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STANDARD METALS CORPORATION

7355 East Orchard Road
Suite 100
Englewood, Colorado 80111
(303) 773-2244

January 5, 1982

Mr. Fred C. Schulte
Director - Marketing & Planning
Santa Fe Mining Inc.
4775 Indian School Road N.E.
Suite 100
Albuquerque, NM 87190

Dear Fred:

As a follow up to our telephone conversation of last week, I am enclosing a copy of a Preliminary Feasibility Study on our Antler Project in Mohave County, Arizona that was prepared by Paul Gilmour in June, 1975. Also enclosed is a copy of a brief report of a metallurgical study of the Antler ore which was completed by Union Miniere in January, 1977 (English language translation) and a copy of a geological study by Art Still prepared in June, 1974.

As I mentioned to you, Standard Metals considers the information contained in the enclosed reports to be of a confidential nature and we ask that these reports be treated accordingly. Should you decide that Santa Fe has no interest in the property, we would appreciate your returning the reports to this office.

If the terms of this letter regarding the confidential nature of the information contained in the enclosed reports are acceptable, please indicate by signing the enclosed copy of this letter and returning it to me. If you have any questions regarding the Antler property, or if you would like to discuss further a possible arrangement for the development of the property, please feel free to phone me at any time.

Very truly yours,

A. F. Bissett,
Senior Vice President,
Western Operations

AFB/sb
Enclosures

ACCEPTED AND APPROVED
Santa Fe Mining Inc.

[signature] 1-12-82
Date

Santa Fe Mining Inc.

INTERNAL CORRESPONDENCE

TO Wm. H. Crutchfield, Jr.

DATE January 12, 1982

FROM Fred C. Schulte

SUBJECT Standard Metals/Antler Project

Attached is a packet of information that Alex Bissett forwarded to me concerning their Antler Project. I have executed the Confidentiality Agreement covering this information. A copy of this Agreement is included with the material.

After you have had a chance to review this information, let's discuss it to see if any follow-up information or action is required. If we are not going to proceed further on this project, we will be required to return all of this information to Standard.

Fred C. Schulte

FCS:aml

Attachment

SANTA FE

X

Free translation of the Union Miniere Metallurgical Research Department Report on Standard Metals - Antler, by V. Archipov.

Dated Brussels: 1/25/77

Subject: Standard Metals - Antler

Reference: 1/MET 228 of 5/4/76
T/U.S. 0016 of 9/24/76

Summary and Introduction

A total of 21 samples representing 147.27 feet of drill core and weighing 282 ounces or approximately 8 kg. were received by the L.T.M. for the purpose of examining them and flotation test work.

The samples were blended in order to provide a single composit averaging 2.83% Cu, 1.4% Pb, 5.55% Zn, and 48 grams per ton silver. These values are higher than the average for the actual deposit.

The very small quantities of the material received allowed for a very limited amount of testing, and the conclusions we have arrived at on the basis of the work done by the L.T.M., should be viewed with reservation depending upon the representative nature of the treated composite.

While encouraging, the results should be confirmed by a further study on one or more samples. Be it as may, we have to once again congratulate the L.T.M. on the exceptional quality of their presentation.

II. L.T.M. Results

2.1 Mineralogy: The sulphide mineralization is composed of sphalerite, chalcopyrite, galena, pyrrhotite, and pyrite. The sulphides show little dissemination in the gangue (with the exception of galena) while exhibiting considerable locking with each other. Sphalerite is relatively high in Fe, not counting the fine inclusions of pyrrhotite. The gangue material contains significant quantities of talc followed by amphiboles, micas, chlorites, serpentines, quartz, feldspar, and magnetite.

2.2 Grinding: The necessary grind may be on the order of 70-75% -200 mesh. The rougher Cu-Pb and Zn should be reground to 90-95% -400 mesh, which indicated a rather complex flow sheet.

The grindability index could not be determined with precision. The preliminary estimates indicated 16 KWH/metric ton, or approximately 14.5 KWH/short ton. This is a relatively high value.

2.3 Flotation: The presence of talc calls for a talc float with re-cleaning in 3 or 4 stages. The floated talc contains a relatively important quantity of galena and to a lesser degree Cu and Zn.

Cu-Pb is floated next in rougher concentrate which is reground prior to 2 or 3 stage cleaning. A Cu-Pb separation appears to be feasible.

Flotation of Zn presents no special difficulties, provided the product is reground prior to cleaning in 2 or 3 stages. It appears that the quantity of reagents used is normal average for this type of ore. However, due to the small size of the sample, the exact quantity could not be determined.

III. Metallurgical Balances

Using the Gilmour report which had served to establish the original metallurgical balance (I/MET 228) following is our metallurgical balance on the basis of the L.T.M.:

See Table on following page.

IV. Smelter Return

On the same basis as the I/MET 228 we calculate the revenues proceeding from the Cu, Zn, and Pb (per short ton of concentrate and per short ton of ore milled). Considering metal prices as per I/MET 228 we come up with the following:

63.50 ¢/lb. for the Cu is 1,340.00 $/m.t.

39.00 ¢/lb. for the Zn is 859.79 $/m.t.

24.50 ¢/lb. for the Pb is 540.01 $/m.t. and

4.33 $/oz. for Ag

4.1 Zinc Concentrates: Metals paid:

Zn paid (52.50 - 8) x 20 = 890 lb.		$347.10
other: none		
Penalties: none		
Smelter Charge:		
Fusion: 0.907 145 + 0.17 (859.79 - 795)	=	- $141.37
N.S.V.	=	$205.73
per short ton of ore 205.73 x 0.05952	=	$ 12.24

4.2 Cu Concentrate: Metals paid:

Cu: 0.95 x 20 x 29.5 = 560.5/lb	at 63.5	= $355.92
Ag: 3.65 - 1 = 2.65 ounces	at 4.33 =	11.47
		+$367.39

Penalties: None

Smelter Charges:	Fusion	$62.00	$ 62.00
	Refinery	9.00 ¢/lb	50.45
	Blister Transport	0.90 ¢/lb	5.04
			- $117.49
		NSV	249.90

per short ton of ore 249.9 x 0.046864 = $ 11.71

4.3 Pb Concentrate: Conditions Tamargo

Metals Paid

Pb (58 - 1.5) x 20 = 1.130

market value: 0.75 x 24.5 = 18.38	$207.69
Cu 7.24 x 20 x 0.9 : 130.32	
market value: 63.5 - 22.68	53.20
Ag 0.95 x 55 = 52.25 ounces	
market value: (4.33 x 0.99) - 0.125	217.45
	$478.34
Penalties: Estimation 0.6	- 0.6
Smelter Charges: Fusion 36 x 0.907	- 32.65
	$ 33.25
NSV	= $445.09

per short ton of ore 445.09 x 0.004836 = $ 2.15

Total paid of ore milled: Concentrate Zn	=	12.25
" Cu	=	11.71
" Pb	=	2.15

Total $\underline{\$26.11}$

Which is close to estimate found in I/MET 228 of $26.83.

Conclusions

The work done at L.T.M. had shown that Antler ore is amenable to conventional concentration without special difficulties with resulting production of Cu concentrates, Pb concentrates, and Zn concentrates. The ore is relatively hard, calling for a complex flow sheet. All conclusions are made with certain reservations due to a small size of the sample tested (approximately 8 kilo). In order to be able to proceed we say that the smelter returns which can be expected from the Antler deposit are on the order of $26.1/short ton treated. This calculated average by the L.T.M. is very close to $26.8 calculated on the basis of a hypothetical I/MET 228 (better revenues for Cu and Zn, lower for Ag and Pb.) This total was calculated on the basis of a weak metal market which in reality prevails today. In view of the NSR value of $26/short ton of ore, we believe that some additional information will be needed in order to decide if an economic exploitation of this deposit could be envisaged.

J. Thiriart

Table for Metallurgical Balance

	Short Tons	% Pb	Unit Pb	Net Rec. Pb	% Cu	Unit Cu	Net Rec. Cu	% Zn	Unit Zn	Net Rec. Zn	Ozs Ag	Unit Ag	Net Rec. Ag
Heads ~~Alimentation~~	1,000.	0.94 ~~0.85~~	850.0	100	1.95 ~~1.75~~	1,750.0	100.0	4.13 ~~3.72~~	3,720.0	100.0	1.05 ~~0.95~~	950	100
Cu Conc	51.55 ~~46.864~~	1.45	68.0	8	29.5	1,382.5	79.0	3.18	148.8	4.0	3.65	171	18
Pb Conc	5.32 ~~4.336~~	58.0	280.5	33	7.24	35.0	2.0	2.31	11.16	0.3	55.0	266	28
Zn Conc	65.47 ~~59.520~~	0.86	51.0	6	1.03	61.25	3.5	52.5	3,124.80	84.0	1.28	76	8
Tails	877.66 ~~889.780~~	0.51	450.5	53	0.31	271.25	15.5	0.49	435.24	11.7	0.492	437	46

Antler Mine #4510

REVIEW OF GEOLOGY

and

RECOMMENDATIONS FOR EXPLORATION

ANTLER MINE & ADJACENT AREAS

MOHAVE COUNTY, ARIZONA

written for

Standard Metals Corporation

By

Arthur R. Still

June 7, 1974

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* Small Plates bound with text

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* bound with text

Volume II

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Appendix G - Map of Ore Reserve Blocks as calculated by Richard Dwelley in 1973

Appendix H - "Folding", by S. Warren Carey, Jour. of Alberta Soc. Pet. Geol., Vol. 10, No. 3, pgs. 95-116, 1962 (entire article is pages 95-144)

Appendix I - "En Echelon Folding", by J. D. Campbell, Economic Geology, Vol. 53, pgs. 448-472 (1958)

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Volume III

DRILL LOGS

SUMMARY

The Antler is a Precambrian age, stratabound, pyrrhotite rich, copper-zinc massive sulfide deposit in a very complex structural setting. In addition to copper and zinc, moderate silver, and minor gold and lead, also are recoverable from the ore. The deposit is situated about 22 airline miles south southeast of Kingman, Arizona. The Standard Metals mill, a modern 300 ton per day concentrator erected in 1969-1970, is located near Yucca, ten miles from the mine.

The Antler has produced (Table 1) about 78,000 tons of ore which averaged 2.9% copper and 6.2% zinc plus minor values in gold, silver and lead. Of this past production, 34,236 tons were produced by Standard Metals during a 10 month milling period in 1970. Indicated ore reserve (Table 2) in the main ore zone down to the 2400 ft. elevation, or to about 800 ft. of depth, are in the order of magnitude of 350,000 to 400,000 tons which would have an average grade per ton of about 0.01 oz. Au, 1.0 oz. Ag, 1.2% Pb, 3.0% Cu and 6.5% Zn. The deposit is open in depth with three existing drill holes below 9L - the bottom mine level - all being in ore.

In addition to the main (i.e. north end) ore zone, relatively narrow tabular massive sulfide, and quartz-sulfide, mineralization occurs in several "veins" for approximately 1500 ft. to the south of the main ore zone. Some stoping has been done in this south end mineralization on the 4th, 5th and 7th levels of the mine, and a recent drill hole by Standard Metals (Hole 20) encountered moderate widths of strong mineralization, but protore grade (8 ft. at 1.45% copper and 2.58% zinc), in this area at a depth of 1100 ft. below outcrop about 700 ft. south of the Antler shaft position. No material from this south end zone is included in the indicated ore reserve cited above. The current inclined shaft extends to a depth of about 650 ft. vertically below the shaft collar, the mine has been partially developed by underground levels (5 old and 3 new) and the deposit has been tested to date by a total of 20 surface diamond drill holes and 51 underground diamond drill holes (see Plates 5, 8 through 16, 36 and 37).

On a regional basis, (Plate 2) the Antler deposit is situated on the west side of a 6 mile long by 1-1/2 mile wide northeast trending schist belt which is bounded to the northwest and southeast by Precambrian granite. A second copper-zinc deposit - the Copper World - occurs on the east side of the schist belt, a tungsten deposit - the Boriana Mine - occurs on the north end of the belt, and small occurrences and

prospects of copper-oxide minerals occur throughout the belt. On a more district scale basis, the rocks within the schist belt are found to comprise a series of tight folds overturned to the west (Plate 3). A major fold, probably anticlinal and doubly plunging, occupies the center of the schist belt and the adjacent volcanic, or sedimentary-volcanic rocks, on either side display a pattern of small scale folding which generally parallels the more major central feature. On the northwest side of the schist belt hornblende rich rocks, and quartz-biotite gneiss, fill a large embayment in the adjacent granite gneiss. This structure, termed the "Bulge", contains numerous showings of copper oxides, tremolite and garnet in areas of extreme deformation. The "Bulge" is a geological anomaly worthy of additional exploration effort. The rocks of the overall schist belt are cut by a system of northwest trending faults, most of which do not appear to have had more than a few hundred feet of displacement.

Immediately west of the Antler mine the most pronounced structural feature is a very complex appearing predominately synclinal fold which, when examined in detail, is found to represent two distinct ages of superimposed similar folding. On the north end of this feature, adjacent to the main ore lens, the second stage folding developed in a left-hand en echelon style and a series of synclines and anticlines were formed. This en echelon style of folding appears to have also occurred in the rocks to the east - which contain the Antler deposit - as many features of tight folding, usually of a left-hand en echelon style, can be recognized in the deposit. The Antler ore zone, and the hanging-wall rocks, form patterns of complex folding which are as intricate when viewed in section (Plates 18 through 21) as when viewed in plan (Plates 3 and 7, and Figure 3).

In the upper levels of the Antler mine, above 5 level, the main ore zone is in the form of a lens of fibrous silicate minerals (tremolite, anthophyllite, etc.) which is completely surrounded by massive sulfides (Plates 8 through 12). At depth, below 5 level, this lens shaped configuration has disappeared, and the massive sulfides exposed by mine workings to date north of the shaft form complexly folded patterns (Plates 13 and 14).

Two faults, the Ocotillo and the Saguaro, bound a block within which most of the better massive sulfide ore found to date occurs. The displacements along these two faults have been resolved (Plates 21 through 25) as a part of this study. Both faults have been found to have rotational movement, and the central block is relatively downdropped as compared to the adjoining blocks. The fault resolutions have indicated that the Antler "lens" splits into two "limbs" below about 5 level. As a result of the existence of two distinct "limbs", or loci for "ore", and the rotational component of the faulting, the mineralization exposed by mine workings in the central fault block ("West Limb" and ore grade) below 5 level does not correlate with the mineralization found by workings north of the Ocotillo Fault or south of the Saguaro Fault ("East Limb" and usually either thin or protore). Thus, two potential ore horizons, or positions, occur at depth in the deposit instead of only one as had been previously believed. The recommended exploration drilling at the property has been designed to test both of these positions on a systematic basis.

An exploration program is recommended herein which will cost approximately $381,000 and will require 7 months to complete. This program consists of 24 underground and 8 surface diamond drill holes at the Antler, aerial photography coverage (both black and white and color) of the entire Antler-Copper World schist belt, a gravity survey over the area of boulder-alluvial cover southwest of the Antler, (where extensive magnetic surveys were conducted in the past), and a continued geologic study of the schist belt, the Bulge area and the immediate Antler Mine area. The estimated costs of the various components of the exploration program are shown on Table 3.

Unfortunately the topography near the north end of the Antler ore zone precludes further testing of that zone at depth by surface drilling. Due to this, it will be necessary to reactivate the mine and drive approximately 1300 ft. of drifts and crosscuts on the 9 level to establish hangingwall drilling stations. This factor increases the cost of the exploration program appreciably. Because of the cost of reactivating the mine and keeping it open for 7 months solely for exploration purposes, in conjunction with current high metal prices, serious consideration should be given to reopening both the mine and the mill and placing the mine back in productive operation at this time. On that basis, further exploration and production could go on simultaneously and the production should at least pay for the exploration costs.

It is my opinion that the Antler deposit has a very good likelihood of becoming a major mine as it is further explored and followed to greater depth. In addition, the district as a whole has an excellent potential for containing other economic massive sulfide deposits. I strongly recommend that the program as outlined herein be followed as the next logical stage for the further exploration of the Antler Mine and the Antler region.

INTRODUCTION

In January of 1974 I was asked by Standard Metals Corporation to review data on the Antler deposit, and surrounding area, and to make recommendations for further exploration. The objective of this new exploration program is to increase the ore reserves prior to again placing the mine in production. Hopefully, sufficient reserves will be developed to justify increasing the size of the mill (now 300 tons per day) and the sinking of a new vertical shaft such that a more efficient operation can result.

I met with Messrs. Boris Gresov, Chairman of the Board and President, and Richard C. Dwelley, Vice President, in the Standard Metals Corporation offices in Denver on January 3rd, to discuss the assignment and the corporation's objectives. At that time I indicated that an analyses of the data available, and report preparation, would require only a few weeks. The day of January 4th was spent in gathering data from the files of the Denver office. At that point in time it became obvious that much of the information developed during 1969 and 1970 had never been compiled. This factor, in conjunction with the overall complexity of the geology of the Antler area, and of the Antler ore zone in particular, has resulted in a much longer period for preparation of this report than had been anticipated. I wish to apologize here for this delay, which I realize has caused Standard Metals some inconvenience, but I believe that the geologic interpretations which have been developed as a result of this study will be highly beneficial in the further exploration and exploitation of the deposit.

For background purposes it should be pointed out that I have been associated with the property since I initially examined it for Standard Metals - and recommended its acquisition - in July of 1965. From that date until early 1969 I was, as a consultant, nominally in charge of the geologic work conducted on the property. During this period 13 surface diamond drill holes were put down, a decision was made to deepen the shaft to the 7 level, and the ore zone on the 6th and 7th levels was partially exposed. By February of 1969 twenty-six diamond drill holes had been completed underground.

During 1965 through 1968 geologic mapping was done of all underground workings (1"=20'), and of the immediate surface over the Antler (1"=40' and 1"=200'). In addition, reconnaissance geologic mapping was conducted for about 3 miles along the schist belt to the northeast. The areas covered by surface mapping are shown on Figure 1. A number of geophysical surveys were also conducted (Plate 39), and industrial water was developed for a mill.

I would like to here acknowledge the high caliber of geological work done by Jim Hill, Resident Geologist at the Antler from May 1966 to April 1969, and of R. G. Raabe, Chief Geologist of Standard Metals from March 1968 until late 1969.

During the period of February 1969 through 1973 I was not associated with the property. During 1969 and early 1970 a new and modern mill was constructed. This mill operated sporadically from February 16, 1970, until December 15, 1970. The operation was hampered by the limited stoping areas which were available, by the poor condition of (mostly used) equipment in the mine and probably, at least in part, by a rapid turnover of technical staff. Underground development and exploration during this period consisted of driving south on the 7 level, deepening the shaft to the 9 level, crosscutting and drifting on that level, and the drilling of an additional 25 underground diamond drill holes. Since mid-December of 1970 the property has lain idle.

The Standard Metals Corporation records indicate a total expenditure on the property of $2.7 million through the year 1970 as shown on Appendix A, attached. Exploration work done since that date consists of some limited geophysical surveys (M-16 and ground magnetometer) done by Standard Metals personnel, and the drilling of one deep surface diamond drill hole (Hole 20) on the south end of the property.

LOCATION, ACCESSIBILITY AND PROPERTY

The Antler deposit is located in Mohave County approximately 22 airline miles south-southeast of Kingman, Arizona, as shown on Plate 1. The 300 ton/day mill is located 4 miles southeast of the small town of Yucca and is 10 miles from the mine. Access to the mine and mill is by graded county roads which leave U.S. 66 just south of Yucca.

Land holdings in the area of the mine consist of two patented lode claims (Antler and Spuyten Duyvil), 12 unpatented lodes held since 1965 (Plate 1), and in the order of 25 unpatented lodes located (or re-located) during early 1974. Mineral rights on much of the land to the southwest of the Antler, and on some land to the northeast, is vested with the Santa Fe Pacific Railroad Company. In 1966 and 1967 Standard held 2580 acres of this railroad land under exploration leases.

It is my understanding that negotiations are now in progress to again lease some of the railroad lands which have exploration potential.

The industrial well and concentrator are located on federal millsite claims.

PAST HISTORY & PRODUCTION

The Antler claim was initially located in 1879, and the Spuyten Duyvil in 1888. Both were patented about the turn of the century. Little production was achieved until the First World War. The history of ownership and past production, as it can be reconstructed, is as given in Table 1. Thus it appears that the property has produced approximately 78,000 tons at an average grade per ton of about 0.01 oz. Au, 1.2 oz. Ag, 1% Pb, 3.0% Cu and 6.2% Zn.

Metallurgical data on the Standard Metals milling of 1970 is enclosed as Appendix B. It should be noted that due to the intermittent operation of the mill, since the mine could not keep it supplied with feed, these metallurgical results are probably not representative of the optimum which could be achieved on this type and grade of ore.

Enclosed as Appendix C is a tabulation of earlier reports, which exist in the Standard files, that give further data on the early development of the property.

ORE RESERVES

A number of ore reserve calculations have been run since Standard Metals acquired the Antler property. These past ore reserve estimates are summarized in Table 2 and some are detailed in appendices attached.

No new ore reserve has been made as a part of this study since I was principally concerned with reviewing the geology of the deposit and recommending an additional exploration program in order to substantially increase the currently indicated reserve. Based upon the past ore reserve calculations, I think that it is reasonable to say that the Antler has indicated reserves of in the order of 350,000 to 400,000 tons above the 2400 elevation, without taking into account any potential for the relatively narrow "vein type" ore south of the main shaft. Based upon past production, drill hole intercepts, longholing and underground channel sampling, this reserve should have an average grade per ton of approximately 0.01 oz. Au, 1.2 oz. Ag, 1.2% Pb, 3% Cu and 6.5% Zn.

Attached as Appendices D, E and F are reports by R. G. Raabe which detail his calculations and also show the results of underground sampling, longholing and diamond drilling completed to that date. Attached as Appendix G is a map showing Mr. Dwelley's ore blocks with average thickness, tons per vertical foot, etc., used in his calculations. To arrive at the grade for Block C, the largest block, Mr. Dwelley averaged the results of 20 drill holes put down from underground and two from surface.

GEOLOGY

Regional Geology & General Setting:

As shown on Plate 2, the Antler deposit is situated in an elongate Precambrian gneiss (or "schist") belt between adjoining masses which have been mapped on a regional scale as Precambrian granite. This northeasterly trending schist belt is about one and one half miles wide by six miles long. The belt is broken into two segments on its north end by a Laramide intrusive, the two segments of schist joining larger masses of schist to the north and east. It is debatable whether all of the Precambrian granite is actually "granite", since in the immediate Antler area evidence of an intrusive contact is lacking and the "granite", at least in part, may be a very thick acid volcanic.

This belt contains two known copper-zinc deposits, the Antler Mine on the west side and the Copper World Mine on the east side. In addition to these deposits, many copper prospects, or showings or copper oxides, occur. On the north end of the belt, near the tip of the Laramide ? age intrusive, is the Boriana tungsten deposit.

In the geologic mapping conducted on the surface at the Antler the rocks were subdivided and named as based upon the major rock forming minerals in each mappable unit, i.e. "quartz-biotite gneiss", "quartz-feldspar-hornblende gneiss", "hornblende gneiss", etc., This procedure was followed since it is essentially impossible to accurately determine the initial texture, composition, and nature of origin of these rocks. It is my belief that the lighter colored rocks - quartz rich and hornblende defficient - were probably originally crystal tuffs of rhyolite to dacite composition, whereas the hornblende rich rocks were probably initially andesitic to basaltic flows and volcanic fragmentals.

It should also be pointed out that there is no basis, at this point in time, to determine which way is "up" in the sequence. Thus, since we do not know which rocks are relatively younger, or older, the terms "anticline" and "syncline" as used in the following text relate only to the general form of the observable feature and do not necessarily mean that younger rocks occupy the center of a "syncline" or, conversely, that older rocks occupy the center of an "anticline".

Moving down from a regional to a more local scale, Plate 3 shows an interpretation of the structure and lithology of the western two thirds of the immediate Antler schist belt. This map is based upon a (time consuming) compilation and correlation of all of the geologic data obtained by the surface mapping of the areas outlined on Figure 1*. The dominant feature shown on Plate 3 is a large, probably anticlinal structure (qfb) which trends NE-SW (along the length of Plate 3). This feature closes to the southwest and probably closes - off the map - to the northeast. That is to say, it is probably a doubly plunging fold. This large anticlinal(?) feature forms a long, discontinuous topographic ridge line on the ground, the ridge being broken by a major drainage along the "major shear zone" shown on Plate 3.

The volcanics, or sedimentary-volcanics, adjoining the qfb anticline(?) to the east and west reveal a pattern of NE-SW elongate folding which is generally roughly parallel to the qfb feature but locally trending into it at a small to moderate angle. Some of these adjoining rocks - such as the "synclinal" structure with which the Antler deposit is associated, clearly show at least two ages of superimposed similar folding. While the "Antler Syncline" is the most pronounced and complicated feature of this type on Plate 3, other similar areas (which have been mapped in less detail) are clearly indicated and these may prove to be equally as complex as the Antler feature when mapped in greater detail.

A second very large and pronounced feature evident on Plate 3 is an embayment of hornblende rich rocks and quartz-biotite gneiss into

* This report contains only new interpretative geology maps and not full scale, colored copies of the surface geologic maps outlined in Figure 1, the originals of which are on file in the Denver office.

the "granite gneiss" in the left upper portion of the plate. This area, which we have called the "bulge", is certainly a geologic anomaly. In the "bulge" area there are a number of exposures of copper oxides, tremolite and garnet associated with areas of extreme deformation. This area is a prime target for future exploration as will be discussed more fully later in this text.

Before leaving the discussion of Plate 3 some mention should be made of the nature and percentage of outcrop in the area. The area immediately to the west and southwest of the Antler ore lens (i.e. the complexly folded "Antler Syncline") forms essentially 100% outcrop. To the south and east of this feature recent alluvial cover (see Qal line on Plate 3) largely masks about the southernmost 6000 ft. of the area shown. In that portion of Plate 3 actual "outcrop mapping" is shown. Starting about 500 ft. north of the Antler ore lens and continuing up the western valley throughout the entire length of the map boulder talus masks probably 50-60% of the bedrock outcrop. In this zone, although sporadic outcrops occur in profusion, no attempt has been made on Plate 3 to show the individual outcrops. The area of the "bulge", which is mostly topographically high, is probably 80% outcrop. The valley to the east of the qfb anticlinal(?) structure is in large part (50-60%) masked by recent alluvium and boulder talus.

Immediate Antler Mine Area:

The area directly adjacent to the Antler Mine on the west (i.e. the "Antler Syncline") is one of apparent extreme complexity from both a lithologic and a structural point of view. Actually, the apparent complexity is due to the fact that the area is one of superimposed similar folding where the units were folded once, and then these earlier folds were re-folded. In such a case, the second stage folding in effect folds the axial planes of the first stage folds. Such a situation makes for a complicated, but usually recognizable, structural configuration. As will be seen later, this structural feature will look no less complex in section than it does in plan.

In an endeavor to make the following discussion easier to follow, I am enclosing herein as Appendix H an article on similar folding, and as Appendix I an article on en echelon folding. Such complications of folding are not rare, and have been recognized associated with many Precambrian, stratabound massive sulfide deposits throughout the world.

To discern in better detail the nature of the superimposed folding, the area of the "Antler Syncline", as initially mapped, was simplified somewhat by resolving the four principal mapped faults as if the displacements had been entirely strike-slip*. The procedures as outlined by Carey (Appendix H) were then followed to work out the axis of first and second stage folding as shown on Plate 4. Little more can be said about the earliest (first stage) folding without going to very laborious techniques - as described by Carey - which did not seem justified in this case. From the overall configuration, however, it appears that the first stage folding may have plunged steeply north.

The situation is even more complex than that which is shown on Plate 4, however, since the second stage folding in the area covered by the north portion of Plate 4 is in the form of left-hand en echelon folds. You will note that whereas the major portion of the second stage

* This results in good lithologic matches indicating that probably little dip slip component was involved.

structure is synclinal in form, it changes to predominantly anticlinal in form north of the Saguaro Fault. Plate 7 shows this area in detail without the faulting resolved.

Since the trace of the fold axis as shown on Plate 4 describe the entire synclinal - and anticlinal as the case may be - structures, it is necessary to follow a trace of the fold axis and some specific lithologic contact in order to better relate the en echelon nature of the folding. This is done on Figure 2, which shows in plan the trace of a qm-hbf contact as the major syncline (S-1) changes into an anticline (A-1) which then changes again into a syncline (S-2). The trace of this same qm-hbf contact is shown in longitudinal section on Plate 6. Short lengths of other specific contacts, which describe parts of folds A-2 and S-3, are also shown on Plate 6.

Several features typical of superimposed similar folding patterns are highlighted by color on Figure 2. These include hooked shaped (gt, qm and qb of Figure 2) and heart shaped (hbf-qm of Figure 2) which correlate with similar features described on pages 101 and 113 of Appendix H.

Additional left-hand en echelon folding on a smaller scale probably accounts for the very irregularly shaped outcrop patterns of qb and hbf on the east side of the Antler "syncline" about 1000-1200 feet southwest of the Antler ore lens outcrop (Plate 3). Further, there is good evidence that the same style of folding (i.e. left-hand en echelon) influences the Antler ore zone in the underground workings at depth.

ANTLER OREBODY

General Statements:

The Antler is a fairly typical stratabound, Precambrian age, copper-zinc-pyrrhotite massive sulfide deposit. The sulfide mineralogy is relatively simple consisting of pyrrhotite, some pyrite, chalcopyrite, sphalerite and minor galena. The sulfide minerals are normally coarse grained, and the ore zone frequently contains, is adjacent to, or extends in strike or dip into, masses of iron-magnesium or calcium-iron-magnesium silicates (actinolite, anthophyllite and tremolite) which contain varying amounts of sulfides. These amphibole group minerals are sometimes collectively referred to as "tremolite" or as "fiberous silicates". Although the overall ore host rock is quartz-biotite gneiss, locally the immediate wallrock to massive sulfide ore is a pegmatitic looking, highly siliceous material rich in quartz, feldspar and usually magnetite. The "vein like" tabular masses of sulfide on the south end of the deposit, and in places at depth, "nose out" into, or become in their entirety, similar pegmatitic looking "vein material". This material could represent what was originally either a siliceous sinter, or a weakly developed siliceous iron formation. Locally within the ore, and as irregular areas adjacent to ore, masses of coarse grained (up to 2"), green plagioclase feldspar (labradorite) are common. In several instances "veins" in outcrop trail off along strike into a garnet rich stratigraphic zone.

Copper and zinc content varies widely within the deposit (copper from less than 1% to 10±% and zinc from less than 1% up to 20±%) but average about 3% copper and 7% zinc throughout most of the massive sulfide material. There is insufficient data available to indicate any clear cut zoning of copper and zinc values within the deposit as explored to date. Gold values are nominal (0.01 oz./ton), and the gold recovered reports about evenly to the lead and copper concentrates. Silver, which averages about 1.2 oz/ton, is quite clearly related to the galena content of the deposit and is in a ratio of about 1 oz. of Ag per percent of Pb.

Enclosed herein are a series of Plates (8 through 14 and 16) which show the general configuration of the massive sulfide ore on a somewhat "simplified" basis. These plates were prepared from 60 scale reductions of the underground mine mapping of the various levels. These workings were originally mapped on a scale of 1"=20', and although copies on that scale (which show much more detail) are not included herein they are available in Standard's Denver office. Photocopies of the 60 scale reductions of the actual level maps are enclosed as Appendix J. These photocopies show the location of all underground diamond drill holes. In addition, horizontal drill holes are shown on Plates 13 and 14 and inclined drill holes are shown on Plate 27.

In addition to the underground workings, the deposit has been tested by 20 surface diamond drill holes and 51 underground diamond drill holes. All drill hole intercepts are shown on Plate 5. Enclosed in a separate folder, labeled "Drill Logs", are complete copies of the logs of all underground holes, and a tabulation of mineralization intercepts, with assays, for surface holes number 7 through 19*.

Plates 14A, 15 and 17 were constructed on the basis of the down holes drilled from the 7 level. Thus, Plates 7 through 17 form a

* Surface holes 1 through 6 were drilled by the U.S.B.M. in 1947, (they are detailed in U.S.B.M. RI-4214) and the intercepts made are shown on Plate 5. Surface hole 20 was drilled by Standard in 1974.

RI-4214

set of oriented plan maps through the known part of the deposit. In addition to these plans, four geologic cross-sections were constructed (Plates 18 through 21) which illustrate the complexity of folding of both the hangingwall rocks and of the Antler ore zones.

In general, copper-zinc mineralization at the Antler occurs in outcrop over a strike length of approximately 2000 ft., or for 2400 ft. if the copper mineralization offset to the north and east of the Antler shaft is considered to be a part of the same zone, which may or may not be the case.

In the outcrop, and above the 5 level in the mine, a thickened "ore lens" occurs near, and north of, the Antler Shaft. This lens consists of a core of fiberous silicates which is largely encased by massive sulfides. Appreciable thicknesses of massive sulfides existed at the north and south ends of this lens like mass (stopes ranging from 30 to 40 ft. wide) moderate widths existed on the western limb (stopes up to 20-30 ft. wide), but only narrow widths (4-10 ft.) existed on the eastern limb. The most complete exposure of this "lens" is on the 4 level (Plate 11) where it has been completely delimited by drifting. Mine workings, and long hole drilling, have also fairly well delimited the lens on 5 level (Plate 12), but on the levels above 4 mine workings have only partially outlined the lens like configuration and some limited tonnages of ore undoubtedly remain to be found. South of this lens like mass in outcrop, and on the 4, 5 and 7 levels, are a series of tabular vein like masses of sulfide which constitute ore, but only over narrow (1 to $6^{\pm}$ ft.) widths.

Below 5 level the main mineralized zone explored by existing workings has been complexly contorted and folded. The distinctly lens shaped configuration has disappeared, but fiberous silicates are still associated with the north end of the sulfide masses on 6 and 7 levels, and by drill hole interpretation fiberous silicates occupy a similar position at the elevation of 8 and 9 levels.

The deposit has been tested to a depth (see Plates 5 and 6) of only 840 feet below outcrop on the north end (hole 45) and approximately 1100 feet below outcrop by a single deep hole on the south end (surface hole 20). The deepest north end holes show ore grade material over good widths (7 ft. of 5.5% Cu and 17.6% Zn; 10.95 ft. @ 2.62% Cu and 8.24% Zn and 20 ft. @ 3.1% Cu and 4.8% Zn) whereas the single southend, deep hole has revealed marginal grade ore (1.45% copper and 2.50% Zn) over a moderate (8 ft.) width. The deposit is certainly "open at depth". ✓

The longest lateral workings underground are on the 7 level, which has tested parts of the potential ore structure for a length of 1130 feet (Plate 14). The only other levels which go south of the shaft for any distance are 4L and 5L (Plates 11 and 12), both of which had stopable ore along the tabular "vein type" structures. 1130'/2000' oc

<u>Faulting and Fault Resolutions:</u>

The main Antler ore lens is cut by two steeply dipping, northwesterly trending faults which have been named the Ocotillo and Saguaro. Both faults are exposed by mine workings down to the 7 level, and the Saguaro Fault has been exposed on 9L. Although the lateral displacements along these faults does not appear to be large in the outcrop, or in the upper levels of the mine (see Plate 11, 4 level for example), a resolution of the faulting indicates that both faults have rotational movement which makes the lateral displacements greater with depth. Also, the fault resolutions indicate that the block between the Ocotillo and Saguaro Faults is relatively down dropped, and that below 5 level two distinct mineralized zones exists. Deeper level mine workings have, for the most part, tested only the "West Limb" zone in the block between the two faults. Mineralized material found north of the Ocotillo Fault on levels 6 and 7, and south the Saguaro Fault on levels 6, 7 and 9, does not correlate with the mineralization found between the two faults on these levels. Some drill holes at depth have intersected ore in the "West Zone" and some have intersected ore in the "East Zone". Thus, ore potential exists in two distinct zones at depth rather than in just one zone as had been previously thought.

Plate 22 shows, in plan, the Ocotillo and Saguaro Fault traces on the various levels. Surface traces (Plate 7) were not used since they are distorted by topographic effects. The average planes used in the fault resolutions are also shown on Plate 22. The average Ocotillo plane is a straight line in plan and the fault is essentially vertical. The Saguaro average plane is a curved line, and the average dip of the fault is very steep southwest to vertical. Fault resolutions were made by constructing sections, from all available data, of the geology on the north and south walls of each fault. Plates 23 and 24 show the geology of the north and south walls of the Ocotillo Fault, and Plates 25 and 26 show the geology of the north and south walls of the Saguaro Fault.

It is quite evident at the Antler that these two faults are post-ore in age. The control for constructing the geology on the walls of the faults is quite good over a vertical distance of about 600 feet. Thus, a fault resolution is determined when a "match" is made between the two walls by shifting one wall (i.e. Plate) over the other. In the resolutions, and in the displacements discussed, it is assumed that the blocks north of the Ocotillo and south of the Saguaro are the stable blocks and that the block between the two faults is the mobile block.

The resolution of the Ocotillo Fault makes an essentially perfect match (on 5L and above) by shifting the south wall up 55 ft. and rotating it 4° bottom-left (match A'-B' on Plate 24 with A-B on Plate 23). In this position the average dip of the fiberous silicate sulfide lens in the upper levels becomes 61° in both blocks, the thickness of fiberous silicates at the outcrop on the north wall and (55 ft. below the outcrop) on the south wall are the same, and on the surface the contacts of the hangingwall rocks all match. In this position for the south block, however, it is evident that mine workings, and drill holes, below the 5 level have been testing two distinctly different mineralized zones in the block north of the fault as compared to the block south of the fault. In the north block this split, into an "East Limb" and a "West Limb", occurs a short distance below 5 level. In the south block the split occurs (due to displacement) at or about the 6 level. Thus, in the block north of the Ocotillo fault a completely untested mineralized zone, or at least locus of mineralization, exists in a "West Limb" below 5 level. This is of appreciable consequence since this untested "West Limb" has been the zone of principal mineralization (i.e. the main ore zone) developed, and partially stoped, north of the shaft on 6 and 7 levels. Conversely, in the block south of the Ocotillo Fault an "East Limb" can be inferred, below 6 level, by the fault resolution.

The resolution of the Saguaro Fault makes a less perfect fit than that of the Ocotillo, but it still makes a relatively good fit (match A'-B' of Plate 26 with A-B of Plate 25). This resolution involves a rotation of about 11-1/2°, the hinge point being about 150 ft. into the hangingwall of the ore zone between 5 and 6 levels. The best match lines for use in the resolution are the average dip of the fiberous silicate-sulfide lens on both Plates above 5L (65-1/2° on Plate 26 and 75° on Plate 25) and, more specifically, the westernmost hangingwall of massive sulfide ore from the outcrop down to 5 level on both plates*. Lithologic contacts in the outcrop in the hangingwall of the ore zone do not match particularly well. However, due to the rotation it is necessary to project these lines for some distance and, as shown by Plates 18, 19 and 20, these hangingwall rocks are intricately folded such that straight line projections cannot reasonably be expected.

The Saguaro fault resolution again indicates that mine workings and drill holes below 5 level have tested different mineralized zones in the block north of the Saguaro Fault as compared to the block south of the Saguaro Fault. Here again, a relatively untested "limb" exists in both blocks at 6 level and below.

It should be pointed out that relative to the ore zones the fault resolutions are "straight line average projections" below about 5 level, whereas the ore horizons themselves are actually intricately folded as shown by Plates 18 through 20. This fact places some restrictions, although not too severe, on the accuracy with which the zones can be located at depth.

It also should be pointed out that the irregular bulge of massive sulfides indicated in the hangingwall between 5 and 6 levels on both Plates 25 and 26 is based upon projecting the 6 level ore zone

* a portion of the hangingwall configuration immediately above 3L on Plate 26 is based upon a stope map made by ARS and Jim Hill in 1966.

to the south "up plunge". It is not a part of the fault resolution but is indicated here rather as an area which should eventually be tested by drilling or raising.

The positions of the "East" and "West" limbs of mineralization inferred from the resolution of the Ocotillo and Saguaro Faults have been shown in plan on Plates 13 through 17 (i.e. 6 level down to 2450 elevation). The recognition that these two locus of mineralization occur at depth in the deposit has played a major part in formulating the recommendations for underground drilling presented in this report.

Folding:

There is no question but that the rocks forming the "Antler Syncline" in the hangingwall of the Antler ore zone are intricately and tightly folded, in part in a left-hand en echelon style. Similar folding of the ore zone, or zones, is also demonstrated in the underground workings.

Minor folds have been mapped on 2L - immediately north of the shaft in the sulfides and along the footwall north of the Saguaro Fault - and on 3L prominent folding is present at both the north and south ends of the large stope adjacent to the shaft. Small flextures which are developing in the hangingwall of the northernmost stope on 3L are pronounced in that same wall on 4L and 5L. The sulfide at the north end of the enclosed fiberous silicate mass on 4 level is folded, as can be seen in plan (Plate 11) and in section (Plate 19).

The folding in evidence on the upper levels is, however, very minor as compared to the folding of the West Limb sulfides as evidenced by geologic mapping on 6L and 7L, and as inferred by drill hole interpretation below 7 level. The main sulfide mass on 6 level as viewed in plan has been greatly contorted into a series of minor anticlines and synclines which plunge 45° north. The center of this sulfide mass consists in part of massive chlorite and in part of fiberous silicates. The overall sulfide area on 6L is convex to the east, and it is bounded to the north, for the most part, by quartz-biotite gneiss.

On 7 level the exposed West Limb sulfides north of the shaft (i.e. the main ore zone) again exhibits a syncline, with an accompanying smaller anticline, which plunge about 45° north. This sulfide mass is slightly convex to the west, the core of the sulfides is cut by a wide zone of massive chlorite, and the trough of the synclinal feature is occupied by massive fiberous silicates.

As pointed out by Gilmour (1969), the "ore shoot" as exposed on the 6 and 7 levels fails to "meet" between the two levels when it is projected up from the 7L and down from the 6L. Although the exact nature of the connection between the two levels is still not entirely clear, it probably approximates that which is shown on the geologic cross sections of Plates 18, 19 and 20. These sections indicate a very complex zone of crumpling whereby hangingwall quartz-biotite gneiss has been injected into the area between the sulfide masses which exist on the 6 and 7 levels. At the same time, the hangingwall rocks are embayed (convex to the west) within this area. Although completely definitive data is lacking, the main features suggest compression and this area may be a "compression crumple" (reverse drag fold) which plunges at a flat angle to the north. It is principally within this area (i.e. between 5 and 7 levels) that the quartz-biotite has been converted into "bronze mica gneiss" and extensive massive chlorite has been developed.

A plotting of the main fold axis on a longitudinal section (Plate 6; S_1, A_1, S_2, A_2) would suggest that the sulfides between 6 and 7 levels may be interconnected between the two levels by a series of en echelon folds, although this is not clearly evident from the three cross sections constructed through the area.

The style of folding on 7 level is probably left-hand en echelon, and complex, as shown by Figure 3. On this level even the East Limb sulfides, near and south of the shaft, are en echelon folded, although in that location the folds plunge to the south nearly paralleling the plunge of the major surface synclinal feature S-1 (see Plate 6).

Below 7 level the folding can only be indicated by the interpretation of drill hole intercepts. A relatively large number of holes (9) make intercepts at about the 2750 elevation (50 ft. below 7L) and data from these holes was utilized to construct Plate 14A. This interpretation suggests two synclinal features, with an intervening anticlinal structure, in the West Limb zone north of the Saguaro Fault. The West Limb ore zone at 2750 elevation has an overall strike which is north northwesterly, whereas its correlary on the 7L has an average strike of just east of north. To the south of the Saguaro Fault at 2750 elevation three holes define a southerly plunging syncline in the East Limb sulfides.

Another series of holes makes intercepts at about the 2690 elevation. These were utilized to construct Plate 15. This plate does not show any clear cut folding, but it does illustrate that Hole 22 probably encountered the East Limb north of the Ocotillo Fault, and that the ore grade intercept of Hole 46 is probably in East Limb sulfides.

A projection of drill hole data from intercepts near the 9L elevation is shown on Plate 16, and Plate 17 shows the three deepest holes projected to a common elevation of 2450 ft. Neither of these plates clearly define any folding although the configuration of sulfides and fiberous silicates just north of the 9L drift face (Plate 16) is suggestive of a north plunging syncline.

Additional folding, not previously discussed, is suggested between holes 43 and S-17 (Plate 20).

Over-All Antler Ore Zone Configuration:

It should be of interest to enter into the realm of geologic conjecture, and look at the over-all configuration of the two mineralized "limbs" at the Antler.

Based upon the position of the two limbs on various levels in the block north of the Ocotillo Fault, geologic mapping in that block on 6L, and the results of surface drill holes number 9 and 11, it appears that the two limbs converge to the north in plan and that this point of juncture plunged north at an angle of about 45° (see Plates 13 through 15 and Plate 6). This juncture then essentially parallels the plunge of anticline S-2, and it is probably a continuation of the north point of juncture of the east and west limbs of the Antler fiberous silicate-massive sulfide lens which occurs at and above 5L. On this basis, it is not difficult to carry the reasoning one step further and to suggest the possibility that the two "vein like" sulfide bodies south of the Antler shaft on 4L and 5L may be the same two limbs and that the Antler fiberous silicate-sulfide "lens" in the upper levels occupies the nose (crest) of a northward plunging anticline. The fact that the "lens" appears to close on the south, and that the two veins on 4L and 5L nearly connect before diverging to the south could either be the result of en echelon folding - which is not as yet clearly understood in that part of the mine, or these configurations could mean that the Antler "lens" is a large "boudinage" type feature where the nose of the anticline is locally detached from the remainder of the anticline. It will require further detailed mapping, both on surface and in the upper levels of the mine, to determine which, if either, of these cases is in fact true.

Current Status of Testing
of East and West Limbs:

As indicated by the level plans, on 6 level and below all of the drifting in mineralized material north of the Ocotillo Fault, and south of the Saguaro Fault, has been done in the East Limb mineralized zone. By the same token, all mine workings on 6 level and below in the block between the Saguaro and Ocotillo Faults has tested only the West Limb mineralized zone.

The status of existing diamond drill holes, relative to the testing of the two limbs, is shown (by symbols) on Plate 6, and all underground holes are shown on either plans (Plates 8-17) or sections (Plates 18-20 and 27). Most of the down drilling from 7 level was concentrated in the Saguaro to Ocotillo block and these holes, with few exceptions, tested only the West Limb zone. The few holes that did penetrate sufficiently deep to reach the position of the East Limb (S-7, S-8, UG-1, UG-4, UG-32, UG-40 and UG-44) did find pegmatitic vein material, usually with some sulfides, at the East Limb position.

In the area north of the Ocotillo Fault only one drill hole (S-11) has penetrated the West Limb position. In the area south of the

Saguaro Fault on 6 level horizontal drill hole 19 found one foot of high grade Pb-Zn-Ag sulfide in the West Limb position. On 7 level, the No. 1 hangingwall crosscut passed through only a chloritic zone with minor pyrrhotite at the position of the West Limb, two down holes (No's. 32 and 44) and one up hole (No. 40) drilled from this crosscut penetrated pegmatitic material with minor sulfides at the West Limb position, and two down holes (29 and 46) drew complete blanks at the West Limb position. At greater depth, holes S-17 and 44 (see Section E-E', Plate 20) encountered fiberous silicates and minor sulfides in the West Limb position, whereas the log of hole 43 - between S-17 and 44 - has no indication of the West Limb mineralization whatsoever. Drill hole 45 (see Plates 17 and 28) made a wide penetration of fiberous silicates at the West Limb position.

In summary, all of this data would seem to indicate that the West Limb is essentially entirely untested north of the Ocotillo Fault, where it should contain ore. The East Limb in the Saguaro to Ocotillo fault block is probably represented largely only by pegmatitic material down to at least the 7L elevation, but may well be ore bearing at greater depth. The West Limb south of the Ocotillo Fault is probably not ore bearing down to at least the 2500 elevation, where it is south of, and under the plunge of, the known north plunging West Limb ore zone. None the less, these potentially ore bearing positions should be regularly tested by either drilling or crosscutting. This statement is made due to the indicated complexity of folding, whereby the "ore zones" can be thickened or thinned within very short distances, and also due to the fact that completely new ore shoots could re-occur along these favorable loci at any point.

Compilation of Data:

Essentially all of the information currently known about the Antler mineralization, its structural setting, and the status of drill holes and current underground workings has been compiled and is portrayed on a longitudinal section, Plate 6. Underground lineations shown on Plate 6 are largely those measured by Gilmour.

This longitudinal section clearly indicates that the configuration of the mineralization at the Antler is closely related to folding that parallels, or at least approximates, the same style of folding as evidenced in the outcropping "Antler Synclinal" feature.

To keep Plate 6 from becoming completely unintelligable, or at least "too busy", a reduction of that Plate, as Figure 4, is included herein upon which has been superimposed one additional feature. Figure 4 shows, in prominent lines, a series of "axis of ore shoot plunges" which are suggested by the abundance of data contained on Plate 6.

As shown on Figure 4, the previously believed "indicated plunge" of the main Antler ore zone as viewed in longitudinal section was steep (63°±) to the north, since - below 5L - most workings in "ore" over mineable widths had tested only the West Limb within the Saguaro to Ocotillo block. This "indicated plunge" is probably erroneous. Actually, the data would suggest that the overall north end Antler zone is probably closely related to left-hand en echelon folding which plunges relatively flattly (50° or less) north and closely parallels the style of the folding in the hangingwall rocks north of the Saguaro Fault. Within this overall "style", a number of "ore shoot axis"*, which tend to flatten with depth, are indicated.

* These are areas of thickening of sulfides. The areas between axis are not barren of sulfides.

Measured lineations, and minor folds underground, all suggest these trends in the area north of the Antler Shaft.

South end mineralization (on 4, 5 and 7 levels) is apt to form ore shoots which plunge to the south essentially - or at least roughly - paralleling the trough of the major synclinal feature S-1. These trend lines, or "ore shoot axis" are also shown on Figure 4. Minor drag folding at the massive sulfide contacts on 3L south of the shaft, and left-hand en echelon folding of East Limb sulfides on 7 level near the shaft, fit this flat, south plunging pattern.

Both the surface and underground drilling recommended in this report are based upon testing along the projections of these indicated "ore shoot axis".

GEOPHYSICAL WORK & MERCURY GEOCHEMISTRY

During 1966 and 1967 Standard Metals contracted with Canadian Aero Minerals Surveys, Ltd., to run a total of 62.8 line miles of ground magnetometer surveys. These surveys were conducted over the outcropping Antler area, to the north of the Antler for about one mile, and over the alluvial filled valley to the southwest for a length of about 3 miles, as shown on Plate 39. This data was reviewed by C. L. Elliot, Geophysical Consultant, in early 1968. Limited induced polarization and resistivity tests were also made by Canadian Aero, and a broad gravity survey was made by the same firm in an endeavor to determine the thickness of cover for industrial water well site selection purposes. A tabulation of all geophysical reports from that period, which are available in Standard's office in Denver, is attached as Appendix K.

In the area of outcrop the magnetometer survey revealed a strong anomaly over the Antler ore zone, and another essentially parallel anomaly in the hornblende (and magnetite) rich (hbf) unit across the syncline to the west. Interpretation of the Antler magnetic anomaly by Elliot strongly suggested that the anomaly was not entirely attributable to the pyrrhotite mass but was supplemental to a large degree by magnetite in the immediate quartz-biotite footwall rocks.

A number of apparently conformable magnetic anomalies (i.e. parallel to the trend of the Antler host rocks) were detected in the valley fill to the southwest. Since magnetite as well as pyrrhotite apparently could be involved in the responses, particularly in hornblende rich rocks, mercury sampling of bedrock was done over the outcropping Antler area to see if this would give a tool to discriminate between the anomalies masked by cover. It developed that the Antler was strongly mercurial (Antler gossan running up to almost 2000 ppb against a background of 20-30 ppb). Based upon these encouraging results, mercury soil sampling was done across areas of anomalous magnetic response in the adjoining valley. The results of some of these mercury profiles are shown on Plate 40.

Unfortunately, the valley fill to the southwest is not entirely alluvium or dirt, but rather it is composed largely of granitic boulder outwash. The outwash ranges in size from cobbles up to boulders several feet in diameter, making for very difficult drilling conditions.

One hole was drilled in the valley in 1968 to test a promising magnetic-mercury anomaly in the position indicated on Plate 40. The anomaly had been interpreted to occur at a depth of approximately 75 ft. below ground level. The hole was drilled to 750 ft. and was abandoned in boulder alluvium.

RECOMMENDED EXPLORATION WORK

Antler Mine Area:

Based upon the geological interpretations presented herein, I have evolved as a next stage exploration drilling program for the Antler one which consists of 24 underground and 8 surface diamond drill holes*. Unfortunately the topography on the north end of the deposit (see Plate 37) is such that further testing of the north end Antler ore zone at depth must be conducted from underground workings. The rapid rise of the mountain to the west, coupled with the need for multiple relatively close spaced intercepts due to the complexity of the geology, rules out further surface drilling in this area.

As shown in plan on Plate 28, a total of 24 underground diamond drill holes are recommended to systematically test both limbs of the main Antler ore zone from 9L elevation (2600 ft.) down to a depth of 2300 ft. Two of these holes on the north end of the structure make penetrations at 2200 ft. elevation, and one hole makes a penetration at about 2125 elevation. The trace of these proposed penetrations are shown on Plate 6, but due to the complexity of data on that longitudinal section a special series of Plates (30 through 35), categorizing the holes and mineralized structures, were also prepared.

As shown on Plate 28, seven horizontal holes (R-1 through R-7) and one down hole (R-11) can be drilled from currently existing workings. The remainder of the underground drilling program will call for driving approximately 1300 ft. of drifts and crosscuts to establish three hangingwall drill stations. The program is designed to make intercepts in both the East and West Limbs on from 100 to 150 ft. centers, in so far as possible, from a minimum number of hangingwall access points.

* Underground drilling totals 6,390 ft., surface drilling totals 7,900 ft.

A "hole" in the drilling pattern occurs directly below the existing ore intercepts of holes 43, 45 and S-17, but this "hole" can be filled in at a later date, if deemed advisable, by establishing a new drill site by drifting northeast from the collar point of hole R-17. Due to the indicated complexity of the geology at depth in the mine (two loci of mineralization, 3 fault blocks, complex folding) it was deemed advisable to do enough drilling in a relatively short interval of depth (i.e. at 9L and for 300-400 ft. below 9L) to give a very clear picture of ore potential by zones, plunge and structure prior to trying any deeper drilling. Hopefully, ore will be found in areas where it had not been previously anticipated - such as in the West Limb north of the Ocotillo fault, or in the East Limb in the Ocotillo to Saguaro block at the elevation of 9L - which will substantially increase the ore potential per foot of depth and preclude the necessity of really deep drilling at an early date. In any event, more data on structure and plunge, or rake, is needed before really deep drilling - such as to shoot for 1000 ft. of depth below 9L - can intelligently be laid out.

Fortunately, the central and southern portions of the overall Antler mineralized zone are topographically suitable for further surface drilling. As shown in longitudinal section on Plate 6, in plan on Plates 36* and 37, and in "typical section" on Plate 39, eight drill holes are recommended as the next logical phase of further exploring this portion of the structure. These holes, for the most part, form intercepts at 250 ft. centers horizontally and 300 ft. centers vertically to test about 1000 ft. of strike length down to a depth of 800 ft. below outcrop.

* southernmost holes R-7 and R-8 fall just off this map but are shown on Plate 37

Double holes are purposely drilled from a single collar point, at three sites, to enable optimum conditions for accurately constructing geologic cross sections. These 8 holes, in conjunction with the already existing shallower holes, should enable a decision as to whether or not this area justifies further exploration and, if so, whether such further exploration could be best conducted from surface or underground.

In conjunction with this surface and underground drilling, further detailed geologic mapping should be conducted both on surface and underground in an endeavor to better define the folding of the area. In this regard particular care should be given to the mapping of lineations and minor drag folds. Also, geologic cross sections on not more than 100 ft. centers should be constructed throughout the entire length of the known mineralization, utilizing all data. The underground workings below 6 level should be re-mapped geologically, as should accessable stopes and raises. In addition, some of the underground drill holes should be re-logged since the large number of geologists after Hill* created a gross lack of consistency insofar as lithologic terminology is concerned.

Bulge Area:

The geologic mapping to date in the bulge area has been reconnaissance in nature. This area should be mapped in greater detail and the areas of known mineralization further studied and sampled. To aid in this work, the entire Antler schist belt should be flown commercially to obtain high quality air photos in both black and white and color. Appropriate ground markers should be set prior to the flying so that later triangulation ground control can be done as necessary to

* Macguire, Gardner, Wendt and Bird all during 4/69-12/70 (see numerous holes on Plate 27 where holes at collar differ in litholoty from that of workings.)

provide a basis for high quality, large scale topographic mapping in any areas where eventually desired. Ultimately diamond drilling will probably be justified in the Bulge area, and at other points along the belt, and better topographic control than the current 1:24,000 quadrangle maps will be needed.

Unfortunately, much of the "massive sulfide" which occurs in the southwestern United States is not sufficiently interlocked to give a strong response to EM geophysical techniques (i.e. they are usually not good conductors). Further, deep oxidation - or even partial oxidation to depth - also hampers the application of EM in this region. For that reason no sizeable additional geophysical effort is recommended in outcrop. Mercury rock or soil sampling, or other geochemical applications, might prove to be helpful but, for the most part, in areas of outcrop I believe that interesting areas will have to be appraised by mapping and then tested by drilling.

Covered Area to South:

The area of cover to the southwest of the Antler certainly has potential, and must be further appraised. It seems entirely unlikely to me that the magnetic anomalies are attributable to magnetite in the alluvium, or boulder talus, and while some of these reponses probably represent magnetite in hornblende rich rocks others have a good likelihood, in my opinion, of being caused by Antler type mineralization. I would suggest that the ground magnetometer, and mercury soil sampling results, be re-examined and reassessed. A detailed gravity survey, with good elevation control by leveling, should be able to determine depth of bedrock, and this information would help in a re-evaluation of the significance of the various magnetite anomalies. Also, a detailed gravity survey would have a chance of directly detecting a very large sulfide mass if one should occur under the post ore age cover in this area. Due to the nature of the granite boulder outwash, there may not be sufficient density contrast between the outwash and bedrock to be definitive. I would suggest an initial preliminary survey of a single line run from bedrock near the Antler to bedrock in one of the outlying outcrops, with readings on 500 ft. stations and closed loop altimeter control (in conjunction with elevations from available topo sheets), to test the applicability of the method in this particular setting. Such a single line should cost, including interpretation, only $2,000 to $3,000. If it does appear that a reliable depth to bedrock interpretation can be made, then I recommend that a detailed gravity survey be made, and that the magnetic data be reinterpreted when depth to bedrock in the pertinent areas is thus better established. Following this reappraisal magnetic anomalies, conformed with mercury highs, should be drilled, although no specific recommendations for drilling can be made at this point in time. If the preliminary single line gravity survey results indicate that the method is not applicable in this setting, the funds allocated herein for a detailed gravity survey should be expended in air rotary drilling vertical holes down directly on the top of several of the better magnetic anomalies to obtain bedrock samples.

COST AND TIMING OF EXPLORATION

Attached as Appendix L is a proposed schedule for the underground drifting and drilling on 9 level. This schedule is predicated on two four man drift crews (after the 6th week) working on two shifts to drive the necessary headings and two diamond drills working on one shift, starting at the end of the second week, sequencing in with the drift work as it advances and as new drill stations are opened up. The first two weeks of the program are allowed for minor shaft repairs, cleaning up the existing 9L and preparing the first three drill stations. On this basis, drifting would be completed at the end of 16-1/2 weeks (4 months±) and drilling would be completed at the end of 29-1/2 weeks or about 7 months.

It is estimated that it would cost about $7,500 to re-activate and prepare for drifting (reset transformers, new hoist cable, minor repairs to shaft, clean up 9 level, etc.) and that the drifting - with all required surface support and supplies - would cost about $80/foot. Diamond drilling is assumed to be done on contract for $7.50/foot. Subsequent to the completion of drifting the remaining diamond drilling period would require a hoistman and toplander (at $80/day) plus power and air (at $100/day) or an additional $4.50 per foot added to the drilling cost. Total cost for the underground work should then approximate $173,000 as shown below:

Preparation	$7,500
Drifting 1305' @ $80	104,400
Drilling 3480' @ $7.50	26,100
Drilling 2910' @ $12	34,920
	$172,920

Surface drilling of holes SR-1 through SR-8 could be carried on during this same period. It is estimated that this drilling will have an overall average cost of $14.50/ft. including mobilization, mud, minor lost casing, etc. Thus, 7900 ft. of surface drilling should cost approximately $114,500.

Aerial photography of the belt, in black and white and color flown at a scale of 1:12,000, should cost only about $1,000. Pre-flying ground markers could be set for about $1,500.

A gravity survey of the area to the southwest, with stations on 500 ft. centers, would cost about $25,000, including a grid survey with accurate elevation control. Alternatively, these funds would be expended for rotary drilling in the valley if a test gravity line gives inconclusive results.

During the entire program at least one, and preferably two, competent geologists - hopefully with past experience in folded Precambrian rocks - would be required. Assuming two geologists, at a total cost of $2,250 per man per month (including subsistence) would add $31,500 to a seven month program.

In summary, the overall exploration program proposed would cost approximately $381,000, as shown on Table 3, and would require about 7 months to complete.

CONCLUSION

The Antler is certainly a very promising copper-zinc massive sulfide deposit which has been tested to date only to a relatively shallow depth. As compared to other deposits of a similar type elsewhere in the world the Antler has, in my opinion, an excellent probability of developing into a major mine. Further, the possibilities appear to be good for additional discoveries, similar to the Antler, along the belt to the north, in the Bulge area, or in the region of cover to the southwest. The geology of the Antler deposit itself, and of the area as a whole, is just starting to be understood. With further geological work the details of this complex structural area will start to fall into place, and the probability of further economic discoveries will increase.

The recognition of two distinct mineralized "limbs" at depth in the Antler mine should enable the development of more tons of ore per vertical foot and thus overcome, to a large degree, one of the past problems with the exploitation of the deposit.

Due to the current high metal prices, in conjunction with the appreciable cost for doing exploration work alone from the current bottom level of the mine, serious consideration should be given to reactivating both the mine and the mill and again going into production during this exploration period.

REGISTERED GEOLOGIST
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Arthur R. Still
Mining Geologist

PRELIMINARY FEASIBILITY STUDY,

ANTLER MINE, MOHAVE CO., ARIZONA

Prepared for

STANDARD METALS CORPORATION

by

Paul Gilour Gilmour

Tucson, Arizona June 4, 1975

PRELIMINARY FEASIBILITY STUDY,

ANTLER MINE, MOHAVE CO., ARIZONA.

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2nd June, 1975
Tucson Arizona

Signed:

Paul Gilmour

PRELIMINARY FEASIBILITY STUDY,

ANTLER MINE, MOHAVE CO., ARIZONA

SUMMARY

Many of the steps in a feasibility study involve a trial-and-error process and ought to be modified or refined in the light of subsequent steps. Thus, assumptions used in the calculations of ore reserves, such as cut-off widths and grades, should be reviewed after profit potentials have been estimated and, if need be, adjusted up or down. Owing to the nature of the request made to the writer, namely, to derive fairly generalized or, as Westerners say, "horseback" figures, this report describes the results of a "single pass" with the relevant data. It is not the last word on the subject and could obviously be improved by further work conducted by the writer and/or others. With this proviso, then, the following facts emerged.

The calculated (roughly, "measured" and "indicated") raw ore reserves to a vertical depth of 2,100 feet in two roughly parallel zones are 5.137 million tons with an average width of 14 feet and grade of 1.05 ozs/ton Ag, 0.94 per cent lead, 1.95 per cent copper and 4.13 per cent zinc. Considering the "habit" of the sulphides explored and the fact that there is no diminution in either width or grade in the deepest holes drilled to date, it seems that further exploration stands an excellent chance of increasing the calculated figure by 50 per cent and at least a fair chance of reaching 100 per cent, representing "inferred" reserves of 2.5 and 5.0 million tons - giving total "measured", "indicated" and "inferred" reserves of either 7.6 or 10.1 million tons. The lower figure, however, was used in the present calculations of potential profitability. Judging by present indications, the best target for additional deep exploration beneath the mine area lies toward the north. Other prospects are known in the Antler area, the most significant of which is the Copper World mine and opportunities for exploration in the district are believed to be reasonably good. The best prospects for further discoveries include an E.M. anomaly located between the Antler and Copper World and the so-called "bulge" area.

Mining recovery (allowing for pillars, etc.) was assumed to be 90 per cent and dilution to be 10 per cent (at zero grade) giving minable reserves of the same tonnage averaging 0.95 oz per ton silver, 0.85 per cent lead, 1.75 per cent copper and 3.72 per cent zinc (equivalent, of course, to mill heads).

After estimating fixed costs (F.S. & R., mining, milling and overhead, etc.), amortization, depletion and taxes, the per-ton profit and cash flow capable of being generated by the calculated reserves were placed at, respectively, $7.29 and $10.62.

Based on these figures the net present value was found to be $9.646 million and the discounted cash flow rate of return on the capital outlay 15.5 per cent.

These estimates were all made without bonus payments or royalties - that is to say, as the economics might appear if Standard Metals alone were to exploit the Antler. In order to determine what bonus and royalty might be reasonable, the D.C.F. R.O.R. was calculated for a $500,000 bonus payment plus 5 per cent (Net Smelter) royalty and for a $1,000,000 bonus and 10 per cent (N.S.) royalty. It was found that each increase of $500,000 and 5 per cent reduced the D.C.F. R.O.R. by about 1.75 per cent (in the range of R.O.R. under consideration, i.e., around 10 to 20 per cent).

Finally, the present values of the bonus payments and royalties (discounted at 10 per cent) were calculated and found to be $5.517 and $11.004 million (for $500,000 and 5 per cent and $1,000,000 and 10 per cent, respectively). Of course, if Standard were to calculate the net present value of its position since 1965, inflating past expenditures and discounting anticipated future income, the relative significance of these expenditures would be put in better prospective.

It was concluded that the Antler exhibits a good profit-making potential - certainly good enough to warrant continued investigation -

especially since most of the assumptions and estimates made by the writer are thought to lean toward conservatism. Initially, most of this investigation would involve "sharpening" the data on which technical questions rest - metallurgical tests, engineering estimates, possibly additional drilling, and so on.

Whether this additional work is conducted by Standard or a potential partner is a matter for policy decisions and negotiation and does not affect the technical problems. In either event, it is recommended that a start be made with the most basic information, putting drill logs, mine co-ordinates and plans and sections in "top notch" shape, refining ore reserve estimates, and so on. Representative samples for metallurgical purposes should be collected under proper supervision and the requisite test work undertaken. Engineering estimates should be refined. In other words, the time is ripe for a detailed feasibility study, the results of which should help to elucidate some current questions, such as the need, or otherwise, of additional exploratory drilling.

Should Standard find in the near future a suitable partner willing to undertake this next stage, so much the better, but, failing this and considering what Standard has spent on the Antler overall or even in the recently completed drilling program, it seems to the writer that it would be worth spending an additional $35,000 to $40,000 to obtain the results of a formal feasibility study. This would help Standard to determine the most advantageous course to pursue and/or provide a really substantial body of information to present to a potential participant in a joint venture.

INTRODUCTION

Scope and Authority

The writer was asked by Mr. Richard C. Dwelley, Vice President of Standard Metals Corporation, to examine the available information on the Antler deposit to consider its potential profitability and, perhaps, to indicate some guidelines for a joint venture. This is not a feasibility study in the formal sense of the term: for one thing, such a task requires the expertise of more than one individual and, for another, the requisite basic information is not available.

It is proposed to omit many of the usual preliminaries regarding location, access, production history and ownership, as they have been adequately covered before (Still, 1974). Suffice it to say here that since Still's report was written Standard has completed 8 diamond drill holes totalling 13,020 feet, the results of which will be discussed below.

Acknowledgements

The writer would like to acknowledge gratefully the unstinting assistance of R.C. Dwelley, J.W. Joyce and B.E. James - all of Standard - which made possible the completion of this report.

GENERAL GEOLOGY OF THE ANTLER

Setting

The Antler deposit is located near the northwestern contact of a belt of schist and gneiss of "older" - in the nomenclature of Arizona - Precambrian age. The belt is 1 to 1½ miles wide, and some 6 miles long, elongated in a northeasterly direction. This "schist belt" is enclosed by granitic rocks which are also believed to be Precambrian.

The formations of the schist belt have been identified by previous workers on the basis of mineralogical composition - quartz-biotite gneiss, quartz-feldspar gneiss, amphibolite, and so on. They are believed by Still and Dwelley (and the writer concurs) to represent metamorphosed pyroclastic deposits. Still observed (1974) - and Antler personnel seems to agree - that some, at least, of the enclosing "granite" may have been coarse grained rhyolite or silicic pyroclastics.

One aspect of the general geology not adequately discussed in previous reports deserves special mention, namely, the abundance of "fibrous" silicates (anthophyllite?, tremolite?, etc.), generally in close proximity to the sulphide minerals. Rosen Spence (1969) has shown that the alteration pipes in the Noranda district, Quebec, which contain cordierite and anthophyllite occur around the margin of the Lake Dufault granodiorite and she argued that these minerals resulted from thermal metamorphism (in the contact aureole of the granodiorite) of iron-rich chlorite. Biotite in the pipes resulted in like manner from original sericite. Whether as transgressive pipes or conformable bodies, chlorite and sericite are typically abundant in and around massive sulphide deposits. The proximity of the Antler deposit to the contact of a granitic mass has already been noted and it is tempting to suspect that the anthophyllite(?) and abundant biotite in the host rocks may have originated in the manner proposed by Rosen Spence. This suggestion is in keeping with the coarse-grained texture of the Antler sulphides which the writer believes also resulted from contact, or thermal, metamorphism.

Structure

The strike of individual units tends to be very uniform and to parallel the trend of the schist belt. In the vicinity of the Antler mine the schists dip toward the northwest at approximately 60 degrees. Beyond these simple facts, considerable differences of opinion exist regarding the geological structure of the Antler area.

Still has believed for some time that the Antler rocks lie on the northwest limb of a large fold which closes about a mile southwest of the mine. More recently (1974) he has also proposed that the rocks in the Antler mine area were deformed during two different periods of deformation, the limbs and axial planes of the first set of folds being folded by the second. And, just to complicate matters farther, Still concluded that the second set of folds are *en echelon* structures. Two mineralized horizons which are present in the Antler mine area are thought by Still to be the same bed duplicated by tight isoclinal folding.

The present writer does not believe that the quality of the proof marshalled by Still to support this complicated structural interpretation is adequate. Instead, the uniform strike and dip is thought to reflect the true state of affairs, namely, the presence of a monoclinal structure which strikes northeast and dips steeply to the northwest. The original order of superposition is not known, but, by comparison with other massive pyritic sulphide deposits and the districts in which they occur, the present structural order is believed to be the original stratigraphic order, that is to say, the rocks "face", or "young", toward the northwest. This inference is suggested chiefly by the distribution of mafic and felsic rocks and supported by the zoning of lead, copper and zinc in the sulphide horizons (which, incidentally, is the same in both sulphide horizons - an impossible state of affairs if the two horizons represent portions of the same bed repeated by folding).

Mineralization

Sulphides - not necessarily economic - are developed in the Antler area over a strike length of approximately 2,800 feet and extend some 2,200 feet down-dip (1,800 feet vertically).

As noted at two or three points in the previous discussion, sulphides occur in significant amounts in at least two horizons. The distances between these range from 150 feet to zero (i.e., where they seem to coalesce). The two horizons have not been identified everywhere in the mine area: one or other may be missing in individual penetrations of the general horizon by mine workings or drill holes. Needless to say, this fact complicates the correlation of sample locations and, accordingly, attempts to estimate ore reserves.

One other generalization may be made about the form and structure of the sulphide horizons: as revealed in workings and drill holes the portions situated, roughly speaking, north of the existing inclined shaft pinch and swell, whereas those portions of the two zones lying to the south of the shaft tend to be much more uniform in width and strike.

When, for the purpose of estimating reserves, an attempt was made to distinguish between mineralized intersections in the Hanging- and Foot-wall zones it was found that the two zones appear to coalesce below an elevation of 2,200 feet (1,100 feet below surface) and toward the north end of the mine area (drill holes B-3, B-6, B-7 and, possibly, B-8). Conversely, the two zones seem farthest apart, i.e., roughly 150 feet, on surface toward the south (it would be convenient to be able to write, "around Section Such-and-such"). Whether this appearance results from folding or a wedge of intervening waste is another matter, although the writer inclines toward the latter view, for the reasons given above.

ANALYSIS OF RECENT DRILLING

Drilling at the Antler falls into three phases: an initial series of 19 holes drilled from surface; approximately 50 holes drilled underground from the mine openings; the series of 8 holes drilled from surface during 1974 and early 1975 (and designated B-1 through -8). This discussion will be restricted to the recent drilling for two reasons: first, the records of the earlier drilling - especially that conducted from underground - are scarcely good enough to warrant detailed analysis (especially as regards directions and angles); second, the results of the recent drilling account for by far the larger part of the ore reserves estimated by Standard. Before describing the recent drilling, however, the writer would like to digress briefly to discuss what he considers to be an issue of the first importance.

Geologists resident in the Southwest have become accustomed to thinking in terms of vertical drill holes. In such cases vertical cross sections can be drawn in any direction, but, typically, they are plotted parallel to the mine grid which thereby acquires an enhanced importance. This is simply not sufficient in operations dealing with relatively narrow, steeply dipping mineralization which is seldom, if ever, considerate enough to align itself parallel to the mine grid! A base line, parallel to the average strike and changing direction, if necessary, should be adopted and section lines laid out at right angles to it. Holes should be spotted on section planes at rational - not necessarily uniform - intervals and, as nearly as possible, drilled parallel to and plotted on the standard sections. The existence of such a system and adherence to its imperatives would avoid much of the confusion of the early Antler drilling, permit holes to be plotted on sections with a minimum of projection and sections to be immediately compared or contrasted with each other (unlike the cross sections in Still's 1974 report, for example), thereby facilitating efforts at correlation of mineralized intersections with all that implies. Level plans should, of course, also be tied to this reference system and should be made uniform in format throughout the mine (again, unlike the level plans in Still's report). Whatever organization - Standard or a venture partner(s) - embarks on further major expenditures should certainly adopt such a system as soon as practicable. The importance of a rational and consistant co-ordinate system and related plans and sections cannot be over-estimated.

At any rate, the assays for copper, lead and zinc for holes B-1 through B-7 were plotted on graphs in order both to facilitate the selection of potential mining widths and to learn something of the relative proportions of the three major non-ferrous base metals (DDH B-8 did not intersect significant values). These graphs are shown in Figures 1 though 7 which also indicate the intersected, true and horizontal widths. In addition, it may be seen that in DDH B-2 (Figure 2), which cut two well mineralized zones, the lead content of the lower is negligible. This suggests a possible difference between the hanging-wall and foot-wall horizons. An examination of the shallower surface drilling and of the remaining holes in the B-series (considered in the light of other evidence to distinguish between the two zones - such as non-sulphide mineralogy, position of the hole relative to other holes and/or the mine workings) lends some support to this view. It must be emphasized that the evidence is not clear-cut, only suggestive. In addition, there seems to be a tendency for the lead, where present, to be concentrated toward the top of the intersections - relative to copper and zinc, that is. A preferred distribution of copper versus zinc (such as the zoning in which zinc commonly overlies copper) is not discernable to the writer.

If valid, - and again, it should be stressed that the evidence is weak - these observations suggest: first, it is unlikely that the two mineralized horizons represent the same bed; and second, both zones considered together, as well as the hanging-wall zone considered in isolation, indicate that the rocks face northwest.

The B-series of holes, along with a few of the previously drilled surface holes, were plotted by Standard on a series of vertical cross-sections drawn on a scale of 1 inch to 100 feet. These sections are not parallel, do not have any common references - other than elevations - and were not drawn at right angles to strike. Additionally, holes not on the section planes seem to have been projected perpendicular to the plane of the sections, rather than parallel to the strike. However, it was not though advisable to take the time to re-plot the holes and sections, so they are shown here slightly modified as Figures 8 to 11.

Considering all relevant features (such as their position in the holes; relationship to adjacent holes; mineralogy, e.g., the development of anthophyllite; and the composition of the metallic sulphides, notably the presence or absence of lead) the intersections in the B-series of drill holes were all tentatively identified as either Hanging-wall or Foot-wall zones.

When this attempt to distinguish to which zone each intersection belongs was first made, those in B-1 and B-4 were thought to belong to the Hanging-wall mineralization (Blocks 14 and 16, Figure 12). Subsequently, it was thought more probable that the mineralized intersections relate to the Foot-wall zone. Ideally, the reserve estimated should be amended to conform to this conclusion, although it was not thought to be necessary to do so at the present time.

Re-calculating and plotting all of the shallow surface and underground drilling would have been very time consuming and was not felt to be justified for the purposes of this report, partly because the holes had been analysed by both Still and Dwelley (and reasonable agreement found) and partly because they obviously account for a relatively small part of the calculated reserves (specifically, about 20 per cent).

MINERAL RESERVES

As information gleaned from diamond drilling and underground work has increased mineral reserve estimates have also increased ranging from a low of 349,000 tons (Still, 1966: see Still, 1974) to the current figure of 9.161 million tons (Dwelley, 1975).

Most of these figures were derived from data presented on vertical longitudinal sections (Raabe used plans, at least, in part: see Still, 1974, Appendices D and E). In light of the fact that a minimum of two mineralized zones exist (there could be more than two) longitudinal sections seem singularly ill-suited for the purpose of calculating reserves, since they provide a relatively poor means of distinguishing between the two overlapping zones. The requisite correlations and distinctions could more readily be made on either plans or vertical cross sections. Unhappily, the random layout of drilling is not conducive to the use of the "section-method" for calculating reserves (here, again, the disadvantage of the absence of drilling co-ordinates and sections is illustrated). It might be possible to construct "projected" level plans from the drill sections and to estimate reserves from plans (thereby facilitating the use of information derived from mine workings), but the method would be very time-consuming and introduces an additional element of uncertainty. For these reasons the writer reluctantly decided to use longitudinal projections for the present - with a difference, namely, a deliberate attempt was made to distinguish between the Hanging- and Foot-wall zones. They were then shown on two separate vertical longitudinal sections. One other major change in methodology was believed justified. Previous workers who employed longitudinal sections to calculate the Antler reserves superimposed blocks on sample locations (drill-hole intersections, chip-sample lines, etc.). However, determination of these blocks was evidently arbitrary. The "polygon method" is the standard technique used to deal with randomly distributed sample points (whether viewed in plan or longitudinal section - depending generally on the dip of the body) and, consequently, it was adopted here (Figures 12 and 13). One major drawback of the polygon method is that it does not provide a "tidy" way of dealing with the margins of the body under study.* The "equal-area-

* The writer has proposed a solution to this and other disadvantages of the polygon method (Gilmour, 1964), but, since it requires a different contoured map, or section, for each metal studied, its use would be too cumbersome in this instance.

(or length)-of-influence" principle was used to rough out the margins and awkward-looking excrescences were smoothed off (e.g., Block 15 in Figure 12).

Since, volume is obtained by multiplying the apparent, or projected, area on a longitudinal section by the horizontal width (as well as by multiplying the true area - not shown on a section, unless the body is vertical - by the true width), the writer shows horizontal widths on Figures 12 and 13. The true widths in the upper level holes shown on existing vertical longitudinal sections were corrected in the course of the calculations.

A glance at a longitudinal projection of the drilling at the Antler indicates very considerable differences in the closeness, or density, of sampling. It was believed that this fact should be reflected in the reserve estimates and, consequently, the calculated blocks were divided into two groups, distinguished here as "measured" and "indicated".*

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* Most geologists and mining engineers agree on dividing ore reserves into three classes, but there is little agreement on what these three classes should be named. In 1943 the U.S. Bureau of Mines and Geological Survey proposed the terms "measured", "indicated" and "inferred". For "measured", others have used "proved" (or "proven"), "positive" and "developed". Other terms used in place of "indicated" are "probable" and "partly-developed" and for "inferred", "potential" or "possible". On balance, the writer favours the U.S.B.M. usage, but feels that the degree of reliability of some of the Antler reserve estimates (and conveyed here by the term "measured") lies below that implied by "positive" or "proven", but above that of "probable". In the writer's mind "indicated" and "probable" are approximately equivalent and are so used here.

The distinction was necessarily arbitrary and is not entirely satisfactory. Some individual polygons might be divided into two, but the danger of "splitting hairs" has to be avoided too.

Many samples for which width and grade were given were not employed here, for the simple reason that they could not be reliably identified as to zone. The merits of distinguishing between the two zones are believed to outweigh this defect, however. If accurate cross sections relating the surface drilling and underground sampling (chip, jackleg, etc.) were constructed, perhaps all or most of the ore intersections could be identified and employed.

At any rate, the reserves for the Hangingwall and Footwall zones are shown in Tables 1 through 4, while the figures for measured, indicated and both combined for the two zones are summarised in Table 5.

The discrepancy between the 5.137 million thus estimated by the writer and Standard's 8.161 (at very nearly the same grade) is easily explained. The Standard estimate included blocks below and along strike of the

TABLE 1 - *Measured reserves in the Hangingwall mineralized zone, Antler Mine, Mohave Co., Arizona*

BLOCK	DDH	WIDTH		AREA	VOL	TONS	ASSAYS				
		TRUE	HOR.				Au	Ag	Pb	Cu	Zn
		ft	ft	ft^3x10^3	ft^3x10^3	$x10^3$	oz/t	oz/t	%	%	%
1	S-1	14.1	16.97	61.4	1,042.0	104.2	0.010	0.77	1.03	3.22	6.07
2	S-15	12.6	14.55	51.8	754.0	75.4	0.004	0.27	0.32	0.49	2.29
5	S-8	7.4	8.55	150.1	1,283.0	128.3	0.009	1.10	0.80	3.20	3.50
6	S-14	15.0	17.32	109.7	1,898.0	189.8	?	0.40	0.40	1.30	2.50
8	U-49	6.0	6.93	8.5	58.9	5.8	-	0.10	1.10	1.80	16.50
9	S-4	6.1	7.04	6.4	45.0	4.5	-	1.00	1.13	1.81	9.56
10	U-48	2.0+	5.00	5.0	25.0	2.5	-	0.40	0.40	0.68	3.68
11	U-50	3.0+	5.00	4.9	24.5	2.4	-	1.25	1.25	3.13	9.76
TOTAL				397.8	5,130.4	512.9					
AVER.			12.9			512.9	-	0.64	0.63	2.06	3.70

Follows p. 12

TABLE 2 - *Indicated reserves in the Hangingwall mineralized zone, Antler mine, Mohave Co., Arizona.*

BLOCK	DDH	WIDTH		AREA	VOL	TONS	ASSAYS				
		TRUE	HOR.				Au	Ag	Pb	Cu	Zn
		ft	ft	ft^2x10^3	ft^3x10^3	$x10^3$	oz/t	oz/t	%	%	%
4	S-18	3.2+	5.0	108.2	541.0	54.1	0.002	0.90	0.50	4.43	6.21
12	U-51	4.0+	5.0	139.7	698.5	69.9	-	1.62	1.62	0.92	10.53
13	S-17	12.3	14.2	289.6	4,240.1	424.0	0.013	1.05	1.08	2.62	8.24
14	B-4	-	5.9	389.0	2,295.1	229.5	-	1.96	1.25	4.20	4.13
15	B-7	-	8.5	198.1	1,683.8	168.4	-	0.77	0.62	1.66	10.88
16	B-1	-	6.5	582.8	3,788.2	378.8	0.005	0.03	0.10	1.66	3.57
17	B-2	-	12.0	194.2	2,328.0	232.8	-	1.25	1.35	1.93	8.31
18	B-6	-	45.0	444.7	20,011.5	2,001.1	-	1.37	1.01	1.55	1.36
TOTAL				2,346.3	35,586.2	3,558.6	-				
AVER.			15.2			3,558.6	-	1.18	0.95	1.92	3.75

Follows p. 12

TABLE 3 - *Measured reserves in the Footwall mineralized zone, Antler mine, Mohave Co., Arizona.*

BLOCK	DDH	WIDTH		AREA	VOL	TONS	ASSAYS				
		TRUE	HOR.				Au	Ag	Pb	Cu	Zn
		ft	ft	$ft^2 x10^3$	$ft^3 x10^3$	$x10^3$	oz/t	oz/t	%	%	%
19	S-1	7.4	8.5	82.70	702.95	70.29	0.008	0.23	0.07	0.70	6.81
20	S-15	4.6	5.3	68.70	364.11	36.41	0.005	0.76	1.94	0.12	2.85
22	S-18	12.2	14.1	11.70	164.97	16.49	-	0.3	0.3	0.6	3.4
23	S-8	16.8	19.5	58.90	1,148.55	114.85	-	0.4	0.4	0.9	4.2
26	S-4	8.8	10.2	25.30	258.06	25.81	-	1.4	4.2	1.8	4.1
27	U-50	6.5	7.5	14.50	108.75	10.87	-	0.9	0.9	9.3	9.1
28	S-5	4.1	"5.0"	17.20	86.00	8.60	-	0.19	0.09	1.29	10.3
29	S-11	9.3	10.7	119.70	1,280.79	128.08	-	-	0.3	1.1	1.9
30	U-43	14.5	16.7	80.20	1,162.90	116.29	-	1.0	1.5	1.6	6.7
TOTAL				478.90	5,277.08	527.69					
AVER.			11.0			527.69	-	0.49	0.87	1.24	3.78

Follows p. 12

TABLE 4 - *Indicated reserves in the Footwall mineralized zone, Antler mine, Mohave Co., Arizona.*

BLOCK	DDH	AVER. WIDTH		AREA	VOL	TONS	ASSAYS				
		TRUE	HOR.				Au	Ag	Pb	Cu	Zn
		ft	ft	ft^2x10^3	ft^3x10^3	$x10^3$	oz/t	oz.t	%	%	%
31	U-51	9.0	10.4	30.20	314.08	31.41	-	1.70	1.70	2.60	4.80
32	B-3	23.0	23.0	88.20	2,028.60	202.86	0.01	1.72	2.60	1.94	2.89
33	U-45	22.6	26.1	50.00	1,305.00	130.50	-	0.40	0.70	2.80	6.40
34	B-2	5.0	5.8	299.10	1,734.78	173.48	-	0.40	-	3.80	13.86
TOTAL				467.50	5,382.46	538.25	-				
AVER.			11.51			538.25	-	1.12	1.25	2.79	7.39

Follows p. 12

TABLE 5 - *Summary of calculated (i.e., measured and indicated) reserves in the Antler mine, Mohave Co., Arizona*

CLASS OF RESERVES	AVER. HOR. WIDTH	TONS	ASSAYS				
			Au	Ag	Pb	Cu	Zn
	ft		oz/t	oz/t	%	%	%
MEASURED							
Hangingwall zone	12.9	512,900	-	0.64	0.63	2.06	3.70
Footwall zone	11.0	527,690	-	0.49	0.87	1.24	3.78
Sub-Total	11.9	1,040,590	-	0.56	0.75	1.64	3.75
INDICATED							
Hangingwall	15.2	3,558,600	-	1.18	0.95	1.92	3.75
Footwall	11.5	538,250	-	1.12	1.25	2.79	7.39
Sub-Total	14.5	4,096.850	-	1.17	0.98	2.03	4.23
TOTAL CALCULATED	13.9	5,137,440	-	1.05	0.94	1.95	4.13

Follows p. 12

deeper holes (S-11, B-6 and -7 to the north; B-1, -4 amd -6 to the south), material which the writer has chosen to regard as "inferred" or "potential" ore. Perhaps an expansion of this subject would be in order.

Considering the widths and grades intersected in three of the four deepest holes (B-1, -2, -6 and -7), it seems virtually certain that the mineralization has not "bottomed", that additional reserves would be encountered by additional exploration. In the context of ore reserve estimates the uncertainty, of course, concerns the magnitude and tenor of these reserves.

Standard ascribed to DDH S-11 a block of 150-foot strike-length which plunges to the north for some 900 feet. This seems to the writer to be stretching the evidence somewhat. However, since only 75,000 tons were allocated to this hypothetical block, its inclusion or exclusion is not very significant.

A second and larger block of reserves extending from an elevation of 2,600 to 1,200 feet and from Cross Section X to X+850N estimated to average 21.9 feet in true width and to contain 2.853 million tons derived from DH S-17, U-43 and -45 and B-2, -3, -6 and -7 was employed in Standard's calculations. One drill hole (B-2) contains two mineralized intersections, one of 10.0 feet and the other 3.2 feet. A straight arithmetical average (i.e., not weighted for area of influence) of the width for all seven holes gives 16.9 feet if the smaller is added, 17.8 feet if the wider is used and 18.2 if both are added together. The width of 21.9 feet (and tonnage) is thus believed to be about 20 per cent (or 500,000 tons) on the high side. Additionally, the block has been drawn so that it extends approximately 600 feet from any existing information. Considered as *calculated* reserves (as distinct from calculated and "inferred", or "potential", reserves), the tonnage of this block is believed to be about 30 or 40 per cent, or approximately 1.0 million tons, too large.

The biggest questions arise when the third deep block employed in

Standard's estimate is considered, however. This block was drawn to extend from 2,700 to 1,200 feet (elevation) and from Section X to X+1550S. The average true width is given as 16.0 feet and the reserve as 4.563 million tons. Only two holes (B-1 and -4) actually intersect this block. The block lies toward the southern extremity of the area explored by the early surface drilling and some underground workings. In general, the widths of the majority of intersections lie in the range 5 to 10 feet and only two (out of 25 or 30 examples) are over 10 (the Hangingwall zone in S-14 and S-15 which measures 15.0 and 12.6 feet, respectively). The two holes in the B-series which intersect this block encountered "true widths" of 5.5 feet (B-1) and 4.9 feet (B-4).* On balance, then, it is

* Standard gives 11.9 and 6.3 feet for the "true widths" of the B-1 and B-4 intersections, respectively. The discrepancy between 4.9 and 6.3 feet can be explained by relatively slight differences in the dip of the hole and mineralization and therefor in the angles the intercept makes with the mineralized zone (B-4, Figure 11), but the disparity between 5.5 and 11.9 necessitates the selection of a longer mineralized intersection. This, in turn, involves the inclusion of 3 feet (of core length) which average roughly 0.4 per cent lead, 0.31 per cent copper and 1.0 per cent zinc and/or 1.9 feet (core length) which contain 0.1 lead, 0.90 copper and 0.4 zinc (Figure 1).

concluded that the average width ascribed to this block of 16.0 feet is too large by a factor slightly greater than 2 and - on this basis - the tonnage in this block alone should be closer to 2.0 or 2.5 than 4.56 million tons.

In addition, the erection of a block 1,550 feet long by 1,500 high around only two drill holes seems a little over-optimistic - even if the "area of influence" of the information gleaned from the shallow drilling and underground workings is considered as extending below the 2,700 foot contour.

This does not mean that the ultimate tonnage which may be mined will not reach 8-odd million tons, or more: it does mean that the writer believes that only some 5 million tons can be shown to exist with a reasonable degree of certainty. One danger of lumping together inferred and calculated reserves lies in the fact that if the first are discredited or discounted the second may become suspect, too, and this might be less than fair to the data available. The question does arise as to how the inferred reserves might be estimated and what figures should be adopted.

Last year when the reasonably well-established reserves lay around 1 million tons, the present writer wrote, "comparison with other deposits suggests that a reasonable liklihood [exists] of finding ultimate reserves in the order of 4 to 5 million tons at the calculated grades". Now that the reasonably well-established reserves lie in the neighbourhood of 5 million tons, while widths and grades show no sigh of diminution and down-dip continuity has been extended, the writer believes that there is an excellent chance that actual reserves will exceed this 5 million tons by 50 or even 100 per cent (2.5 or even 5.0 million tons). Cox (1968, p. 2) noted that 27 out of 29 mining engineers responding to a questionaire did not believe that the figures for inferred (i.e., equals potential or possible) ore should be added to those for measured and indicated to obtain a weighted total figure. When conducting a feasibility study, say, this is no doubt a sound principle. However, for the purposes of estimating the *potential* (as distinct from *virtually certain*) profitability of a deposit, it is believed that adding these figures to obtain an overall total is justified. With this caveat, then, the total reserves, including potential ore, are believed to lie in the range of 7.5 to 10 million tonnage with average widths and grades approximately equal to those of the calculated reserves. The reader should, however, clearly understand the differences between the various figures presented and, in particular, the highly subjective nature of the estimated 2.5 to 5.0 million tons of inferred reserves. For convenience, the various figures are summarized in Table 6.

TABLE 6 - *Summary of estimated reserves in the Antler deposit, Mohave Co., Arizona.*

CLASS OF RESERVES	HOR. WIDTH	TONS	GRADE				
			Au	Ag	Pb	Cu	Zn
	ft	10^6	oz/t	oz/t	%	%	%
Measured[1]	11.9	1.041	-	0.56	0.75	1.64	3.75
Indicated	14.5	4.097	-	1.17	0.98	2.03	4.23
Tot. Calculated	13.9	5.137	-	1.05	0.94	1.95	4.13
Inferred[2]	±13.9	±2.5	-	Approx. Same?			
Inferred Total[3]	"	±7.6	-	"		"	
Inferred Minable[4]	±13.9	±7.6	-	0.95	0.85	1.75	3.72

Notes. 1. - See text for discussion
2. - Highly subjective - see text for explanation.
3. - Calculated, plus inferred
4. - Assume: 90% mining recovery; 10% dilution, at zero grade

Follows p. 15

EXPLORATION POTENTIAL

The exploration potential of the Antler mine and its environs might, for the sake of convenience, be considered under separate sub-headings.

Mine Potential

It has already been observed, in effect, that the mine area is believed to offer an excellent target for additional investigations. The immediate question to be considered concerns the best locus (or loci) for further discoveries.

Between the elevations of the surface (approximately 3,200 feet) and 2,600 feet the style of both sulphide zones proved to be remarkably consistent within the 1,800-odd feet of strike length explored to date: north of the existing inclined shaft (Section 0+00?) the sulphides pinch and swell, with widths typically ranging from 10 to around 20 feet and, locally, attaining much higher figures, e.g., U-22, 40 feet true width; U-23 (or 2 and 3), 70 feet. South of the shaft, however, both sulphide zones are more persistent in development and uniform in width, being typically quite narrow. The widths of intersections of the southern segment of the Hangingwall mineralization range from a foot or so up to a very exceptional 17 feet, with an arithmetical average of 6.3 feet; of the Footwall zone from a foot or two up to 9 feet, with an average of 5.7 feet.

As revealed by the relatively modest amount of information available, at any rate, the same style persists in the two segments from an elevation of 2,600 feet down to 1,400 feet.

This observation confirms what has been evident throughout the exploration conducted during the last 10 years or so, to wit, the best widths and grades lie in a zone which plunges toward the north at an angle of approximately 60 degrees. A bonus seems to be present in the shape of the merger of the Hanging- and Footwall zones suggested by B-3. -6 and -7 (since it is, of course, generally cheaper to mine one 20-foot width than two zones of equivalent grade whose aggregate width is also 20 feet).

If the foregoing is accepted, the implications for exploration in the mine are clear: emphasis should be placed on exploring the down-plunge extension(s) of the northern segment of the Hanging- and Footwall zones (or their combined analogue), while "fishing" to the north and south with much more widely spaced holes and mine openings.

District Potential

The Antler lies on the northwestern margin of a belt of schist and gneiss, bordered by granitic rocks, which measures some 6 miles long by 2 miles wide and strikes in a northeasterly direction. Several "showings" of copper oxides occur to the northeast of the Antler mine, especially perhaps in the area of the so-called "bulge" (simply, an area where the schists and gneisses form a salient projecting into the granite - see Still, 1974, map entitled "Interpretive Geology, Antler Region"). Mineral rights in the "bulge" area are controlled by Standard through ownership of some 33 lode mining claims (although there may be a partial conflict with a railroad section - Sec. 27 of T. 18 N., R. 16 W.). Additional prospecting may be warranted - possibly geological mapping and geochemical surveys.

Near the southestern margin of the schist belt and approximately 3 miles northeast of the Antler lies a small mine known as the Copper World. It is owned by the University of Arizona and is (or was in 1974) held under option by a Mr. Steve Teema of Phoenix. Past production reportedly was nearly 36,000 tons (Stone, 1963, p.2), while reserves are said to be around 50,000 tons averaging 1 oz of silver, 4 per cent copper and 4.5 per cent zinc. Bird (1970) seemed to conclude that the existing U of A. terms are unrealistic, but, under more favourable circumstances, the area beneath the existing workings would seem to the writer to constitute a worthwhile target for a couple of drill holes. At the very least, the Copper World is a good showing and it indicates that the Antler is not unique.

Another prospective area centres on an E.M. conductor detected during the course of a survey conducted by Standard Metals. It is located about 2 miles northeast of the Antler mine area, toward the southeast margin of the schist belt (and therefor *roughly* on the same general zone as the Copper World mineralization?).* This ground, too, is largely controlled by Standard Metals. One or two drill holes are obviously in order, although before they are "spotted" an attempt should be made to determine the plunge of linear structures in the vicinity of the E.M. conductor. Consideration might be given to the advisability of adopting a new sub base line parallel to the conductor (and the local strike of lithological units?). While it is in the area to prepare a drill site, a 'dozer might be used to trench the anomalous zone - not, it might be emphasized, with any intentions of carrying out a conclusive test, but simply as an aid to plotting the drill holes. Needless to say, advantage should be taken of the opportunity to start with "a clean slate" and the holes directed at right angles to strike, etc.

On the whole, the chances of finding additional mineralization are believed to be fairly good - certainly good enough to justify the cost of the effort.

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* The writer did not wish to take the time to place the results of geological mapping and geophysical and claim surveys on the same scale, but it would be desirable to do so, plotting all mineralization, and so on. It would also be advantageous to compile this information on a handier scale than the 250 feet to 1 inch of the existing geological and geophysical maps. Even the 400-scale claim map is a bit awkward, so 1000-scale would be worth adopting for a regional compilation of the type proposed.

FINANCIAL CONSIDERATIONS

It has already been emphasized in the Introduction that this report does not purpose to be a formal feasibility study. For one thing, the solid foundation of data on which a feasibility study must rest does not exist and, for another, that was not what the writer was asked to provide. This report is designed, instead, to provide an estimate of the profit-making *potential* of the Antler deposit in light of present knowledge combined with what are believed to be reasonable assumptions.

In the projection which follows current prices and costs are used. Since costs of materials and, to a lesser extent, labour have risen to their present high levels at an exceptional rate recently, while the prices of some metals (notably copper) are generally believed to be unusually low, the assumption that metal prices are likely to keep pace with rising costs seems reasonable - even conservative. At worst, the outcome seems likely to prove as accurate as attempts to project costs and metal-prices separately.

Before beginning the financial projections, a discussion of the factors employed below seems to be in order.

Metallurgical Treatment

For the month of October, 1970, when the Antler mill was operating the metallurgical recoveries of the principal non-ferrous base metals were reported as follows:

Metal	"Estimated Metall. Recovery" (%)	"Metall. Recovery by Computer" (%)
Pb	69.00	60.30
Cu - Cu conc. 79.0		
Pb conc. 13.9		
Total	92.90	85.40
Zn	68.70	60.30

The basis for these two estimates and the reasons for the differences are not known to the writer. However, the significant point is that neither set of figures is particularly good. On the other hand, since the mill only operated intermittently (owing to deficiencies in the mine) and was not operated in the manner for which it was designed, perhaps the recoveries achieved were in a sense remarkably good. A question immediately arises as to the performance of a better designed and managed operation.

While metallurgical test work was in progress at Standard's Silverton operation the Resident Manager at that time expressed the opinion that copper recovery of 90 per cent and zinc recovery "approaching 80%" appears attainable (Hower, 1968). Lead was not specifically mentioned.

An independent consultant estimated that 90 per cent recovery of copper should be possible with a concentrate containing 25 per cent copper and under 7 per cent zinc (Hill, 1968). The results of flotation tests on zinc were said to be "very disappointing". With a concentrate grade of 43.2 per cent zinc, recovery was only 64.6 per cent and it was noted that, "Every attempt at higher grade resulted in lower recovery".

Mr. J.W. Joyce of Standard Metals has been familiar with the metallurgical characteristics of the Antler mineralization for some time. (Indeed, he designed the plant which was improperly operated in 1968. although he was then with an independent consulting firm.) In a verbal response to a question posed by the writer, Mr Joyce expressed some opinions about recoveries which might be summarized as follows:

Metals	Recoveries	
	Reasonably Readily Obtained (%)	Ultimate Objective (%)
Pb	70 - 75	Same
Cu	85 - 90	93
Zn	75 - 80	85

To be on the safe side, the lowest figures will be used in the esti mates presented below.

"Mill" Capacity and Life of Operation

Mr. R.C. Dwelley expressed to the writer the view that Standard believes the Antler deposit to be capable of supporting a plant treating 2,500 t.p.d., so this figure will be employed here. Later on, it may be found desirable to adjust this figure for optimum results. At any rate, it involves 750,000 tons per year (for 300 working days) and this, in turn, gives the following "life expectancies":

Class	Reserves Tons ($x10^6$)	"Life" (yrs)
"Calculated" (measured and indicated)	5.14	6.9
Inferred (at 50% of calculated)	2.6	3.5
Total (calc. & infer.)	7.6	Approx. 10.5

Freight, Smelting, Refining, Etc.

If the subject of freight, smelting and refining is considered, two questions present themselves, namely, whether or not the concentrates of an operation can be sold and, if they can, the value of the net smelter receipts. Since the first question seems to lie outside the province of this inquiry, it will be passed over and attention directed at the second.

For the purposes of this discussion it is assumed that concentrates of lead, copper and zinc, of acceptable grades and not subject to undue penalties can be produced.

Information supplied to the writer by Standard Metals shows that on lead concentrates shipped from an operation in the Southwest the cost of F.S. &. R. is 9.25 cents per pound of lead in the concentrate, leaving a net value to the mine of 16.25 cents per pound. Equivalent figures for zinc are: F.S. & R. = 19¢; and Net Smelter Value = 20¢.

Recent figures available to the writer indicate that the charges for F.S. & R. at Asarco's Hayden smelter range from 8.5 to 16.5 cents per pound of copper and that comparable figures for that same company's El Paso smelter are 10.5 and 16.5 cents. Short of actually shopping around in order to try to sell concentrates and actually negotiating a price, 16.5 cents per pound is believed to be a realistic figure, leaving a net smelter value of 47 cents per pound for copper.

The "pay" for silver would be greatly influenced by its distribution in concentrates. Since that is unknown, it is proposed to assume an over-all net smelter for silver of $2.00 per ounce in concentrates.

Operating Costs

Clearly, these figures can only be estimates, based on comparable operations. Since mines exploiting massive sulphide deposits are very rare in the United States, it is necessary to turn to Canada for suitable examples. It used to be thought that mining and some other costs in Canada were lower than their equivalents in the U.S., but that no longer seems the case and cost figures should be roughly comparable.

Total mine costs in 1974 in eleven mines in Canada exploiting massive sulphide deposits containing recoverable amounts of copper-zinc (lead) at a rate less than 1000 t.p.d. ranged from $9.36 to $20.38 with an average of $13.34. For mines treating between 1000 and 2000 the equivalent figures for last year were: 5 examples, a low of $5.88, a high of $19.66 (Buchans, Newfoundland) and an average of $10.22. These figures include development costs, but it is unclear to the writer whether or not they include underground exploration. Inevitably, all varieties of mining methods were used. The last figure ($10.22), rounded out to $10.00, seems reasonable in the light of U.S. experience.

Mill operating costs at six Canadian mines making two or three (lead-copper-zinc) concentrates range from 0.797 (for Brunswick Mining and Smelting at 10,000 t.p.d. capacity) to $4.63 (Buchans is the high again) and averaged $2.19. Mr. J.W. Joyce of Standard expressed the opinion based on his knowledge of the Antler metallurgy that milling costs in the range $2.25 to $2.50 should be attainable. It is proposed to use this last figure of $2.50 per ton.

Finally, on the subject of operating costs, it is thought that $4.00 per ton should suffice to pay for the necessary services, maintainance, administration, and so on.

Total operating costs are therefor placed at $16.50 per ton.

Capital Costs

In 1969 at the present writer's request Mr.J.W. Still, Consulting Mining Engineer, estimated the cost of placing a steeply dipping massive sulphide deposit in production at the rate of 2000 t.p.d. These figures are shown in Table 7, Column 2.

According to Marshall and Stevens "Indices of Price and Costs", the cost of Mine and Mill Plants has increased 5.75 per cent during the last 5 or 6 years and Chemical Plants between 6 and 6.25 per cent per annum in the same period. Applied to Still's estimate (Table 7, Column 3) these figures indicate a total capital requirement for 2000 t.p.d. capacity of $18,967 million, of which $15,297 million is amortizable. If the fairly crude assumption is made that costs are directly proportional to size, the cost for a 2,500 t.p.d. mine and mill will be $23,709 million.

It may be noted that this figure compares very closely with Dwelley's (1975) estimate of $23,165 million. However, the latter includes $500,000 for drilling, allocates $6.6 million for interest and refers to 3,000, rather than 2,500 t.p.d. capacity. Relative to the writer's estimate, it "saves" roughly $2.9 million by employing a decline instead of two shafts for access and ventilation.* Obviously, individual amounts

* The writer's use of cost figures for conventional mining is not intended as a criticism of Dwelley's suggestions to adopt inclined shafts and track-less equipment. On the contrary, the writer tends to favour the latter

TABLE 7 - *Estimated capital cost of 2,000 t.p.d. mine and mill (modified after J.W. Still, 1969).*

ITEM	1969 - Column 2 ($$10^6$)		1975 - Column 3 ($$10^6$)	
	AMOUNT	CUM.	AMOUNT	CUM.
AMORTIZABLE				
Mine				
Development				
Main shaft	1.845		2.617	
Ventilation shaft	1.300		1.844	
Stations and pockets	.250		.355	
Haulage levels	.250		.355	
Stope preparation	.500		.709	
Sub-total	4.145	4.145	5.880	5.880
Equipment				
Surface plant	.629		.892	
Underground equipment	1.113		1.579	
Sub-total	1.742	5.887	2.471	8.351
Mill				
Major equipment and bldgs. ($2,000 per t.p.d. cap.)	4.000	9.887	5.674	14.025
Miscellaneous				
Engineering fee	.182		.258	
Contractor ditto	.715		1.014	
Sub-total	.897	10.784	1.272	15.297
Total Amortizable		10.784		15.297
NON-AMORTIZABLE				
Working capital	2.288	2.288	3.245	3.245
Warehouse inventory (mine and mill)	.300	2.588	.425	3.670
Total Non-amortizable		2.588		3.670
TOTAL CAPITAL REQUD - 2000 tpd (i.e., amort. and non-amort.)		13.372		18.967
FOR 2,500 t.p.d. ASSUME:				
Amortizable				19.121
Non-amortizable				4.587
Total				23.709

approach, drilled ventilation raises, and so on, but feels that the cost figures should be compared by someone more competent than himself to do so. Both methods should be evaluated in a detailed feasibility study.

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could be adjusted up or down, but the averall figure of $25 million seems to be of the right order of magnitude. By way of general support for this conclusion the capital cost of $36 million for the recently completed 3,000 t.p.d. Sturgeon Lake development might be cited.

Depletion

Depletion allowance is 15 per cent of net smelter receipts for silver and copper and 22 per cent for lead and zinc.

Taxes

In Arizona, as elsewhere, the tax situation is complicated but, in a study prepared for the Arizona Mining Association, George Leaming concluded that, in effect, Federal taxes amount to some 5.8 per cent of the value of "output" (whether concentrates or finished articles - roughly, net smelter receipts) and state and local taxes some 7.4 per cent, for a total of 13.2 per cent of N.S.R. It should be borne in mind, however, that most of the examples studied are porphyry copper deposits exploited in open pits. The results may not be applicable to the Antler. The other generalized figure used to estimate taxes is to put Federal, State and local taxes at 50 per cent of taxable income. This figure will be employed here, but it is clearly susceptible to refinement.

Financial Analysis

Based on these factors, then, the profit and cash flow which might be generated by 1 ton of ore was estimated (Table 8). The calculation indicates a profit per ton of $7.29 and, when the sum allowed for amortization of capital is added, a cash flow per ton of $10.62.

TABLE 8 - *Estimated per-ton profits and cash flows for different bonus and royalty payments, Antler mine, Mohave Co., Arizona*

	NO ROYALTY		ROYALTY			
			5% NSR		10% NSR	
	AMT.	CUM.	AMT.	CUM	AMT.	CUM.
GROSS INCOME						
Ag - 0.95x50%x433¢ = 2.05 Pb - 17#x70%x24.5¢ = 2.91 Cu - 35#x85%x63.5¢ = 18.89 Zn - 74.4#x75%x39¢ = 21.76 Total = 45.76	45.61	45.61	45.61	45.61	45.61	45.61
Less F.S.R.						
Pb - 17#x70%x8.26¢ = 0.98 Cu - 35#x85%x16.5¢ = 4.90 Zn - 74.4#x75%x19¢ = 10.60 Total = 16.48	(16.48)		(16.48)		(16.48)	
NET SMELTER RETURN.		29.13		29.13		29.13
Less Operating Costs						
Mine - 10.00 Mill - 2.50 Other - 4.00 Total = 16.50	(16.50)	12.63	(16.50)	12.63	(16.50)	12.63
Less Royalty	0	12.63	(1.46)	11.17	(2.91)	9.72
Less Amortization	(3.33)		(3.33)		(3.33)	
NET INCOME		9.30		7.84		6.38
Less Depletion						
Pb - 22% NSR = .42 Zn - " " = 2.45 Cu - 15% " = 2.10 Ag - " " = .31 Total = 5.28	(5.28)		(5.28)		(5.28)	
TAXABLE INCOME		4.02		2.55		1.10
Less Fed., State and local Tax - 50% taxable income	(2.01)		(1.27)		(0.55)	
NET PROFIT		2.01		1.27		0.55
Plus Depletion	5.28		5.28		5.28	
PROFIT		7.29		6.55		5.83
Plus Amortization	3.33		3.33		3.33	
CASH FLOW		10.62		9.90		9.17

By employing the factors already discussed and making some fairly broad assumptions (e.g., regarding the development and construction schedules and, hence, the rate of capital expenditures) the cash flow over the duration of the operation can be "guestimated" in order to appraise the significance of the estimated cash flow relative to expenditure (Table 9). The information given in Table 9 is summarized graphically in Figure 14, in which it is easier to interpolate the "break-even" or "payback" points for "straight" and discounted cash flows, namely, 5.1 and 7.6 years, respectively. Both the table and figure show that the net present value of the cash flow discounted at 10 per cent is $9,646 million.

A further table (Table 10) shows that the discounted cash flow rate of return on investment is approximately 15.5 per cent.

Ideally, of course, this process should be repeated for different plant capacities and capital outlays in order to determine the optimum size of an operation.

The fact that the estimated D.C.F. R.O.R. (or R.O.I.) of 15.5 per cent is close to the number that mining companies commonly seek should not be taken too literally: the range of possible error in many of the assumptions made is such that the actual figure could differ quite markedly from the calculated percentage. It should be recalled that the purpose of this study was to estimate the potential of the Antler in general terms only and, in the event that Standard should decide to seek a participant in a development program, to try to derive some parameters for the terms of a joint venture.

So far as the first objective is concerned, the factors derived indicate that - at the very least - the Antler deposit does possess sufficient potential to justify additional investigation. So far as the second goal is concerned - the derivation of same guidelines for a joint venture agreement - the D.C.F. R.O.R. was calculated for two

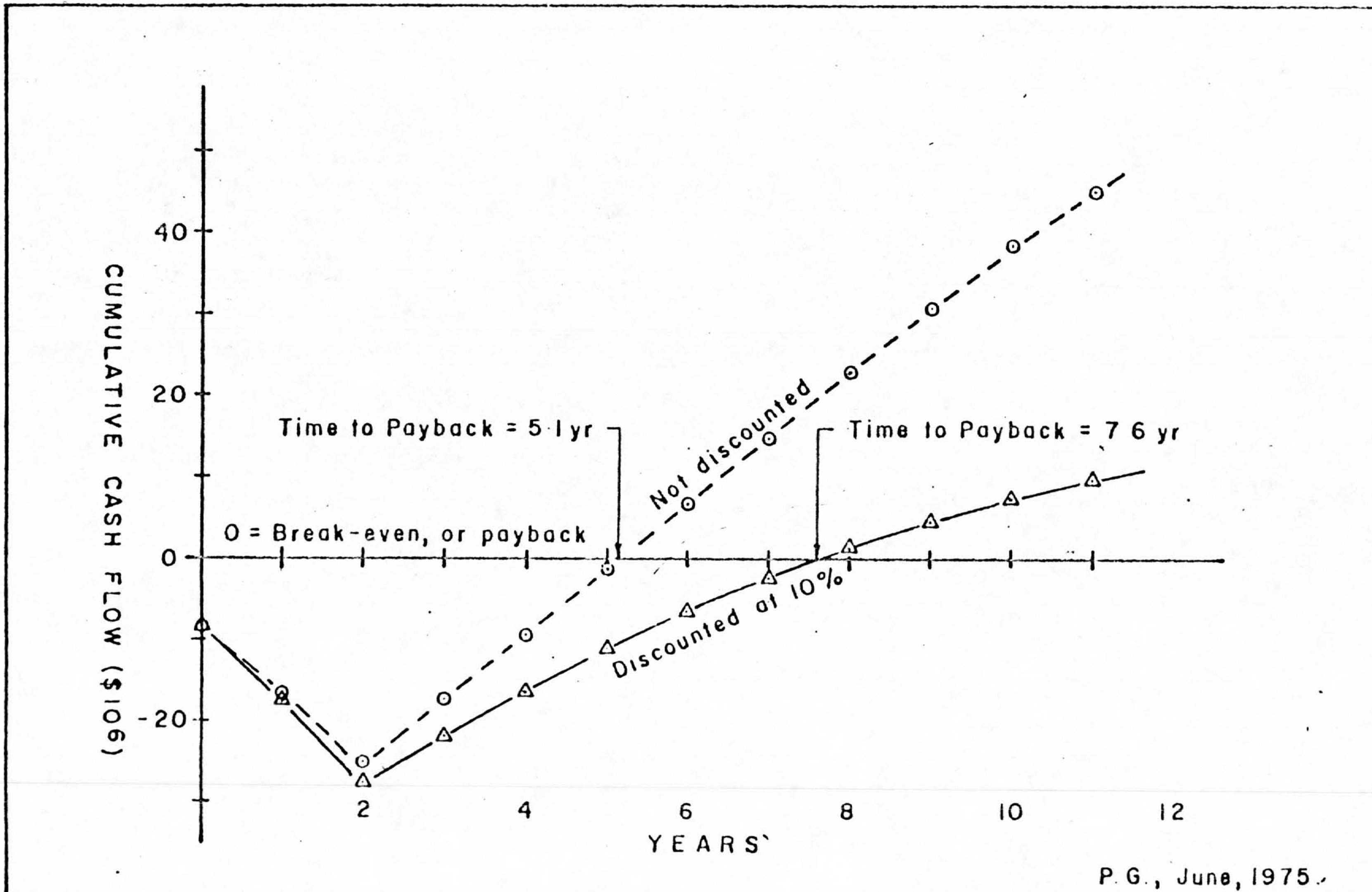

Figure 14 – Graph showing "straight" and discounted cash flows (at 10%) and corresponding times to payback.

Fig. 14. – Follows p. 25

different sets of conditions, namely, "bonus payments", on signing an agreement, of $500,000 and $1,000,000 and royalties (on the net smelter receipts) of 5 and 10 per cent, respectively.*

The actual calculations, which are standard in form, have been omitted and the results are summarized in Table 11 and, graphically, on Figure 15.

Depending on the accuracy of some of the assumptions and estimates employed, the actual D.C.F. R.O.R. may change. However, the general shape and slope of the curve in Figure 15 would remain roughly the same. The figure shows that in the range of values involved (a D.C.F. R.O.R. of 10 to 20 per cent) $500,000 and 5 per cent increments in bonus payments and royalty on N.S.R., respectively, reduce the D.C.F. R.O.R. by about 1.75 per cent.

It is believed that this type of presentation might be used in one of two ways: for example, Standard might say that, considering what it has spent on the Antler property, it could not accept less than $900,000 down and a 9 per cent (Net Smelter) royalty. That means a participant could not expect more than 12.75 per cent R.O.R. Alternatively, a potential participant might, for the sake of illustration, say it could not live with less than, say, 14.5 per cent. In agreeing to that condition, Standard would be alloting itself $480,000 and a 4.8 per cent royalty.

These figures are not in themselves believed to represent the final word on the subject. The estimates on which they are based are all susceptible to considerable refinement. They are used merely to illustrate a presentation of the financial expectations which might be useful in negotiations. So far as the absolute value of the numbers are concerned, the writer believes that - with the sole exception of the 2.5 million tons or inferred or probable reserves - all of the assumptions and estimates which have been made have tended to be conservative and,

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* Dwelley (1975) allowed for the bonus payments to be recovered by the venture partner out of royalties by means of a suitable formula. This was not done here, although the effect(s) could very easily be calculated.

TABLE 9 - *Estimated order of magnitudes of "straight" and discounted cash flows over the potential duration of the Antler deposit.*

YEAR	ALL FIGURES IN $MILLIONS			
	CASH FLOW	CUM. CASH FLOW	PRES. VALUE DISC. AT 10%	CUM. PV AT 10%
0	(8.333)[1]	(8.333)	(8.333)	(8.333)
1	(8.333)	(16.666)	(9.166)	(17.499)
2	(8.333)	(24.999)	(10.083)	(27.582)
3	7.965[2]	(17.034)	5.984	(21.598)
4	7.965	(9.069)	5.454	(16.144)
5	7.965	(1.104)	4.946	(11.199)
6	7.965	6.861	4.496	(6.703)
7	7.965	14.826	4.087	(2.616)
8	7.965	22.791	3.716	1.100
9	7.965	30.756	3.378	4.478
10	7.965	38.721	3.071	7.549
11	5.983[3]	44.704	2.097	9.646

Notes: 1. - Assume $25 million spread evenly over three years.

2. - 2,500 t.p.d. for 300 days, per annum.

3. - 0.5 yr. production, plus approximately $2 million equipment salvage.

Follows p. 26

Antler report

TABLE 10 - *Estimated potential discounted cash flow rate of return on investment, Antler deposit.*

YEAR	CASH FLOW	DCF INCOME AT 16%	CUM. DCF INCOME AT 16%	DCF INCOME AT 20%	CUM. DCF INCOME AT 20%
0	(8.333)	(8.333)	(8.333)	(8.333)	(8.333)
1	(8.333)	(9.166)	(17.499)	(9.166)	(17.499)
2	(8.333)	(10.083)	(27.582)	(10.083)	(27.582)
3	7.965	5.103	(22.479)	4.604	(22.978)
4	7.965	4.399	(18.080)	3.839	(19.139)
5	7.965	3.792	(14.288)	3.202	(15.937)
6	7.965	3.269	(11.019)	2.667	(13.270)
7	7.965	2.818	(8.201)	2.223	(11.047)
8	7.965	2.429	(5.772)	1.856	(9.191)
9	7.965	2.094	(3.678)	1.544	(7.647)
10	7.965	1.805	(1.873)	1.286	(6.361)
11	5.983	1.169	(0.704)	0.805	(5.556)

Say, 15.5 %

Follows p. 26

TABLE 11 - *Showing how estimated D.C.F. varies according to terms imposed.*

CONDITIONS	D.C.F. R.O.R. %
None (no bonus, no royalty - e.g., Standard alone)	15.5
Bonus of $500,000 and royalty of 5% N.S.R.*	14.0
Bonus of $1,000,000 and royalty of 10% N.S.R.	12.25

* Standardised calculations omitted from report.

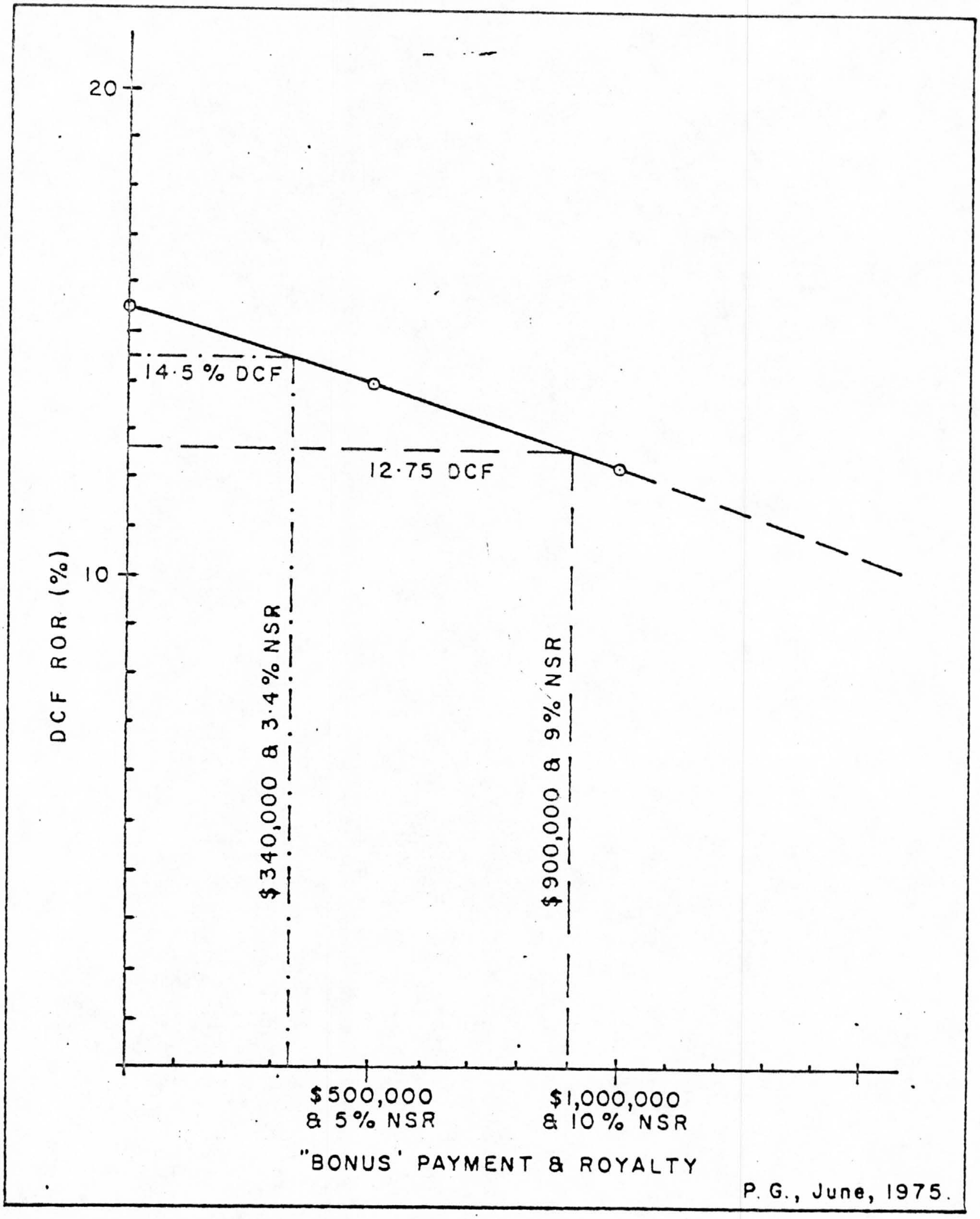

Figure 15.– Graph showing the effect which "bonus" payments and royalties have on the discounted cash flow rate of return.

consequently, to lower estimated rates of return (and, therefor, margins for levying royalty, etc.).

In this regard, one other estimate would, it is believed, be useful. The rates of return estimated thus far have considered either no royalty (i.e., as the economics might appear if Standard Metals developed the deposit unaided) or less various royalties (i.e., as the economics might appear to a venture partner). Table 12 shows "the other side of the coin" of the latter calculations - that is to say, the net present value to Standard of the bonus payments and royalties already considered. The comparison of the figures shown in Table 12 with the N.P.V. of the estimated cash flow - sans royalty - shown in Table 9 is instructive.

Finally, it might be useful if Standard were to estimate the net present value of all past expenditures and potential future income associated with the Antler - inflating the former as though otherwise invested and discounting the latter in keeping with the fact that they are still in the future.

CONCLUSIONS AND RECOMMENDATIONS

The writer does not believe that a consultant is entitled to make policy decisions for a client, even if he were able to do so: his obligation is to provide opinions or information which may help management to make them. In the case of a feasibility study it is difficult for an outsider to reach firm conclusions - certainly not without considerable "feed back" - since he is not privy to some information (such as the client's cost of borrowing money or minimum acceptable rate of return on investments) required to do the job properly.

Judged in the light of the writer's experience of the "habit", or mode of occurrence, continuity (or lack of it), amenability to mining and metallurgical treatment, etc., of massive sulphide deposits the Antler stands an excellent chance of providing a reasonable profit - certainly

TABLE 12 - *Estimated net present value of bonus payments and royalties.*

YEAR	$500,000 & 5% NSR			$1,000,000 & 10% NSR		
	CF	DCF	CUM.	CF	DCF	CUM.
	($\$10^6$)	@ 10%	DCF		@ 10%	DCF
0	.500[1]	.500	.500	1.0[1]	1.0	1.0
1	0					
2	0					
3	1.095[2]	0.822	1.322	2.183[3]	1.639	2.639
4	1.095	0.748	2.070	2.183	1.491	4.130
5	1.095	0.680	2.750	2.183	1.356	5.486
6	1.095	0.617	3.367	2.183	1.231	6.717
7	1.095	0.562	3.929	2.183	1.120	7.837
8	1.095	0.511	4.440	2.183	1.019	8.856
9	1.095	0.464	4.904	2.183	0.925	9.781
10	1.095	0.421	5.325	2.183	0.840	10.621
11	0.547	0.192	5.517	1.091	0.383	11.004

Notes - 1. Bonus payment
2. \$1.46 (5% NSR) x 750,000 (t.p.yr.)
3. \$2.91 (10% NSR) x 750,000 (t.p.yr.)

good enough to warrant additional investigation.

It is therefor recommended that Standard give serious consideration to the conduct of a detailed feasibility study, including, of course, the requisite engineering and metallurgical investigations. The Research and Development Section of Mountain States Engineers of Vail, Arizona, estimates that such a study would cost around $35,000 to $40,000. This would include metallurgical test work, development of a flow sheet and mining plan, estimate of capital and operating costs and a financial analysis. It was emphasized that, owing to the highly uncertain outlook for price, capital costs are being presented with the proviso that they could end up 5 per cent lower or 25 per cent higher than estimates. The actual cost of the feasibility study would largely depend on the completeness or otherwise of the data made available (the presence or absence of "a complete set of mine sections" was specifically noted) and the complexity of the metallurgy.

Considering what Standard has spent on the Antler to date, the acquisition of a detailed feasibility would seem worthwhile - either for the Company's own consideration or as an aid to negotiations with potential venture partners.

Alternatively, Standard might wish to avoid additional sizable expenditures at the present time and to find a prospective partner to undertake such a study, perhaps under a suitable option agreement.

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"UPDATE" OF REPORT ON ANTLER MINE
PREPARED FOR STANDARD METALS IN 1975

SUMMARY

The following notes represent an informal "update" of my 1975 report on the Antler mine (Mohave Co., Arizona) prepared for the owners, Standard Metals Company.

No fundementally new information has been acquired since the previous report was written and these notes were chiefly based on an examination of cores of critical drill-holes [redacted] and a re-consideration of "old" data, recent developments in the mining industry and other general factors.

It is believed that the massive sulphide mineralization revealed by exploration and, especially, by the deep, B-series of holes represents a viable target which, under the appropriate circumstances, deserves further exploration.

Accordingly, it is recommended that consideration be given to acquiring the exploration/exploitation rights, compiling anew the existing data and drilling at least two moderately deep (2,000 - 2,500 ft) holes. Experience suggests that (a) the drilling would require about 5 or 6 months, plus whatever time is required for negotiation, making a total of, say, 1 year; and (b) cost not less than $125,000, plus legal fees ($25,000?) and lease payments (to be determined by negotiation and mutual agreement?).

INTRODUCTION

General Statement

This informal "update" of my 1975 report on the Antler mine was written at the __ quest of after we had spend a day examining drill core and outcrops in the Antler area and a day in the Jerome-Humboldt-Mayer area. I am glad to have this opportunity to comment on the aspects of the report which, on re-reading today, seem to me to require justification and/or explanation. I refer to the optimistic attitude toward metal prices and demand which is expressed and the objectives of the report.

Attitude Toward Copper

Strictly speaking, an economic or engineering estimate should of course be perfectly objective, entirely independent of the prevailing political and economic climate, but when estimating chances and probabilities, outlook for future demand, etc., it is impossible to divorce oneself entirely from sociological factors, whether they are favourable or unfavourable. I am slightly chagrinned when I read today some of the judgements I made in preparing the earlier report. Yet 1974 was a time when eminent spokesmen for the U.S. copper industry like Mr. George Monroe, Chairman of Phelps Dodge, were saying that they did not know how the copper industry was (a) going to be able to meet the surging demand for copper and (b) find the capital needed to build the necessary plants in order to try.

Objectives of Report

Standard Metals, my client, asked me to prepare a *feasibility* study of the *potential* of the Antler and to lay out some guidelines for the form which a joint venture might take.

The first requirement contains an internal contradiction. "Feasibility" refers to what can be done with an existing asset; whereas "potential" refers to what seems possible, although not established at the time of writing. I regret that I did not employ a term like "trial" or "model" (feasibility) in the title. As it was, I took it upon myself to point out that there were not, in my opinion, sufficient data on which to base a feasibility study (sampling, metallurgical and mining-engineering studies, investigation of potential buyers of concentrates, etc.), although - again, in my opinion - the seeming potential was sufficient to warrant the acquisition of the required information (including drilling). I still feel that way (and I will elaborate the point below). As to the second aspect of my assignment - to establish some guidelines for a joint venture - Mr. Richard Dwelley stated Standard's initial terms (a "bonus" payment of between $1,000,000 and $500,000 and 7% NSR royalty). It would be more accurate to say that I investigated what impact Standard's *proposed* terms would have on the profitability of an operation (and not that I had suggested these terms). I implied in the report (and told Mr. Dwelley personally) that I thought the proposed conditions were too onerous and should be modified downward - lest they deter potential purchasers or partners. And I still feel that way, too.

THE PRESENT STATUS

General

Except for what has happened in the interim to metal prices (and perhaps Standard's "asking price"?) nothing at the Antler has changed - that is to say, no new information has been acquired which has a bearing on its value or on the estimation of its value.

On Saturday May 28th and I studied the cores from a number of diamond drill holes, notably the B-series, drilled from surface in 1975; some S-holes, also drilled from surface in previous years; and a couple of holes prefixed U- that were drilled from underground prior to 1975.

Based on this examination, I concur with the suggestion first made by that, considering the distribution of chloritic alteration, base- and precious-metals and lithologic units, both the layered rocks and the sulphides probably "face" or "young" toward the south-east and not the north-west (as I had, somewhat tentatively, previously proposed).

This examination of the drill core also showed that the earlier distinctions, made on the basis of the drill logs and assays, between the Hangingwall (Hw) and Footwall (Fw) zones of mineralization (in their present attitude) was for the most part probably sound, the main remaining ambiguities involving DDH B-1 and B-4 (and they are relatively unimportant, since the intersections are narrow).

While preparing this update a couple of minor steps, not taken before, were adopted: different "breakdowns" of the relatively long mineralized intersection in DDH B-6 were tried, and the polygons in the longitudinal sections used in mineral reserve estimates were colour-coded on the basis of width.

DDH B-6

For the purposes of mineral reserve estimation (previous report, Figures 12 and 13) the Hw and Fw mineralized zones were said to have joined or "coalesced" in DDH B-6, and were treated as one. It would perhaps have been more accurate to say that in B-6 the two mineralized zones lies close together and therefor reflect the tendency visible throughout the mineralized areas for the two zones to converge toward the north in the deeper levels.

In keeping with this view the assays were recalculated for the Hw zone alone (rather than for both zones and the intervening low-grade mineralization). This is shown in the enclosed revised Figure 6 from the 1975 report. It may be seen that although useful from a geological standpoint - to help distinguish the two zones, for example - dropping the narrow, high-grade Fw zone would be a poor policy from a practical standpoint, since doing so results in reductions in both the width and grades of the values in copper and zinc. ...

The Form of the Two Zones

In order to better depict the distribution of mineralization between and within the two zones, the polygons constructed for reserve calculations were colour-coded to reflect thickness (see attached Figures 12 and 13 from previous report). It would have been better still to represent (by means of polygons or contours) variations in the "quality" or "strength" of mineralization obtained by multiplying the thickness by the "value" (expressed in terms of either "metal equivalents" or $ values derived by multiplying the assays for each metal by a factor based on the estimated New Smelter Returns for the same metals).

At any rate, even the simplified coding of Figures 12 and 13 illustrates very clearly some of the properties of the mineralized zones that may be inferred from the relevant numbers:

1. - The distribution of thickness within the two zones is reasonably uniform - or accords with fairly regular patterns - rather than being highly erratic.

2. - In terms of both thickness and lateral extent, along strike and down-dip, the Hw zone might be described as the "stronger" or better developed of the two.

3. - Both zones contain two "shoots" which occur toward the north end of the mine area, or the mineralized area, and plunge very steeply toward the north.*

4. - The nature of the terminations along strike of the better mineralization or shoots differs as between north and south: traced

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* The origin and meaning of the term "shoot" is easier to understand if the old spelling, "chute", is employed.

northward the widths and/or values diminish rapidly; toward the south, although the widths of the main lenses rapidly diminish, the values remain moderately high, so that two well-defined, narrow zones of moderately good grade may be traced for a considerable distance along strike. (The nature of the terminations in the other dimension, namely, up and down, are, of course, respectively, eroded and unknown.)

5. - One hole, the deepest drilled to date, or B-6, suggests that the width of the mineralization may be increasing downward. B-6 intersected some 35.5 feet (horizontal width), if the Hw zone is considered, and 50.5 feet (again measured horizontally), if both zones are included. The grade, however, is not spectacular and is not much improved by breaking the assays so as to produce narrower widths. The extent of this mineralization along strike and down-dip is not known.

Before proceeding further it is necessary to digress briefly to discuss a very important point. It might be argued that, considering the local variations in thickness and grade of the sulphides in the two mineralized zones (which were encountered in both the underground openings and close-spaced drilling of the upper levels), little reliance can be placed on the results of the widly-spaced deep (B-series) drilling. While there undoubtedly are grounds for such an objection, the fact is that - with one exception which has been mentioned above and will be discussed again below - the results obtained by the deep drilling accord with what is known about the upper levels, and, in the absence of more detailed and/or contradictory data suggests the drilling results are reasonably representative.

DISCUSSION

General

The reason for the foregoing exposition was of course to "set the scene", as it were, or establish the salient facts on which an evaluation of the prospect must be based. It might be useful to summarise what I regard as the main "pros" and "cons", favourable and unfavourable features, of the Antler - dealing with the latter first.

Unfavourable Considerations

Quite apart from the fact that it would obviously be "nice" if, for example, the grade and width were greater or the depth to the B-6 mineralization less, other unfavourable factors are:

1. - The short strike length of the principal sulphide lenses. This, in turn, means that development costs would be high and the mining rate limited. Between 2,900 ft and 1,800 ft (elevations) the Hw zone contains about 1,000 tons per vertical foot. With a level interval of 150 ft, a mining cycle of 1 level per year and 300 working days in a year, an appropriate milling rate would be about 500 s. tons per day. Production from the Fw zone might add a little to this figure, but not much. Between 1,200 and 1,700 (*based on one DDH B-6*) the reserves are around 3,300 s. tons per vertical ft, permitting a milling rate of around 1,650 s. tons per day. Neither figure would be liable to amortise the required capital investment, although the larger would obviously be a very great improvement.
2. - Sampling - ie, drilling - of the deeper levels is extremely sketchy, and reserve estimates are of a correspondingly low order of reliability.
3. - Metallurgical recoveries obtained to date are poor - surprisingly so, considering the relatively coarse grain-size of the sulphides.

Since the metallurgical tests and brief production run were badly executed, the final impact of this factor is difficult to evaluate.

4. - Small to medium-sized underground mines are rare in the U.S. Southwest and, accordingly, miners, staff and mining equipment are relatively difficult to obtain (in contrast with, say, the Canadian Shield).

Favourable Considerations

Apart from the fact that the Antler constitutes a "target" of a type much in demand these days, the leading favourable factors are as follows:

1. - The deepest hole drilled to date - B-6 - obtained the best, or one of the best, intersections encountered to date - it is certainly the longest (widest).

2. - The mineralization intersected by B-6 is "open", or the lateral and depth extents have not been defined.

3. - The mineralization is relatively coarse-grained. Even though the recoveries and concentrate grades achieved to date have been poor (see Item 3 above), this factor must be favourable in the long run.

4. - The property is close to an excellent (limited-access, etc) inter-state highway and reasonable communities, one of which, Kingman, already serves Duval's Ithaca Peak open-pit mine; had (has?) a water supply, etc. Thus, relatively little infrastructure would have to be provided.

In some respects the evaluation of the property boils down to the resolution of an apparent paradox, a contradiction; on the one hand, the results of the wide-spaced B-series of holes are believed to be reasonably representative, because they generally conform to earlier findings based on more detailed information; and, on the other, the merits of the property as a prospect depend on the fact that one of the B-holes - B-6 - is better than (*ie, different from*) those above.

The answer to this contradiction is believed to lie in the manner in which the results obtained in B-6 are different from those encountered in other holes. The mineralization encountered in B-6 differs from, improves upon, the mineralization revealed by other sources in an "orderly" or "understandable", rather than random, manner.

The point is so critical to the evaluation of the Antler that it is worth expanding. Had the intersection obtained in B-6 been encountered further south, say beneath B-1, one would have had to admit that it differs markedly in width, spacing between the two zones, etc, from the mineralization explored by the work carried to shallower levels. It would then have been difficult to assert that the intersections obtained in the B-holes seem to have a reasonable chance of being representative of a sizable volume of rock. In fact, the style of mineralization revealed by B-1 through 8 accord very well with what was found above: the two zones converge toward the north at depth and the wide intersection cut in B-6 lies beneath the two shoots in the Hw and Fw zones, and so on. Accordingly, it seems reasonable to conclude both that the results are probably fairly representative and that the intersection in B-6 suggests an increase in width in the shoot in the Hw zone and could reflect a systematic improvement downward. This is, admittedly, reading a lot into 8 - and, especially, 1 - drill holes, but they are all the deep information available and they must be exploited to the utmost.*

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* This situation reminds me of a time when, explaining proposals for a deep drilling program beneath the lower levels of a mine and arguing in favour of as many holes as possible, I concluded, "One never has enough drill holes". The President of the company fixed me with a look and replied, "If we had enough drill holes, we wouldn't need geologists!".

CONCLUSIONS & RECOMMENDATIONS

To a large degree exploration, including property evaluation, is a matter of priorities - of rating available prospects and projects and then undertaking further work on those which are considered most attractive. Needless to say, the criteria used in these comparisons are many and varied in nature and include estimated quality of the prospect or project, cost of acquisition of mineral rights, cost of exploration, size and type of potential (non-metallic, metallic, precious- or base-metals, etc). Some of these, such as other projects and funds available, preferred targets, are generally unknown to an "outsider", while the cost of acquiring the Antler property was not known to any of us who visited the prospect on April 29th - company personnel included. It follows, that these conclusions and recommendations merely represent the view of one individual of a single prospect, considered as nearly as possible in isolation. They are, as a result, put forward tentatively and in the full knowledge that they are likely to be modified in the light of the company's requirements, new information, and the like.

It is always easy to find reasons for rejecting a prospect, and the Antler is no exception: any one of the "cons" listed above would probably suffice. Still, some "pros" are listed too, and, when the difficulty and cost of finding half-way decent prospects are considered, I believe that the Antler deserves some additional work, if the mineral rights can be acquired on reasonable terms. Only then can it be ascertained if they are acceptable, amenable to negotiation or hopelessly "out of line" with the Company's requirements.

The most important additional information required is obviously more deep drilling. A couple of holes, one on each side of B-6, would seem to be about the minimum work worth undertaking. Since B-6 was 2,201 ft deep, between 4,500 and 5,000 feet would be called for. At a direct cost of around $20 per foot, this drilling would therefor amount to some $100,000 - plus, of course, the cost of sampling, assays, supervision, and analysis of results.

Assuming that this point is reached, Standard's records should be put into the best possible shape (along the lines proposed in my 1975 report?) before commencing the actual drilling. The preparation of standard or routine mine plans and sections might take around 4 to 6 weeks of a professional geologist's time (less with a qualified draftsman?), and another 2 weeks should be allowed for experimenting with non-standard presentations and data-analysis. Depending on the seniority and salaries of those involved, this preliminary work would cost at least $5,000 and it might be worth allowing for the expenses of a visit to the Antler to check, say, specific points in the drill cores.

The Standard holes for which commencement and completion dates were given were drilled an an average rate of 35 ft per day, inclusive of weekends (not just working days). On this basis, it would take 143 days, or nearly five months, to drill 5,000 ft with one machine. The cost of supervision could be estimated accordingly.

The cost of the contemplated program would therefor be around $125,000, plus legal fees, assaying and overhead, for a total of approximately $150,000.

4th May, 1979
Tucson, Arizona

Signed:

Paul Gilmour

MARCH 1982

76.0360 - II
Bulge Prospect

Notes - Gilmour Report

EM conductor located 2 mi. NE of Antlers Mine; approximatley on same zone as Copper World Mine.

-------- Determine linear structure in this vicinity.

Smelter charges 1974

Pb	FS&R		(AS&R Hayden)	NSR 16.25¢/#
Zn	"	19¢/#		NSR 20¢/#
Cu	"	16.5¢/#		NSR 47¢/#
Ag		$2.00/T credit		

Mining Costs 1974 Based on eleven Canadian massive sulfide ops.

<1000 tpd $9.36 to $20.38 AVG. $13.34
1000-2000 tpd $5.88 to $19.66 AVG. $10.22

These include development cost.

Mill costs	1974	(AVg of six Canadian mills)
$0.797	@ 10,000 tpd	to $4.63 AUG $2.19

Operating Costs

$4.00 est. to pay for the necessary services, maintenance, administration, etc.

TOTAL COSTS

Est. $16.50/T Net Smelter Value $26.00 (Union Minere)

Evaluation

Feasibility = What can be done with an asset

Potential = What seems possible, although not established at the time of writing.

Capital Costs

J. W. Still	1969	2000 tpd.	$18.967 million
Dwelley	1975	3000 tpd.	$23.165 million

including $500,000 for drilling
$6.6 million for interest

Uses a decline instead of two shafts for access and ventiliation.

The above costs should be evaluated in a detailed feasibility study.

Depletion

15% of NSR Ag & Cu
22% of NSR Pb

Taxes

estimate Federal, State, and local taxes at 50% of taxable income.

Financial Analyses

Profit/T	est. @	$7.29
Amortization/T	est. @	$3.33
Total Cash Flow		$10.62

NSR = Gross Income minus F.S.R.
= $45.61 - $16.48 = $29.13 (6.387%)
(NSR approx. 2/3 of Gross Income)

Less Operating Costs

Mine	10.00/T
Mill	2.50/T
Other	4.00/T
	$16.50/T

	5% NSR	10% NSR
Less Royalty	1.46	2.91
Less Amortization	3.33	3.33
Net Income	7.84	6.38
Less Depletion		
Pb - 22% NSR	$0.42	
Zn - do	$2.45	
Cu - 15% NSR	$2.10	
Ag - do	$0.31	
	$5.28	
Taxable Income	$2.55	$1.10

Less Fed. State, Local		
Taxes - 50% of taxable income	(½ x 2.55)	(½ X 1.10)
	\$1.27	\$0.55
Net Profit	\$1.27	\$0.55
Plus Depletion	\$5.28	\$5.28
Profit	\$6.55	\$5.83
Plus Amortization	\$3.33	\$3.33
Cash Flow	\$9.90	\$9.17

5.137 X 10^6 Tons measured & indicated
Averaging: 1.05 Ag, 0.94% Pb, 1.95% Cu, 4.13% Zn
Deposit open @ depth with no diminuition in deepest drill holes.

"Measured", "indicated" plus "inferred" from 7.6 to 10.1 X 10^6 tons.

P.3 Gilmour Report (Update Report)
------- "drill logs, mine plans, sections must be put in "top notch" shape for presentation.

Has this been done??? WHC

Quote Gilmour p. 3 "As it was ------