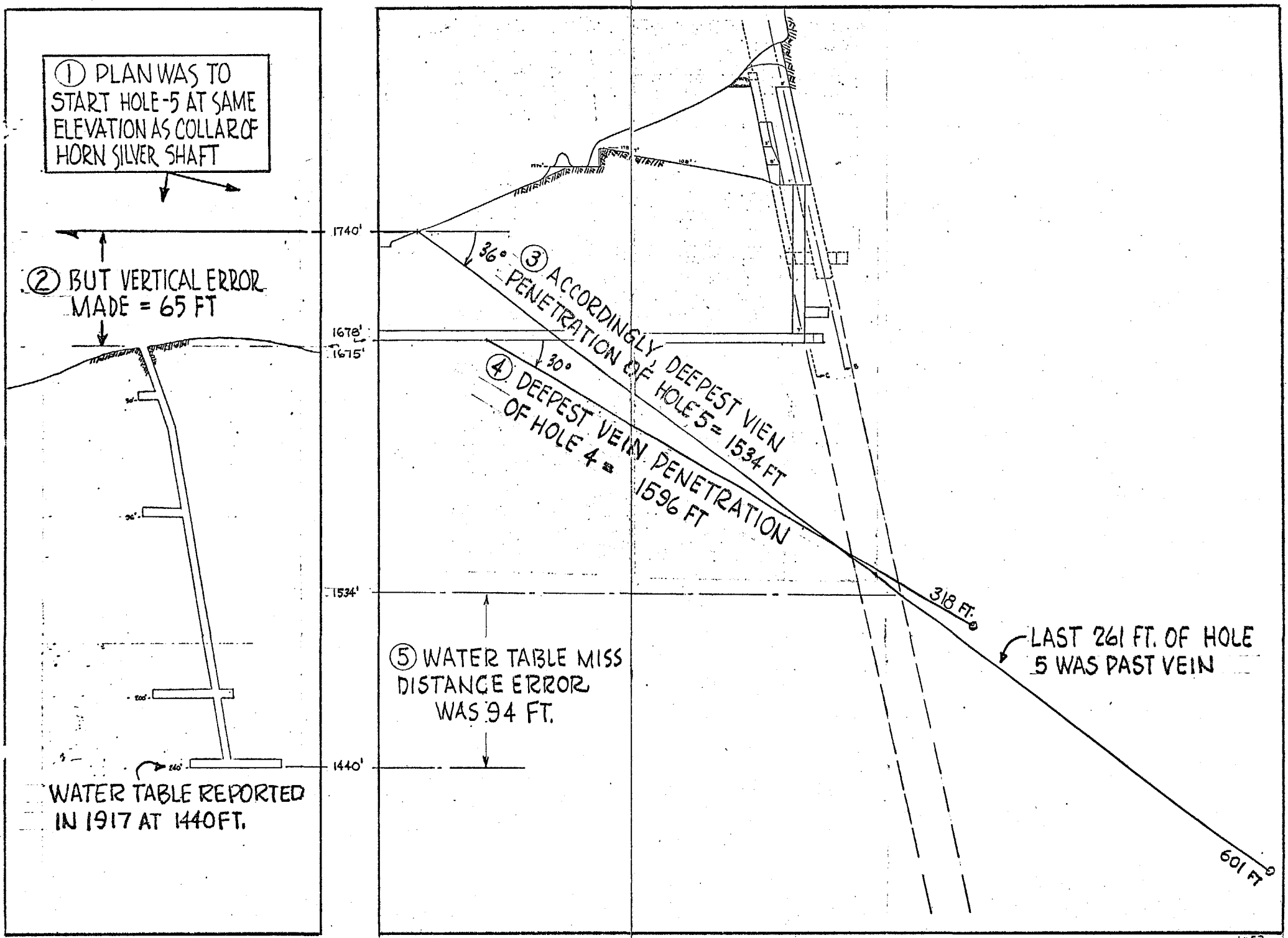


-- BUT DID FIND VALUES HIGHER THAN SHOULD BE EXPECTED FROM A PRIMARY DEPOSIT AT THE 279 FT. LEVEL

CLAUSEN/OWENS "DEEP DRILLING" DID NOT DISCOVER HIGH VALUES

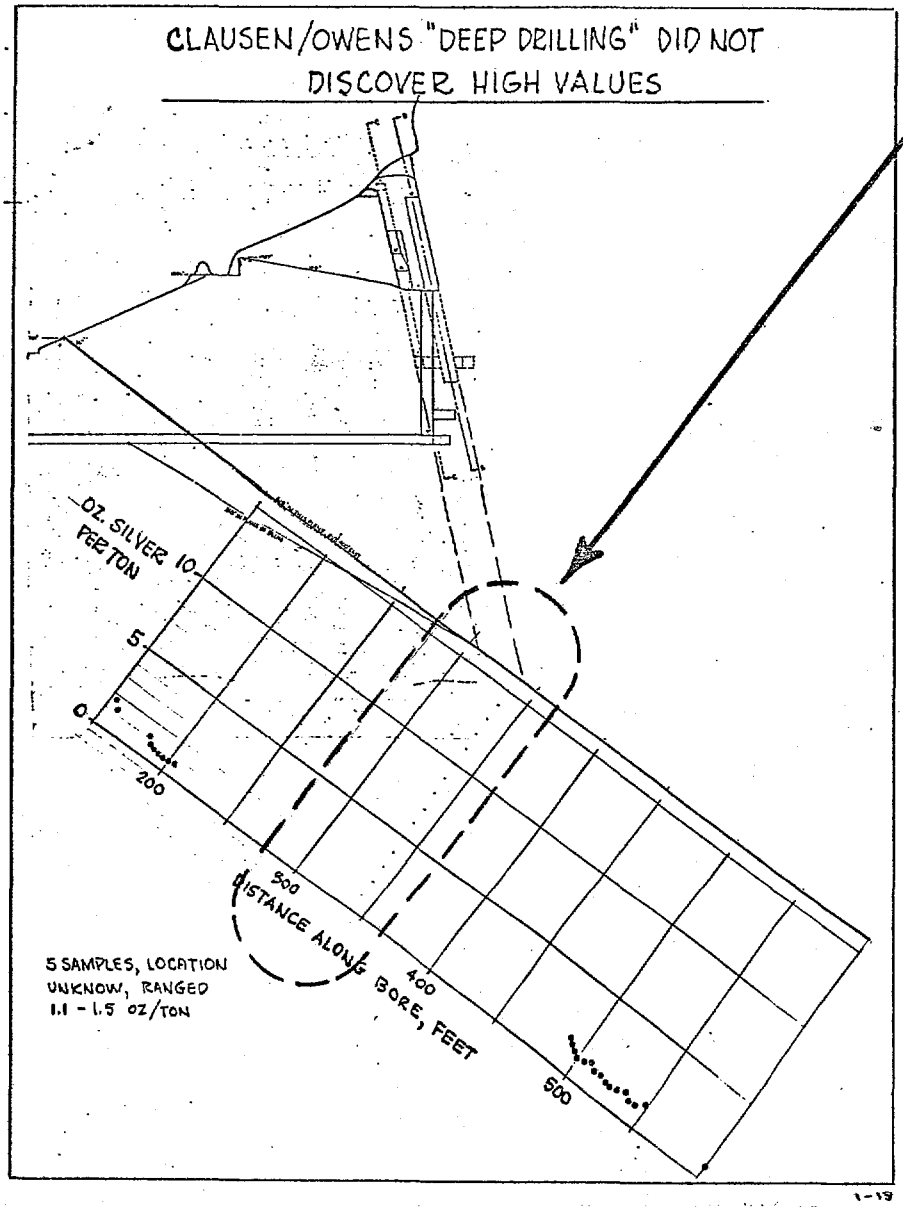


1970 -- ANALYSIS SHOWS CLAUSEN/OWENS DRILLED TOO SHALLOW --



1970-- ANALYSIS SHOWS CLAUSEN/OWENS DRILLED TOO SHALLOW

IN ADDITION, ASSAY REPORTS PROVIDED TO OWNER DID NOT COVER THE ZONE OF VEIN CROSSING



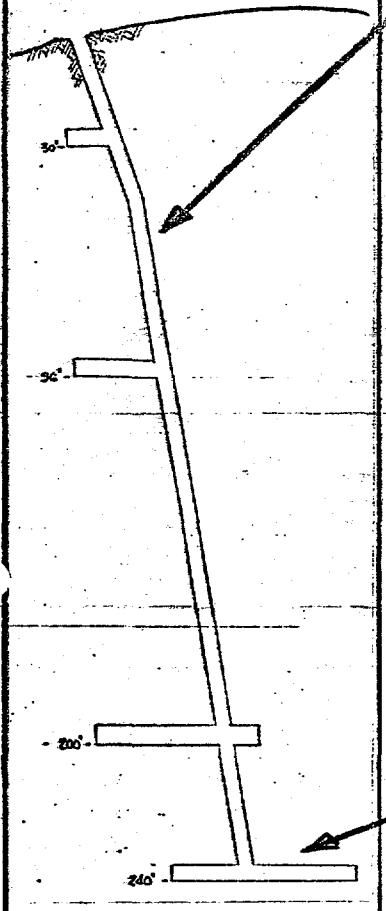
NOTE:

RATIONALE FOR SINKING HOLE NO. 5 400 FT. EAST OF OPEN CUT NOT KNOWN

1960 -- L. A. SMITH, ARIZ. DEPT. MIN. REC., REPORTED ON POSITIVE EVIDENCES AND RECOMMENDED DEEPER EXPLORATION

HORN SILVER

SECTION LOOKING EAST



"THE RICHER SILVER IN THE UPPER PARTS --- MAY INDICATE AN OLD WATER TABLE STOP POINT WHICH MAY BE ASSOCIATED WITH THE LATE PLIOCENE AND EARLY PLEISTOCENE LAKE EPOCH··· PROBABLY REPRESENTS THE TOP OF THE WATER TABLE FLUCTUATION

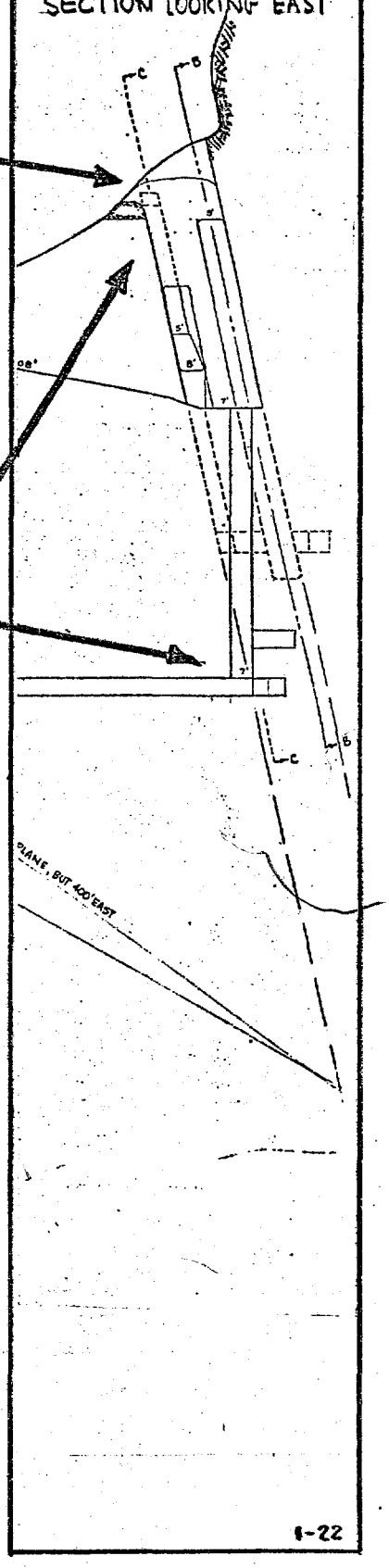
"LEACHING OF THE VEIN MASS HAS BEEN INTENSIVE AS EVIDENCED BY SILICA BOXWORKS AND LIMONITE BOXWORKS WHICH HAVE BEEN WHIPPED CLEAN···"

"WHERE DID THE SILVER, WHICH ONCE OCCUPIED THESE CAVITIES, GO? OBVIOUSLY SINCE THE PREVAILING FRACTURES ARE NEARLY VERTICAL THE SILVER SOLUTIONS MUST HAVE DESCENDED."

"THREE COMPETENT OBSERVERS REPORTED THAT ARGENTITE··· WAS PRESENT [HERE]. ARGENTITE IS GENERALLY BELIEVED TO BE THE PREVAILING SILVER ENRICHMENT SULPHIDE

SILVER NUGGET

SECTION LOOKING EAST



IN SUMMARY, THE "PRO'S" APPEAR TO OUTWEIGH THE "CON'S" AND TO SUGGEST THAT ADDITIONAL EVALUATION OF SECONDARY ENRICHMENT BE UNDERTAKEN

CHRONOLOGICAL HISTORY OF THE SECONDARY-ENRICHMENT STUDIES AND DEVELOPMENT WORK TO DATE

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PRELIMINARY EVALUATION

OF THE OPPORTUNITY THAT

THE SILVER REEF MINES

MAY OFFER

LARGE COPPER COMPANIES

AN IMPORTANT WINDOW INTO

PAPAGO COPPER

FEATURES OF THE SILVER REEF WINDOW INTO POSSIBLE PAPAGO COPPER

- EXTENSIVELY WORKED FOR SILVER
  - -- PRE 1929 : ~20,000 T SHIPPED
  - -- 1940-1942 : 3,500 T SHIPPED
  - -- 1948-1951 : 35,200 T SHIPPED
  - -- 1952 : 53 T SHIPPED
- ASSAY MAPS SHOW GOLD, SILVER, ZINC, MOLYBDENUM, AND VANADIUM MINERALIZATION
- COPPER SIGNS ARE NUMEROUS (CALCACITE IN GRANITE, COPPER STAINS ON SURFACE AND IN WORKINGS)
- PROPERTY AND WORKINGS ARE CONVENIENTLY ACCESSIBLE
- PROPERTY DIAMOND DRILLED FOR SILVER
- OWNERS WILL SIGN 3-MONTHS, NO-CHARGE INVESTIGATION AGREEMENT (RESULTS OF INVESTIGATIONS TO BE PROVIDED TO OWNERS)

MINING COMPANIES TO BE INITIALLY CONTACTED TO DETERMINE THEIR POSSIBLE INTEREST

- EL PASO NATURAL GAS CO - EL PASO TEXAS
- CONTINENTAL COPPER 7441 MIRACLE MILE TUCSON
- NEWMONT EXPLORATION LTD P O BOX M SAN MANUEL, ARIZ
- EARTH RESOURCES 2020 E 13TH TUCSON
- COASTAL MINING CO 2020 E 13TH

--OTHERS UNDER CONSIDERATION

PRELIMINARY EVALUATION OF

THE FEASIBILITY OF

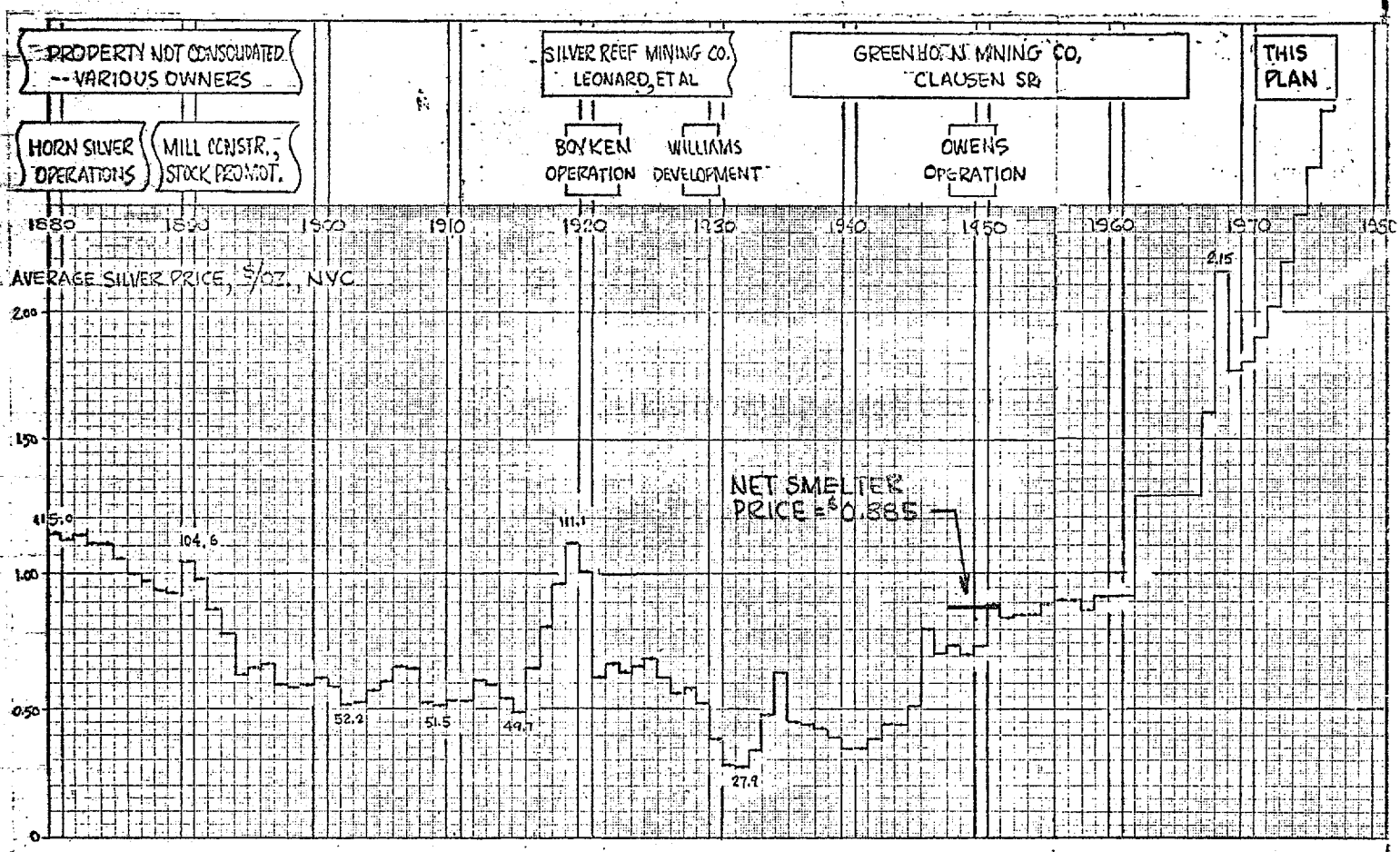
PROFITABLY MINING THE UPPER WORKING

OF THE SILVER NUGGET

EVALUATION OF THE FEASIBILITY OF PROFITABLY MINING THE UPPER WORKINGS

- GROSS REVENUE ESTIMATES
  - -- ORE RESERVE ESTIMATES
  - -- ORE VALUE ESTIMATE
  - -- SILVER PRICE FORECAST
  - -- GROSS REVENUE CALCULATIONS
- COST ESTIMATES
  - -- SMELTING AND FREIGHT COSTS
  - -- MINING AND TRUCKING COSTS
- INCOME ESTIMATES
- SCHEDULE FOR ACCUMULATING SECONDARY ENRICHMENT EXPLORATION FUND

HISTORICAL OVERVIEW OF THE INFLUENCE OF SILVER PRICES ON THE OPERATING PERIODS OF THE SILVER REEF MINES



FUNDAMENTAL ASSUMPTIONS MADE

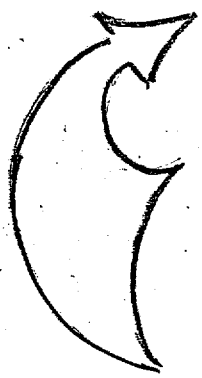
- THAT SHERWOOD B. OWENS FULLY INTENDED TO CONTINUE OPERATING THE SILVER NUGGET BUT COULD NOT REACH AGREEMENT WITH THE OWNER (CLAUSEN, SR.)
- THAT OWENS WAS THE ONE INDIVIDUAL MOST KNOWLEDGEABLE OF THE SILVER NUGGET
- THAT HIS PLANS FOR CONTINUED OPERATION WOULD STILL BE VALID, IF WE CAN DEDUCE WHAT THEY WERE
- THAT WE CAN EXTRAPOLATE HIS COSTS TO THE PRESENT THROUGH A 3.5% PER YEAR INCREASE OVER THE PAST 20 YEARS

GROSS REVENUE — ORE RESERVE ESTIMATES

- OWENS DEMONSTRATED PITCH TO THE EAST AND PLANNED TO WORK BACK INTO THE HILL
- OWENS DID NOT PURSUE THIS PLAN, BECAUSE --
  - -- ALTHOUGH HE HAD OBTAINED MORE FAVORABLE LEASE TERMS FROM CLAUSEN,
  - -- CLAUSEN WOULD NOT EXTEND CONTRACT PERIOD FROM END 1953 TO END 1958
- AS A RESULT, OWENS TERMINATED SILVER NUGGET OPERATIONS IN 1951

GROSS REVENUE — — ORE RESERVE ESTIMATES

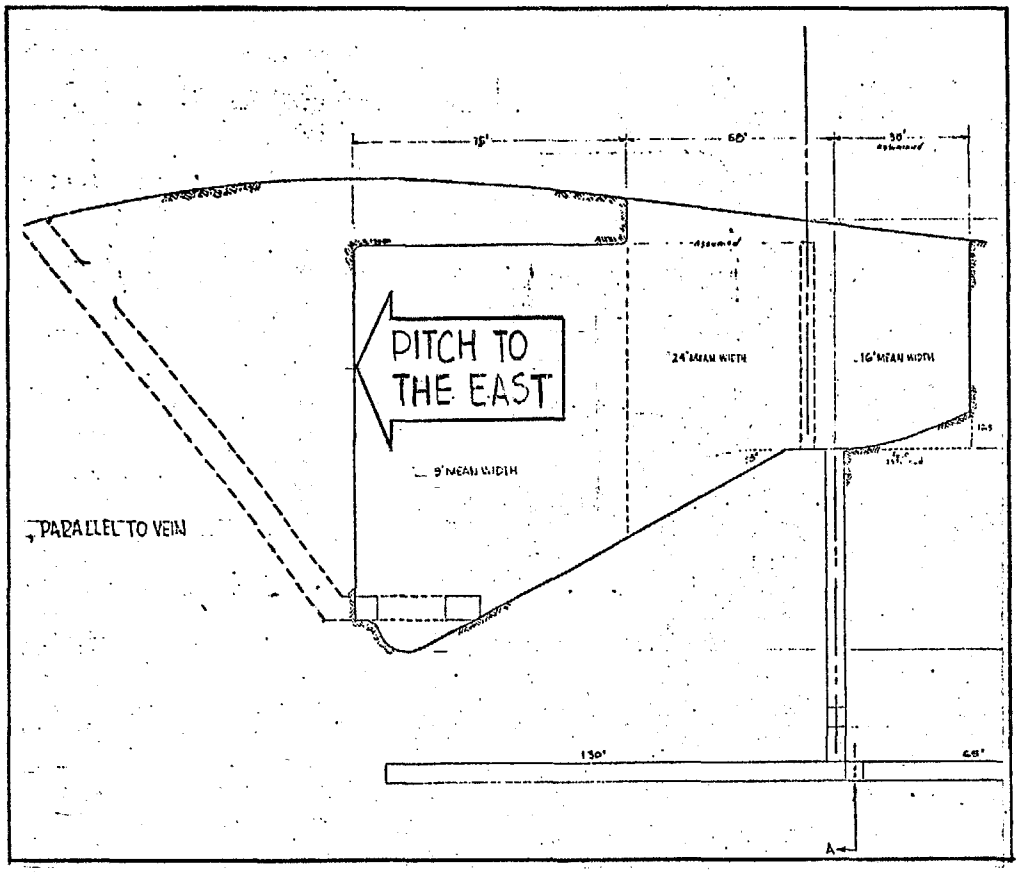
- OWENS DEMONSTRATED PITCH TO THE EAST AND PLANNED TO WORK BACK INTO THE HILL
- OWENS DID NOT PURSUE THIS PLAN, BECAUSE --
  - -- ALTHOUGH HE HAD OBTAINED MORE FAVORABLE LEASE TERMS FROM CLAUSEN,
  - -- CLAUSEN WOULD NOT EXTEND CONTRACT PERIOD FROM END 1953 TO END 1958

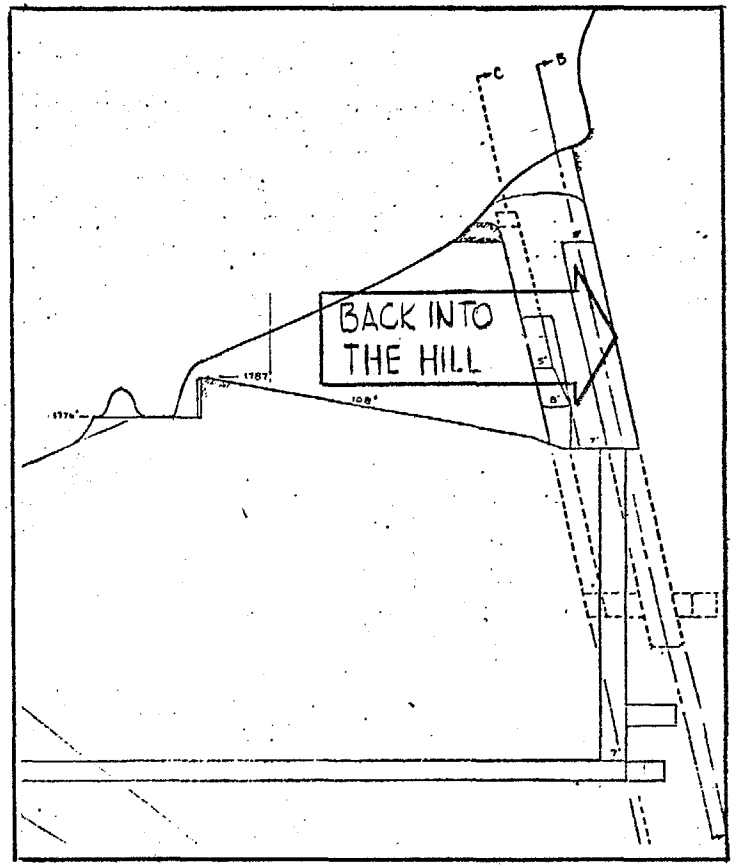


BASIS FOR ORE RESERVE ESTIMATES

- -- OWENS' CONTRACT HAD 2½ YEARS TO GO
- -- HE NEGOTIATED HARD FOR 5 MORE YEARS
- -- HE TERMINATED WHEN HE DIDN'T GET IT
- -- THEREFORE HE MUST HAVE THOUGHT THAT SIGNIFICANTLY MORE THAN 2½ YEARS WORTH OF ORE WAS LEFT
- -- 5 YEARS WORTH USED IN THIS ESTIMATE

OWENS DEMONSTRATED "PITCH-TO-THE-EAST" AND PLANNED TO WORK "BACK INTO THE HILL"



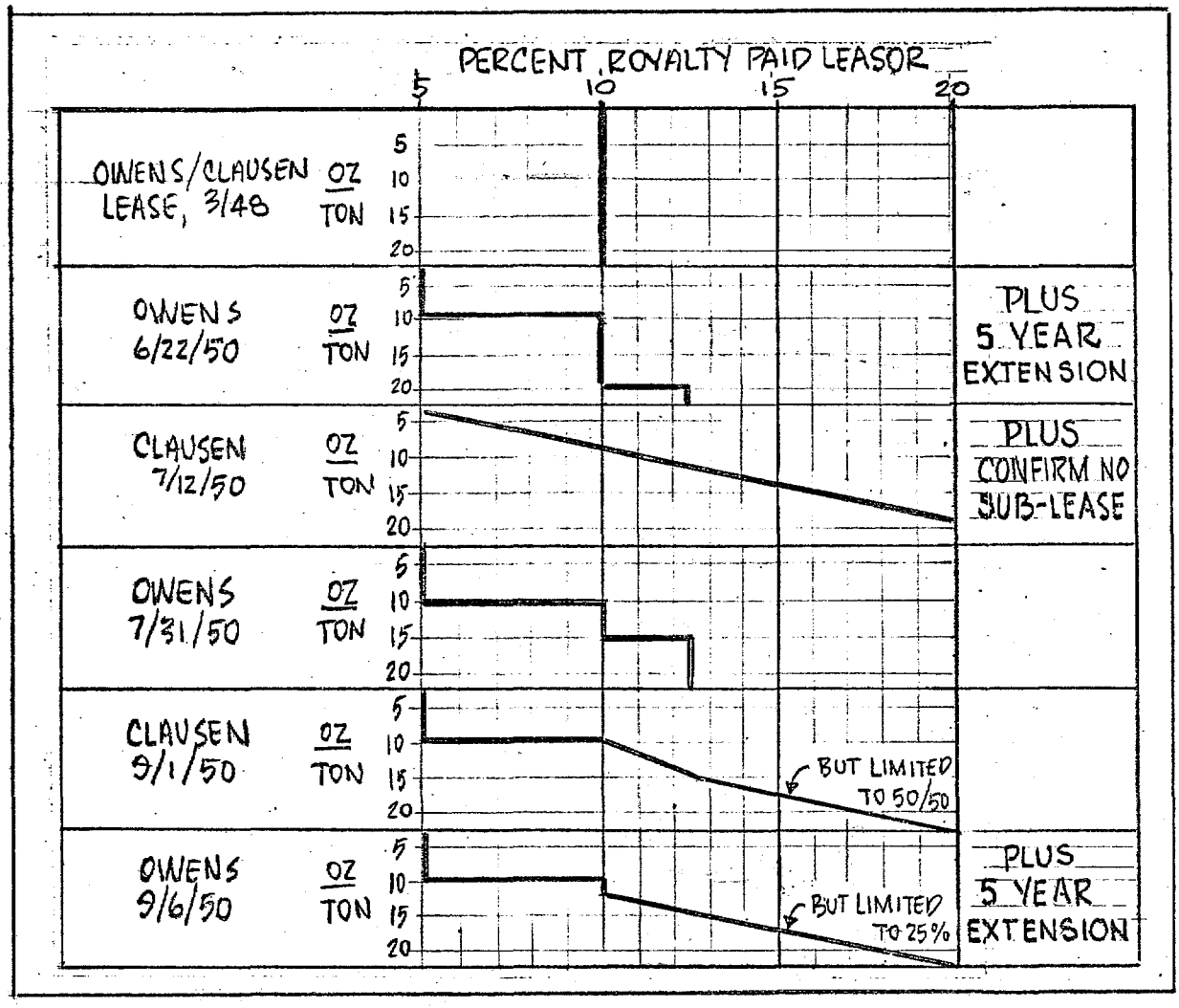


"I SINCERELY BELIEVE THAT THE TIME WILL COME, IF WE CAN CONTINUE TO WORK BACK INTO THE HILL, WHEN WE WILL PRODUCE ORE BETTER THAN TWENTY OUNCES."

S.B.OWENS' LETTER, 7/15/50

OWENS DID NOT PURSUE THIS PLAN, BECAUSE --

-- ALTHOUGH HE HAD OBTAINED MORE FAVORABLE LEASE TERMS,

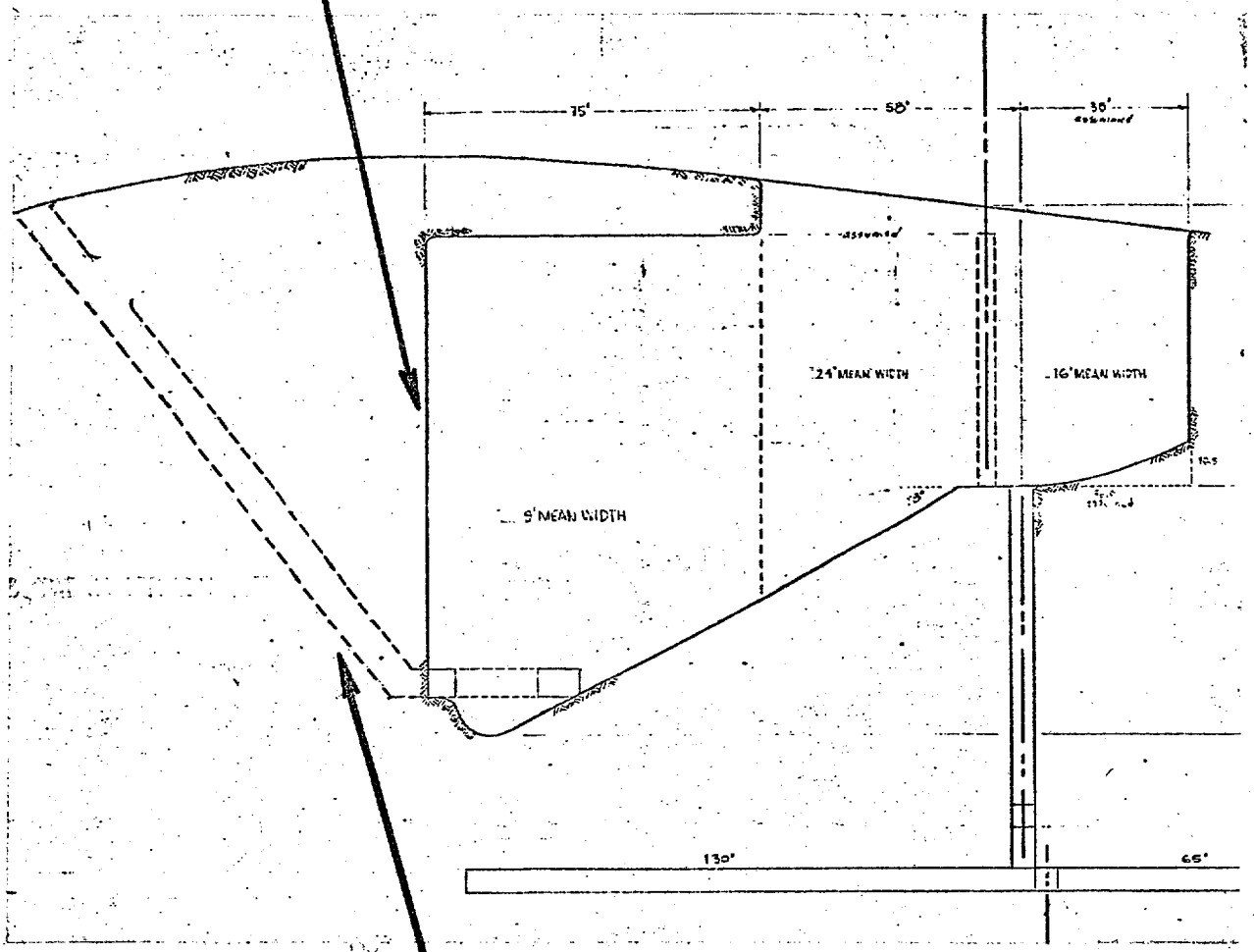


-- HE COULD NOT OBTAIN A CONTRACT EXTENSION FROM END 1953 TO END 1958*

* CLAUSEN'S REASONS FOR REJECTING 9/6/50 COUNTER-OFFER NOT KNOWN

AS A RESULT, OWENS TERMINATED SILVER NUGGET OPERATIONS IN 1951

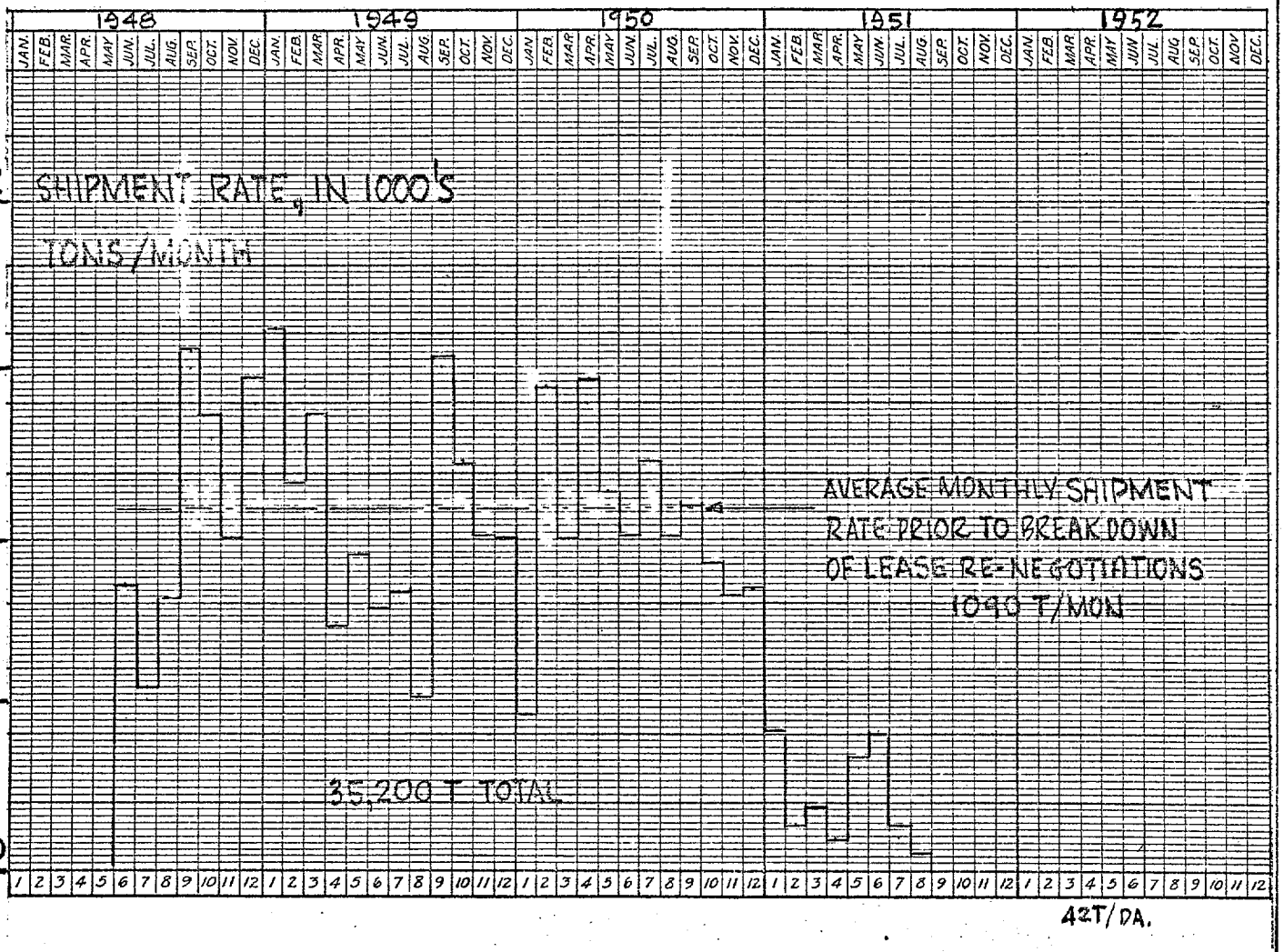
OWENS DISCONTINUED ORE DEVELOPMENT WORK WHEN LEASE NEGOTIATIONS WERE TERMINATED,



AND MINED-OUT THE FEW, HIGHER-GRADE AREAS PREVIOUSLY IDENTIFIED

ORE RESERVE ESTIMATE

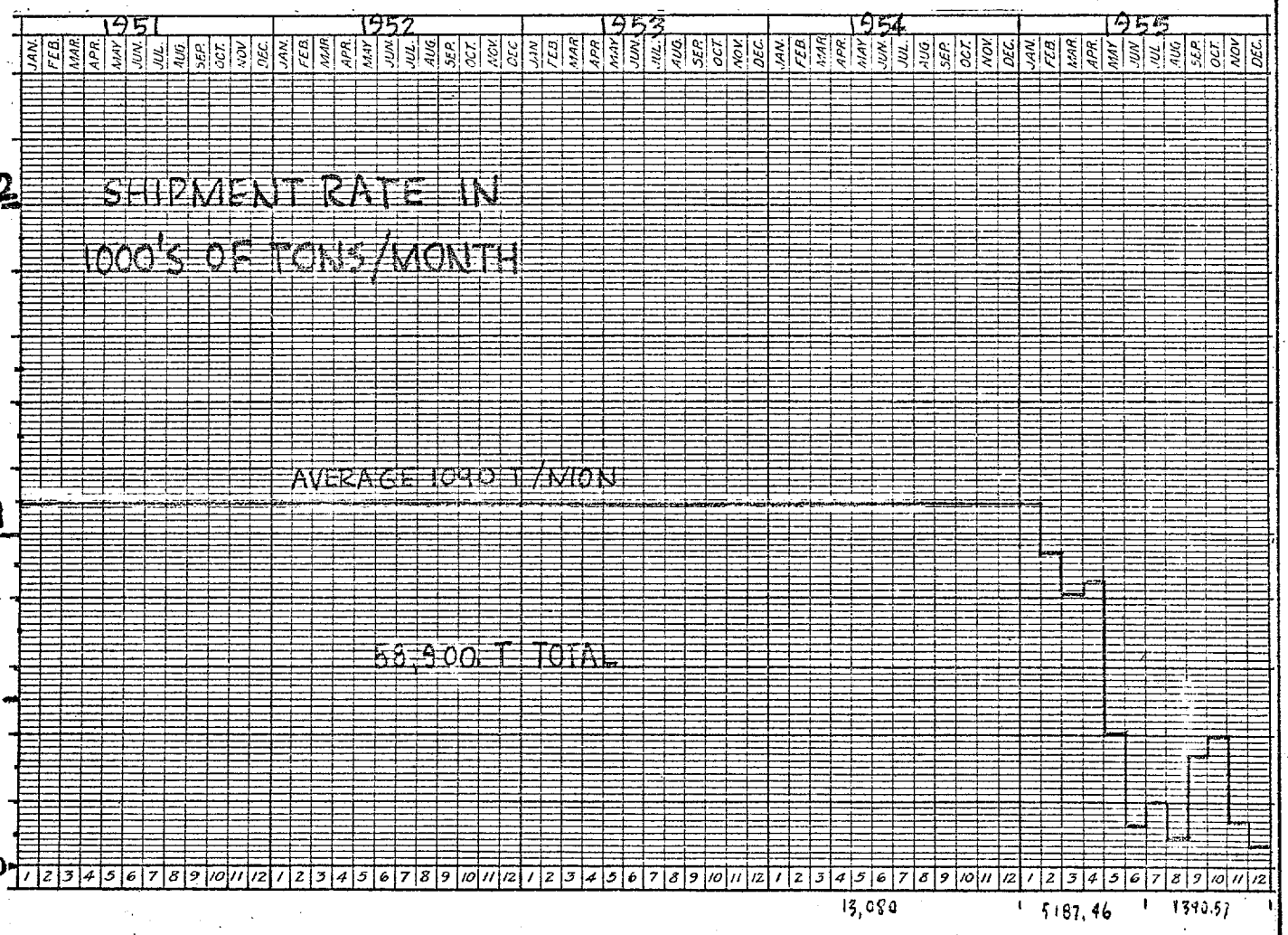
APPROACH USED TO DEDUCE "5 YEARS WORTH" OF PRODUCTION BY OWENS --



- USE 1090 TONS/MONTH FOR 1951, 2, 3 & 4 HYPOTHESIS
- USE SEPT. 1950 THROUGH AUG. 1951 PRODUCTION FOR 1955 HYPOTHESIS

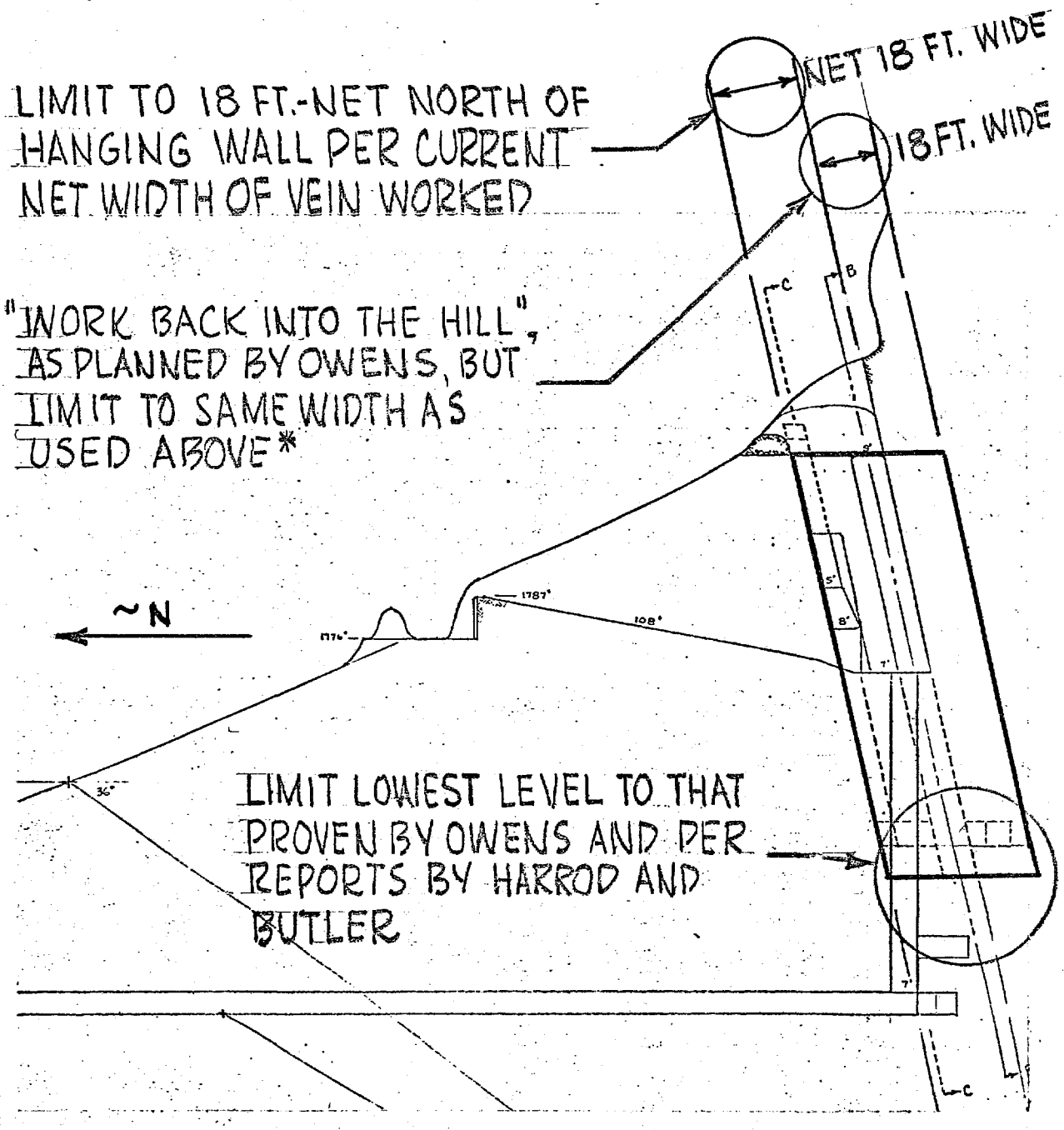
ORE RESERVE ESTIMATE

DEDUCTION OF WHAT WOULD HAVE HAPPENED IF OWENS/CLAUSEN LEASE RENEGOTIATIONS HAD BEEN SUCCESSFUL



ORE RESERVE ESTIMATE

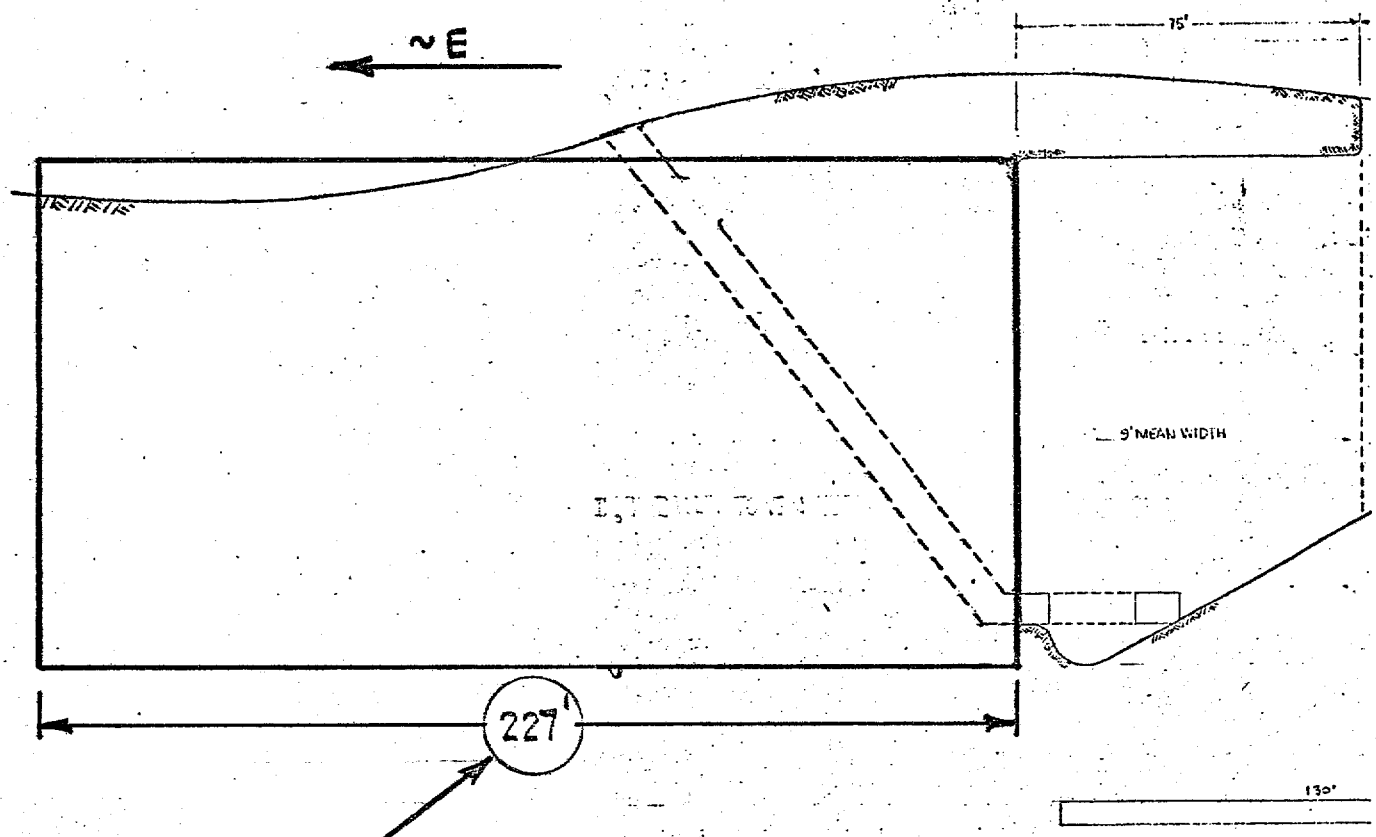
DEDUCTION OF SHIPPABLE ORE BODY FROM OWENS' CORRESPONDENCE AND WORKINGS



* NOTE THAT DIAMOND DRILL NO. 3 SUGGESTS THAT VALUES HOLD UP FOR 45 FT. SOUTH OF HANGING WALL. ON THE OTHER HAND, A.W. GERHARDT IS SAID TO HAVE REMARKED THAT ALUMINA TO SOUTH PREVENTED SHIPMENTS.

ORE RESERVE ESTIMATE

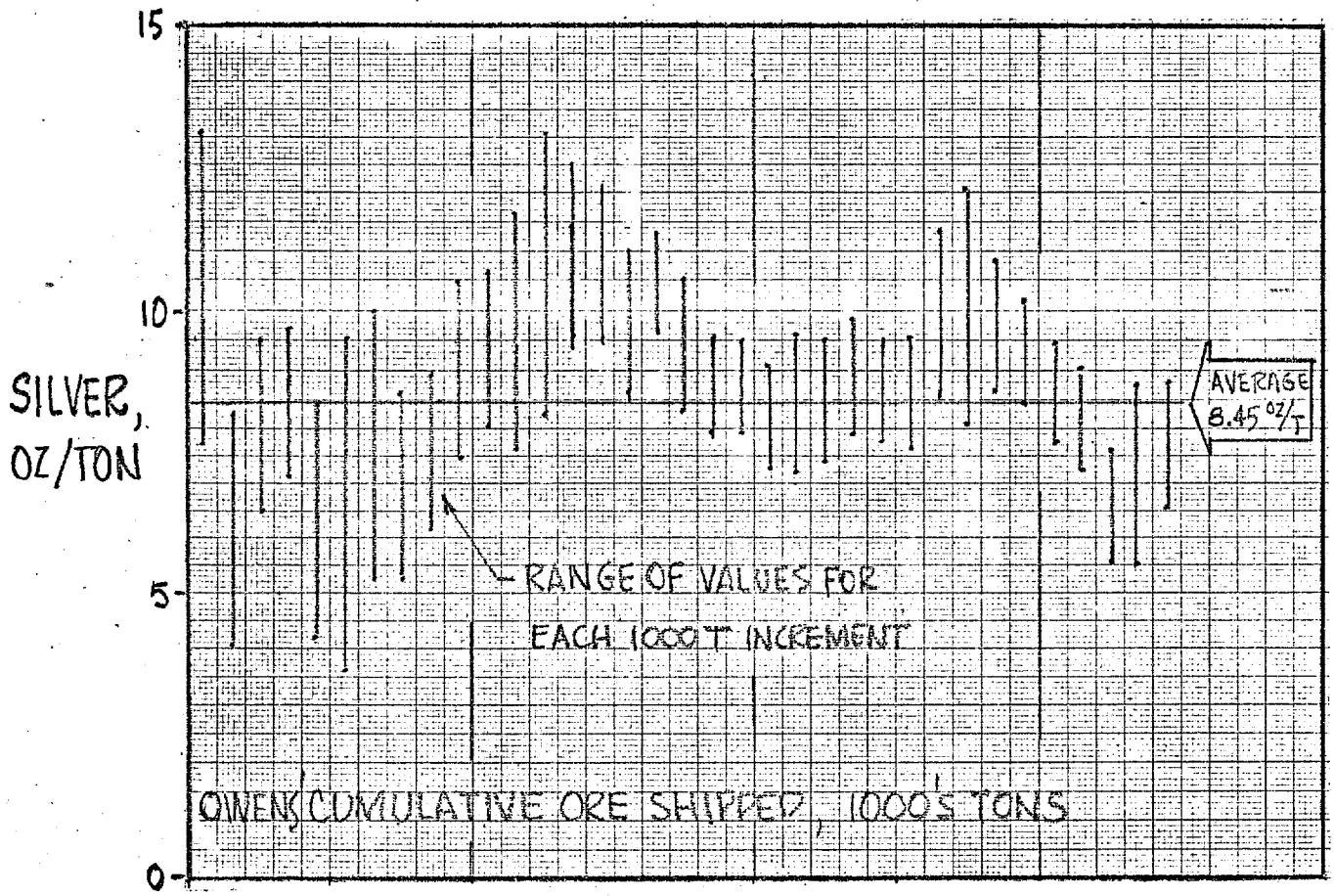
DEDUCTION OF SHIPPABLE ORE BODY FROM OWENS' CORRESPONDENCE AND WORKINGS



TO YIELD 58,900 TONS PREVIOUSLY NOTED, VEIN MUST BE WORKABLE FOR AN ADDITIONAL 227 FT. TO THE EAST

ORE VALUE ESTIMATE

- HISTORY OF OWENS' SHIPMENT VALUES

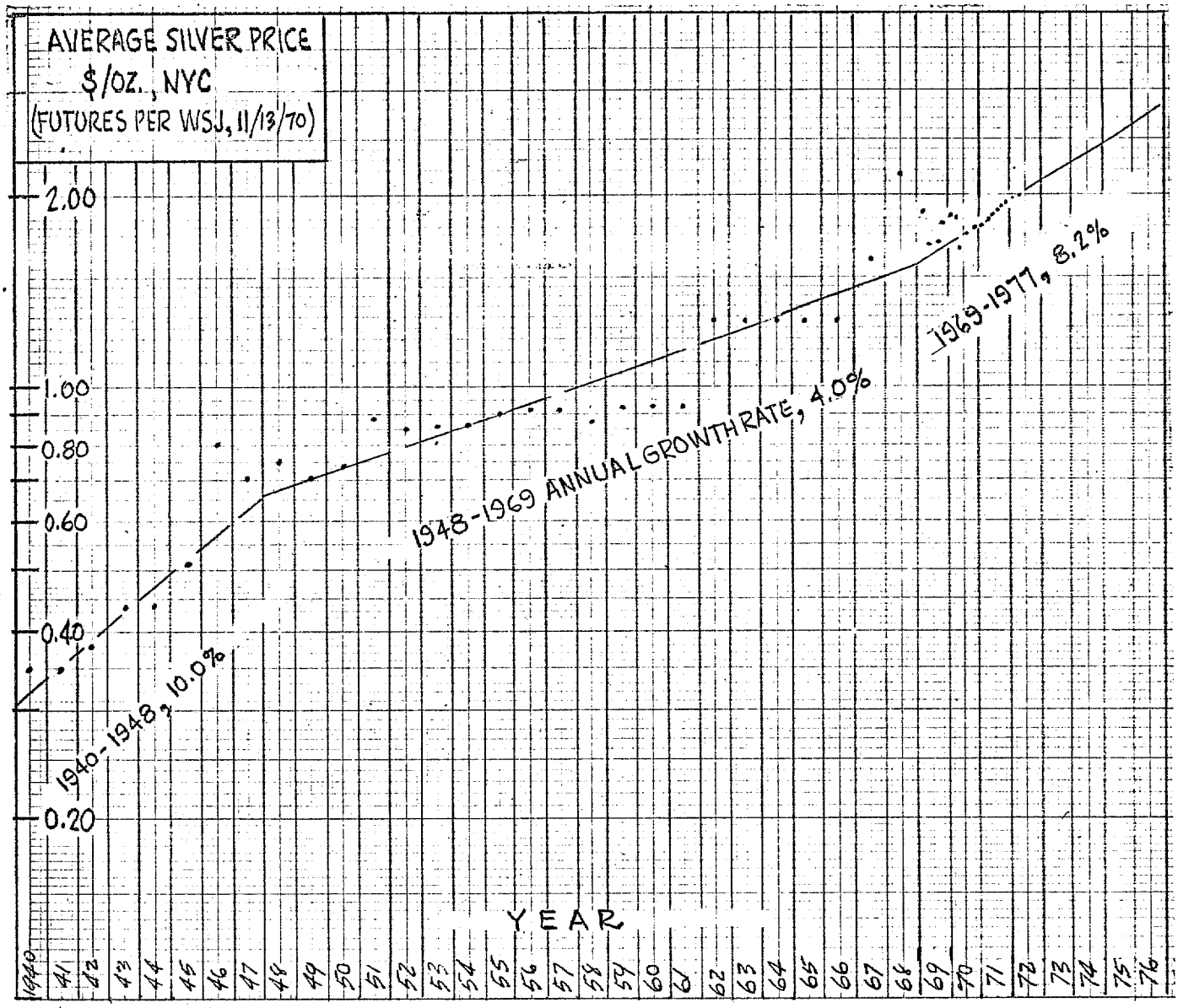


- ORE VALUE ESTIMATE --

-- ASSUME SAME AS OWENS' AVERAGE,

8.45 OZ/TON

SILVER PRICE FORECAST



GROSS REVENUE CALCULATIONS

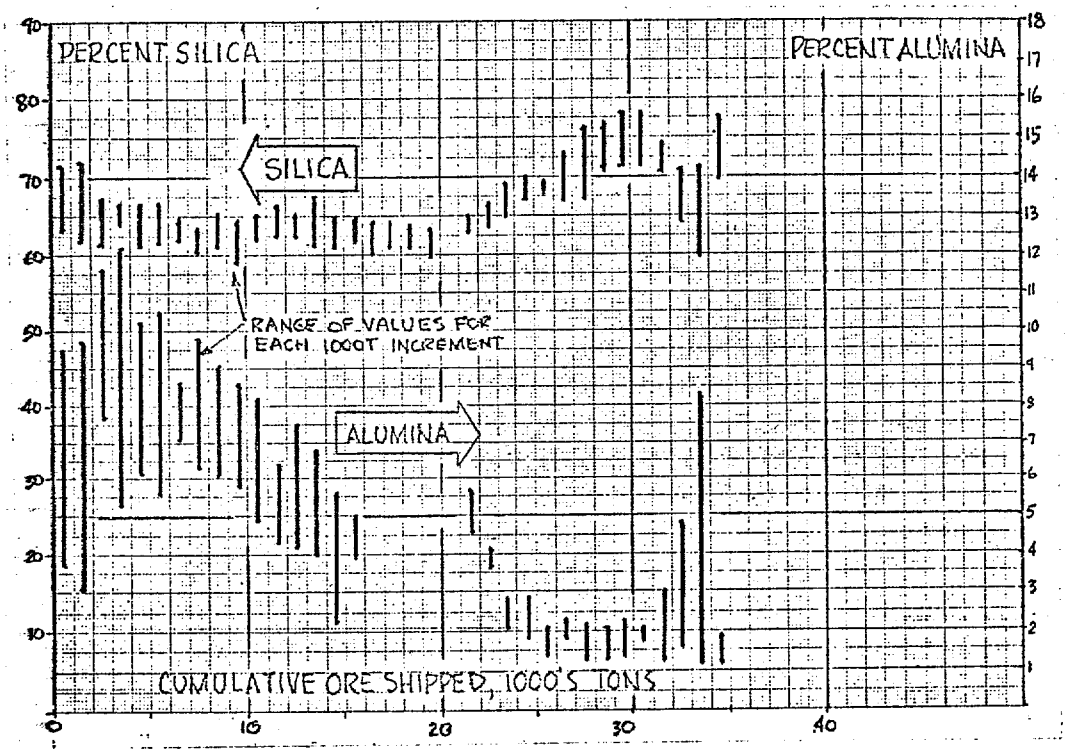
YEAR	TONS SHIPPED	SILVER OZ/TON	VOLITIZATION DEDUCT	SILVER PRICE, $/oz	GROSS REVENUE
LAST HALF 1971	6,540	8.45	- 6%	1.92	$100,000
1972	13,080	8.45	- 6%	2.02	210,000
1973	13,080	8.45	- 6%	2.19	228,000
1974	13,080	8.45	- 6%	2.36	245,000
1975	13,080	8.45	- 6%	2.54	235,000
FIRST HALF 1976	1,391	8.45	- 6%	2.74	30,000
TOTAL	58,898	8.45 AVG	- 6% AVG		$1,048,000

SMELTING AND FREIGHT COSTS

- VALUE OF SILVER NUGGET ORE AS A FLUX TO COPPER SMELTERS
- PREFERENTIAL SMELTING AND FREIGHT COSTS OBTAINED BY OWENS, 1948-1951
- INCREASE IN THE COPPER SMELTING DEMAND FOR FLUXING ORE SINCE 1951
- ESTIMATES OF PRESENT DAY COSTS THAT COULD BE NEGOTIATED WITH THE COPPER SMELTERS

VALUE OF SILVER NUGGET ORE AS A FLUX TO COPPER SMELTERS

- AS SMELTER ANALYSES OF OWENS' SHIPMENTS SHOW, SILVER NUGGET ORE HAS A HIGH SILICA, LOW ALUMINA CONTENT



- OWENS NEGOTIATED PREFERENTIAL SMELTING AND FREIGHT COSTS WITH THE SMELTERS BECAUSE OF THIS

PREFERENTIAL SMELTING AND FREIGHT COSTS OBTAINED BY OWENS, 1948-1951*

- SMELTING COSTS

$$\begin{pmatrix}\text{SMELTING}\\ \text{COSTS}\\ \text{CHARGED}\end{pmatrix} = \begin{pmatrix}\$1/\text{TON}\\ \text{BASE}\\ \text{CHARGE}\end{pmatrix} + 10\%\left(\begin{pmatrix}\text{METAL}\\ \text{PAYMENT}\\ \text{PER TON}\end{pmatrix} - \begin{pmatrix}\$8\\ \text{PER TON}\end{pmatrix}\right)$$

$$\approx \$1.00 \text{ PER TON FOR } 8.4 \text{ OZ/TON ORE}$$

- FREIGHT COSTS

$$\begin{pmatrix}\text{FREIGHT}\\ \text{COSTS}\\ \text{CHARGED}\end{pmatrix} = \begin{pmatrix}\text{ACTUAL}\\ \text{COST}\\ \text{PER TON}\end{pmatrix} - 50\%\left(\begin{pmatrix}\text{ACTUAL}\\ \text{COST}\\ \text{PER TON}\end{pmatrix} - \begin{pmatrix}\$1\\ \text{PER TON}\end{pmatrix}\right)$$

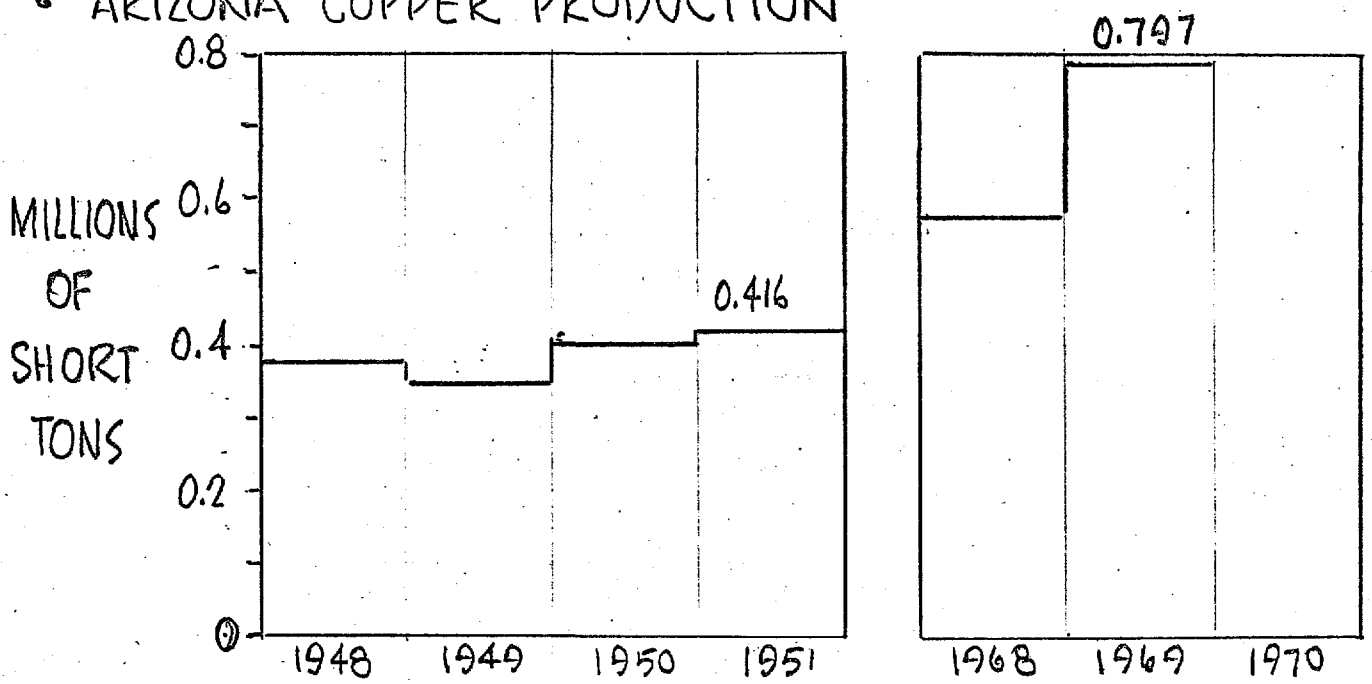
$$\approx \$1.20 \text{ PER TON } (1949)$$

---

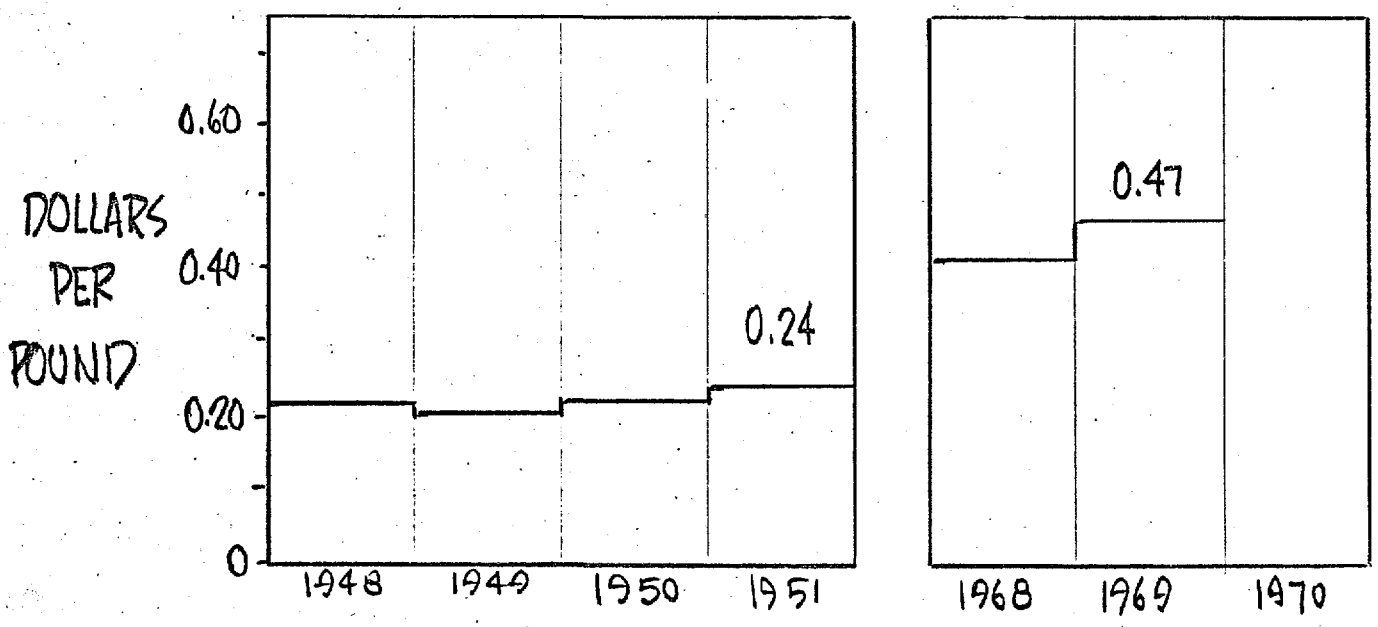
* HAYDEN

INCREASE IN COPPER SMELTER DEMAND FOR FLUXING ORES SINCE 1951

- ARIZONA COPPER PRODUCTION

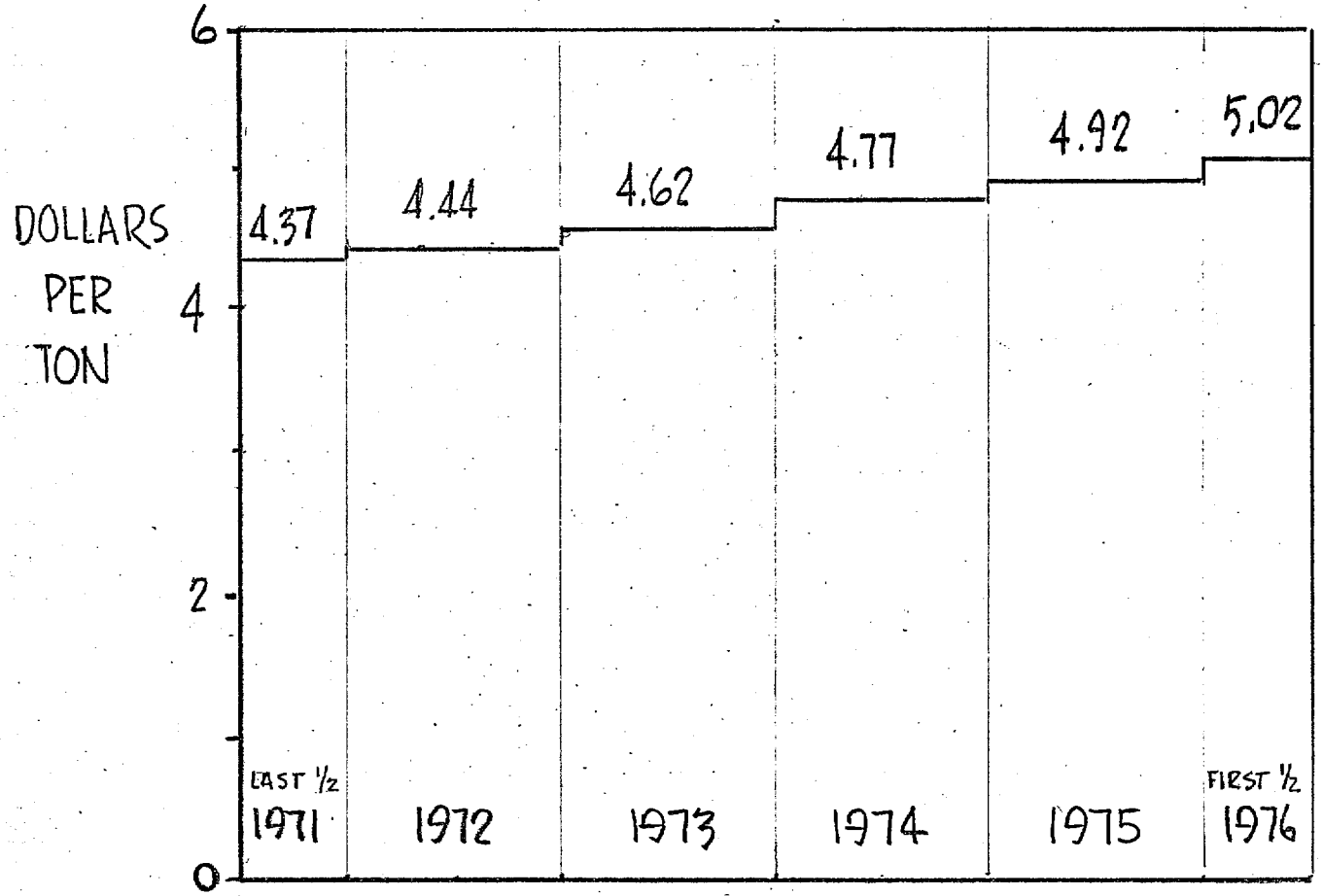


- AVERAGE SPOT ELECTROLYTIC COPPER PRICES, NY RE



ESTIMATES OF PRESENT DAY COSTS THAT COULD BE NEGOTIATED WITH THE COPPER SMELTERS

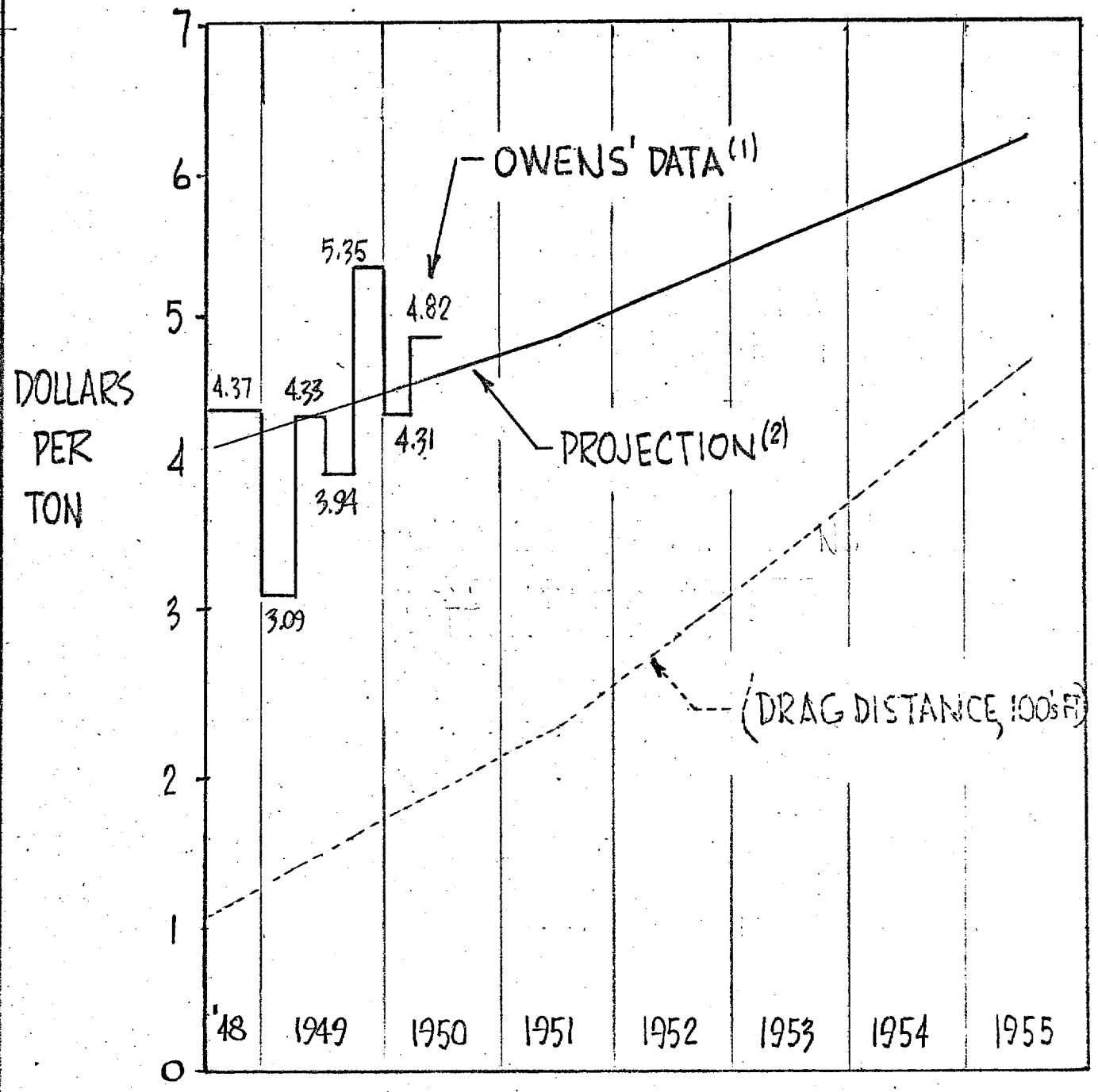
- PROJECTION THROUGH 1976



- PROJECTION EQUATION

$$\left[\begin{array}{c}\text{SMELTING}\\ \text{\& FREIGHT}\\ \text{COSTS}\end{array}\right]_{1971} = \left[\begin{array}{c}\text{SMELTING}\\ \text{\& FREIGHT}\\ \text{COSTS}\end{array}\right]_{1951} \times \left[1 + 0.035\right]^{1971-1951}$$

MINING AND TRUCKING COSTS

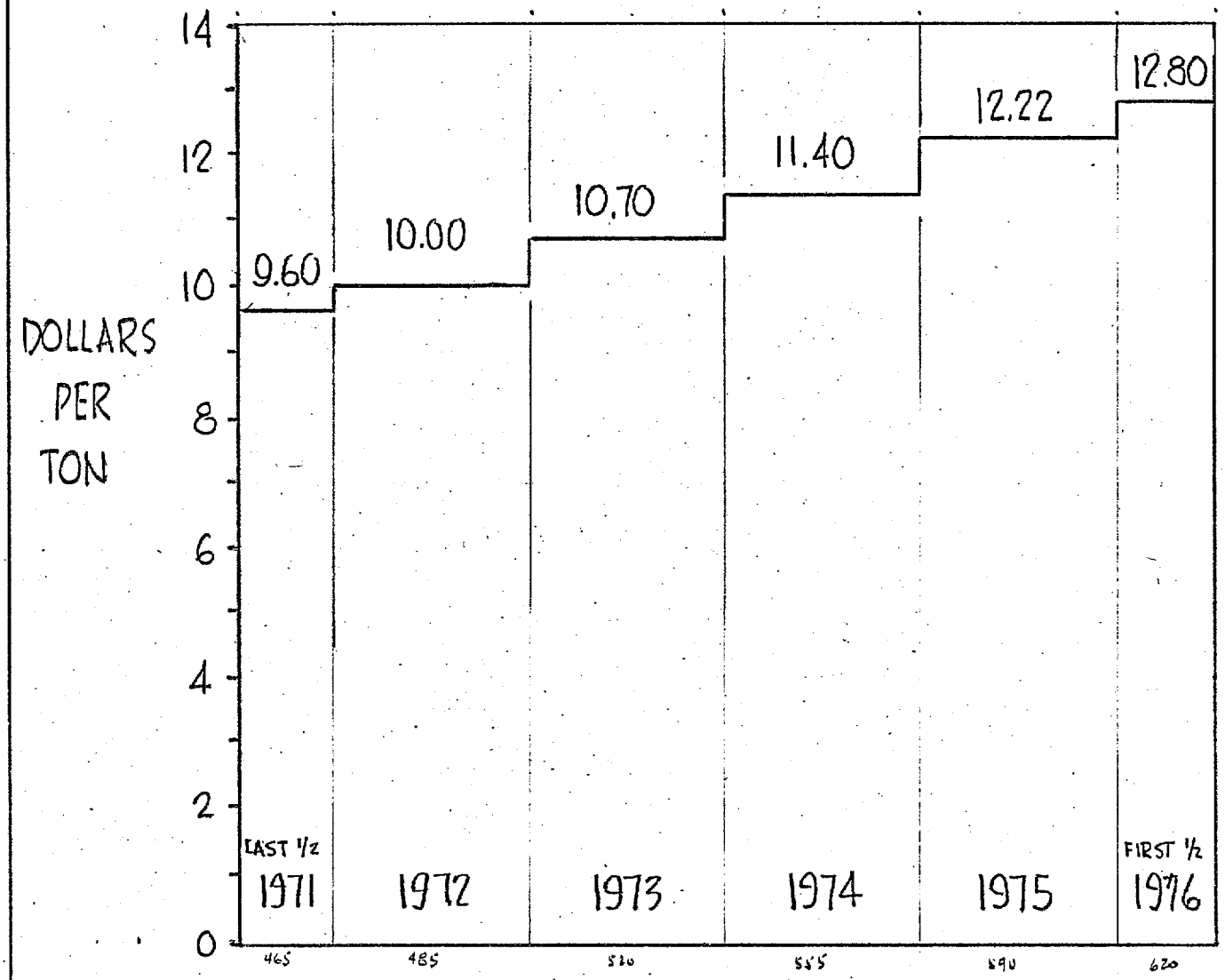


(1) CALCULATED FROM HIS LETTER OF AUG. 8, 1950

(2) ASSUMES 25% OF COSTS ∝ DRAG DISTANCE (2Q50 BASE)

ESTIMATE OF PRESENT DAY MINING AND TRUCKING COSTS, PROJECTED FROM OWENS DATA

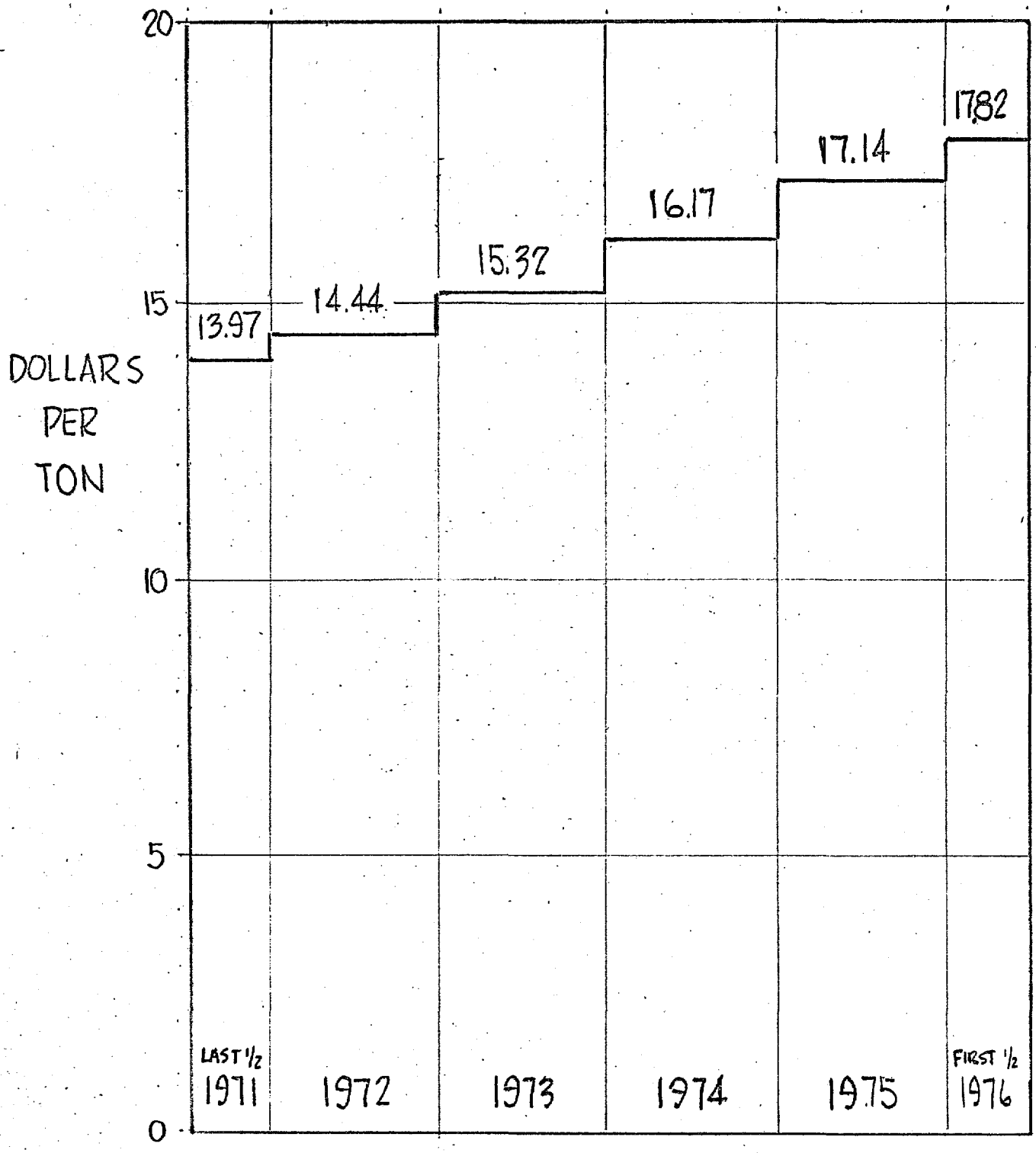
- PROJECTION THROUGH 1976



- PROJECTION EQUATION

$$\begin{bmatrix}\text{MINING \& TRUCKING COSTS}\end{bmatrix}_{1971} = \begin{bmatrix}\text{MINING \& TRUCKING COSTS}\end{bmatrix}_{1950} \times \begin{bmatrix}1 + 0.035\end{bmatrix}^{1971-1950}$$

TOTAL COSTS


20
15
10
5
0
DOLLARS PER TON
13.97
14.44
15.32
16.17
17.14
17.82
LAST 1/2 1971
1972
1973
1974
1975
FIRST 1/2 1976

INCOME SUMMARY

YEAR	TONS SHIPPED	NET SILVER $/TON	GROSS $ REVENUE	COSTS $/TON	TOTAL COSTS $	INCOME $
LAST HALF 1971	6,540	$15.30	$100,000	$13.97	$91,400	$8,600
1972	13,080	16.05	210,000	14.44	188,900	21,100
1973	13,080	17.50	228,000	15.32	200,400	27,600
1974	13,080	18.75	245,000	16.17	211,500	33,500
1975	11,727	19.90	235,000	17.14	201,000	34,000
FIRST HALF 1976	1,391	21.50	30,000	17.82	24,800	5,200
TOTALS	59,200 T		$1,048,000			$130,000

EVALUATION OF THE FEASIBILITY OF PROFITABLY MINING THE UPPER WORKINGS

CONCLUSIONS--

-- INCOME MARGIN IS TOO SMALL (8-17%) TO TOLERATE GROSS APPROXIMATIONS USED HERE ON COSTS

-- FEASIBILITY NOT PROVEN OR DISPROVEN

APPENDIX -- REPORTS ON SILVER NUGGET MINE

• F.W. ROYER REPORT TO J.H. HOLLAND	AUG. 14, 1917
• L.F.S. HOLLAND REPORT	~ MID 1918
• WESTERN METALLURGICAL CO. REPORT	MAY 5, 1920
• W.A. HARROD REPORT TO G.M. COLVOCORESSES	DEC. 4, 1920
• PERCY WILLIAMS REPORT	~ EARLY 1929
• G.M. BUTLER REPORT TO C.A. BELIN	DEC. 4, 1929
• G.M. BUTLER, "SOME FACTS ABOUT ORE DEPOSITS"	AUG. 15, 1935
• I.M. CLAUSEN (SR.) MEMO	~ MID 1937
• L.A. SMITH REPORT	MAR. 3, 1960

c-o-p-y

701 Hollingsworth Bldg.,
Los Angeles, California.

August 14th, 1917.

Mr. John Hays Hammond,
120 Broadway,
New York City.

Dear Sir:-

I beg to submit for your consideration and approval a plan to finance the treasury of the proposed Silver Reef Mining Company.

This company is in process of formation. The holdings consist of eleven mining claims upon which survey for U.S.patents have been made and it is expected that the patents will be granted some time this fall.

The company being formed will have a capital of 1,000,000 shares par value $1.00 per share.

It is proposed to issue 500,000 of the shares of this corporation to the present owners of this property, as follows:

John Hays Hammond - 40%	.....	200,000 shares
Chas. M. Leonard - 20%	.....	100,000 "
Frank M. Leonard - 20%	.....	100,000 "
Frank W. Royer - 20%	.....	100,000 "
Total shares issued	.....	500,000 "

This will leave 500,000 shares unissued, which can be issued and sold as funds are required for developing and equipping this property.

ASSETS:

The assets of this company will consist of 11 patented mining claims upon which are located a number of living houses, boarding house , stables, a twenty-stamp mill containing a 15" x 24" Blake crusher, 5" x 12" tube mill, a number of steel tanks, a 40 H.P. gas engine, etc.

The mill building and much of this machinery is in a fair state of repair and will be used when a new milling plant is built.

Located near the upper end of this mill a shaft 250 feet in depth has developed enough water to supply a camp and mill of at least 100 tons daily capacity.

This shaft is equipped with a Cornish type pump, operated by a gas engine, all of which is in good working order.

VEINS AND ORE BODIES:

The country rock is granite and rhyolite. The veins are lead, copper, silver bearing veins at the contract of the granite with the rhyolite, and in some instances entirely in the granite.

The gangue rock of the veins is quartz and brecciated country rock.

Four large veins are within the boundaries of these claims. At one time the veins included within the limits of these claims were owned by a number of different companies or individuals, and considerable work was done and ore shipped from every vein.

The workings having the best showing of ore at present are located in the Nugget claims. A map of these workings accompanies this report.

ORE BODIES IN THE NUGGET WORKINGS:

The workings shown on the accompanying map consist of a short cross-cut tunnel which cuts the vein at a depth of 60 feet below the outcrop; a drift along the vein for a distance of 150 feet, and a winze 40 feet deep below this adit level.

These workings have been thoroughly sampled by me.

The adit level for a length of 120 feet and for a width of ore exposed of 15 feet gives an average of 14.2 ozs. silver per ton. This average does not include high grade ore which has been gouged out and shipped.

Above the adit level there is exposed in the accessible portion of the vein, ore which, over an average width of 4.7 feet assays 36.7 ounces silver.

The vein on the surface and the adit level is from 24 to 35 feet wide,

ORE BODIES:

Before a tonnage of ore can be estimated some development work must be done.

It is estimated that there remains in the old workings above the adit level to the surface and to a distance of 50 feet

beyond the present breasts, 7000 tons of ore having an average value of 25.0 ounces of silver per ton. This is obtained by assuming the vein to be but 15 feet in width while the outcrop and two crosscuts on the adit level show the width of ore to be 33 feet.

Below the adit level, to a depth of 100 feet and assuming the ore to continue to a distance of 50 feet beyond the extremity of the ore opened on the adit level, or a total length of ore shute 250 feet, and assuming the width of workable ore to be but 15 feet, there will be in this block 26,000 tons, value 14.2 oz. silver.

On the dump at the mouth of this adit is 200 tons of ore assaying 15.9 oz. silver.

SUMMARY

	Tons	Ounces Silver	Total Ounces
Above adit level	7,000	25	175,000
To depth 100 feet below	26,000	14.2	369,200
In dump	200	15.9	3,180
	33,200		547,380 oz.

Average per ton 16.5 oz. Silver.

The cost of doing the work necessary to open up this ground sufficient to put the above tonnage figures in sight will be

	feet
Drifts and raises on and above adit level	290
Winze to depth of 100 feet	60
Drifts on 100 foot level	250
Raise	100
TOTAL	600

Practically no timbers or equipment would have to be purchased for this work.

The total cost of doing this work including general expenses, etc. will not exceed $25,000.

Tests have been made upon samples of this ore by several metallurgical firms and they report that by combined flotation and cyanide, a recovery of 90 to 93% of the silver value, with a loss of cyanide of from 1 to 3 lbs. per ton of ore treated.

Assuming a recovery of 80% of the silver and giving no consideration to the lead or small amount of gold in the ore which would be saved by flotation and cyanide, we have:

Total tonnage - - 33,200.

Basis 100 tons daily-Average value per ton 16.5 oz. Silver Silver at 85 cts.

80% of 16.5 oz. - 13.20 oz. at 85 cts. ---------$11.22

Costs.

Mining	$2.00	
To Mill	.25	
Milling	3.00	
Metal realization	.25	5.50
Estimated profit per ton .....1.....$		5.72

To put the present mill in shape to mill economically 75 to 100 tons per day using a combined flotation and cyanide treatment should not exceed a total of $40,000.

SUMMARY AND CONCLUSION

The development of the Nugget mine should bestarted at once. The bottom of the winze and both breasts of the adit level, where work will be started, are in low grade ore, and judging from the meager data obtained from sampling the outcrop, ore may be expected to extend for much longer distances than I have estimated. The money necessary to do the work required is $25,000. which should be raised immediately. Considerable high grade silver ore has been encountered and shipped while running the adit level and it is probable that in doing the work contemplated some revenue can be obtained from shipments.

The chances for opening up a big low grade silver mine are extremely good and the figures given above are simply meant to illustrate what I consider to be the poorest possible outcome of this development work provided the values to not leave entirely as we go down.

Sincerely,

(signed) F.W.Royer

HR 13/19 [illegible] 7/16/19

PRECEEDS STOCK SALE TO GERHARD

COPY

SILVER REEF MINING COMPANY'S PROPERTY

LOCATION AND TITLE.

The nearest railroad point is Casa Grande, Arizona, 13 miles to the north, on the main line of the Southern Pacific Railroad. The property comprises eleven adjoining and partly overlapping mining claims. Patent had been applied for in the name of Frank M. Leonard, and so far as is known, there are no adverse suits. The Pinal County Records show that Frank M. Leonard purchased the Nugget Claim for $2000.00; the Silver Nugget Claim for $2500.00; the Lead Boulder and Horn Silver Claims, with the mill and other improvements, at Sheriff's Sale for $3127.88; and paid various small sums at tax sales.

The property is now vested in the Silver Reef Mining Company, incorporated under the laws of Arizona, with a capitalization of 1,000,000 shares, par value $1.00 each. All the shares have been provisionally allotted as follows:

John Hays Hammond	150,000	shares
H. H. Burger	50,000	"
Chas. H. Leonard	100,000	"
Frank M. Leonard	100,000	"
" " "	500,000	"
Frank W. Royer	100,000	"
	1,000,000	"

The half million block of shares allotted to Frank M. Leonard is intended for sale for development etc. The legal business of incorporation has been attended to by Mr. Chas. H. Leonard, an eminent corporation lawyer, and it may be safely assumed that everything in this connection is in order.

TOPOGRAPHY.

The ore deposits occur in rugged hills of mederate elevation above desert plains usual in Arizona. Aneroid readings at the camp varied from 1575 to 1675 ft. during my visit. (The elevation of Casa Grande thirteen miles to the north, is given by the railroad as 1395 ft.) The mount of the main crosscut tunnel on the Nugget Claim showed 1850 ft.; the outcrop of the Nugget vein above the crosscut, 1900 ft; and the collar of the main shaft on the Horn Silver vein 1675 ft. Water for milling and domestic purposes is obtained from the mine. There is no local timber. Mining operations can be conducted all the year round, though the summer is rather hot for surface work.

GEOLOGY.

The basal formation is coarse granite or pegmatite, containing lenses and veinlets of quartz in all directions, as is common with permatite. Overlying the pegmatite are he remains of deposits of sndesitic breccia and tufa, which no doubt once covered much larger areas, but have been eroded so that the underlying pegmatite is exposed in the gulches and lower hillsides. The rather basic andesitic breccia immediately above the main corsscut on the Nugget Claim bears much resemblance to the Marshall Basin formation with shich you are so well acquainted, but no resemblance to the more acidic rhyolite. I am therefore adopting Royer's nomenclature.

COPY
GEOLOGY Cont'd.

The veins, of which there are three or four, appear to me to be in shattered fault zones. There is some cross-faulting, but the throw is generally only a foot or two, so that the vein can be easily followed up in drifting. The shattered fault zones are silicified so that the quartz filling has a banded structure, both in the andisitic breccia and in the underlying pegmatite. The original constituent quartz veinlets and lenses of the pegmatite do not have this banded structure, nor apparently any considerable values in silver outside of what I am calling the shattered fault zones. The pegmatite does, however, show interesting bunches of sulfenite (molybdate of lead) and vanadinite (CHloro-vanadate of lead) which I will refer to lated when describing the old Horn Silver workings. The portal of the main Nugget crosscut is in pegmatite, but the open workings on the vein a short distance up hill have both walls in the andesitic breccia, though the contact of the andesitic breccia and pegmatite is nearby. A short distance to the west a clean and polished contact shows no ore on the contact. Farther west, towards the middle of the property, both walls of the vein here exposed are in pegmatite, as are both walls of the Horn Silver vein still further west. I must conclude, therefore, that Royer's description of the veins as contact deposits is not justified by the evidence, though where the shattered fault zones happen to coincide with the contact, ore may be found on the contact of the formations. This is no disadvantage to the prospect of finding pay ore in depth in the pegmatite by means of the prospect development work, but rather an advantage. I appears to be a fact, however, that the best silver values have hitherto been found in or near the overlying andesitic breccia; and that the formation is comparatively shallow.

WORKINGS

The notice of application for patent, now posted on the ground, mentions 36 shafts, 8 tunnels, 7 cuts, 7 drifts; 1 winze, 3 crosscuts; and 2 stopes. The total cost is estimated at $22,350.00.

THE NUGGET WORKINGS

These, the only ones considered in Royer's report, are located at the joint end of the Nugget and Silver Nugget claims. The vein has a strike of about N 79 E (true) and only a slight dip. A short crosscut tunnel, commencing in pegmatite and soon reaching the andesitic breccia, cuts the vein at a vertical depth of about 50 feet below the outcrop. For a length of about 120 feet stoping has been carried to the surface, and pillars of ore left; presumably less valuable than the ground stoped. About halfway to the surface I took a sample across 8 feet of banded quartz and andesitic breccia which assayed (n) 18.10 oz. silver. Near this point Royer's assay map indicates that a sample across 6 feet assayed 15.5 oz. silver. Here and elsewhere the ore showed no visible silver except possibly a very little argentite, too fine for identification without a microscope. Down below at the fork, in the level, near where Royer indicates a value of 25.8 oz. for 6 feet, my sample across 4 feet assayed (B) 18.30 oz. Next to this I sampled 8 feet which assayed (a) 11.90 oz. My two samples therefore indicate a value of 14 oz. for the total width of 12 feet, which happens to be very close to Royer's figure of 14.2 oz. for 12 feet, based on a large number of samples. My six check samples taken at arbitrary points, averaged 13.5 oz. for 6 feet. Omitting the one sample (N) taken 25 feet above the level, my five samples averaged 12.2 oz. for 5.9 feet. Along the drift at a point where Royer's map indicates 14.6 oz. for 4 feet, my sample across

COPY

THE NUGGET WORKINGS CONT'D.

4 feet assayed (C) 9 oz. May sample across ten feet along both walls of the crosscut immediately north of the drift assayed (L) 11.80 oz. Royer here shows two samples, each 5 ft. assaying 14 oz. and 8 oz. respectively, or 11 oz. for the 10 feet I sampled, a remarkably close check. At apoint above 20 feet east of the fork in the drift where Royer indicates 11.6 oz. for a width of 3½ feet, my sample across the same width assayed (M) 11 oz. another remarkably close check. My grab samples from the small dump outside assayed (F) 10.10 oz. From these few check samples I cannot but conclude that the values are about as represented on Royer's assay map, and that they are a reasonable basis for estimating possible ore to be developed by the work now proposed.

With regard to the total width of the pay ore, the crosscut at the end of the drift was so nearly full of broken dirt, that it could only be fairly sampled after doing more work that would seem warranted at this time. Grabs along 35 feet of broken country rock and quartz which had been thrown back assayed (F) only 2 oz. silver. At the northeast end of the crosscut, extended, I am informed since Royer's sampling, and which might in a few feet be extended through to the surface, is an interesting exposure of the contact of the andesitic breccia where it fills the troughs in the former surface of the pegmatite. At the contact can be seen specularite, iron oxide, a little manganese and slight copper stains. A sample across three feet assayed (K) 2.30 oz. of silber and a trace of copper. A four inch streak of feldspar, with iron and manganese, assayed (D) 3.50 oz. silver. These are apparently beyond the limits of the pay ore. To arrive at the estimated width of the pay ore expected to be developed below the present crosscut level, Royer has added 3' to the 12' of his average samplings, making 15'. This appears to me to be reasonable. a 40 foot winze, which is proposed to extend to 100 feet, shows ore near the bottom. Water now in the winze prevented my sampling the ore without the erection of a stage etc. which did not appear to be warranted at this time. The 25,000 tons of possible ore estimated by Royer as below the crosscut level have, of course, yet to be developed by the extension of the winze another 60 feet and the driving of 250 feet of level and a 100 foot raise from the bottom. Some development work will also have to be done above the crosscut tunnel level to make the ore there available. The estimated cost of $25,000 should be plenty for the proposed development work on the Nugget vein.

THE HORN SILVER WORKINGS

The shaft, called 325' deep, on the considerably flatter slope of the vein than the Nugget Vein, is shown by the aneroid to have a vertical depth of 235 feet. A 50 foot winze, now full of water, has been sunk from the bottom level. Considerablestoping has been done, but I am informed that the silver ore in sight is mostly of too low grade to be commercial. Both vein walls are pegmatite and I judge the average width of the vein to have been about four feet. In places the vein matter is brecciated. The silver values were probably bunchy. On the bottom level near the mouth of the winze, are small bunches of wulfenite and vanadanite. One sample (H) across one foot assayed 4.40 oz. silver; .42% molybdic acid; and .16% vanadic acid. Another sample nearby, same width, assayed (I) 4.50 oz. solver; .66% Molybdic acid; .65% vanadic acid. On the second level above is a considerable showing of disseminated wulfenite and vanadanite. On the chance of finding a definite pay streak of molybdenum or vanadium ore, some prospecting would seem to be adviseable here. Fifteen to twenty percent molybdic acid concentrates are now worth two dollars or more a pound at Arizona points, for the contained molybdenum, which is six-tenths of the molybdic acid. The wulfenite is not difficult to concentrate. the vanadium is generally

COPY

considered objectionable with the molybdenum, but can easily be separated chemically and then has a good market value. Some grab samples I took from the Horn Silver dump, more particularly for the molybdenum and vanadium, assayed (J) 18.0 oz. solver; 10% Molybdic acid; and .50% Vanadic acid. The small tailing pile at the mill grap sampled by scraping some of the surface assayed (G) silver 9.20 oz. Molybdic acid .64%.

METALLURGY

Reports on Cyanide test made on the ore by Sill and Sill, Los Angeles, for the owners, indicates an extraction of 80 to 89.3% of the silver values. (The gold content is generally negligible.) The consumption of cyanide varied from 1 lb. to 4.2 lbs. per ton of ore treated, and of lime, from 2.4 to 5.2 lbs. A combined flotation and syanide process has also been experimented with. In any event, Royer's estimate of $3.00 per ton for milling should cover the cost.

EQUIPMENT

The mill contains a Dodge crusher; 2o Fraser and Chalmers gravity stamps; old vanners (dismantled); tube mill; cone classified; and a Fairbanks and Morse 40 HP enigne. The building itself is in bad repair. Outside are two old type copper smelters, one never erected; and 2 Baker blowers. The complete set of tools for a small crew on the ground. The camp buildings, other than the mill, are in fair condition.

CONCLUSION

The property appears to be worthy of further development, with a good chance of success. As suggested in my telegraphic message, I think you are entitled to more favarable terms, inasmuch as without the expenditure of such funds as you are asked to supply, the present promoters can reap little, if any, profit from their investment.

Respectfully submitted,

(Signed) L. F. S. Holland

Mining Engineer

HR 4/28/20

NOTES ON SILVER NUGGET and SILVER REEF MINE.

Location. 12 miles south of Casa Grande, Arizona; by very good road; approximately 19 miles south of the Lake Shore Mine.

Date Visited. April 28th, 1920, with F. W. Leonard and F. B. Church.

The property consists of 10 claims and one fraction; owned by the Silver Reef Mining and Milling Co; see blue print of claims and assay maps attached.

Outcrop and workings lie on the slope of steep hill facing to the north and on tilted contact between granite foot wall and rhyolite hanging wall. I am not certain whether there is a true contact fissure at this point or not; strike of veins East and West.

Silver Ledge workings about 425 feet deep and considerable drifting; also some stoping. Equipped with an old Mill and Lead Jacket for smelting ore. Treatment was concentration and cyanidation of tailings. An attempt was made to smelt the concentrates but appears to have been unsuccessful. The first work done here was in the 70's and 80's; mill and smelter constructed in the 90's. Was apparently largely a stock selling project. Ore carries lead and low values in silver. Workings were not visited and were stated by Leonard to show very little ore.

The Silver Nugget Mine lies 3500' east of the Silver Ledge. It is developed by an adit with old stopes and raises to the surface, about 60 feet above a winze about 60' deep. Equipment consists of a gasoline engine; small compressor and some rails and mine cars.

Vein is developed for length of about 120 feet in an adit level and apparently no working was done at the bottom of the winze, although it is said that good ore was found continuously in the winze. Assay maps show ore to continue both ends of drift and apparently ore body is somewhat wider than development would indicate. The width appears to be about 50 feet and the average grade of ore according to Royer's sampling which was checked by Johns is 14 oz. silver. There is no gold and very little lead in this ore. The values are mainly in the form of silver-chloride, also some argentite. The ground is quartz; crushed wall rock and considerable lime. The high grade ore has been stoped out in stringers and small lenses.

Royer estimated as positive 30,000 tons of 14 oz. ore above the adit. This estimate appears reasonable from measurements and assay map. The principal value of the property lies in the probability of developing a much larger tonnage below the adit and at the other end of the drift. If the vein is actually 50 feet wide it will run into tonnage fast, and the prospect seems well worth additional development which could be accomplished at comparatively small expense.

There is a good site for a mill or treatment plant on the hillside below the mouth of the adit and the ore should be susceptible to treatment by cyanidation or Volatilization.

NOTE: SEE Volatilization test on sample taken from dump.

There is said to be plenty of water at the bottom of the Silver Ledge shaft and the quality is reported good. The property has all been surveyed and passed for patent and

patent will be issued on payment of the necessary fee, according to Leonard.

The company owning this property is known as the Silver Ledge Mining & Milling Co., an Arizona corporation; capital 1,000,000 shares of Common Stock at $1.00 par value per share. The stock is now held as follows:-

F. W. Leonard	100,000	shares
Chas. Leonard	100,000	"
F. W. Royer	100,000	"
John Hays Hammond	150,000	"
James Gerard	100,000	"
Total Issued	550,000	"
Stock in Treasury	450,000	"
	1,000,000	"

There is apparently no cash in the Treasury and no market for the Treasury stock. The owners of the issued stock put up part cash and altogether some $50,000 appears to have been spent by the present company, this including the cost of purchasing the claims and a very small amount of development work.

My suggestion to Leonard was that all owners of stock should put back into the treasury one-half of their holdings which would then provide the Treasury with a total of 725,000 shares leaving 275,000 shares of stock with the present stock-holders pro rata. A syndicate then to be formed by parties to whom 25,000 shares of stock should be given for promotion and on the basis of a new sampling to be conducted at the expense of these parties. The syndicate should guarantee,provided such sampling checked Royer's results--to purchase at once 100,000 shares of Treasury stock at 25 cents per share, thus providing the company with $25,000. --necessary for additional development. If the expenditure of this money resulted in developing an additional 70,000 tons of ore, or thereabouts, the Syndicate should further guarantee to purchase the remaining 600,000 shares at 25 cents a share thus providing the company with an additional $150,000 of which sum approximately $25,000 would be required for additional Mine equipment and approximately $100,000 for the construction of a treatment plant, leaving $25,000 working capital which, under the conditions, should be sufficient. The present stock holders should have the right to participate in the syndicate in such share as to leave to them 49% of the total authorized stock of the company; leaving to the new investors and promoters 51%, i. e., the controlling interest.

I would estimate working costs roughly as follows:

MINING	$2.00	
Treatment	4.00	
Overhead & selling expense	1.00	
Total		$7.00 per ton.

Assume recovery of 80% of the values and average grade of ore 14 oz. per ton with silver at $1.00 per ounce and a recovery of $11.20 per ton should be effected, leaving a net profit of $4.20 per ton of ore mined or $420,000 on the 100,000 tons which should be developed before the Syndicate was obliged to purchase the principal quantity of stock. In this way the Syndicate would be assured of getting their money back even if no more ore were developed and would have a most excellent chance to make a large profit in the probable event of additional ore reserves being proven and subsequently mined and treated.

It would appear from the above that the mine might be worked profitably with silver down to 70 cents per ounce and the cost figures are believed to be liberal estimates which might be materially improved with practice.

Humboldt, Arizona
May 5th, 1920

(NOTE: Statement not signed but prepared by some member of the Engineering Staff of Western Metallurgical Co.)

T. B. Form 103 2M-8-18

Silver Reef
Case Property, Arizona

CONSOLIDATED ARIZONA SMELTING COMPANY

MINE DEPARTMENT

ALL COMMUNICATIONS SHOULD BE ADDRESSED TO THE COMPANY

Original Letter Report

Blue Bell Mine,
Mayer, Arizona,
December 4, 1920.

Mr. G. M. Colvocoresses, General Manager,
Consolidated Arizona Smelting Company,
Humboldt, Arizona.

Dear Sir:-

Pursuant to your request, I have carefully examined the Silver Reef Mine, also, I have gone over the Horn Silver workings, as carefully as possible under the conditions. On the Horn Silver property, only those samples were taken, that, in my judgment, seemed necessary. I spent seven days, from October 21st to October 28th, on the ground and herewith submit my report:

The Silver Reef property is worthy of further development. On it, there is probable ore exposed, of such value, that with a mill on the ground, it may be worked profitably; also the quantity is such that it would pay, for the necessary development and putting the mill in order.

The Silver Reef workings lie at the junction of the Silver Nugget and the Nugget claims -- the two having coincident end lines. The vein is well defined and may be traced the full length of the Silver Nugget claim to the East and also about two hundred feet Westward into the Nugget claim. It is a quartz vein associated with the contact of rhyolite and earlier granite and made up of small quartz stringers. In some places the vein lies

wholly in the granite and in others in the rhyolite; but the best ore seems to be found where it is at the contact, or, in the rhyolite. There are small amounts of wulfenite and vanadinite throughout the workings; also some galena, argentite and native silver. However, the valuable minerals in the upper workings are the hronsilvers. These minerals indicate a lead silver vein in the depth and this is born out by the appearance of galena in the bottom of the winze. At points along the outcrop, the vein is as wide as thirty feet. In the bottom of the winze which is one hundred and twenty five feet below the adit level, or, about two hundred feet below the surface, the vein is fully fifteen feet wide. I believe the longitudinal extension of the ore will be at least fifty feet beyond the present faces. I do not believe ore will be found at any greater depth than the bottom of the winze.

My sampling of the outcrop did not indicate the presence of other ore shoots. There is another vein about seven feet wide seen in the adit at the west end of the Nugget claim. It's strike is about perpendicular to that of the Silver Reef vein. It is highly mineralized. Where I sampled it, it contained 2.20 ounces of silver and some copper. This vein, the Horn Silver and Silver Reef veins constitute the only three veins of any importance on the property.

The property is situated in Pinal County, Arizona, twelve miles from the Southern Pacific railroad, at Casa Grande, and is in the low rugged hills at the edge of the desert. The climate, although very hot in the summer, is such that work may be conducted all the year round. The road across the desert from the Mine is almost level and always passable.

From the assay map, it will be seen that for one hundred and twenty-eight feet along the adit level, the ore averaged 17.36 ounces of silver per ton, over an average width of 7.4 feet. For one hundred and twenty-three feet down the winze, the ore averaged 8.38 ounces of silver per ton over an average width of 5.8 feet. In the raise above the adit level for seventy-two feet, the ore averaged 17.88 ounces of silver per ton over an average width of 3.55 feet. From these figures, there are 1,540 tons of probable ore above the adit level, averaging 15.06 ounces of silver per ton. There are also 7,760 tons of probable ore below the adit level averaging 13.50 ounces of silver per ton.

Assuming a fifteen foot vein and extension of the ore body to fifty feet beyond the present faces, there are 7000 tons above the adit level and 34000 tons below the adit level. The development work necessary to prove or disprove the probable ore and also to develope the ore to the extent of 34000 tons below the adit level and 7000 tons above, could be done by four hundred feet of drifting and one hundred and twenty-five feet of raising. This development work could be done for fifteen thousand dollars. No timbering would be necessary.

There is no appreciable amount of ore above the adit level that will average twenty-five or more ounces of silver to the ton.

The equipment of the old cyanide mill on the Horn Silver property is as follows:

1 - 12" x 14" jaw crusher
1 - Stampmill consisting of 4 batteries of 5 stamps each
1 - 5' x 12' tube mill
1 - 40 H.P. Fairbanks-Morse gas engine
3 - 5' x 16' steel leaching tanks
2 - 8' x 12' steel tanks
5 - 8' x 8' steel tanks
16 - zinc boxes

All this equipment is in a good state of repair and could be made use of in reconstructing the mill. There are several other pieces of equipment such as vanners, boilers and an old type blast furnace. These are all practically worthless. The mill could be made modern and put in order to handle one hundred tons for forty thousand dollars. There is also a Cornish pump and a six horse power gasoline engine on the Horn Silver used to pump water from the Mine. These are in good condition. At the Silver Reef, there is a six horsepower gasoline hoist and forge in good condition.

There is plenty of water in the Horn Silver shaft to run a mill of one hundred ton capacity. A cyanide mill or combined cyanide and flotation mill will be best suited to treat the ore. The cost of mining and milling should not exceed seven dollars per ton. Transportation to Casa Grande costs thirty-five cents per ton mile or four dollars and twenty cents per ton. This price could probably be reduced to three dollars on a contract for a large amount of haulage.

The accessible workings of the Horn Silver showed no material that could be handled profitably. The water level was three hundred and twenty-seven feet below the collar of the shaft measured along the dip. This made some of the lower workings inaccessible. All the available ore has been taken and was mined from the narrow stope shown on the map to the left of the shaft. There is much more wulfenite and vanadinite shown in these workings than in the Silver Reef.

Very truly yours,

Wayne A. Harrod

Wayne A. Harrod

WAH/H

HR ~1928-1929

P. WILLIAMS

DESCRIPTION OF SILVER REEF MINES

Near.

CASA GRANDE, ARIZONA.

OWNERS:

Silver Reef Mining Company, $1,000,000 capital stock divided into $1.00 par value shares.

LOCATION:

In Casa Grande Mining District ten miles from Casa Grande on the Southern Pacific R. R. in Pinal County, Arizona.

MINING CLAIMS AND ACREAGE:

Eleven claims comprising approximately 300 acres, extending 6000 feet along the strike of the main Silver Reef fissure vein and covering several minor fissures and spurs; also taking in sufficient area of land for camp site, mill site, stores and townsite.

Property all surveyed for patent by Paul E. Fernald, U. S. Deputy Mineral Surveyor.

HISTORY:

The Silver Reef was the scene, some seventy years ago, of extensive production of high grade chloride silver ores from pockets and streaks occuring in the big quartz fissure near the surface. When these superficial bonanzas were exhausted, the hardness and low grade character of the vein quartz discouraged early miners from anything more than half-hearted attempts at deep mining.

After lying idle for many years, the property was purchased some fifteen years ago by present owners (a group of experienced mining men) who recognized not only its possibilities of future, deep-seated bodies of high grade silver-lead ores, but also were aware of the great value of its low grade 15 and 20 ounce silver ores, when blocked out in quantity sufficient to justify large operations by the cyanide process.

The Silver Reef was incorporated and a control of its stock apportioned amongst this group of skilled mine operators who were actively engaged in various mining and engineering operations elsewhere. They always intended to do something with the Silver Reef, but on account of their preoccupation with other interest, never got around to doing any active work beyond giving temporary, superficial leases on the Reef to contractors who shipped large tonnages of 15 and 20 ounce silver quartz to smelters requiring millis flux.

No systematic, deep exploration on this great vein has been done. The present owners are now unable to get together upon plans for re-opening and developing the silver-lead ores of this property, and have optioned the treasury stock to a group of younger mining engineers and business men who will undertake to place the property on a profitable basis within a year after equipping with machinery and doing some preliminary shaft-sinking and deep mining.

GEOLOGY:

The Silver Reef is a great fissure in granite from two to thirty feet thick, averaging 10.2 ounces of silver at

its widest point with high grade hanging wall and footwall streaks (now largely mined out from the surface down to the 100 foot level.)

The vein dips easterly at varying degrees, and at the surface is traceable on the Company's property for approximately 6000 feet, being covered for much of this distance by uneroded rhyolite capping rocks. Several intrusions of basic dykes, aspecially Syenitic rock, is noticeable and much undoubtedly have much importance in the geological history of this vein system.

The Silver Reef has numerous unexplored, smaller and seemingly parallel hanging wall veins. The deepest workings show lead sulphides beginning to appear in quantity sufficient to encourage expectations of profitable lead ores to result from deep exploration of the main reef, in addition to the silver values.

DEVELOPMENT:

It is proposed to drive a 300 foot crosscut tunnel from the surface to cut the vein at a lower horizon, and then sink 200 feet on the vein from this intersection, and drive exploration drifts and crosscuts from the bottom of this new shaft. It is expected that this work (requiring about a year) will result in an increase of present reserve of 15 to 20 ounce silver ore, extensive enough to justify installation of a 300 ton cyanide plant. Also it is believed this development program will render available important tonnage of 25 to 50 ounce silver smelting ores and lead smelting ores carrying some silver and 25 to 40 percent lead.

After equipping the property and placing compressed air drills at work, it is certain that the upper portion of the great vein, already partially opened up, can be made to yield at least 50 tons daily of 25 oz. silver ore that can be shipped direct to the smelters at a profit. This means it would not be necessary to await the completion of the deep development program before some profits were coming in. With R. R. freight to smelter from Casa Grande at $1.00 per ton, trucking from mine to railroad at $1.50 per ton and smelter treatment charge of $2.00 per ton, the profits on 50 tons daily of 25 oz silver ore would be $5.50 per ton after deducting a $3.00 per ton mining cost. This is a probable profit of $8,000.00 per month obtainable before the deep mining exploration and development is complete.

If the grade can be raised to 50 ounces per ton and 50 tons daily this profit would amount to nearly $20,000.00 per month. Such a return in the early stages of the venture is only possible if the grade of the smelting ore encountered in the unexplored upper portions of the vein should unexpectedly prove to be twice the grade conservative sampling indicates.

The substantial and lasting profit resulting from the deeper exploration of this vein system (aside from contingent discoveries of high grade silver and lead ores) lies in the practically assured development of large reserves of 15 to 20 ounce silver ore susceptible to cyanide process recovery with flotation auxiliary on a scale of at least 300 tons daily.

Tests have shown that the average 15 oz silver quartz which constitutes the mass of the vein will show a recovery of 88% of its silver contents.

Based on a recovery of 88%, a 15 oz. silver ore, on a scale of 300 tons daily, will show a profit of approximately $3.00 per ton, or $900.00 per day, or over $300,000.00 net per year. This profit is based on a mining cost of $1.65 per ton, a milling cost of $2.00 per ton and freight and refining cost of $0.53 per ton.

The assay maps accompanying this description show, at the Eastern and widest part of the Silver Reef (where exposed by erosion of overlying rhyolite) for a length of 180 feet and a depth of 100 feet, 7000 tons of 25 oz. silver ore and 26,000 tons of 14 oz. silver ore. 200 feet deeper development at this point, together with 1500 feet of deep levels driven, will certainly vastly increase this tonnage of low grade ore at the same time yielding a notable tonnage of higher grade smelting ore.

When it is considered that several thousand feet of this vein remains to be explored for further shoots of high grade silver and lead (whose probable outcrops are concealed at the surface by rhyolite capping) the possibilities of the enterprise become strikingly apparent. Less than one-third of the vein extent laterally has been even superficially explored.

It is believed that with machine drills and a properly equipped assay office, it is possible to recover, from ore blocks

already available near the surface, enough 25 oz. smelting ore to return the entire additional investment of $52,500.00 now to be made. This would protect the investment in the remote possibility that the deeper exploration as planned proved disappointing.

This $52,500.00 will be expended as follows:

1 air compressor and receiver erected	$ 5000.00
Water tanks, pipe, pump, tools, drills, mountings and repair parts	4000.00
1 one-ton truck	1200.00
1 automobile	800.00
1 warehouse and shop	500.00
Overhauling dwellings	1000.00
Assay outfit	500.00
Mexican houses	1000.00
Pumpt for shaft (water and drills)	1500.00
25 H. P. gas hoist	2500.00
2000 ft 12 lb rails and four mine cars	1500.00
300 feet of ait tunnel	3000.00
200 ft of shaft	7000.00
2000 ft drifts and cross-cuts	8000.00
1 pilot mill	10000.00
Mangement one year	5000.00
	$ 52,000.00

Estimated earnings:

Second six months of first year 50 tons daily 25 oz. ore shipped to smelters net	42,700.00
Second year - 100 tons daily of 25 oz silver shipped direct to smelter	200,000.00
Third year and thereafter from Cyanide plant only	350,000.00

Or approximetly $0.25 per share earned annually after one year of development work.

When equipped as above recommended and when financed to accomplish the development work recommended, all properly managed with expert and frequent assay guidance, I can see no reason for any but extremly profitable results from this enterprise.

(Signed) PERCY WILLIAMS

HL 12/4/29

COPY

G. Montague Butler
Geologist and Mining Engineer
TUCSON, ARIZONA

December 4, 1929.

Mr. C has. A. Belin,
Wilmot Road,
Tucson, Arizo.

My dear Mr. Belin:

I have been extremely busy since I visited the Silver Reef Mine last Friday, and have found it impossible to call upon you and report my findings. Today Archie Conner told me that you are not feeling at all well, and I decided that it would be best for me to make my report, briefly, by letter. If you would like to discuss my visit with me at any time, and will so inform me by telephone, I shall be very glad to make an appointment with you.

First, I wish to say that I feel that Mr. Williams was quite justified in feeling decidedly optimistic over the possibilities of developing the property profitably. A very large amount of ore was evidently removed in the early days, since the openings are large and the waste dump is comparatively small. The grade of this ore must have been high since only high grade ore could have been mined profitably under conditions existing at the time. Since practically no mining has been done below a very short tunnel, and the size of the stopes indicated that the ore extended at least to the level of this tunnel, it was only reasonable to hope and expect that more good ore might be exposed by deeper development.

It is evident that Mr. Williams has expended the funds available economically and efficiently, and that he has taxen a great personal interest in the progress of the work.

Relative to Mr. Williams' expressed hope and belief that secondary encrichment of silver may be struck at or near the ground-water level, I am forced to report that I cannot see evidences that would justify this expectation. It is true that there are abundant evidences of oxidation wherever the ore is exposed, and that a great deal of iron oxide is present on the 55-ft level bel ow the old workings and in the

Belin tunnel. It is also true that cavities in the ore suggest that sulphide minerals have been oxidized and leached therefrom. These are the factors that have caused Mr. Williams to believe that valuable metal has been leached from the upper workings, carried in solution to the groun d- water level, and there deposited so as to form a valuable deposit of secondarily enriched ore, but he has apparently neglected to give sufficient weight to the fact that calcite (calcium carbonate) forms a large portion of the gangue throughout the vein material excepting close to the footwall. The presence of any considerable amount of calcite in a vein prevents the going into solution of any amount of silver, and solutions containing silver in solution would be forced to deposit this metal if they came in contact with calcite. It is only within the last few years that these facts have been conclusively demonstrated, and even now they are not widely known to many very competent mining engin eers. Such knowledge, is in fact, largely confined to men who specialize on economic geology. In order to prove that these ideas are not limited to myself, I desire to quote a few paragraphs from Lodge's "Leached Outcrops as a Guide to Copper Ore," which was published in 1936.

Page 164: Carbonate prev ents the leaching of all the metals, even zinc, and a limestone wall, lying alongside or bel ow the oxidizing ore-body, sometimes precipitates those metals in oxidized form."

Page 88: "If the metors (ore that has undergone or is undergoing exodization) carries abundant calcite or other carbonate, leaching does not occur."

Page 82: "The presence of abundantfeldspar makes the migration of gold improbable, and the presence of abundant calcite makes it impossible."

Although the last quotation refers specifically to bold, t applies equally to other metals.

It should be noted from the last quotation that feldspar also acts as a deterrent to leaching, and there is some feldspar in the vein meterial, especially in the footwall which is granite but the most serious factor is the presence of the calcite.

There are other reasons why leaching of this particular ore seems improbable, but the evidences of their presence are not as easily proved and understood as is the presence of this calcite.

It is, admittedly, barely possible that some silver in portions of the vein where there is little or no calcite may have been taken into solution, may have worked down to the footwall, and then descended along the footwall to the ground-water level. In order that this process might take place, the descending water that dissolved the silver must have been acid and remained acid throughout its passage down to the ground-water level even though the vein contains much calcite which would neutralize the acidity if the water struck it. While barely possible, the conditions just mentioned are to be regarded as highly improbable, and I do not feel that they justify sinking the winze of the Belin tunnel to the ground-water level unless it seems important, that all conceivable possibilities should be exhausted.

Although my conclusions relative to the sinking of the winze are adverse, I believe that there is a chance that some good ore may be encountered by driving the east drift on the 55-ft. level further east, since it is not yet under the point from which the greatest amount of ore was removed, and the ore shoot may pitch to the east. Since the eastern part of the Belin tunnel has already been driven 104 feet, it might be thought advisable to drive it further, but, if no good ore were encountered in it, we should still lack proof that it did not exist above the tunnel level. I believe, therefore, that it would be best to drive the 55-ft level east for at least 100 feet, cross-cutting frequently so as to expose fully both foot and hanging walls. If no good ore is encountered in this operation I believe that it is useless to expect to be able to develop shipping ore in this property. I do not anticipate that the good ore will extend very deep, since deposits of this type are usually quite superficial, but it is at least possible that a considerable tonnage of good shipping ore may be developed as the result of the relatively inexpensive development work recommended.

There is no doubt but that a very considerable tonnage of low grade ore exists in the property, and, if no shipping ore is found, it might be desirable to consider seriously the possibility of installing a plant for the treatment of this ore. Mr. Williams has assayed material frequently, and already has a very good basis for estimating the value of the low grade ore. From an inspection of the assays, I am somewhat doubtful whether the grade is high enough to justify the erection of a treatment plant, but the matter is worthy of consideration. It will be quite possible to determine accurately just what form of treatment is best adapted to the ore, and what the percentage of extraction will be. If these tests are carefully conducted on a relatively large amount of material, subsequent work can be done with little risk, or it will be quite evident that the property must be abandoned.

I am enclosing herewith my bill for examination. Since my report is hardly a formal one, and involved merely the writing of a rather lengthy letter, I am charging my minimum fee of $150.00 a day instead of $200.00 which is the minimum when I prepare a formal report. The charge for auto hire resulted from the fact that I was not met at Casa Grande. I waited nearly an hour and then thought it best to hire a machine to go ut to the property. A machine was sent to meet me, but a gas line broke which occasioned a long delay.

Hoping that I may have made this matter clear to you, and assuring you that I shall be glad to try to clear up any points concerning which you may still be in doubt, I am

Very sincerely,

G. M. BUTLER (Signed)

Vol. VI, No. 8 August 15, 1935

University of Arizona
Bulletin

Arizona Bureau of Mines

SOME FACTS ABOUT ORE DEPOSITS

By G. Montague Butler

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4. Where an ore deposit occurs in well-bedded rocks with a more or less pronounced dip (and even under other conditions), the solutions may work downward and *laterally* along the bedding planes and other channels, and their metallic content may ultimately be deposited far to one side of vertical lines extending downward from the points where the metals were dissolved.

5. Secondarily enriched oxidized deposits above the ground-water level are by no means uncommon in semiarid regions. It should also be remembered that sudden or decided elevations or depresions of the ground-water level sometimes occur. If such changes have occurred recently a zone of secondarily enriched sulphides may exist above or below the present ground-water level.

6. Not only will fluctuations in the ground-water level leave secondary enrichments below the upper surface of the water, but it is also true that some water is often encountered overlying relatively impervious beds at one or more horizons above the true ground-water level. Such "perched" water levels may have little influence upon descending solutions.

Important Influence of Carbonates

Well trained, experienced mining engineers have not infrequently overlooked the importance of one factor when they have attempted to decide whether secondary enrichment has or has not probably taken place. It is not surprising, therefore, that many prospectors should have made the same mistake, yet there is really little excuse for anyone to do so since the significant features are easily recognized. The factor involved is the presence or absence of carbonates in the gangue or walls.

Descending solutions that dissolve metals are acid and no metals will be dissolved unless the solutions are acid. Any condition, therefore, that neutralizes the acidity of the solutions will prevent the dissolving of most metals. There can then be no transportation of these metals to some other position and no enrichment can occur.

Calcium carbonate is a substance that will quickly neutralize any acid solution that comes in contact with it. This substance, as the mineral called calcite, very frequently occurs in gangue material, and, as limestone, it constitutes a common rock. Although any mineralogist can readily recognize calcite by its physical properties, it and limestone may be most easily and certainly identified by the fact that, if placed in cold hydrochloric (muriatic) acid, they will dissolve with vigorous effervescence (bubbling).

If any considerable amount of calcite is present in the gangue of a sulphide ore body through which surface water is descending, any metal excepting silver that may be dissolved will be transported only far enough to bring the solution containing it into contact with calcite. The metal will then immediately be deposited. There can, under such conditions, be no considerable

downward migration of the metal. In fact, if calcite is plentiful in the gangue, a metal other than silver cannot be transported to any appreciable extent. It will oxidize and remain at or very close to the point where it was deposited as primary ore. Silver may be transported in spite of the presence of carbonates if no chlorine or other halogen element is present.

Calcium carbonate is not the only natural substance that neutralizes acid solutions. Any carbonate will have this effect, but carbonates other than calcite are relatively uncommon constituents of primary ore bodies, although ankerite (calcium-iron-magnesium carbonate) and dolomite (calcium-magnesium carbonate) are plentiful in some deposits. Feldspar also acts as a neutralizer, but its action is much slower than that of calcite, and, unless the solutions are very weakly acid and are percolating down through feldspar with unusual slowness, the migration of metals through a gangue that contains feldspar may occur and an enrichment may form.

Not only does the presence of considerable calcite in the gangue of an ore body prevent the migration of metals in solution, but it is undeniably true that limestone walls may also have the same effect. Whether limestone will or will not act as a neutralizer of acid solutions and a precipitant of the dissolved metals depends wholly upon whether the solutions come in contact with it. If a vein contains no calcite and it is sufficiently porous so that descending solutions work downward through the vein material without coming in contact with limestone walls, an enrichment may be formed below, but such conditions are unusual. In most instances most of the downward movement of solutions is along one or both walls and then the solutions will be quickly neutralized if the walls are of limestone.

There is a possibility that acid solutions that descend along limestone walls may sometimes attack and react with the walls and form protective layers of alteration products which will themselves not neutralize acid solutions, and that thereafter migration of metals may take place. If the inclination and physical condition of a vein that contains no calcite is such as to indicate that descending solutions were concentrated along one or both walls of limestone, yet the wall material does not effervesce with hydrochloric acid and other conditions indicate that leaching of one or more metals has occurred, there is a chance that a secondary enrichment may exist at greater depth, but in general one cannot hope to find enrichment of deposits in limestone. Similarly, there is a bare possibility that deposits that contain some calcite in the gangue may be leached of one or more metals, to some extent, if the calcite is not very plentiful or is so situated in the deposits that a considerable part of the solutions does not come in contact with it and descends along walls that are not limestone. It is rarely safe to predict the existence of a

MEMO

ALL OF THE INFORMATION AND OPINIONS EXPRESSED IN THIS MEMO, WITH THE EXCEPTION OF THE COPIES BY MR. BUTLER WERE OBTAINED FROM HEARSAY

In 1936 I acquired title to a group of claims known as the Silver Reef. Naturally I became interested in its history and previous operation. In the course of my studies I came across one fact which, I think, has particular significance. The following is an explanation of what happened.

1. In 1928 a Mr. Percy Williams (a mining Engineer of wide experience and the man who wrote the report just preceeding this memo) interested Mr. Charles A. Belin (whom I understand was a member of the Dupont family) in this property.

Under Mr. Williams direction some fifty or sixty thousand dollars was spent in sinking a shaft and driving an adequate extraction tunnel and doing considerable drifting. It is my understanding that, when this work was completed, they were going to sink on the vein until they encountered a secondary enrichment which Mr. Williams was sure existed.

In the latter part of 1929 Mr. Belin (whom I understand was tubercular at the time of the beginning of the operation) became bery ill and was not expected to live. Mr. Belin then retained Mr. G. Montague Butler, of the University of Arizona, to make an examination of the property and advise if in his opinion the mine has possibilities of developing into a large property or if it looked like a small deal.

On December 4, 1929 Mr. Butler wrote a letter to Mr. Belin a copy of which immediately follows this memo.

Acting on the conslusions drawn by Mr. Butler, Mr. Belin withdrew from the project and the work was shut down. Nothing further was done on the property other than a small amount of leasing until 1936 when I acquired ownership of the property.

2. The reason Mr. Belin abandoned the project was based on the statement made by Mr. Butler on Page 1, Par. 4, of his letter of December 4, 1929. The significant statement made by Mr. Butler that there could be no secondary enrichment are contained in that part of the Par. which I have underscored with red lines. You will note that he states that silver could not be transported because of the presence of calcite (calcium carbonate) in the vein.

3. In 1936 I acquired title to this property and in the course of my search into its past history I secured a copy of this letter written by Mr. Butler. In the latter part of 1936 I called upon Mr. Butler at the U. of A. And asked him if he had any information which would be of value to me concerning this property. From his I ovtained some of the information which I have related in the foregoing.

4. In 1937 I came across a publication written by Mr. Butler. This was Geological Series No. 8, Bulletin No. 139, Arizona Bureau of Mines and was published August 15, 1935. In this bulletin in the last Par. on Page 35 and completed on Page 36 Mr. Butler directly contradicts the statements made in his letter to Mr. Belin on December 4, 1929.

5. I then wrote Mr. Butler concerning this particular item and you will note that in his letter dated March 26, 1937 he again states that the presence of calcite does not cause a precipitation of silver that is held in solution in natural solution.

I. M. Clausen

3/3/60

DEPARTMENT OF MINERAL RESOURCES

STATE OF ARIZONA

FIELD ENGINEERS REPORT

Mine Silver Reef Claim (Silver Reef Mine) Date March 3, 1960

District Silver Reef Mtns. (Casa Grande Dist.) Engineer Lewis A. Smith
Pinal Co.

Subject: Mine Visit by Lewis A. Smith and interview with Bob Clausen, part owner.

Owners: I. Clausen, Bob Clausen, et al (Greenhorn Mining Co)

Geology: General Geology is in files along with other mine data.

The Silver Reef Claim forms the northwest unit of the property and adjoins the west end line of the Silver Reef No. 3 claim and the north side line of the Horn Silver No. 2 claim overlaps it on the south. The principal workings lie in the west 2/5 of the Silver Reef No. 3. These underground workings consist of a 325 foot inclined (70°) shaft with three levels largely as drift on the vein. The breast of the western most drift is about 150 feet from the east end line of the Silver Reef. East of these workings, at a distance of 200 feet, is a 350 foot adit from the end of which is a 300 foot drift on the vein. The vein, in the area of these workings, strikes E-W and dips about 75° south. The quartz vein appears to range in width from 4 to 7 feet, but the zone of mineralization is much wider, possibly 20-25 feet. The vein and accompaning brecciated zone are much more resistant than the granite country rock and therefore stands as a bold rib or "reef" to as much as 10 feet high. This vein structure continues across the south 1/2 of the Silver Reef for at least 800 feet and then crosses the NW corner of the Horn Silver No. 2 for another 500 feet where it is submerged by valley fill. That portion of the vein lying west of the Silver Reef No. 3, has been prospected by several 10-12 foot shafts and a 15 foot adit. As the vein structure goes toward the west it narrows somewhat, becomes lighter, and curves toward the southwest, striking S 85° W where it disappears under the aluvium. The quartz portion of the vein in this portion, contains veinlets and blebs of chrysocolla, lead carbonate, vanadinite, wulfenite, silver minerals (principally silver halogens) and considerable manganese dioxide (principally psilomelane). Silver greatly predominates in value, according to assays taken by the owners. A 6 foot wide sample, across the vein, in the first pit west of the Silver Reef No. 3, assayed $5.00 per ton in lead, silver, and gold with minor copper. This value , as in other samples, was mostly silver. A sample, from the second pit to the west, ran $6.00 over a vein width of 7 feet. More samples along the outcrop and in the adit and third pit are being processed. The vein material in these was lithologically similar to that in the two pits already sampled.

Minor transverse faults appeared fairly frequently, but since these have only minor throws, they had no appreciable effect upon the vein trend or dip. A dike (reported by some observers to be similar to syenite)appears to cross the vein west of the shaft workings. Since the vein mass uninterruptedly crosses this dike, and may even disjoint it, the dike is considered to have been injected prior to most of the vein formation. It, more than likely, does act, in part, as a curtailant to the flow of the mineralizing solutions, but did not cut them off entirely since valuss continued on westward but to a less degree of intensity.

The country rock in the Silver Reef and Horn Silver No. 2 claims is mainly graphic, or semi-pegmatitic granite which had been intensely shattered prior to vein formation. The shatter planes are filled with dense white quartz and manganese and iron oxides.

Silver Reef Claim (continued)

The vein quartz and breccia quartz, both parts of the vein formation, distinctly cut the silicated granite. The quartz vein has strong walls whose continuity has been irregularly echeloned by post-quartz shearing. Metallization followed the silicification and locally extends out into the granite.

The main vein structure is traceable for some 6000 feet to the east. The mineralization is stronger and the vein structure is wider in the east half of the claims. This may be due to the fact that the upper portions of the vein were in andesitic agglomerate (called, by some, rhyolite) which is more susceptible to shattering and replacement.

The most important identifying characteristics of this vein are the presence of a typical banding and vanadinite and wulfenite. Galena and argentite (?) are also reported in the deeper parts. The gangue is generally neutral for silver, but contains sufficient calcite and siderite to hold up gold, lead and copper. Argentite generally is regarded as the secondary enrichment sulphide of silver. The richer silver in the upper parts of the east workings may indicate an old water table stop point which may be associated with the late Pliocene and early Pleistocene lake epoch. During this period the climate was more humid than now and water tables higher. However, this does not preclude other deeper enrichment zones which might have formed at other stop points in the water table as the water table rose. Several other mines in the Cordilleran Region have shown this. The intervening zones are relatively low grade. This suggests that it may be advisable to drill to intercept the veins in depth. Thus far no workings have penetrated to the true primary mineralization even though the relicit sulphides thus far encountered do give a hint of the character of the primary minerals other than silver. The silver primary more than likely consists of sulpharsenides and sulphantimonides of silver, such as pyrargyrite proustite and stephanite. The presence of some copper oxides may indicate tetrahedrite or stromyerite. The silver in most of the area probably is in the form of cerargyrite (AgCl) or embolite (Ag (Br.-Cl) although none was seen because of masking by manganese dioxides or iron oxides.

Therefore, that prospecting, which has been done in the Silver Reef claim is entirely too shallow to be of much use in determining the real worth of the claim. The area near the surface could conceivably lie between two enrichment zones. Leaching of the vein mass has been intensive as evidenced by silica boxworks and limonite boxworks which have been "whipped" clean, or nearly so, by weathering. The leached out silver sulphide values may thus have moved downward.

This inference is supported by two such typical cases at Morenci and the Commonwealth Mine at Pearce. At Morenci 50 to 500 feet of leached capping overlies the enriched chalcocitic zone. The leached capping averaged between 0.0h and 0.21% copper, whereas the underlying enriched zone has to date, averaged about 0.9h% copper. At the Commonwealth 5 to 150 feet of leached silver capping averaged about 1 oz. of silver while the upper enriched zone, immediately below the capping, averaged from 15 to 200 ounces of silver. There were two deeper enriched zones within a vertical distance of 200 feet. In between these enriched zones the tenor averaged from 3 to 15 oz. silver. Such leached capping zones are prevalent over many disseminated porphyries, and in some cases the Morenci situation is duplicated. In other cases where the gangue rocks are more chemically reactive the degree of enrichment may

vary in proportion to the hold up copper as oxidized minerals. Similarly silver may be held up where chlorine and bromine are prevalent to variable degrees. At Ajo the gangue is so intensely reactive that nearly all of the copper remained in sites as oxides converging rapidly into primary sulphides with minor enrichment. At Bullfrog in Nevada the same was true as regards silver. The oxide silver mineral (cerargyrite) persisted down to the old water table where a rapid transition to primary silver minerals occurred.

The zoning of enriched ores or transitions from oxidized ores to primary ores is controlled to a marked extent by fluctuations in the geological water table. In this region and most of the entire Cordilleran Region, the water table started rising shortly after the Miocene Revolution, and continued to rise in spurts until late Pleistocene. The even rise of the water table was apparently interrupted at least three times during this period of rising himidity. At Pearce three enrichment zones in the mine were closely tied to three stop points in the history of Old Lake Cochise, west of Willcox. The stop points were evidenced by three old shore lines each of which contained fossil mamalia by which they could be dated. Since remnants of old lake beds of unknown depth have been reported in the Silver Reef area, it is possible that at least one and maybe more stop points may have existed here also. Similar lake deposits are prevalent all over the Cordilleron region, some of which, such as "Lake Mahontan" and others in Nevada, had a vertical range of up to 500 feet during the period of rising himidity. The Benson and San Pedro Lake beds have considerable depth range. The apparent light upper enrichment in the east half of the Silver Reef claims, probably represents the top of the water table fluctuation. The deepest penetration in the claims is 325 feet in the Silver Reef No. 3 claim. Oxidation and strong leaching is present throughout most of this depth as evidenced by silica honeworks and lead oxides. Where did the silver, which once occupied these cavities, go? Obviously since the prevailing fractures are nearly vertical, the silver in solution must have descended. Three competent observers reported that argentite, or what they believed to be this mineral, was present in the lower level of the Silver Reef No. 3 workings. Argentite is generally believed to be the prevailing silver enrichment sulphide. The reported argentite was found as a sooty coating in galena fractures. The galena had partly been converted to vanadinite and wulfenite in most cases.

Therefore, in lieu of the climatic history of the region, and the presence of argentite and lake deposition, it would seem out of line to condemn a claim, or a group of claims, in a known mineral district, on no more than surface assay conditions, especially since these outcrops show strong evidence of leaching of sulphides. This is particularly pertinent when one looks at the evidence from such deposits as Morenci and Pearce in particular, and others of less positive appearance without the opportunity to find out.