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DRILLING AND SAMPLING
Mission (East Pima) and
San Xavier Projects,
Pima County, Arizona

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona
October 31, 1958

Mr. T. A. Snedden, Manager
Southwestern Mining Department
American Smelting and Refining Company
813 Valley National Building
Tucson, Arizona

DRILLING AND SAMPLING
Mission (East Pima) and
San Xavier Projects,
Pima County, Arizona

Dear Sir:

Accompanying is a report on the above subject prepared under the supervision and editing of Mr. Courtright and me.

Mr. Samuel C. Fall and Mr. Jackson L. Clark prepared the tabulations on cost, performance and other data, and wrote portions of the text. Others who made significant technical contributions to the conduction of the drilling and sampling program were Messrs. Keith Papke, Jarvis Klem, Byron Hardie, and John Kinnison.

The report has two purposes: It can serve as reference for those conducting similar work, and it provides the fundamental information on sample accuracy needed to support ore reserve calculations. Considerable detail has been included in an effort to make the report useful in both categories.

Yours very truly,

Original Signed By
K. Richard
KENYON RICHARD

KR:S
cc: DJPope - 2 copies
LHHart - 2 copies
RJLacy
ACHall
JHCourtright
SCFall

DRILLING AND SAMPLING
Mission (East Pima) and San Xavier Projects
Pima County, Arizona

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INTRODUCTION

This report covers the drilling and sampling procedures and equipment, the sample processing, and the costs of this work on the Mission (formerly East Pima) and the San Xavier Projects. Also included are methods used in compiling and analyzing the sample data.

Summary of Drilling Performance and Costs:

		Mission	San Xavier	Combined
Total Footage:	Core Drilling (1)	85,589.2'	29,307.6	114,896.8
	Rotary Drilling (2)	46,875.6	24,619.2	71,494.8
	Churn Drilling	5,513.0	-	5,513.0
	Total Drilling	137,977.8	53,926.8	191,904.6
Number of Holes Drilled		239	106	345
Average Hole Depth		577.3'	508.7	556.2
Range of Hole Depths		161.5-1501.8'	75.9-1637.9	75.9-1637.9
Average Core Recovery:				
	Within Ore Body	91.2%	-	-
	Total Core Drilling (1)	88.5	86.3	88.0
Average Advance per 8 Hrs. Drilling Time (3):				
	Core Drilling (1)	17.6'	20.0	18.2
	Rotary Drilling (2)	125.8	136.8	129.4
	Churn Drilling	21.4	-	21.4
	Total Drilling	25.1	32.8	26.1
Average Advance per 8 Hr. Shift (4):				
	Core Drilling (1)	13.3'	14.8	13.7
	Rotary Drilling (2)	105.9	106.0	105.9
	Churn Drilling	13.2	-	13.2
	Total Drilling	18.9	24.4	20.2
Total Number of Shifts Worked:		7,292.9	2,210.0	9,502.9
Contract Cost per Foot:				
	Core Drilling (1)	$ 9.31	9.67	9.41
	Rotary Drilling (2)	2.66	2.26	2.53
	Churn Drilling	8.88	-	8.83
	Total Drilling	$ 7.03	6.29	6.82
Indirect Cost Per Foot (5):				
	All Drilling	$ 3.59	4.03	3.71

	Mission	San Xavier	Combined
Total Cost Per Foot:			
Core Drilling (1)	$ 12.90	13.70	13.12
Rotary Drilling (2)	6.25	6.29	6.24
Churn Drilling	12.42	-	12.42
Total Drilling	$ 10.62	10.32	10.53
Total Contract Cost	970,348	338,966	1,309,314
Total Contract-Plus-Indirect Cost	1,465,491	556,050	2,021,541

Capital Costs:		
Lab Building & Equipment	32,164	
Water Well, Pump, Tank, etc.	10,931	43,095
Total Contract-Indirect-Capital Cost		2,064,636

NOTES

(1) All Core drilling -- including coring in the "scout" holes (commonly termed "rotary" holes, see page 15).
(2) All drilling done with "rockbit" and mud circulation.
(3) Drill operation time only, includes running rods, etc.
(4) Including casing, reaming, cementing, repairs, moving, etc.
(5) Indirect costs as used in the foregoing and all ensuing cost tabulations are as follows:

	Mission	San Xavier	Combined	% of Indirect
Salaries- Geological & Engineering	$131,671	31,697	163,368	23.0
- Geophysical	5,301	10,295	15,507	2.2
Payroll Labor - Geological & Eng.	228,565	105,589	334,154	46.9
- Geophysical	4,436	18,593	23,029	3.2
Assaying	21,817	3,174	24,991	3.5
Preliminary Metal-lurgical Testing	19,979	-	19,979	2.8
Supplies	41,482	9,701	51,184	7.2
Automobile and Truck Expense	20,480	11,312	31,792	4.5
Insurance	1,638	520	2,158	0.3
Taxes	8,477	4,547	13,024	1.8
Other	11,295	21,746	33,041	4.6
	$495,143	217,084	712,227	100.0

History:

Mining operations of small scale have been in progress in the general vicinity of Twin Buttes and Mineral Hill since the latter part of the Nineteenth Century. In 1951 United Geophysical Company drilled magnetic and electromagnetic anomalies east of the Mineral Hill Mine, disclosing a replacement ore body in limestone and disseminated mineralization in argillite. This property, known as the Pima Mine, was then developed by a shaft and numerous drifts on various levels. Features observed by ASARCO personnel during a study of the district indicated that the gravel-covered area to the east and north of the Pima property might contain a large zone of disseminated mineralization. Claims were staked, and in September, 1954 drilling and geophysical work were begun.

Only one drill rig was used for the first several months of preliminary probing. As encouraging results were obtained, drill rigs were added, as is shown on a chart, Attachment A. In several instances the rate of drilling was increased due to disputes with neighbors over the superposition of surface rights and mineral rights both on Federal and State-owned land. Except during a drillers' strike of several weeks' duration, drilling on the Mission area was carried on continuously until it was terminated in May, 1958.

Active drilling on the San Xavier Reservation was begun in August, 1957 immediately after prospecting permits had been obtained on 24 sections. This drilling was stopped in August, 1958.

Core and sludge samples from the Mission Project were taken in the beginning to Silver Bell for preparation and assay. In November, 1955, a temporary laboratory was installed in South Tucson, nearer to the project, for preparation of samples for assay. Construction of the present laboratory on the Pima Mine Road four miles east of the Mission property, was begun in November, 1956, and the laboratory operation was moved to this building in December, 1956. All sample storage was consolidated in this building at that time. An additional 1200 square feet of storage was added in August, 1957 to accommodate San Xavier Reservation samples.

Geography and Geology:

The Mission property lies northeast of the Sierrita Mountains, about twenty miles southwest of Tucson, Arizona. It is situated in portions of Section 31, T.16S., R.13E., and Section 36, T.16S., R.12E., some six miles west of the Nogales Highway. See Index Map, Attachment B. The San Xavier Reservation adjoins the Mission area on the north as can be seen on Photograph No. 14.

The area including both projects lies on a relatively smooth alluvium-covered pediment which slopes gently to the Santa Cruz River five miles to the east. The depth of the alluvium averages about 200 feet in the Mission area; it is somewhat thinner and more variable on the Reservation. There are no bedrock outcrops in the Mission area and only two on the Reservation, both small and showing some mineralization.

The alluvial cover is composed of coarse and fine gravels and sand with occasional bands of cobbles. Some thin caliche lenses are present. A well consolidated layer of conglomerate termed "caliche conglomerate", varying in thickness from a few inches to 40', occurs immediately above bedrock. It contains, in places, abundant exotic copper oxides and silicates. In the San Xavier Reservation the gravels are underlain in certain localities by a thick series of post-mineral volcanics and sediments.

The Mission and San Xavier areas include an extensive zone of hydrothermal alteration-mineralization in sedimentary and intrusive rocks. Disseminated pyrite and chalcopyrite pervade all pre-mineral rocks in this zone, with the principal ore grade mineralization occurring along certain favorable limestone and argillite horizons in the sedimentary sequence. These horizons form moderately to steeply dipping tabular ore bodies ranging from a few feet to over 200' in thickness.

The principal rock types of the sedimentary sequence are argillite, arkose, quartzite and limestone. Limey members have been converted to tactite and hornfels. The ore occurs principally in tactite, hornfels and argillite. Large, sill-like bodies of monzonite porphyry and narrow dikes of andesite intrude the sediments of the area. The monzonite is mineralized throughout, but the copper content is generally low, ranging from 0.10 to 0.60% and averaging about .20%. The andesite dikes, being post-mineral in age, are barren.

The ore minerals in the primary zone are chalcopyrite with rare bornite; in the thin, leached zone there are copper silicates and oxides with rare chalcotrichite, cuprite, and malachite. Between these two zones is a thin, discontinuous blanket of chalcocite, which occurs mainly as coatings on sulphide grains. Also present in the deposit are galena, sphalerite and molybdenite with very minor scheelite. The copper content of the mineralized zone ranges from 0.10 to about 10.0%. The ore averages approximately 1.0%. Within the ore zone the sulphide content (mainly pyrite and chalcopyrite) ranges from 3.0 to 12.0% and averages around 7.0%. Locally, within short drill intercepts, the range in grade and sulphide content may be much wider.

The recovered core shows that numerous faults and slips having various attitudes traverse the ore zone. These fractures range in thickness from 1/8" gouge seams up to several feet of breccia and gouge, and are considered to be mostly post-mineral in age. These thicker zones are a kind that commonly is difficult to core with high recovery. The physical character of the ore zone as a whole is such that it is more difficult to core than the average disseminated sulphide deposit.

Engineering:

Excepting the first 60 holes which were irregularly spaced, the Mission area was drilled on a rectangular grid. Holes were spaced at 300' intervals north-south and 250' intervals east-west.

In the eastern and central parts of the ore body, a number of holes were spaced at 150' intervals along some of the north-south lines.

The San Xavier Reservation was laid out so that holes could be spaced to form equilateral triangles. The basic east-west lines were roads put in 2000' apart (see Photograph No. 14) with stations along these roads 2309.4' apart. These stations were further subdivided, if closer spaced holes were needed. The attached diagram shows the basic subdivisions (Attachment C). This grid was surveyed by transit and tape with triangulation control in advance of all work on the Reservation. It was designed to provide a rectangular set of accurately surveyed points for geophysical surveys as well as to permit the preliminary, wide-spaced scout holes on a triangular pattern to be systematically tied in with the subsequent closer spaced holes needed to define mineralized zones.

Locations for drill hole setups were prepared by a local heavy equipment contractor. All road building and line brushing was done by the same operator.

DRILLING AND SAMPLING

General:

Drilling on the Mission property was begun on 9/28/54, under contract by the United Geophysical Company. The initial drilling consisted of 12 shallow (161-271') holes spaced at intervals of about 2000' to determine the areal extent of mineralization in the alluvium-covered bedrock. This drilling was done by a Mayhew Model 1000 rotary drill.

On 1/10/55 the Joy Manufacturing Company started drilling on the property, under contract. It soon became apparent that the large Model 250 diamond drill being used would not give the desired results when coring, due to lack of sensitivity of controls. This drill was replaced by a Model 22HD (see Photograph No. 5) after drilling one hole. The Joy Manufacturing Company continued to drill on this project and on the San Xavier ground using from one to seven of these truck-mounted drills. This contractor also used a Model 75 (see Photograph No. 4) rotary type drill for shallow scout holes and for deep rotary rock bit drilling through certain blocks of post-mineral volcanics and sediments in the San Xavier area.

Several other contractors drilled a few holes each on the projects in unsuccessful attempts to improve on sampling results and/or reduce drilling costs. These contractors drilled core, rotary and churn drill holes.

The prepared drill sites consisted of flat-topped mounds of earth 30' x 12' with a 20' x 10' pit 6' deep alongside (see Attachment D). Due to the flat terrain, it was necessary to dig pits beside drill setups in order to gain head for sampling equipment and sump tanks.

Water was supplied to the drilling contractors at the Company's field laboratory, located approximately 4 miles east of the drilling areas.

The contractors supplied all equipment and personnel necessary to perform the drilling operation. The personnel included a driller and helper for each drill shift, water truck drivers, and a foreman for each shift operated.

The drills were run on a two-shift per day schedule for most of the program. The churn drill contractor and some of the others operated three shifts per day.

A Company-employed sampler was assigned to each drill each shift. This man took charge of the core, sludge, and character samples; measured hole depths and lengths of runs; and recorded these data on various reports. The samplers were supervised by a Company engineer.

Diamond Drilling:

Equipment. Most of the diamond core drilling on both projects was done with the Joy Model 22HD truck-mounted drill. The coring was started NX size. The hole was reduced to BX size only when caving and/or water loss became excessive and could not be controlled by hole conditioners or cement.

The "M" series, non-rotating, 10' core barrels were used in drilling all mineralized rock. When rotary drilling the post-mineral volcanics and sediments on the San Xavier ground, a core sample was obtained at certain intervals (when needed for rock identification) with a standard core barrel, with or without the swivel innertube. In these instances good core recovery was not a requirement.

For most of the drilling, a three-waterway medium matrix bit of conventional design was used. Face discharge bits were tried in an effort to improve core recovery in softer rocks. The results showed low bit life with core recovery data being inconclusive as to any advantage existing over conventional bits.

Procedures. The diamond drill holes were started by drilling through the gravel overburden and into the caliche conglomerate using 4-1/4" tri-cone rock bits. By using a thick drilling mud and a 20' drill stem behind the rock bit, a clean hole was drilled and held open, allowing easy passage of the NX casing. This casing was then set in the conglomerate and the sandy mud washed out of the casing. Coring was started at this point using one of two methods: (1) Water circulation with recovery of sludge samples, as was done in the bulk of the Mission drilling, or (2) mud circulation without recovery of sludge samples, as was done in most of the San Xavier drilling.

A coring run was stopped whenever the driller recognized a "block", regardless of the shortness of the run. A uniform interval of run was not maintained because this would have promoted "grinding" by the driller, and it offered no advantage other than clerical. Most of the coring runs ranged within 2.0 and 5.0'. The average for all runs was 4.08'.

Much of the mineralized rock in both areas is of the type that is difficult to core -- highly fractured and non-uniform in hardness, with numerous zones of gouge and breccia. Conventional drilling techniques with standard barrels (or careless use of swivel barrels) would probably result in average core recoveries of 50-60% (as obtained during early coring in the Pima ore body by United Geophysical Company). However, a high average of recovery was maintained throughout the Mission area by Joy, the principal contractor. This was largely due to the development of a special drilling technique by Joy's foreman, Mr. Art Ecklund. This involved slow rotation speeds (100-200 rpm) and low bit pressure. This method was especially applicable to broken arkose, argillite and quartzite. When high rotation speed and pressures are used in this type of ground, the inner barrel can be caused to rotate by being jammed against the outer barrel, with consequent loss of core by grinding.

Conventional practice, involving water circulation and sludge collection, was employed in drilling Mission holes 13 through 204 (with some exceptions), and average core recoveries exceeded 90%. For the first few holes in some of the mineralized rocks of the San Xavier area, however, this same method resulted in average core recoveries in the 70-80% range. Mud circulation then was adopted as general practice, resulting in increase in average core recovery to 90% or better. It was found that if a hole was started and continued with mud circulation, less difficulty with cave or fluid loss was had than when mud circulation was begun only after trouble was encountered. The core recovery increase is attributed to the lubricating qualities of the mud in the barrel and the dampening effect of the mud on rod vibration. Subsequent to drill holes 204 on the Mission area and X120 and X216 on San Xavier, all drilling was done with mud circulation. No sludge was recovered in this drilling; however, the loss of sludge samples of questionable accuracy is believed to have been more than offset by recovery of reliable core samples.

Drilling mud consisted of Bentonite which was mixed to give a viscosity of 45 to 55 seconds, as measured by the Marsh funnel. Mud viscosities as high as 62 seconds were used, but a thicker mud than that would invariably block off in the small clearances of the "M" series core barrels. Determination of the proper mud viscosity by the driller proved very simple with a little practice.

As noted before, all holes were cased NX through the overburden and cored NX in the bedrock as far as possible. With few exceptions, the holes were bottomed either NX or BX size. Seven holes had to be reduced to AX size, but none were bottomed smaller than that. In addition to providing more sample bulk, larger core diameters give better core recovery, assuming use of "M" series or other swivel barrels.

When necessary, the holes were conditioned or cemented to correct fluid loss or caving. Conditioning was done with perlite or horse manure by merely pouring a thick mud of same into the hole. Sometimes, when circulation could not be regained and sludges were not being saved, the hole would be continued "blind" as long as it was not caving; otherwise, it would be cemented. In many instances the cement failed to set properly. It was at first believed that these failures were attributable to the acid conditions prevailing in the mineralized rock; however, laboratory tests showed that the pH of the solution in the hole seemed to have very little effect on the hardness of the set. Although not definitely proven, the main factor appears to have been excessive dilution of the cement slurry with wash water.

The procedure followed was to pour the slurry down the rods, or directly into the top of the hole. Water was then poured behind the cement to wash it on down the hole or through the rods while they were being pulled up.

Less dilution can be attained by pumping a thick cement slurry through the rods, followed by flushing of the rods with water while removing them from the hole. The contractors were reluctant to use this method since their drillers had limited knowledge of drill hole cementing. The need for cementing did not arise often; therefore, Company men did not press contractors on this point.

The following table indicates the frequency and effectiveness of the cementing on the two projects:

	Mission	San Xavier
Number of attempts to cement holes	221	10
Number of shifts spent on cementing	199.8	7.8
Per cent of total time spent on cementing	2.89%	0.36%
Number of successful or partially successful cementing attempts	92	3
Effectiveness of cementing	41.6%	30%

<u>Sampling</u>. A trained Company sampler was assigned to each drill, for each shift that it operated. This man's duties were to collect and take charge of both core and sludge samples, as well as character samples. He measured each run, calculated the hole depth and tagged all samples. He also reported to the Company engineer the procedures and techniques used by the drillers.

As the driller removed the core from the barrel, the sampler placed the core in steel trays 6' long (Photograph 7). The core was then washed to remove mud and grease (gougy intercepts were washed very little to prevent core loss), and placed in core carrying boxes of 10' capacity.(Photograph 10). A small wooden block marking the hole number, core box number and footage separated each run. The sampler then recorded the linear measurement of core recovered.

Perhaps the most accurate sludge sample is obtained when the entire sludge run (no overflow) is collected in a large cone-bottom tank which permits more efficient settling and decantation. This requires a side hill environment providing some 15 or 20' of head room. The flat terrain precluded our use of this arrangement, and it was necessary to use the flat, wide sludge tank, (Attachment E).

In the beginning of the Mission program the sludge was conducted directly from the hole collar to the sludge tank which was allowed to overflow. It was recognized that this overflow contained solids which might affect adversely the accuracy of the sludge sample, but this was acceptable because core recovery was high, and the mineralogical texture of the rock was such that the core assay was considered to be representative of the rock.

When later it became evident that an ore body was being measured, splitters were made for all coring setups. These splitters permitted collection of a representative portion of sludge in one tank without overflow. This was a precautionary measure only, because it had become apparent that core samples alone would accurately define the ore body. In other words, to correspond with the occasional low core recovery interval, sludge samples were obtained in case these assays might some day be needed. After collection, sludge samples were processed only if recovery of corresponding core was below 70%. Otherwise, they were discarded at the drill site.

When a sludge sample was to be collected rather than discarded, the sludge was allowed to settle for several minutes. The water was then slowly decanted out of the sludge tank by using a float and flexible hose drain on the tank. The sludge and a small amount of remaining water were then drained into a 5-gallon milk can, a rubber window-washing "squee gee" being used to clean all of the sludge out of the tank.

Prior to the use of rotary splitters, the entire contents of a sludge tank were reduced to 1/4 by passing it through a Jones splitter before pouring it into 5-gallon milk cans for transport to the laboratory.

The rotary splitter design was obtained from Kennecott-Ray Division. With our modifications this is shown as Attachment F. Rotation is accomplished by the force of the sludge discharged vertically onto the curved vanes. Although expensive to fabricate, this type of splitter produces an accurate cut and is mechanically simple.

When drilling with water and collecting sludges with the rotary splitter, the drill and equipment were set up as shown in Photograph 8. Sludge from the drill hole was conducted through a 2-1/2" galvanized iron pipe to the rotary splitter (Photograph 9). The 1/8 cut taken passed to one of the 150-gallon side sludge tanks. The 7/8 reject discharged into the center tank. Overflow from the center tank dropped into a 600-gallon stock tank.

When one or more core runs reached or exceeded 5', a sludge sample was taken. Using this procedure with a 10' barrel, sludge runs were limited to a maximum of 14.9' and a minimum of 5.0'. Each sludge run coincided in all cases with one or more core runs. On occasion, such as loss of water return, bottoming a hole, etc., a sludge run might be shorter than 5.0'.

When drilling with the rock bit, a character sample was collected in a kitchen strainer. Some of the drilling mud from the hole was passed through the screen of the strainer during each foot of drilling until about 300 grams of cuttings had been obtained during a 5' run. After washing out the mud with water and drying in the sun or over an open fire,the sample was placed in an envelope and marked with hole number and footage intercept. Character sampling (5' interval) was usually started in the gravels about 20 feet above bedrock, and continued in bedrock as far as the hole was drilled with the rock bit.

The sampler was required to fill out a complete report for each drill shift (Attachment G-1). This report showed depth and condition of the hole, footage drilled and core recovered, sludge data, and all other information pertinent to the drilling and sampling operation during the shift. These data were used by Company geologists and engineers in constant checking on contractors' performance. This latter is an important function. Much of the drilling done by contractors is of a type which requires accurate samples only for certain short segments of a hole. Also, many mining companies are satisfied with 50 or 60% core recoveries. As a result contract drillers tend to become careless, if not under constant Company surveillance, on a job of this type where continuously accurate samples are required. In this situation there must be close cooperation between Company men and contractors' foremen and drillers. The Joy people were particularly cooperative, as were some of the other contractors. They were willing to experiment a great deal at our suggestion, and in many instances Company men actually dictated operating procedures. This is too complex a relationship to be written into a contract, but it must be cultivated if continuously accurate samples are to be obtained.

Wire Line Drilling. During the early part of the Mission program three holes totaling 1936.4' were drilled by the Longyear Company with wire line equipment, the purpose being to compare costs and results with those of conventional methods. Upon completion of three holes the contract was terminated, as the core recovery proved to be relatively low and the cost per foot relatively high.

This comparison, however, should not be taken as a measure of the efficiency of the wire line method because the principal reasons for the relatively poor performance on the Mission Project were lack of properly trained drillers, and inadequate equipment. In the past three years wire line drilling has been adopted by numerous contractors and the results reported indicate that the method is definitely superior to conventional drilling in terms of speed, cost and core recovery, particularly if mud circulation is used with careful attention to character of mud.

Diamond Drilling Cost and Performance (1):

	Mission	San Xavier	Cobmined
Total Footage:			
Core Drilling	82,675.6'	27,931.3	110,606.9
Rotary Drilling	38,480.5	12,887.7	51,368.2
Total Drilling	121,156.1	40,819.0	161,975.1
Number of Holes Drilled	190	72	262
Average Depth of Holes	637.7'	566.9	618.2
Footage Cored with Water Circulation and Collection of Sludge Samples	78,429.9'	5,608.9	84,038.8
Footage Cored with Mud Circulation (No Sludge Samples)	4,245.7'	22,322.4	26,568.1
Average Core Recovery:			
Water Circulation	89.5%	77.4	88.7
Mud Circulation	91.9	90.7	90.8
Total	89.6	87.8	89.2
Average Advance per 8 Hours Drilling Time (2):			
Core Drilling	17.5'	19.8	18.0
Rotary Drilling	115.5	123.1	117.3
Total Drilling	23.9	27.0	24.6
Average Advance per 8 Hour Shift (2):			
Core Drilling	13.2'	14.8	13.6
Rotary Drilling	99.9	98.9	99.6
Total Drilling	18.3	20.2	18.7
Total Shifts	6,637.5	2,022.0	8,659.5
Time Distribution:			
Drilling	76.3%	74.9	76.0
Reaming and Casing	8.8	6.8	8.3
Repairs	4.5	4.1	4.4
Cementing	3.0	0.3	2.4
Moving	2.5	2.2	2.5
Other	4.9	11.7	6.4
	100.0	100.0	100.0

Diamond Drilling Cost and Performance (Cont'd.)

	Mission	San Xavier	Combined
Contract Cost:			
Core Drilling			
Average Cost Per Foot	$ 9.36	9.72	9.45
Total Cost	773,753	271,565	1,045,318
Rotary Drilling			
Average Cost per Foot	2.71	2.29	2.60
Total Cost	104,257	29,543	133,800
Total Drilling			
Average Cost per Foot	7.25	7.38	7.28
Total Cost	878,010	301,108	1,179,118
Indirect Cost per Foot (2):	3.59	4.03	3.71
Average Total Cost per Foot:			
Core Drilling	12.95	13.75	13.16
Rotary Drilling	6.30	6.32	6.31
Total Drilling	10.84	11.41	10.99

Notes: (1) Includes wire line drilling, but excludes "scout" drilling.

(2) See notes (3), (4), and (5) on page 2.

Wire Line Drilling Cost and Performance:

	Mission
Total Footage:	
Core Drilling	1,328.3'
Rotary Drilling	608.1
Total Drilling	1,936.4
Number of Holes	3
Average Depth of Holes	645.5'
Average Core Recovery	80.6%
Average Advance per 8 Hours Drilling Time (1):	
Core Drilling	19.0'
Rotary Drilling	91.7
Total Drilling	25.2
Average Advance per 8-Hour Shift (1):	
Core Drilling	9.5'
Rotary Drilling	33.3
Total Drilling	12.2
Total Number of Shifts Worked	158.7

Most of the drilling was done with the standard paddle bit, but the star-type was used when boulders in the overburden or hard portions of bedrock caused the hole to deflect. The gauge and cutting edge of the bits were maintained by electric welding at the rig.

Procedures. Holes were collared and drilled 13 or 16" in diameter through the overburden and leached bedrock to the sulphide zone. The holes were then cased and reduced to the next smaller size. Subsequently, the holes were reduced in diameter and cased whenever caving was encountered, or when the hole passed through a zone of particularly strong copper mineralization. The holes were reduced through sizes 10, 8, 6 and 5", using liners (35' lengths) for casing in most instances. If it became necessary to case when drilling a 5" hole, one or more of the liners was removed and the hole was reamed to the bottom.

Occasionally, blasting was employed to straighten a deflected hole.

At the end of each 5' of advance the drilling was stopped and the sludge was removed from the hole. Usually 3 to 5 passes in the hole with the dart-valve bailer were sufficient, but the driller was required to bail until only a negligible amount of sludge remained in the hole. With the sand pump, which was frequently substituted for the dart-valve bailer, two runs were usually sufficient to clean the hole. The sand pump was also run occasionally to determine the actual amount of sludge left in the hole by the dart-valve bailer (discussed under "Sample Accuracy").

The bailer was discharged into a dump box and the sludge conveyed by a launder to a 4-tier Jones splitter (Attachment H). By varying the number of splits, a sample weighing about 8 to 10 pounds when dry was obtained. Generally the size of the sample and the number of splits for different hole sizes were as follows:

Hole Size	Splits	Size of Sample
10", 13" and 16"	6 to 7	1/64 to 1/128
8"	5	1/32
6" and 5"	3 to 4	1/8 to 1/16

The split portion of the sludge was caught in a wash tub and transferred to a 19" x 19" x 3-1/2" cake pan. The sample was then placed over an open wood or coal fire at the drill rig for initial drying. It was removed from the fire when still moist to prevent overheating with consequent sulphide roasting and loss of water of recrystallization from the clays. The still moist sample was then sent to the laboratory for further drying at a controlled temperature.

When drilling through the overlying gravels, character samples were taken by screening a small portion of the cuttings from the sludge discharged from the bailer. These character samples, from a depth of 150' to bedrock, were placed on the sludge boards as a part of the geologic record. Upon reaching bedrock regular sampling procedures were commenced.

A Company sampler was assigned to each churn drill each shift to take charge of the samples from the holes. After a sample run was completed and the sludge collected and split, the sampler washed the dump box, launder, splitter and tubs with clear water. In addition, the sampler filled out a complete report of the shift's drilling (Attachment G-2).

Churn Drilling Cost and Performance:

	Mission
Total Footage	5,513.0'
Number of Holes Drilled	6
Average Depth of Holes	918.8'
Average Advance per 8 Hours Drilling Time (1)	21.4
Average Advance per 8 Hour Shift (1)	13.2
Total Number of Shifts Worked	418.6
Time Distribution:	
Drilling	61.4%
Reaming and Casing	21.6
Repairs	5.8
Moving	2.1
Other	9.1
Total	100.0
Contract Cost:	
Average Cost per Foot	$ 8.83
Total Cost	48,692
Indirect Cost per Foot	3.59
Average Total Cost per Foot	12.42

Note: (1) See notes (3), (4), and (5) on page 2.

Scout Drilling:

The initial exploration on the Mission area had the objective of obtaining a few feet of core from the top of bedrock from holes spaced at intervals of 2000' and more. These samples were needed as indicators of the character and areal extent of mineralization. High core recovery, therefore, was of no concern.

The method adopted involved heavy mud circulation with rockbit (4-1/4" tri-cone) drilling through the gravel to bedrock. Without setting casing, coring then was begun with a standard double or single tube barrel, using the same drilling mud. It was found that this coring procedure could be continued for at least 20 or 30' into bedrock, usually all that was needed, and on occasion it was continued 75 or 100' into bedrock.

This proved to be a rapid and inexpensive means of obtaining information on bedrock geology. The method later was used extensively for delineation of mineralized zones in the Mission and San Xavier areas and for validation (discovery of mineral in place) of many outlying mineral claims in the Mission area. When significant mineralization was encountered, and greater hole depth with high core recovery became necessary, the hole was cased NX and regular coring procedures with a 22HD drill were undertaken.

This scout drilling, usually termed "rotary", was done on the two projects by several different types of drills. A Mayhew Model 1000 was used at the beginning of the Mission drilling. The Joy Model 250 was tried on one hole, and several of the scout holes were drilled by the Joy Model 22HD; however, the truck-mounted Joy Model 75 proved to be the most satisfactory rig. With this drill, rates of 75 to 85' per hour were common in the gravels.

In the San Xavier area it was found in places that post-mineral volcanic and sedimentary formations extended to considerable depths. Scout holes were drilled to depths of over 1000' in penetrating these rocks. In these instances cuttings were screened continuously for character samples in 5' segments. At intervals of around 50', one or more core runs were made with a standard barrel in order to get better samples for rock identification.

Two of the deep scout holes through the post-mineral rocks were drilled with the 22HD rig. The rate of advance with this rig was much less than with the Model 75. Also, wear on the NX rods used by the 22HD proved excessive.

Before the drill was moved from each scout hole drill site on the San Xavier area, the hole collar was reamed to 6-1/4" to a depth of 40'; 4" iron pipe was then installed; and the hole was pumped full of heavy mud. In a number of instances, as the geology became better understood, these holes subsequently were deepened with a 22HD drill.

The scout drill sampler was required to take character samples when drilling with the rockbit and to take care of the core that was recovered. His reports were similar to those on the diamond drilling and were made on the same forms.

Scout Drilling Cost and Performance:

	Mission	San Xavier	Combined
Total Footage:			
Core Drilling	2,913.6'	1,376.3	4,289.9
Rotary Drilling	8,030.1	11,426.3	19,456.4
Total Drilling	10,943.7	12,802.6	23,746.3

Scout Drilling Cost and Performance (Cont'd.)

	Mission	San Xavier	Combined
Number of Holes Drilled	42	36	78
Average Depth of Holes	260.6'	355.6	304.4
Average Core Recovery	57.6%	55.8	57.1
Average Advance per 8 Hours Drilling Time:			
Core Drilling	24.4'	23.9	24.2
Rotary Drilling	219.4	151.9	174.0
Total Drilling	70.1	96.3	82.2
Average Advance per 8 Hour Shift:			
Core Drilling	15.9'	16.0	16.0
Rotary Drilling	148.4	112.0	124.6
Total Drilling	46.2	68.1	55.9
Total Number of Shifts Worked	236.8	188.0	424.8
Time Distribution:			
Drilling	65.9%	70.7	68.1
Reaming and Casing	2.0	4.3	3.0
Repairs	9.5	11.5	10.4
Moving	9.0	7.5	8.3
Other	13.6	6.0	10.2
Total	100.0	100.0	100.0
Contract Cost:			
Core Drilling			
Average Cost Per Foot	$ 8.11	8.61	8.27
Total Cost	23,630	11,849	35,479
Rotary Drilling			
Average Cost per Foot	2.23	2.22	2.22
Total Cost	17,909	25,364	43,273
Total Drilling			
Average Cost per Foot	3.80	2.91	3.32
Total Cost	41,539	37,213	78,752
Indirect Cost per Foot	3.59	4.03	3.71
Average Total Cost per Foot			
Core Drilling	11.70	12.64	11.98
Rotary Drilling	5.82	6.25	5.93
Total Drilling	7.39	6.94	7.03

Experimental Drilling:

In an effort to find a lower-cost method of drilling scout-type holes, two contractors were allowed to drill with air as the circulating medium.

One attempt involved a drill rig that pumped air down the rods. Drilling was fairly fast, but caving halted progress at 185' depth. A very light weight, 5", galvanized pipe casing was installed and failed.

In another instance a Failing Model 1500 rotary drill with special equipment for handling reverse air circulation was tried out. A vacuum pump pulled air and cuttings from the rock-bit up through the rods and into a system of cone separators and filters. At a location in the Mission area the rig managed to penetrate the gravel, but progress was retarded by caving of sand and gravel on top of the bit. Water was encountered at bedrock, and the the vacuum could not pull the cuttings from the hole unless the water inflow was less than 5 gpm. At a San Xavier location another hole was drilled with this rig. It was collared in an outcrop of bedrock. Moderate progress was made; but dust representing high proportions of the cuttings was lost by the separators and filters, and the recovered samples were therefore not reliable.

Reverse air circulation drilling no doubt can be applied successfully under certain conditions, but it does not work in loosely consolidated sand and gravel or in wet ground.

<u>Experimental Drilling Cost and Performance (1):</u>

Footage Drilled	555.2'
Number of Holes	2
Average Depth of Holes	277.6'
Average Advance per 8 Hours Drilling Time	38.6'
Average Advance per 8 Hour Shift	15.3'
Time Distribution:	
Drilling	39.7%
Reaming and Casing	2.2
Repairs	22.0
Moving	4.7
Other	31.4
Total	100.0
Average Contract Cost per Foot	$ 2.56
Indirect Cost per Foot	3.68
Total Cost per Foot	6.24

Note: (1) Reverse air circulation only.

<u>Drilling Contracts:</u>

Most of the drilling was carried out under the terms of a more-or-less standard contract with the Joy Company; one which specified a price per foot for rotary drilling and prices per foot for coring, depending on the diameter and depth of hole, and a price per 8 hour shift for reaming, cementing and for delays not caused by the contractor.

Contracts with other companies varied somewhat. For instance, in the case of Hoagland and Dodge, the drilling was done under an arrangement wherein the contractor was paid a price per foot drilled plus a price per foot of core recovered. The two rates were proportioned so that the contractor would receive a bonus for high recovery and a penalty for low recovery. The Longyear Company operated under a cost-rental agreement whereby the contractor was paid for direct costs incurred, plus rental on equipment, plus $0.50 per foot drilled.

The churn drill contract with the Wininger Company contained a special provision which guaranteed the contractor a certain sum per shift operated, amounting to the approximate total of his direct and indirect costs. This, in effect, eliminated any risk of loss and thus permitted the contractor to accept a relatively low price per foot for the drilling. This arrangement, first tried out in 1948 at Silver Bell, has worked out satisfactorily in all cases. Refer to Attachment I for a digest of the more important items in the churn drill contract as well as those of the principal diamond drill contracts.

Toward the end of the drilling program our accounting department learned that, in their development of certain cost data and other special summarizing information, it would have been helpful if the contractors had been required (1) to match their billing periods with the Company's monthly accounting periods and (2) to segregate all charge items according to individual holes. They suggest that future drilling contracts should incorporate these two features.

Drill Hole Surveying:

While drilling on the Mission Project, three holes were surveyed to determine the probable deviation that might be expected in some of the deeper holes. Holes number 137, 139 and 140 were selected for surveying.

A Tropari instrument recorded the bearing and dips of the drill holes on 100 to 200' intervals. The results showed a maximum deflection of one degree in holes 139 and 140 and 4 degrees in 137. The bottom of hole 137 at 1501.8' was determined to be 42' out of position.

Drill Hole	Depth	Dip	Bearing
DDH 137	200'	86°	-
	400	89	-
	600	88	S28°W
	700	88	S03°W
	800	88	South
	900	89	S21°E
	1000	88	S08°E
	1100	89	S33°E
	1200	88	S02°W

Drill Hole	Depth	Dip	Bearing
DDH 139	220'	90°	-
	420	90	-
	620	89	N58°E
	820	90	-
DDH 140	300	90	-
	500	90	-
	700	90	-
	900	89	S39°W
	1000	90	-
	1100	89	S86°W

Plastic Casing for Geophysical Probing:

Plastic casing was placed in certain of the drill holes to prepare them for electrical probing. Upon completion of a hole 1-1/2" ID plastic casing was inserted. The metal casing was then removed from the hole, leaving the plastic pipe to keep the hole open.

Twenty-four holes in the Mission Project and three on the San Xavier ground were cased in this manner. A total of 17,080.9' of plastic casing was installed.

The plastic casing installed in the earlier Mission holes was "Carlon-T" 1-1/4" ID pipe in 20' sections with solvent-welded outside sleeve joints. Later in the Mission drilling and in the San Xavier holes, "Kralastic" pipe 1-1/2" ID (Swanson Company, Phoenix) was used. This pipe would fit only in BX or larger size holes because of the sleeve OD (1.900"), whereas the 1-1/4" ID casing used in the earlier drilling would fit into an AX size hole.

The casing was first perforated by drilling 1/4" holes through both walls of the pipe on 2" centers alternated at 90°. The casing was laid out on the ground and welded into one long string which was then bent into an arc above the driller's platform and pushed down the hole (see Photograph No. 6). About 10 minutes time was required to insert a 1000' string of plastic pipe.

SAMPLE LABORATORY

General Description:

The present East Pima sample laboratory is located three miles west of the Nogales Highway on the Pima Mine Road. The building is constructed of a prefabricated, structural steel frame, with corrugated iron covering and concrete floors. Construction was started in November, 1956 and was completed in January, 1957, with an additional sample storage room being built in August, 1957.

The lab is divided into four main parts (Attachment J): two for sample storage and work areas, a third for preparing samples for assay (Attachment K), and the fourth for the office.

Equipment installed in the sample preparation room consists of the specific gravity apparatus, scales for weighing core, sludge, and cuttings, one Joy Model 90067-AK core splitter, one 4 x 6 Massco jaw crusher, one 10" Massco gyro roll reduction crusher, one Bico-Braun type UD pulverizer, four 250° electric ovens (locally fabricated), one Binks Model 33-1005 air compressor plus spray gun, and two small Jones splitters used for splitting samples after crushing. Dust control is provided by a Power Engineering Company type 35 SP blower with a 2 horsepower electric motor. This services hoods over both crushers, the pulverizer, and the Jones splitter table. (See Photographs 11 and 13.)

Equipment in the office consists of various computers, file and storage cabinets, drafting instruments, and petrographic and binocular microscopes with index oils and micro-chem reagents.

Water is obtained from a well drilled prior to construction of the laboratory. Total depth of the well is 713'. Equipment includes a 20 HP electric deep-well turbine pump and a 2000 gallon storage tank.

Processing Core for Assay:

The core was delivered to the sample lab in small boxes (Photograph 10). Field sheets with a record of the coring runs accompanied the core (Attachment G-3). The boxes were first placed on benches outside the lab and linear measurements for computing per cent recovery were made. Next the core was logged (Attachment G-4) with respect to rock type, degree of alteration, structure, and mineralization. This was done outside the building in order to take advantage of natural light. After logging, the core was moved inside to the field corebox storage rack (Attachment L).

The specific gravity was determined by selecting a representative piece of core 4 to 6" long from each run and determining its weight in air and in water in grams (see computations). Total weight of each run in pounds was also determined at this point. Next, the core was split and one-half stored (Attachment M and Photograph 12) in channeled cardboard core boxes.* The remaining half was crushed to minus 1/2" in the jaw crusher and then divided into 4 parts with a Jones-type splitter. One-quarter was discarded, one-quarter (or a portion thereof) was placed in a sealed quart jar for storage, and one-quarter was screened and panned to provide material for the sample boards. The remaining quarter was reduced to about minus 10 mesh in the gyro roll reduction crusher. This

*Boxes were obtained from: Love Box Company, 608 South Commerce St., Wichita, Kansas, or from Arizona Container Corporation, P.O. Box 7292, Phoenix, Arizona quarter was then split on a Jones type splitter to approximately 250 grams and pulverized with the remainder of the split being discarded. The pulverizer was cleaned by running through it about 200 grams of barren quartz ahead of each sample. Proper fineness of pulverizing grind was determined periodically by rubbing between thumb and forefinger and occasionally by wet screen analysis. After assaying at Silver Bell or at Jacobs in Tucson, the pulp remainders were returned to the lab and stored.

Processing Diamond Drill Sludge:

After receiving the sludge at the lab it was transferred to 19"x19"x3-1/2" deep metal pans and dried in electric ovens for 48 hours at 200° F. Following drying, the weight of each sludge run was determined for the purpose of computing recovery (see computations). Next the sludge cake was crushed in the jaw crusher and split on a Jones type splitter. One-half was screened and panned for the sample boards and one-half was split to approximately 250 grams and pulverized. The remainder was discarded. The pulverized portion was then sent for assay and the pulp, after being assayed, was returned to the lab for storage.

Processing Churn Drill Sludge:

The sludge was dried as described in the foregoing paragraph. After drying, the samples were weighed for the purpose of computing recovery (see computations). Next the samples were crushed in the jaw crusher and then quarter split on a Jones type splitter. One-quarter was discarded; one-quarter, or a smaller split if necessary, was stored in quart jars for future reference; one-quarter was screened and panned for core boards, at which point it was logged; and one-quarter pulped for assaying. The pulp reject after assaying was returned to the lab for storage.

Sample Boards:

These boards were prepared for each hole drilled. They were made of 1/2" clear pine boards as shown on Attachment N.

The crushed core fragments, or rotary bit cuttings, were selected as described above and screened on nested 8" Tyler standard scale screens of 10, 20 and 30 mesh size. These various sized fragments were placed in "boats" made of sheet metal (Attachment N). A cupful of minus 30 mesh reject was panned to a concentrate weighing 2 or 3 grams. This concentrate was also placed in the sheet metal boats which were then put in electric ovens to dry. The rock fragments were secured to the board with Arrowhead brand liquid waterproof cement. This was applied with a brush to the assay interval previously scaled (1" = 10') on the board. A few of the larger pieces were selected and put in place first, then the interspaces were filled by simply dumping on the finer material. After applying light pressure to the sample, all loose material was removed by simply tilting the board.

The concentrate of the sample was then applied adjacent to the core fragments.

The boards were allowed to dry and then painted by spray gun, masking tape being used to cover the core and sludge fragments. After drying, the hole number was inked at the top. Footage intervals were recorded on the right hand side in black ink, the assay value in red ink.

Records:

Records were kept on various forms in the laboratory. Examples of these forms appear as Attachments G-5 through G-11. They include (5) preliminary geologic log (weekly report), (6) diamond drill hole data work sheet, (7) diamond drill hole core weight work sheet, (8) diamond drill hole assay log, (9) hole cost sheet, (10) hole progress report, (11) summary (monthly report sheets and geologic log). These forms were utilized in compiling the data as the hole progressed and were assembled in the lab file for each hole upon its completion.

Computations:

Computations were made to determine: percentage of core recovered, percentage of sludge recovered, and weighted assay average of ore intercepts in each hole.

The diamond drill hole assay log (Attachment G-8) was used as a basic form for all final data recording. Minor modification of the headings fitted it for churn drill and rotary holes.

Computations to determine the core and sludge recovery were based on simple formulae:

Theoretical Weight of Core

$Twc = SpG \times L \times C$ where

Twc = Theoretical weight of core

SpG = Specific gravity of core

L = Length of run in feet

C = Constant, which is the product of core cross-section area and 62.4 (wt. of 1 cu. ft. of H_2O)

C for various sizes of core area, as follows:

NX = 1.534
BX = 0.9335
AX = 0.479

Computations (Cont'd.)

Per Cent Core Recovery

$$Rc = \frac{Awc}{Twc}$$

where Rc = Core recovery per cent

Awc = Actual weight of core revered

Twc = Theoretical weight of core for length of run

Theoretical Weight of DD Sludge

$$Tws = (SpG \times L \times C) - (Awc)$$

where Tws = Theoretical weight of sludg

SpG = Specific gravity of rock type in run

L = Length of run

C = Constant, the product of hole size area and 62.4 (wt. of 1 Cu. ft. of H_2O)

Awc = Actual weight of core as obtained from hole

C for various hole sizes are as follows:

NX = 3.000
BX = 1.8689
AX = 1.198

Percentage of DD Sludge Recovery

$$Rs = \frac{Aws}{Tws}$$

where Rs = Per cent of sludge recover

Aws = Actual weight of sludge recovered

Tws = Theoretical weight of sludge

Theoretical Weight of CD Sludge. Calculations for sludge recovery of churn drill holes were essentially the same as above. In order to simplify the work standard bit sizes were first computed and constants derived. The following formula was used:

Tws = Split x C x SpG where C = Constant, cu. ft. in 5' run multiplied by 62.4

SpG = Specific gravity of rock type drilled

Split = Fractional portion of total sludge saved after treatment in Jones type splitter (1/2,1/4,etc.)

Tws = Theoretical weight of actual sludge sample delivered to lab

C for various hole sizes are as follows:

Hole Size	C
17-1/2"	521.16
14	333.53
11	205.92
8-3/8	119.37
6-3/4	77.50
5-1/2	51.48

Recovery Percentage of CD Sludge. Same formula as that used in computing diamond drill sludges (see above).

Percentage of core recovery was also determined from linear measurements of the core to provide a check against errors in computations of recoveries by weight.

Miscellaneous:

Reports submitted regularly to the Tucson and New York offices were: (1) weekly report which was a brief explanation of the rock types and assay values of the advance of the previous week, (2) a monthly geologic description which gave in detail the run-by-run description of core with recoveries and assay values, and (3) a monthly progress report which gave the amount of footage drilled and a listing of all significant intercepts of copper mineralization encountered. Forms for the weekly report and monthly geologic summary are attached (Attachment G-5, 11).

An estimate of the contractors' charges was compiled and submitted at the close of each month. This was used by the accounting department to check the invoices of the various drilling contractors and to afford a further check and breakdown of overall drilling costs.

Graphic logs of all holes were prepared on individual letter-size sheets of tracing paper. These logs showed collar elevations, rock types, depth to bedrock, contacts between rock types, significant structures, intercepts of ore grade (+0.40% cu) rock, bottom depth, and other geologic data pertaining to the hole.

Numerous samples for metallurgical tests were made up by splitting the stored half of the core. These core quarters were shipped to El Paso in sealed 5 gallon cans with a description of the rock types.

SAMPLE ACCURACY

Diamond Drill Samples:

Assuming something less than perfect core recovery, the accuracy of diamond drill samples in general is largely dependent on the nature and distribution of the ore minerals and the physical character of the enclosing rock. If the ore minerals tend to be concentrated in relatively soft portions of the rock, or if they occur as soft, friable masses or veins, the core sample may be robbed and the sludge enriched by selective grinding. The action of water on the walls of a hole in such material may also upgrade the sludge value. Conversely, if the ore minerals are concentrated in dense, siliceous zones, the softer, low grade or barren zones may be ground out and thus cause dilution, or lowering of sludge values and upgrading of the core. However, in the case of the Mission ore body, where the ore minerals occur mainly as discrete grains or small masses firmly embedded in the gangue, and where values are not relatively concentrated in either soft or hard zones, there is little opportunity for appreciable error in any method of sampling, providing reasonable care is taken in securing and processing the samples.

During the early stages of the Mission Project it was noted that the sludge assays rarely agreed with the corresponding core assays and that in most cases the sludges were on the low side. Due to the fact that the core recovery was with few exceptions above 90%, and in view of the character of the mineralization, the cores were considered the more reliable of the two types of samples, and their assays were accepted as an accurate measure of the copper content of the ore. Accordingly, the core assays have not been combined with the sludge assays. Sludge collection was continued, however, as a measure of insurance in case core recovery should unexpectedly drop off.

Although the sludge assays were not used in calculating ore grade, analyses of core-sludge assay relationships and recovery data were made and are included here as being of possible interest. Attachment O, Table I, is a tabulation of 1183 core-sludge runs in holes 16 to 201. The core samples are here grouped in various recovery ranges, starting with 96 to 100%. In this range there are 525 core samples which average 1.28% cu. The principal feature to be noted is that, as the core recovery decreases, there is little change in the core-sludge assay ratio. (Below 66% core recovery the number of samples becomes too small to be of much significance.) These results indicate that selective grinding did not take place to any appreciable extent and that a 70% recovery core sample is probably as accurate as a perfect, or 100% recovery core sample.

Table II (Attachment O) is a tabulation of core samples in the 96 to 100% recovery range compared to sludge samples in various recovery ranges, starting with 100 to 120% recovery. Of principal note in this comparison is the relatively low average value of the sludge where recovery is near perfect (80 to 100%), and the closer agreement of core and sludge in the 40 to 80% sludge recovery range. This is the reverse of what might be expected -- that is, assuming core samples with near perfect recovery (96 to 100%), the sludge assay should more nearly agree with the core assay as the sludge recovery approaches 100%. There are a number of possible causes for the apparent error in the sludge samples, but to theorize regarding these would serve no useful purpose. The principal conclusion to be drawn would seem to be that further emphasis on core recovery in diamond drilling -- at the expense of sludge recovery -- is well justified.

To check the accuracy of the rotary sludge splitter, comparisons were made of the dry weight and assay of the 1/8 split with the dry weight and assay of the 7/8 reject. The results obtained on nine different sludge runs indicated a volume accuracy of 85 to 100%. In copper content, the split and reject showed an average difference of .03% Cu, or about equivalent to the variation to be expected in duplicate assay pulps. This indicates that the rotary splitter provides a reasonably representative 1/8 portion of the sludge.

Churn Drill Samples:

Although the churn drilling represented only a small proportion of the total, a study was made of certain factors which might affect the accuracy of the samples.

The dart-valve type bailer, rather than the sand pump, is commonly employed in churn drilling because of its simple, rugged design and operational efficiency. However, in sampling a deposit lying below the water table, as was the case on the Mission Project, bailing with the dart-valve type may tend to churn up the sludge, causing it to mingle with the water column. Thus, some of the slimey portion of the sample may not be recovered. Also, the dilution with water may provide a better opportunity for concentration of the heavier, sulphide fraction in the bottom of the hole which is not entirely cleaned by the dart-valve bailer.

To determine the magnitude of possible error involved, the sand pump -- which removes all of the sludge with only minor dilution -- was substituted for the dart-valve bailer on alternate sample runs; also, in 34 instances the sand pump was run after the hole had been bailed with the dart-valve to determine the volume and grade of the residue.

The samples thus obtained were compared as to recovery and assay, with no appreciable difference being found in the accuracy of the samples produced by the two methods. Only a very slight tendency toward concentration of sulphides in the sludge left by the dart-valve bailer was noted. In the 34 pairs of samples the residue averaged .01% cu higher than the regular sample. This difference is negligible; therefore, use of the dart-valve bailer did not introduce a possible error of any consequence.

CHECK ASSAYS

Assaying was done electrolytically by the Silver Bell laboratory whenever possible. During periods when Silver Bell could not handle these samples, they were sent instead to Jacobs, commercial assayer in Tucson, who used the permanganate method run in duplicate. Silver Bell assayed about 2/3 of the total samples.

Periodically, checks of individual assays were made (1) by returning pulps to Silver Bell under coded numbers for re-assay, and (2) by sending the same pulp to each assayer in turn.

Attachment P-1 is a tabulation of the Silver Bell re-assays. The average difference of 92 examples is .05% Cu. Much of this average difference is accounted for by 5 examples, all of which had high Cu values -- 2.63 to 11.24% -- and were presumably more susceptible to assay differences. Eliminating these 5 examples, the average difference is .034% Cu, an acceptable figure.

Attachment P-2 is a tabulated comparison of Jacobs and Silver Bell assays of the same pulps. The average difference in 95 examples is .021% Cu. Silver Bell is high for 31 of these examples with an average difference of .055% Cu; Jacobs is high for 57 examples with an average difference of .064% Cu; 7 examples were even.

These results in both categories indicate there was no particular, systematic error by either assayer, and the average differences are within the limit of usually acceptable Cu assay variation.

Another check on assaying is provided by pulps representing composites of sequences of individual core intervals. These pulps were prepared by weighing an amount from each individual pulp proportioned according to the length of each interval. Theoretical assay values for the composite pulps were calculated by weighting individual assays in the same proportions. Comparisons with the actual assays of these composite pulps then indicate the precision of the entire procedure of pulverizing, compositing and assaying.

These composites consisted of original assays made (1) by Jacobs alone, (2) by Silver Bell alone, and (3) by both. The composite pulps all were assayed by Silver Bell. Tabulated comparisons of assays in these above categories appear as Attachments P-3, P-4, and P-5.

Category (1) (P-3): In 94 examples the composite assays were higher in 20 examples for an average difference of .032% Cu, lower in 61 examples for an average difference of .030% Cu, and even for 13 examples. In total average difference the Silver Bell composites assay .013% Cu lower.

Category (2) (P-4): In 103 examples the composite assays were higher in 32 examples for an average difference of .028% Cu, lower in 47 examples for an average difference of .027% Cu, and even for 24 examples. In total average difference the Silver Bell composites were .0036% Cu lower.

Category (3) (P-5): In 13 examples the composites were higher in 5 examples for an average difference of .032% Cu, lower in 6 examples for an average difference of .045% Cu, and even for 2 examples. In total average difference the Silver Bell composites were .008% Cu lower.

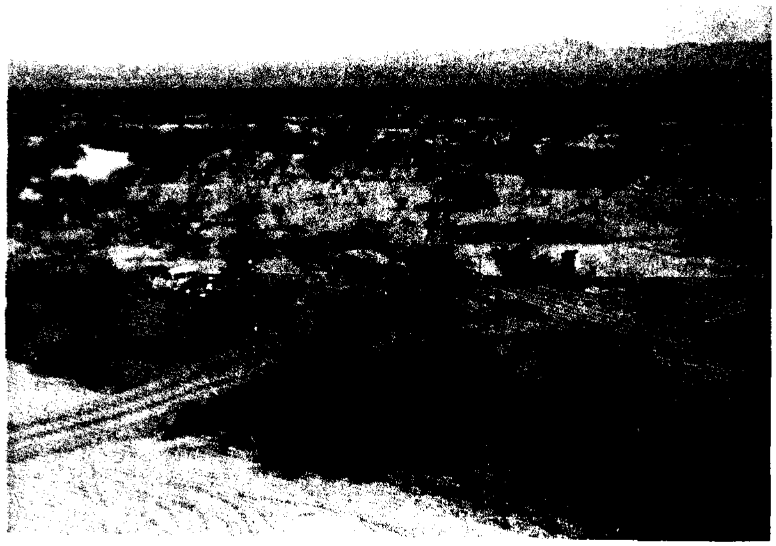
In average difference of all categories combined -- 210 composite assays against several thousand original assays -- the Silver Bell composite assays were .008% Cu lower. Although the trend of Silver Bell assays is slightly on the low side, the amount is so small that these results are regarded as a flat check and conclusive proof that no systematic errors of consequence exist either in the pulverizing or assaying.

TAB

Photographs

-1-

Looking easterly across Santa Cruz Valley. Drill set up on Hole No. 49 in foreground.



-2-

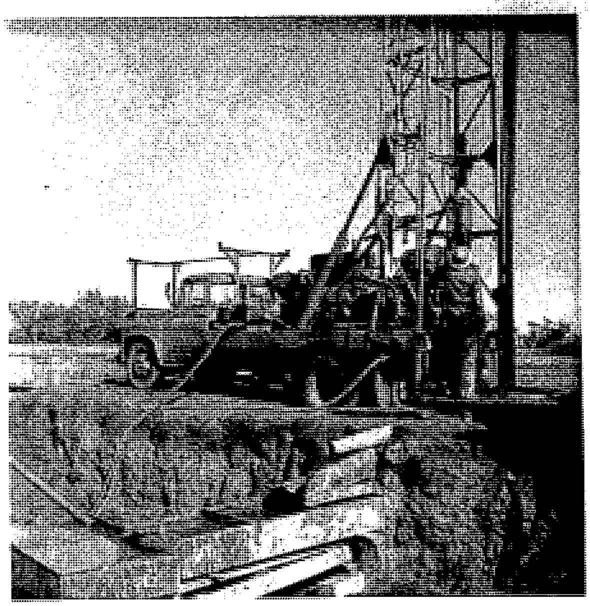
Looking west from outcrop on San Xavier Reservation. Road is on coord. 374.000 North.

-3-

Looking NE - Mission Sample Laboratory.

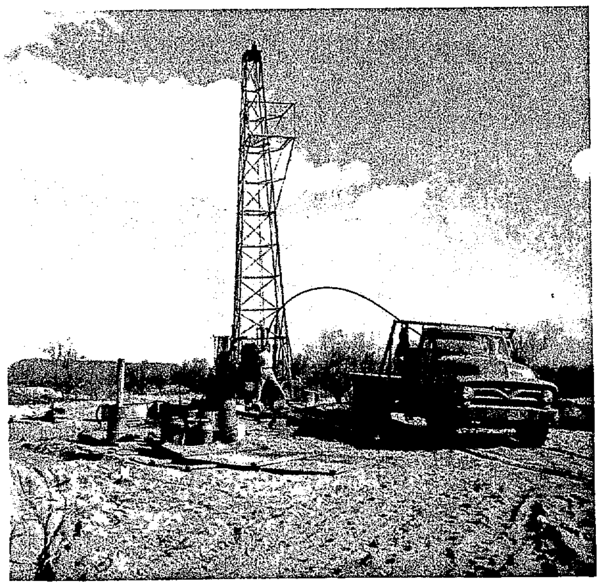
-4-

Joy Model 75 (chain pull down, rotary type).



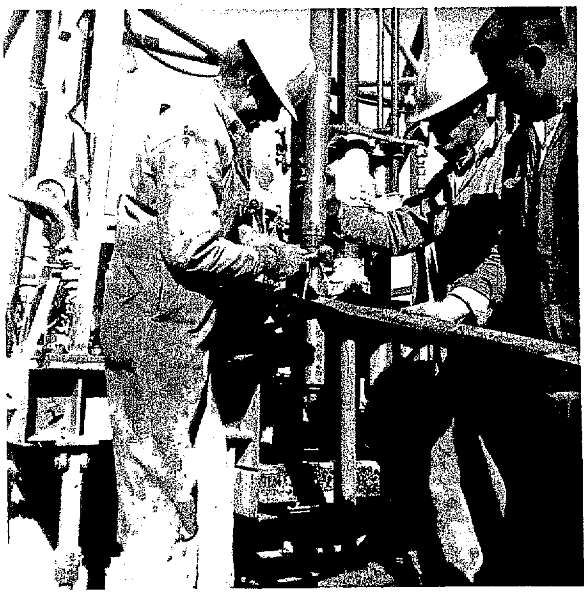
-5-

Joy Model HD 22 Diamond Drill. Mud circulation tank set up.



-6-

Joy Model HD 22 Diamond Drill. Installing string of plastic casing.

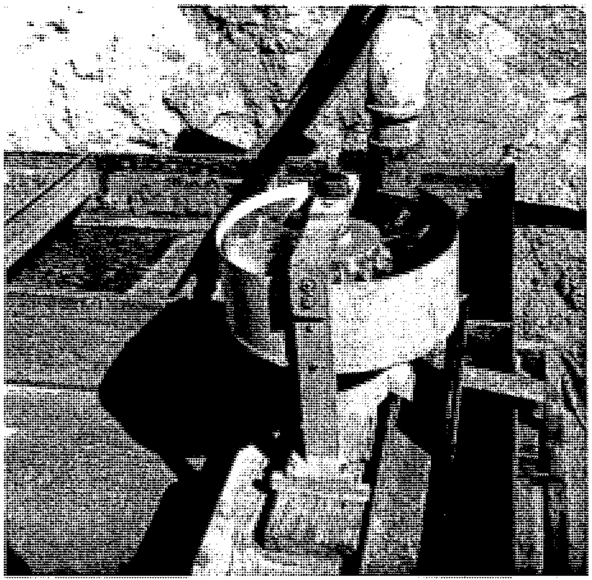


-7-

Transferring core from barrel to tray.

-8-

Rotary sludge splitter with three sludge settling tanks and sump tank.

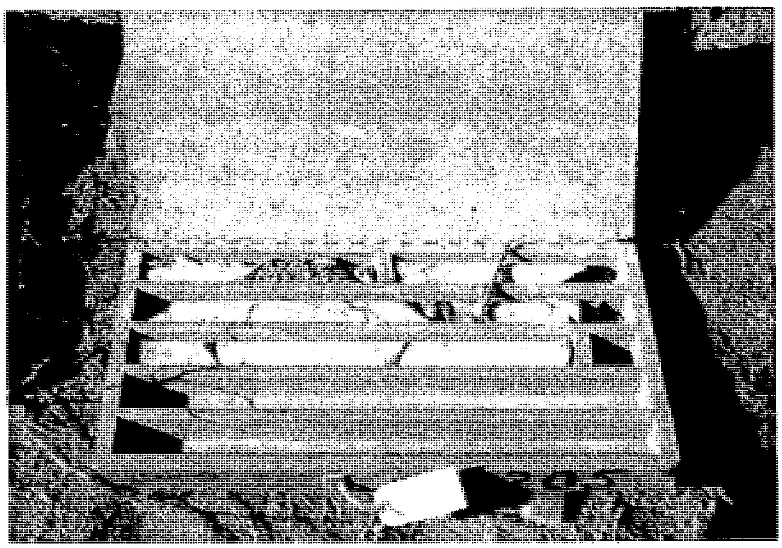


-9-

Rotary Sludge Splitter

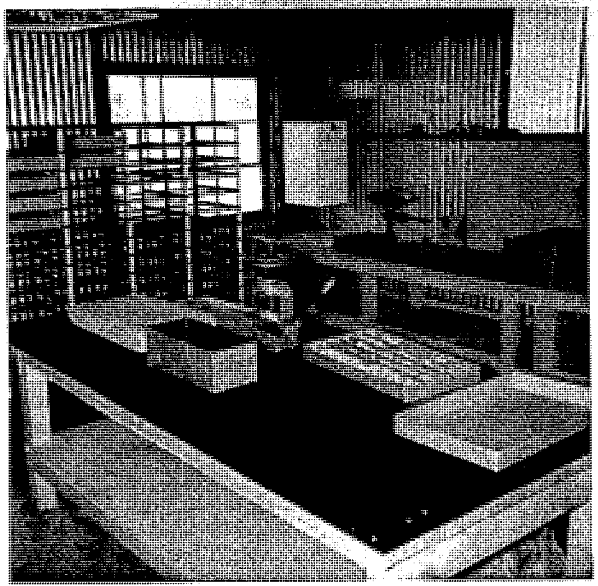
-10-

Box for transporting core from drill to laboratory (note that box is of small size -- 10' core capacity).



-11-

Interior sample preparation laboratory. Foreground, steel-topped core splitting table; core in cardboard storage box. Left background, core box receiving rack.

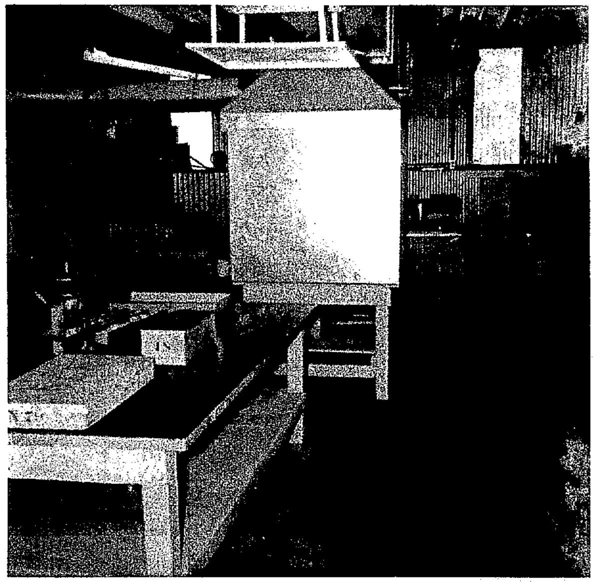


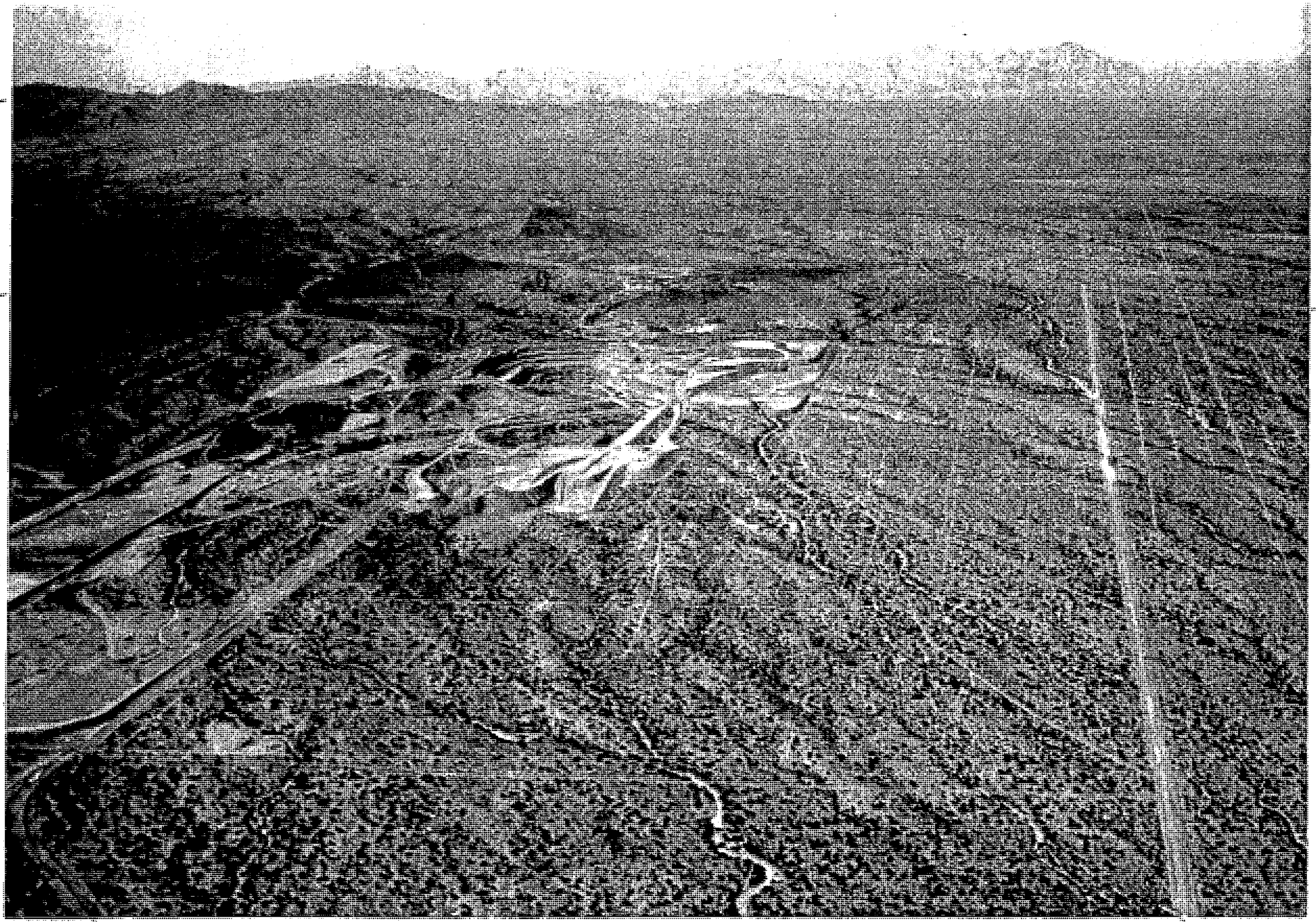
-12-

Core storage.

-13-

Ventilation hood over table for splitting crushed samples. Pulverizer and gyratory, left background.



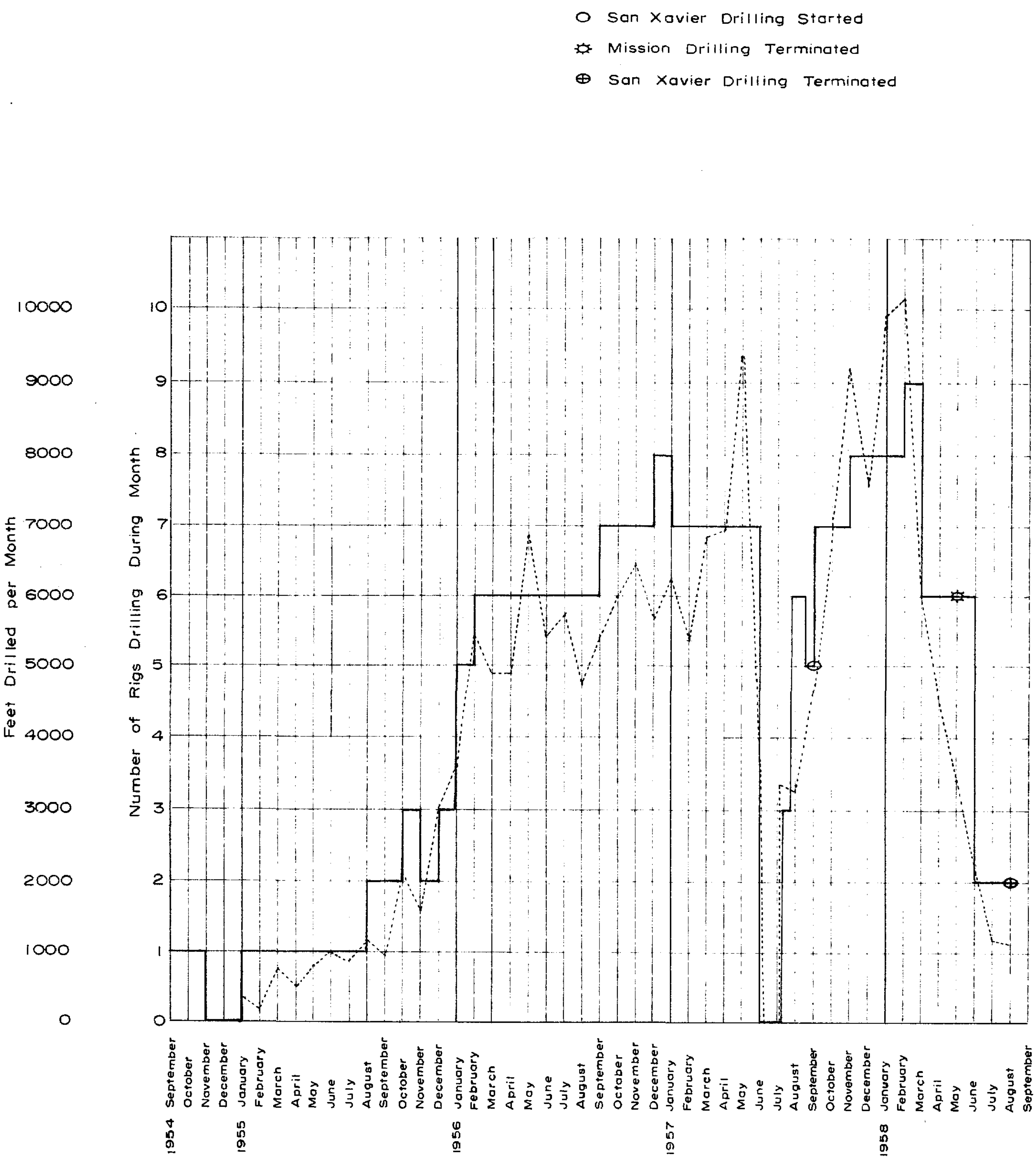


PIMA DISTRICT - LOOKING WESTERLY
Mission Area in right center between Pima waste dumps and Reservation line. Pima Open Pit, left center.

No. 14

TAB
A

Attachment A

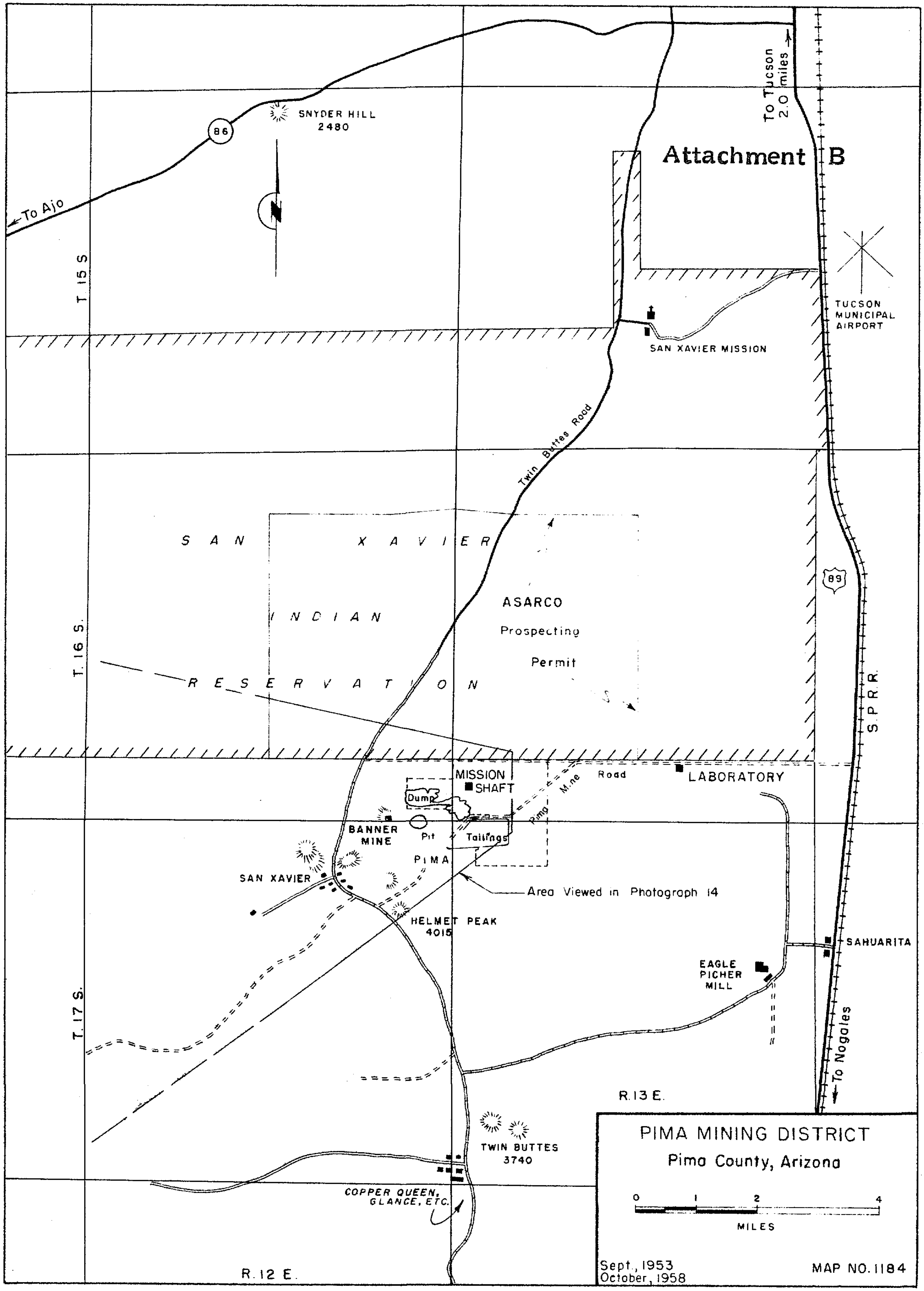


NUMBER OF DRILLS AND DRILLING RATE

TAB

B

Attachment B

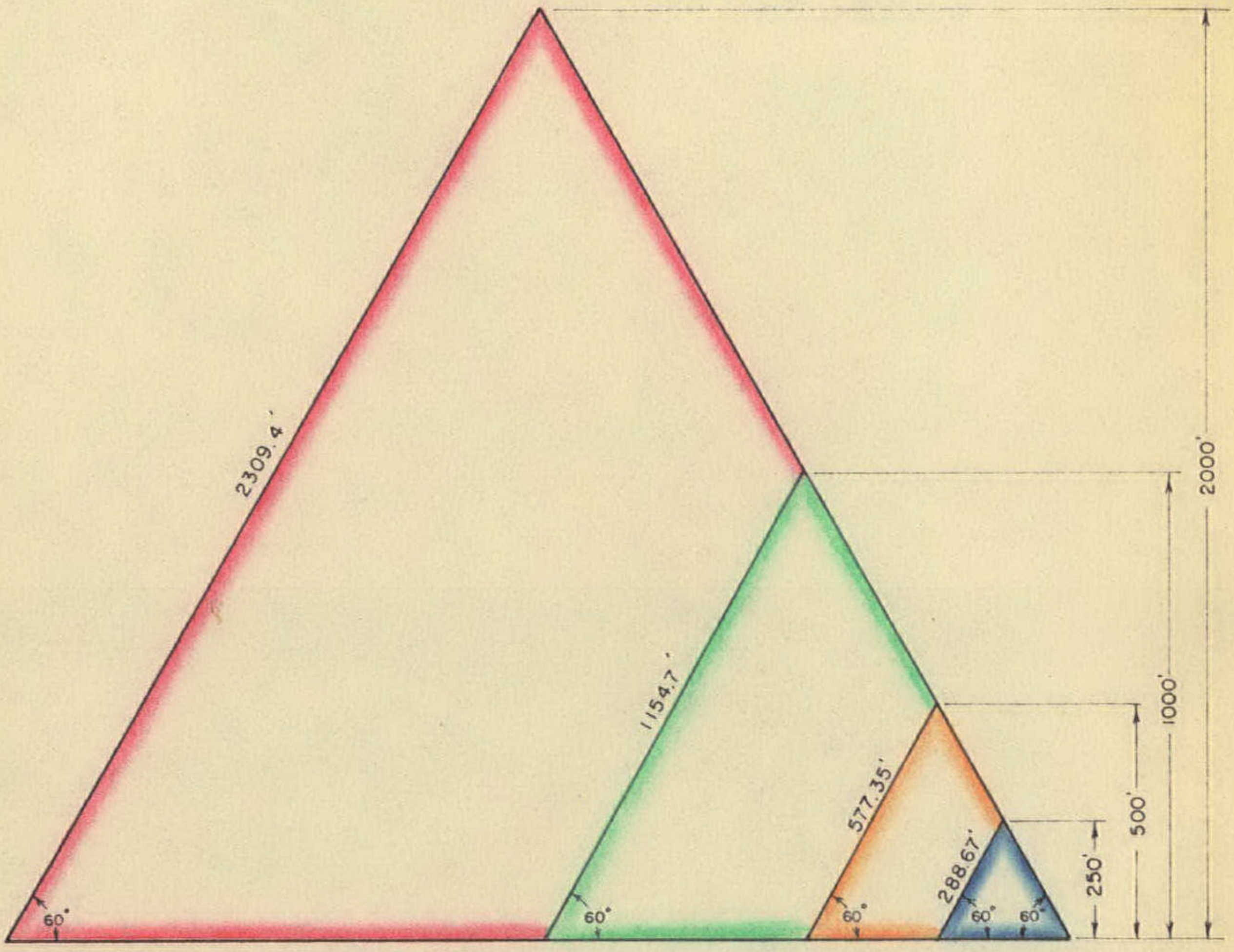


TAB

C

~~0039~~	~~03~~	~~W~~
~~0174~~	~~02~~	~~C~~
~~0024~~	~~04~~	~~C~~
~~0066~~	~~06~~	~~C~~
~~0005~~	~~12~~	~~C~~
004D	02	C

Attachment C



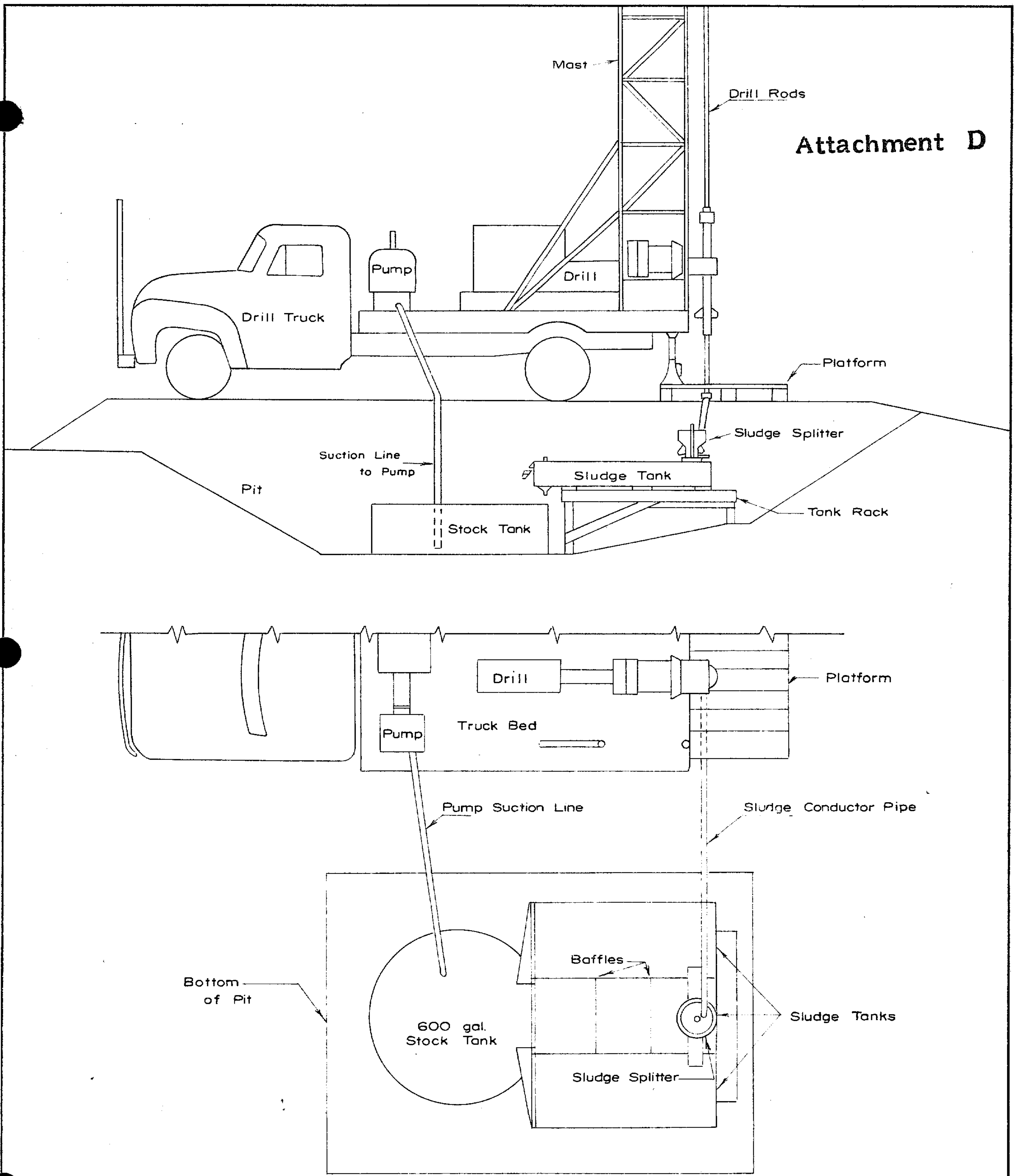
GENERALIZED TRIANGULAR GRID SYSTEM

SAN XAVIER RESERVATION PROJECT

TAB

D

Attachment D

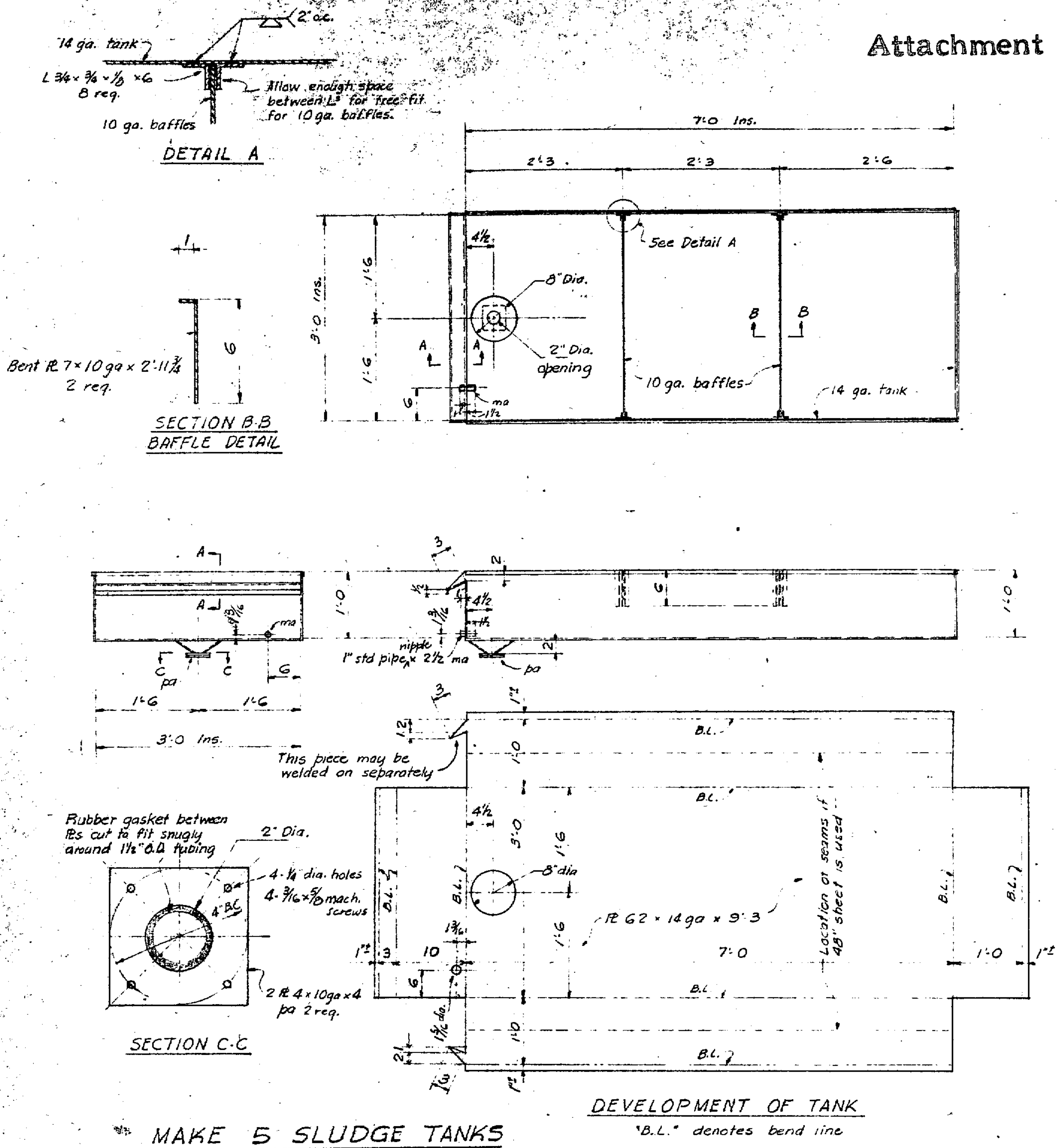


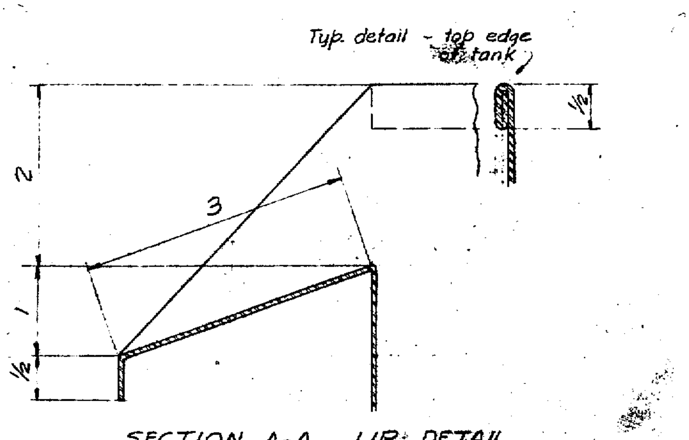
EAST PIMA LABORATORY
DIAMOND DRILL
&
SLUDGE SAMPLING SET-UP
July, 1958
EP-704-6A

TAB

E

Attachment E





SH PC	DET PC	DESCRIPTION	LGTH.	PC.MK	MAT.	REF.	SHOP	WT.	AMT.
	5	PL 62 × 14 ga.	9'3	(TANK)					
	10	PL 7 × 10 ga	2'11¾	(BAFFLES)					
	5	1" std pipe nipple	0'2½	ma					
	40	L ¾ × ¾ × ⅛							
	10	PL 4 × 10 ga	0'4	pa					
	20	3/16 × 5/8 R.H. mach screws							

Paint 1 S/C RED OXIDE

AMERICAN SMELTING & REFINING CO.
TUCSON, ARIZONA

LA 1-29-57

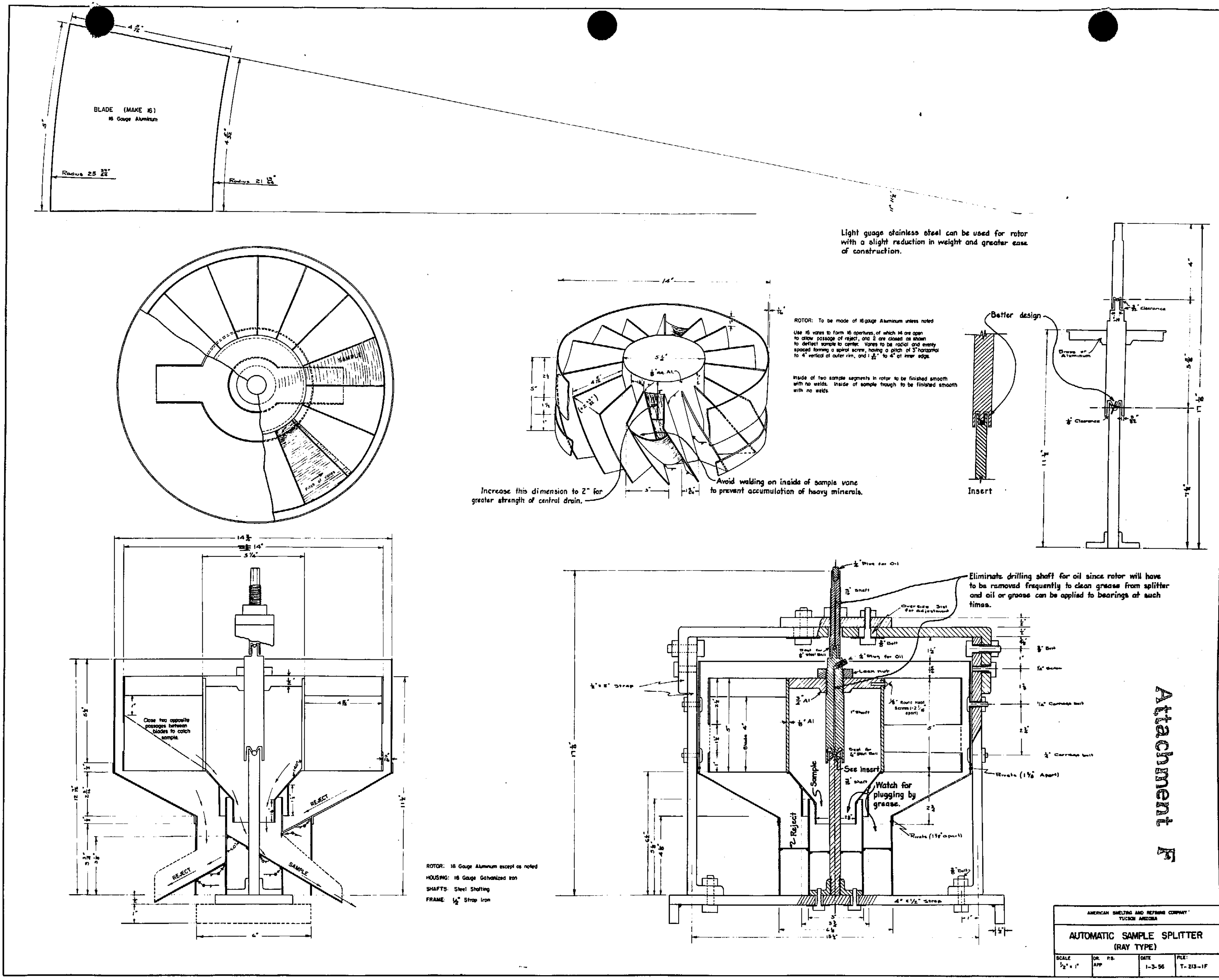
SLUDGE TANKS

AUSTAD STEEL & CONSTRUCTION CO.
TUCSON ARIZONA

W.O. 397

1

TAB
F



BLADE (MAKE 16)
16 Gauge Aluminum
Light guage stainless steel can be used for rotor with a slight reduction in weight and greater ease of construction.
ROTOR: To be made of 16 gauge Aluminum unless noted
Better design
Insert
Increase this dimension to 2" for greater strength of central drain.
Avoid welding on inside of sample vane to prevent accumulation of heavy minerals.
Close two opposite passages between blades to catch sample.
REJECT
SAMPLE
ROTOR: 16 Gauge Aluminum except as noted
HOUSING: 16 Gauge Galvanized Iron
SHAFTS: Steel Shafting
FRAME: ½" Strap Iron
Eliminate drilling shaft for oil since rotor will have to be removed frequently to clean grease from splitter and oil or grease can be applied to bearings at such times.
See Insert
Watch for plugging by grease.
Sample
Reject
Attachment F
AMERICAN SMELTING AND REFINING COMPANY
TUCSON ARIZONA
AUTOMATIC SAMPLE SPLITTER
(RAY TYPE)
DATE 1-3-56
FILE: T-213-1F

TAB

G

Attachment G I

HOLE No.________

DIAMOND DRILL SHIFT REPORT

AMERICAN SMELTING & REFINING CO.

FILE NO.________

PROPERTY________

DATE________19____

DRILL No.________

SHIFT________

SIZE OF BIT - NUMBER - FROM - TO - ACCUML. TOTAL

____

____

DRILLER________

HELPER________

WATER - DEPTH ENCOUNTERED________FEET

LOST - WATER AT ________FEET

CASING LOWERED - SIZE - FROM - TO

________FEET

________FEET

CASING REMOVED________FEET

EMPLOYMENT OF TIME

MOVING AND SETTING UP________

DRILLING ________

SETTING CASING ________

EQUIPMENT REPAIR ________

OTHER DELAYS ________

CEMENT USED - TYPE________QUANTITY________

DRILLING CEMENT - FROM________TO________

CEMENTING HOLE - FROM________TO________

DRILLING MUD - FROM________TO________

REAMING HOLE - FROM________TO________

SAMPLES

DEPTH		RECOVERIES			HARDNESS OF ROCK V.H. VERY HARD H-HARD M-MEDIUM S-SOFT V.S. VERY SOFT	CONDITION OF HOLE	COLOR OF SLUDGE	DRY WEIGHT		SP. GR.	REMARKS
FROM	TO	% CORE	% SLUDGE	% WATER				CORE	SLUDGE	CORE	

GENERAL REMARKS

DEPTH OF HOLE AT BEGINNING OF SHIFT________

DEPTH OF HOLE AT END OF SHIFT________

TOTAL LOADS OF WATER HAULED DURING SHIFT________

WATER ON HAND________GALLONS

SAMPLES LEFT IN SLUDGE BOX________

SAMPLES CANNED________

SAMPLER________

FILE NO.

CHURN DRILL SHIFT REPORT

AMERICAN SMELTING & REFINING CO.

Attachment G 2

PROPERTY

HOLE NO.

DATE 19

DRILL NO.

SHIFT

BIT TYPE

DRILLER

CASING LOWERED - SIZE - FROM - TO

HELPER

FEET

WATER - DEPTH ENCOUNTERED FEET

FEET

BIT USED FEET

FEET

EMPLOYMENT OF TIME

MOVING AND SETTING UP

REPAIRING ENGINE OR RIG

DRILLING AND BAILING

CEMENTING HOLE FROM TO

SETTING CASING

FISHING

REMOVING CASING

REAMING HOLE FROM TO

EQUIPMENT REPAIR

CLEANING HOLE FROM TO

OTHER DELAYS

SAMPLES

DEPTH		COLOR OF SLUDGE	CONDITION OF HOLE	HARDNESS OF ROCK V.H. VERY HARD H. HARD M. MEDIUM S. SOFT V.S. VERY SOFT	IS SAMPLE RELIABLE, ETC.	SIZE TO WHICH SAMPLE WAS CUT (NUMBER OF SPLITS)	NUMBER OF BAILERS	DRY WEIGHT OF SPLIT SAMPLE	REMARKS
FROM	TO		CAVING, ETC.						(NOTE THICKNESS OF EXTREMELY SOFT AREAS) (SPECIFY DRY WEIGHT OF AQUA-GEL ADDED)

GENERAL REMARKS

DEPTH OF HOLE AT BEGINNING OF SHIFT FEET

SAMPLES LEFT IN TUBS

DEPTH OF HOLE AT END OF SHIFT FEET

SAMPLES CANNED

SAMPLER

EAST PIMA

DDH No. ____________

CORE

Box	Size	From	To

SLUDGE

Can	From	To

REMARKS

FIELD SHEET

GEOLOGIC LOG

AMERICAN SMELTING & REFINING CO.

FILE NO.__________

DIAMOND DRILL HOLE NO.__________

DATE__________

TOTAL DEPTH OF HOLE__________

PROPERTY__________

LOG BY__________

DEPTH		ROCK CLASSIFICATION	MINERALIZATION			ALTERATION	HEAVY MINERALS IN CONCENTRATES	REMARKS
FROM	TO		OXIDE	SULPHIDE	SILICIF.			

Attachment G 4

Attachment G 5

ASARCO

PRELIMINARY GEOLOGIC LOG

____

D. D. Hole No. _______________

Location _______________

____

Depth of Hole _______________

Collar Elev. _______________

FOOT	APPROX. CORE RECOVERY %	DESCRIPTION

From	To	Assay Data % Cu (Core)	From	To	Assay Data % Cu (Core)

DIAMOND DRILL HOLE DATA

EAST PIMA

Attachment G 6

HOLE NO.________

FOOTAGE	SPECIFIC GRAVITY			CORE WEIGHT		FOOTAGE	SLUDGE WEIGHT
	Wgt. - gms	Vol. - cc	S.G. - gms/cc	lbs			lbs

Hole No. ________

DIAMOND DRILL CORE WEIGHT

SAN XAVIER

Attachment G 7

SPECIFIC GRAVITY

BOX NO. ________

Weight with core					
Weight less core					
Weight of Core					
Weight from Preceding Box					
TOTAL Weight Core					

BOX NO. ________

Weight with core					
Weight less core					
Weight of Core					
Weight from Preceding Box					
TOTAL Weight Core					

BOX NO. ________

Weight with core					
Weight less core					
Weight of Core					
Weight from Preceding Box					
TOTAL Weight Core					

BOX NO. ________

Weight with core					
Weight less core					
Weight of Core					
Weight from Preceding Box					
TOTAL Weight Core					

BOX NO. ________

Weight with core					
Weight less core					
Weight of Core					
Weight from Preceding Box					
TOTAL Weight Core					

BOX NO. ________

Weight with core					
Weight less core					
Weight of Core					
Weight from Preceding Box					
TOTAL Weight Core					

SHEET NO. ____

EAST PIMA PROJECT
DIAMOND DRILL ASSAY LOG
AMERICAN SMELTING AND REFINING COMPANY

DATE STARTED ____________

DATE COMPLETED ____________

HOLE NO. ____________

COORDINATES ____________ N ____________ W   COLLAR ELEVATION ____________   BEDROCK ELEVATION ____________

FOOTAGE		INTERVAL	HOLE SIZE	SPECIFIC GRAVITY	% RECOVERY		CORE		WEIGHTED AVERAGE	SLUDGE		REMARKS	DATA OK	MEASURED CORE RECOVERY
FROM	TO				CORE	SLUDGE	WT	ASSAY		WT.	ASSAY			

Attachment G 8

AMERICAN SMELTING AND REFINING COMPANY
Tucson Arizona

Mr. T. A. Snedden, Manager
Southwestern Mining Department
Tucson Office

Attachment G 9

Drilling Cost Estimate
Joy Manufacturing Company

Dear Sir:

The following is an estimate of drilling costs for the month of ________, 195 . A total of ________ feet was drilled by Joy Manufacturing Company (______ diamond drills) at an estimated cost of $________ per foot.

DDH # ( ) (.)
(-) @ $ /ft.

DDH # ( ) ( )
(-) @ $ /ft.

DDH # ( ) ( )
(-) @ $ /ft.

DDH # ( ) ( )
(-) @ $ /ft.

Attachment G 10

PROJECT..

DRILLING PRO

Location.. Contractor.......................................

Date	Drilling						Casing and Reaming			Cementing			
	Size	Depth	Hrs.	Runs	Adv.	Rec.	Size	Depth	Hrs.	Bags	Type	Hrs.	Drilling

GRESS CHART

DIAMOND DRILL HOLE NO...

Coordinates of collar...

Delays						Remarks
Equip.	Water	Move	Mud	Tanks	Other	

Month ________

SUMMARY - DIAMOND DRILL HOLE NO.________

________N ________W Collar Elevation________

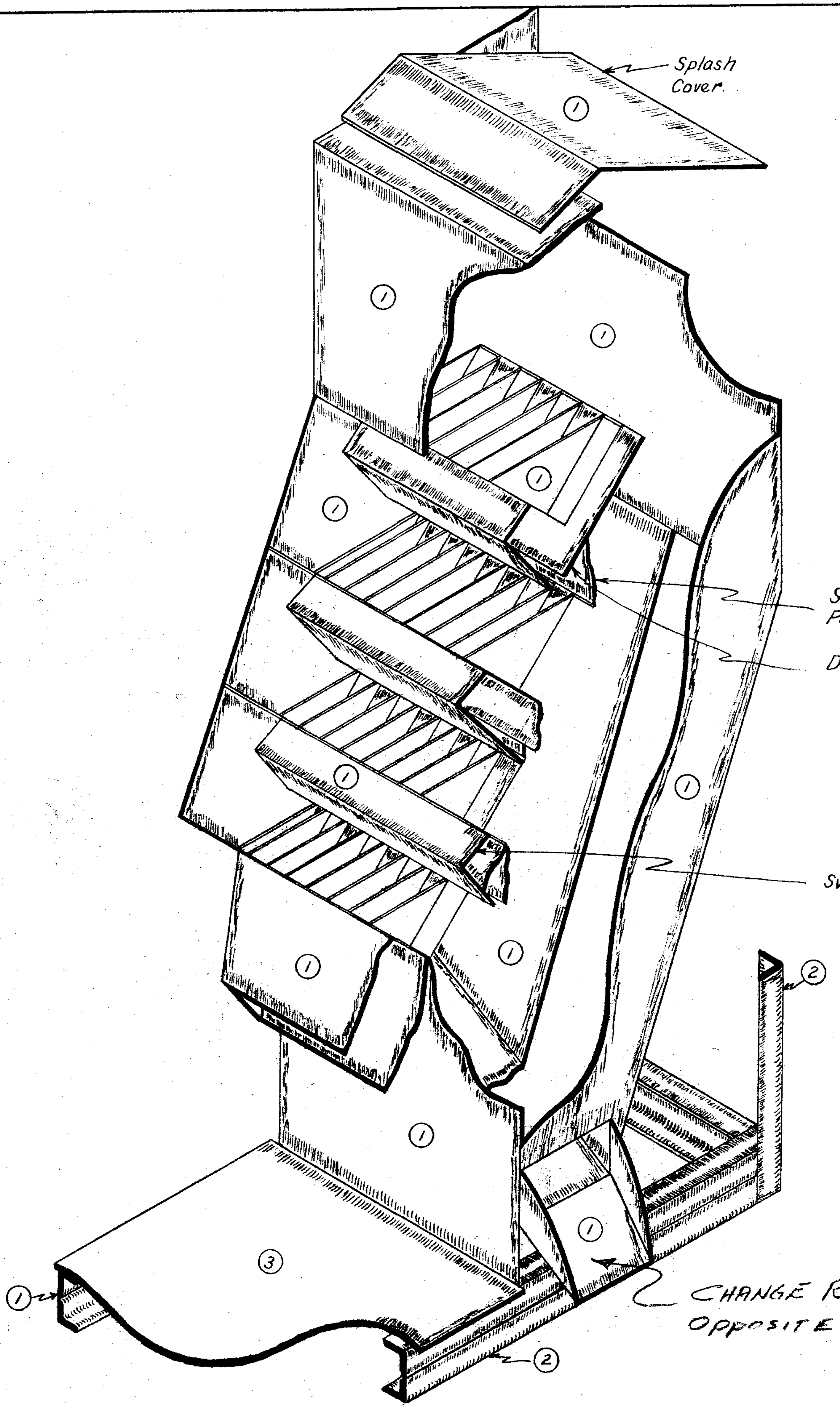
From	To	Interval	Core Rec. %	% Cu. Core	Geology

Attachment G II

TAB

H

Attachment H



NOTE

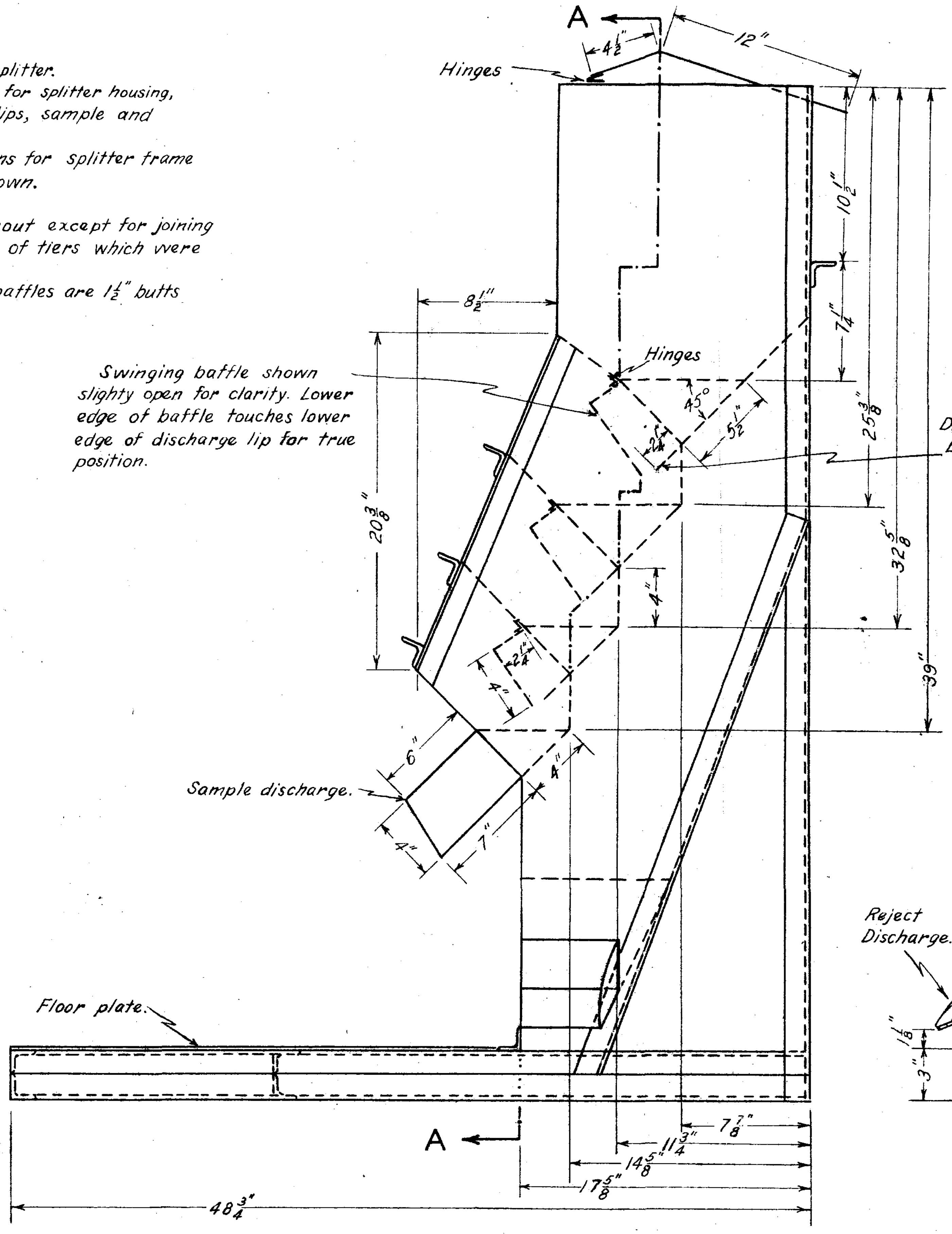
Material used in construction of splitter.

1. 16 gauge black sheet iron for splitter housing, tiers, baffles, discharge lips, sample and reject discharges.
2. $1\frac{1}{2}$" equal leg x $\frac{3}{16}$" angle irons for splitter frame and reinforcements as shown.
3. $\frac{1}{8}$" Diamond floor plate.

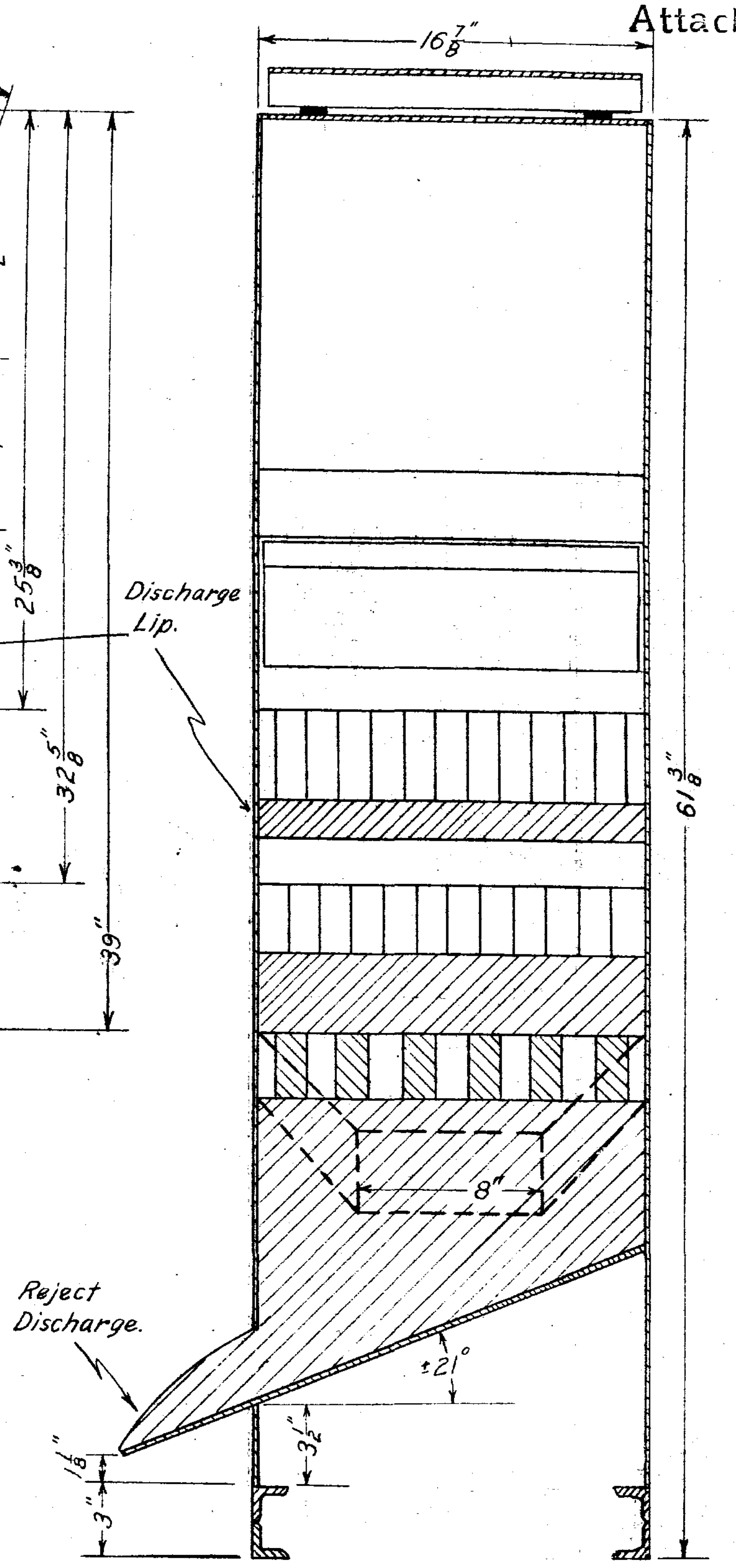
Welded construction used throughout except for joining of sample and reject dividers of tiers which were solder sweated.

Hinges used for splash cover and baffles are $1\frac{1}{2}$" butts welded in place.

CHANGE REJECT CHUTE TO OPPOSITE SIDE.
J.H.C.
9/56



SIDE ELEVATION



SECTION A-A

DESIGN OF CHURN DRILL SLUDGE SPLITTER

American Smelting and Refining Company

Scale 1 ½" = 1' April, 1950

DESIGNED BY J. H. COURTRIGHT AND R.E. MIERITZ
DRAWN BY R.E. MIERITZ

File No. S-214-30

TAB

I

Attac... ent I

RESUME OF DRILLING CONTRACTS

Joy Manufacturing Company

Contract dated December 6, 1954

1. Maximum depth of hole - 1000'
2. Maximum number of holes - 10
3. Minumum footage - 4000'

   (Penalty: contrctor to receive 1/2 rate on remaining footage if less then 4000' drilled)
4. Prices:

Overburden drilling $2.25 per foot

	NX Core	BX Core
From ledge to 500', per foot	$5.50	$5.00
From 500' to 1000', per foot	$6.00	$5.50

Extra charge for drilling quartzite or chert - $1.00 per foot.

5. Company to provide water; contractor to transport water to the drills.
6. Company to pay contractor for casing lost, or left in hole.
7. Company to provide roads and drilling sites.
8. Company to pay contractor $50.00 per 8-hour shift for delays, caused by Company.
9. Company to pay contractor $50.00 per 8-hour shift, plus cost of materials used, for reaming, casing and cementing.

Note: Well before the completion of the 4000' of drilling under the foregoing contract, Joy reported a considerable operating loss and requested higher rates per foot. After cost studies had been made certain increases were approved. Subsequently, other adjustments, both up and down, were made. Eventually, a new contract, outlined below, was negotiated.

Contract dated September 16, 1957

Provisions in this contract essentially the same as in contract of December 6, 1954 above, except for the following:

1. Maximum depth of hole - 1200'
2. Maximum number of holes - Not specified
3. Minimum footage - 13,000'
4. Prices:

Overburden drilling $1.65 per foot

	NX & NXM	BX & BXM
From ledge to 400', per foot	$7.75	$7.25
From 400' to 600', per foot	8.25	7.75
From 600' to 800', per foot	8.75	8.25
From 800' to 1000', per foot	9.25	8.75
From 1000 to 1200', per foot	9.75	9.25

8 & 9: Company to pay $75 per shift for delays, casing, reaming, etc.

Revised rockbit prices - effective January 15, 1958

As drilling proceeded on the Reservation, a number of holes were continued below the overburden to substantial depths by rotary methods. This deeper rock bit drilling, which had not been provided for in the original contract, proved more costly than the gravel overburden drilling; therefore, the following revisions were made:

#75 drill (chain pull down)

	Per Foot
From ledge to 400'	$2.75
400' to 600'	3.25
600' to 800'	3.75

#22HD Drill (hydraulic feed)

From ledge to 400'	$4.25
400' to 600'	4.75
600' to 800'	5.25

The above prices included cost of drilling mud and time consumed in mixing mud, cleaning tanks, etc.

Hoagland Dodge Drilling Company

Contract dated January 18, 1956

1. Minimum footage - 3000 feet
2. Non-coring drilling (rotary) - $3.20 per foot
3. Core drilling

All NX size, except where reductions are necessary,

	Per Foot
a. From 0' to 400'	$5.20
b. From 400' to 600'	6.20
c. For each foot of core recovered	2.00
4. Reaming BX to NX	2.00

5. Delays for Company account - $8.00 per hour

On May 11, 1956 the above rates were revised as follows:

Non coring	$3.25
Coring to 400'	6.20
Coring 400' to 600'	7.20
For each foot of core recovered	2.75

E. J. Longyear Company

Three holes were drilled by this contractor under a "Cost-Rental" arrangement, the principal features of which are listed below (excerpts from Longyear's proposal dated July 23, 1955):

2. We understand that the work as now planned will consist of a series of vertical holes ranging from 400 to 700 feet in depth, with a minimum aggregate footage of 1,000 feet; that the materials to be penetrated will consist of any one or possibly all of the following: limestone, dolomite, arkose, siltstone and quartzite; that the water required for the drilling operations is available within approximately two miles of the drill site. We also understand that you will provide, at no expense to the Longyear Company, sumps, access roads and leveling of drill sites.

3. For this work we propose to furnish one truck-mounted diamond core drill unit of suitable capacity, together with the following items:

a) Diamond bits, reaming shells, supplies and other miscellaneous equipment including NX and BX-size wire line equipment required for recovering cores by diamond drill method to a maximum depth of 1,000 feet.

b) Runner foreman, one driller, and drill helpers as required for two-shift operation.

c) Tank truck for hauling water required for the drilling operations.

d) One-half ton pick-up for transporting drill supplies to and from the drill site.

e) Core boxes, if desired, as a supply item.

4. We will carry public liability insurance covering personal injury and property damage; Workmen's Compensation, Old Age Benefit, Unemployment and any other insurance on our employees required by state or federal laws; also, all-risk insurance on the drilling equipment protecting against loss by theft, fire, flood, land-slides and other similar hazards. Certificates showing the coverage referred to will be furnished if desired.

5. Costs

It is agreed that you will reimburse the Longyear Company or pay directly the expenses of the Longyear Company in the performance of the work as follows:

a) All wages and subsistence allowance of drillers and drill helpers and their travel expenses from nearest available point to the scene of the work and return; this to include personnel replacements as required.

b) All freight, express and trucking charges.

c) All supplies used, repairs, replacements; fuel; oil, bortz, bortz bits and bortz reaming shells at our listed retail prices, less credit received for salvaged stones; Carboloy, roller bits and all other special type bits required, at list prices.

d) All premiums on insurance as outlined in paragraph 4.

e) Payment in full for any rods or casing lost in holes or discarded on account of damage due to causes other than ordinary wear.

f) Cost of cement, Aquagel, Fibretex, and other drill hole stabilization agents used in connection with the drilling operations.

In addition to the costs outlined above, you will pay the Longyear Company rental on the drilling equipment used as follows:

Drill and accessory equipment - $600 per drill per month for single-shift operation, $725 per drill per month for double-shift operation; this charge to cover rental of drill outfit, interest, depreciation and overhead expenses. This rental is to commence at the time the drill outfit and crews are delivered at Tucson, Arizona, and continue until the project has been completed.

You will also pay rental rates on the service equipment used as follows:

a) One-half ton pick-up - $100 per month, plus cost of gas, oil, and maintenance.

b) Water truck - $250 per month, plus cost of gas, oil, and maintenance.

6. Compensation

In addition to all costs as outlined in paragraph 5, you will pay the Longyear Company compensation at the rate of $0.50 per foot drilled. It is understood that the charge of $0.50 per foot drilled covers total compensation for overburden drilling, diamond core drilling and reaming, or other work pertaining to the execution of the drilling program.

7. It is understood that in the event drilling operations are temporarily terminated and you request retaining the drills and equipment at the drilling site on a stand-by basis, the rental charge for the outfits would be $300 per month per unit, or proportionate part thereof for fractional month.

The Wininger Drilling Company (Churn Drilling)

Exerpts from contract dated September 15, 1956:

Article 1.

The CONTRACTOR agrees to furnish at his own expense all equipment, labor, tools, casing, supplies and materials necessary for the drilling of churn drill holes, as hereinafter stipulated, and to commence within ten days after the date of this document, upon and within such mining claims in the Pima Mining District, Pima County, Arizona, as may be designated by the Company and to continue the drilling of said holes with all reasonable diligence. Said churn drill holes shall be drilled at the locations designated by the COMPANY. Said churn drill holes shall be drilled to the depth designated by the COMPANY, with 1000 feet being the maximum. Said churn drill holes shall be drilled in sizes designated by the COMPANY, within a maximum of 14" and a minimum of 5" in diameter. If any hole does not reach the depth designated by the COMPANY's engineer in charge, a new hole must be substituted, and the cost of drilling the abandoned hole shall be divided equally between the CONTRACTOR and the COMPANY.

Article 2.

The CONTRACTOR agrees that the maintenance and repair of the machinery and equipment employed in this drilling will be for his account. Water necessary for the proper conduct of drilling and sampling operations will be made available to the CONTRACTOR by the COMPANY at the properties. Water will be transported from supply reservoir to the drilling sites at the expense of and for account of the CONTRACTOR.

Article 3.

The COMPANY guarantees to the CONTRACTOR that the footage of churn drilling to be required and/or paid for shall not be less than 5,000 linear feet of hole except as specified in Article 15 hereof, and shall pay the CONTRACTOR for the footage drilled and other work hereunder as follows:

1.	Total footage drilled of diameter 5" and above	$6.00 per foot
2.	Installing or removing casing	.26
3.	Installing or removing liners	.64
4.	Under reaming or straight reaming	6.92
5.	Casing left in hole 14"	5.50
6.	Casing left in hole 10"	4.00
7.	Casing left in hole 8"	3.50
8.	Casing left in hole 7"	2.50
9.	Casing left in hole 5"	2.00
10.	Delays when caused by COMPANY	$10.00 per hour

All work under Items 2 to 4 inclusive, i.e. installing or removing casing or liners and under reaming and straight reaming shall be done at the option of and as directed by the COMPANY.

Items 5 to 9 inclusive are to apply to casing left in the hole when it is deemed impracticable by the COMPANY at its sole discretion to remove the same.

In the event that less than 5,000 feet of holes are drilled the COMPANY agrees to reimburse the CONTRACTOR for costs incurred in transporting men and equipment from Tucson to the worksite and return.

Article 4.

In the event that the total payments therefor at the rates set forth in Article 3 amount to less than an average of $96 per eight hour shifts worked on each rig occupied in the drilling of the 5,000 feet of hole, the COMPANY agrees to pay to the CONTRACTOR an amount sufficient to make up the difference, that is to say, to make said average equal to $96. A shift worked is defined as one in which a full drilling crew employed by the CONTRACTOR fulfills eight hours of work on one rig on location. In computing said average, shifts or fraction of shifts not worked due to failure or lack of equipment, supplies or labor shall not be taken into consideration; and the corresponding expenses incidental to such interruptions of drilling shall be for account of the CONTRACTOR.

Article 7.

The CONTRACTOR shall arrange for the bailing out of each hole at 5 foot intervals in order to enable the COMPANY to sample the hole, and such bailing shall continue until the COMPANY's sampler or engineer-in-charge shall be satisfied that the hole is clean and that an accurate and adequate sample has been obtained. Any questions arising under this provision shall be taken up and resolved, not by the drill runner and sampler, but in conference between: on the one side, the CONTRACTOR, or the CONTRACTOR's representative (foreman) on location; and, on the other side, the COMPANY's engineer-in-charge on location. Moreover, any questions regarding other performance provisions of the present agreement shall be resolved in like manner. In case no agreement is reached in this manner then the matter shall go to arbitration.

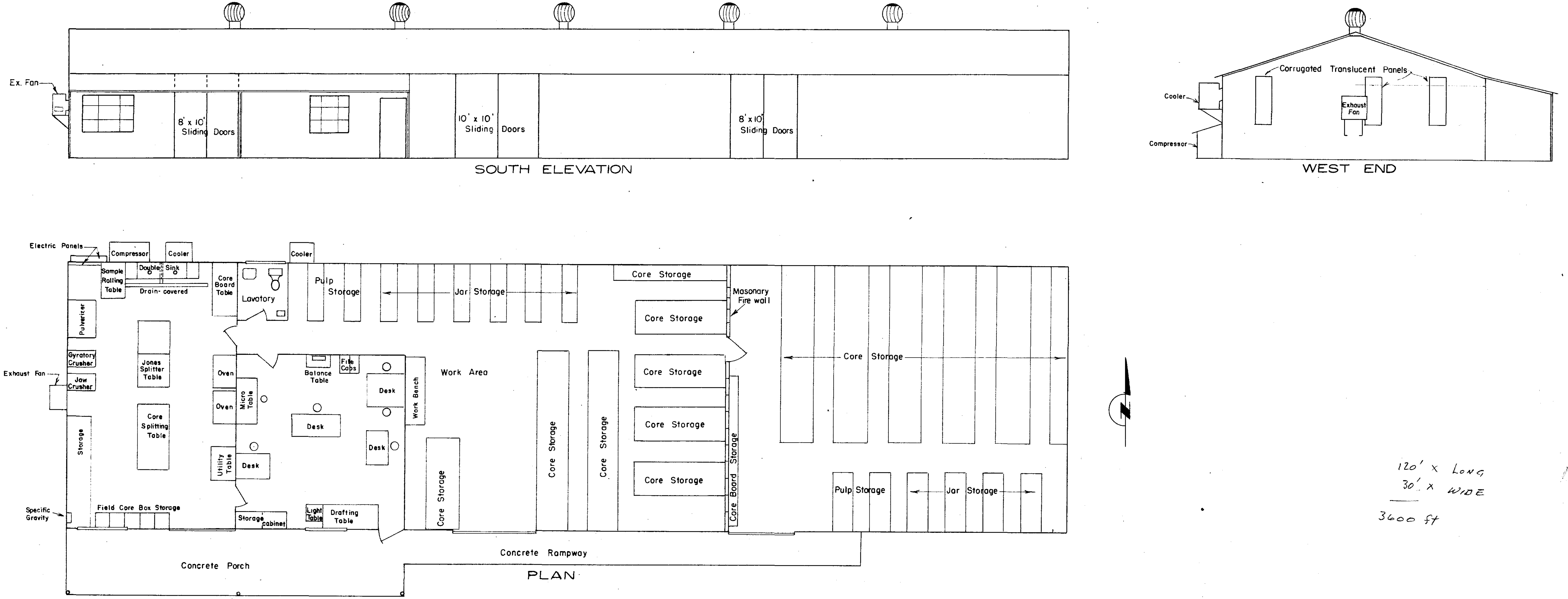
Article 15.

The COMPANY may terminate this contract in its entirety at any time prior to the completion of 5,000 feet of drilling upon payment to the CONTRACTOR of the sum of $1,000.00 (One Thousand Dollars) in addition to the amounts then due to the CONTRACTOR for drilling. In the event of such termination and in case that total payments under this clause for footage drilled at rates set forth in Article 3 amount to less than an average of $96.00 per eight hour shift worked on each drilling rig on location, then, in that event, the COMPANY agrees to pay the CONTRACTOR a sufficient amount to make up the difference required to assure payment of the agreed minimum of $96.00 per shift per rig.

TAB

J

Attachment J



120' x Long
30' x WIDE
3600 ft

EAST PIMA LABORATORY

Scale 1" = 16' (approx)

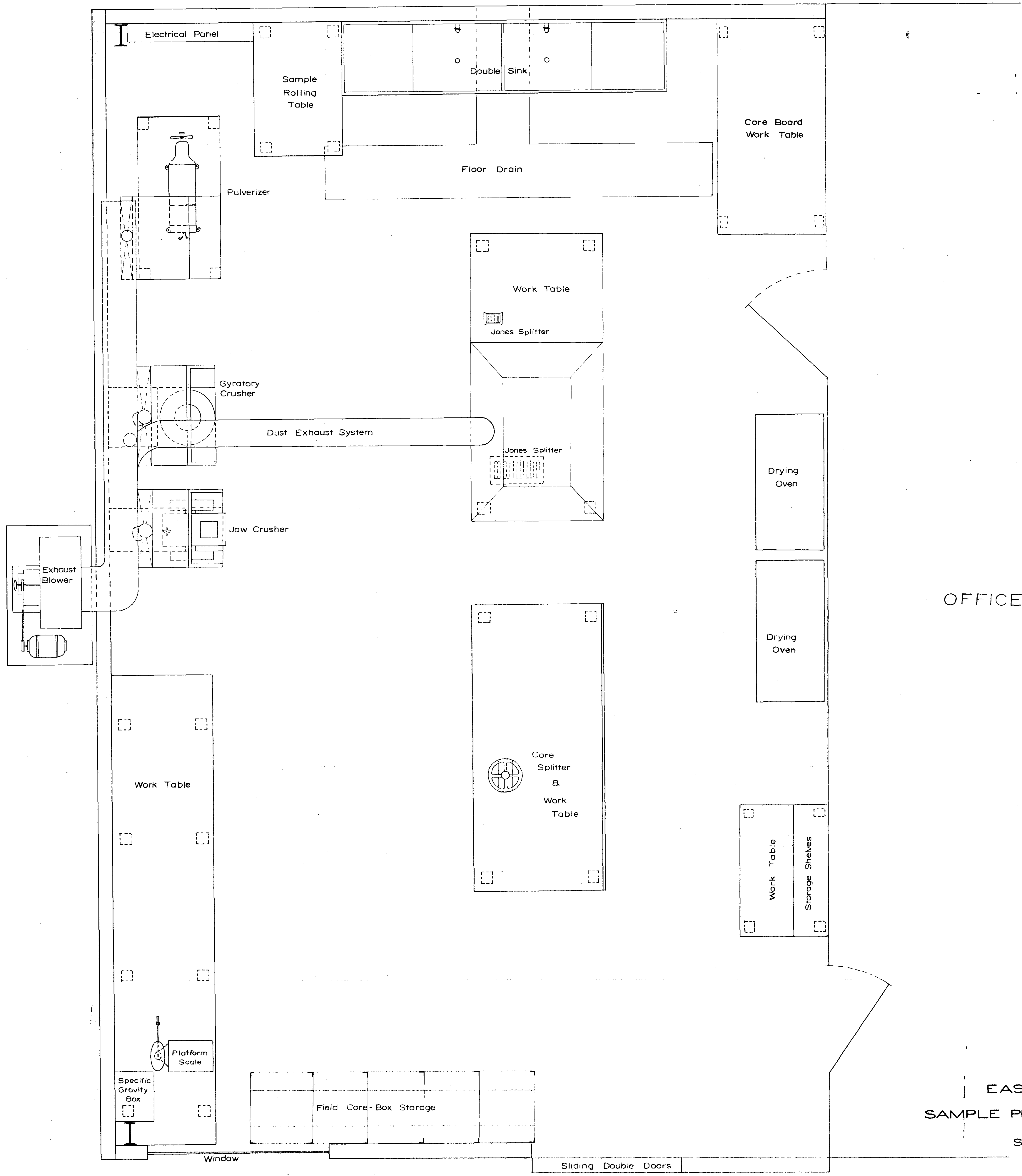
July, 1958

EP-704 IC

TAB

K

Attachment K



EAST PIMA PROJECT

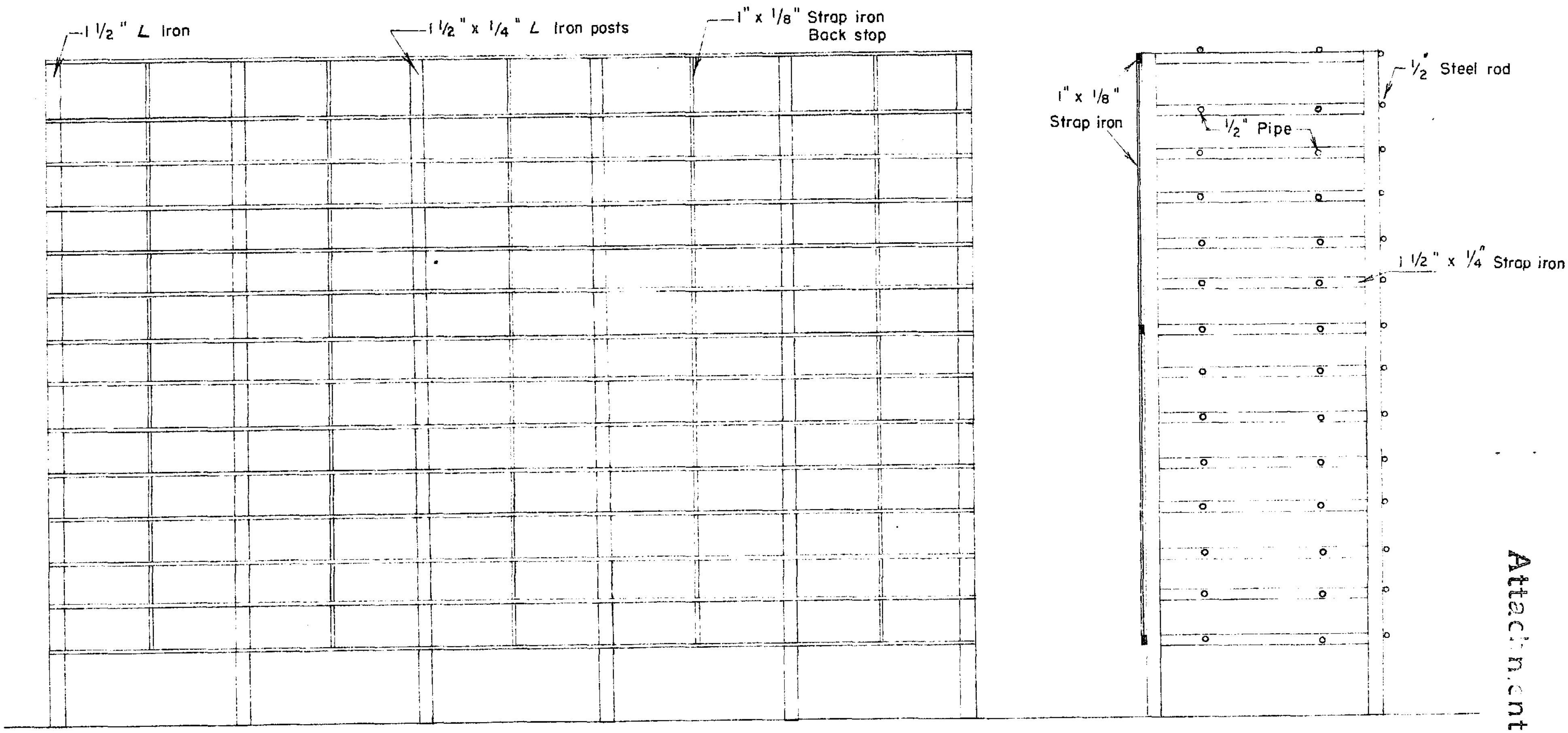
SAMPLE PREPARATION LABORATORY

Scale 1" = 2' (approx.)

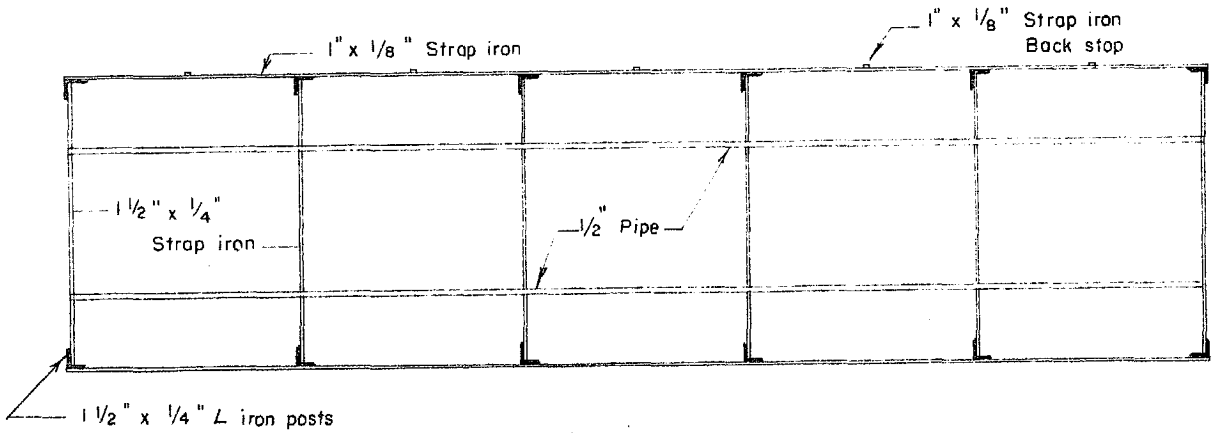
EP-704 2D

TAB

L



NOTE: All welded steel construction



Attachment L

EAST PIMA LABORATORY

FIELD CORE-BOX STORAGE

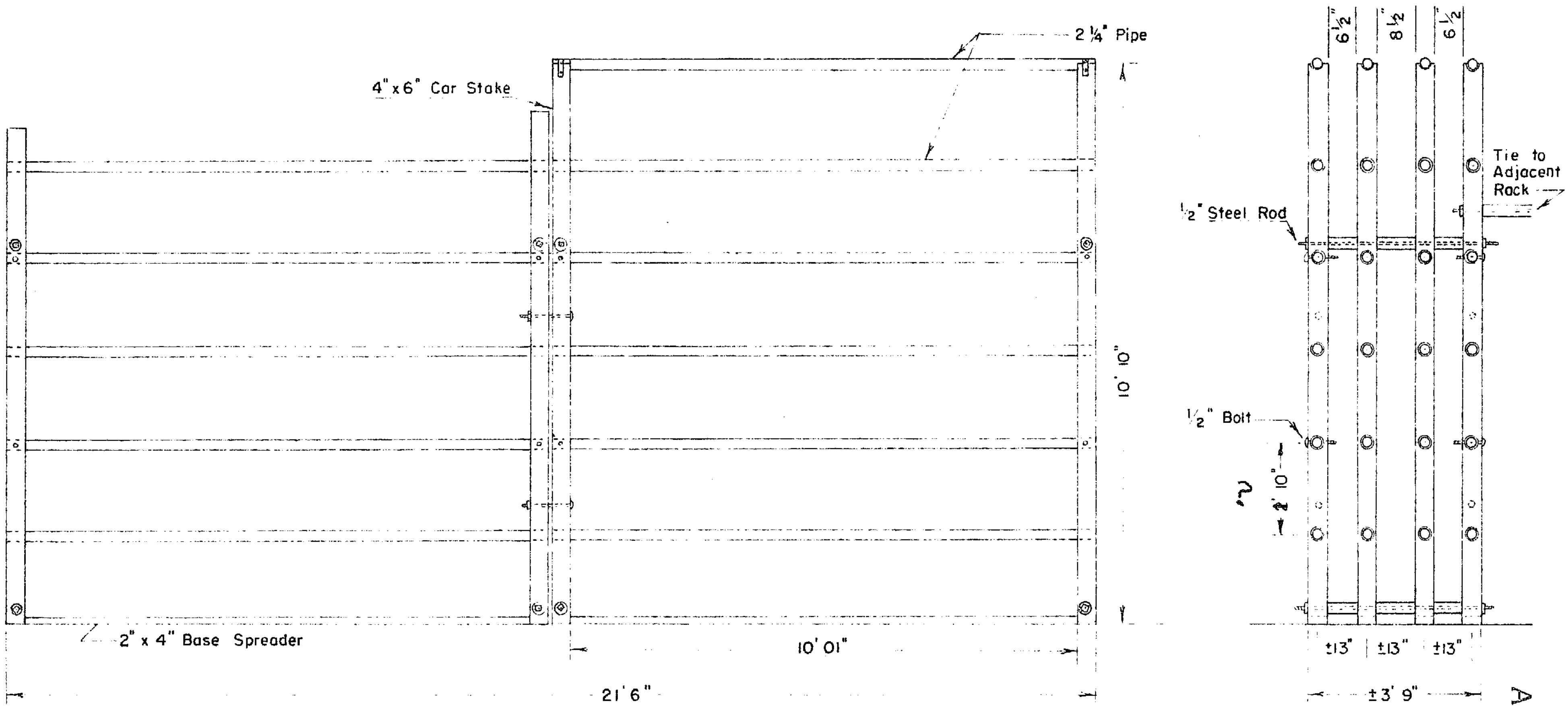
Scale 3/4" = 1' (approx)

July, 1958

EP- 704-3A

TAB

M



Attachment M

CORE RACK LAYOUT
EAST PIMA LABORATORY
Tucson, Arizona

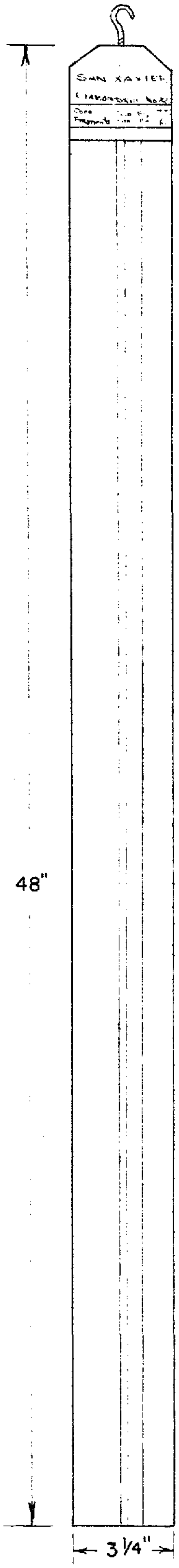
NPW 6-20-58

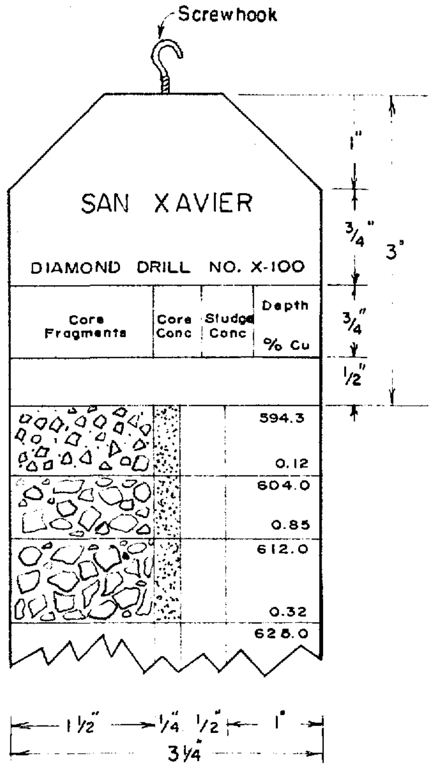
EP-704-4A

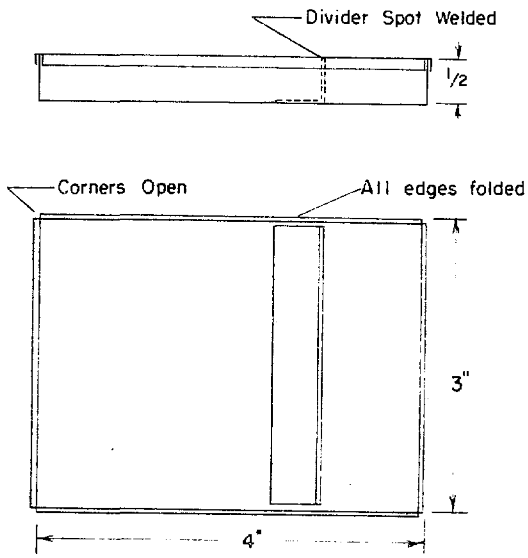
TAB

N

Attachment N







Sheet Metal "Boat" for Core and Sludge Board Construction

EAST PIMA LABORATORY

CORE & SLUDGE BOARD

EP-704-7A

TAB

O

Attachment O

Table I

COMPARISON OF CORE AND SLUDGE ASSAYS, MISSION PROJECT
Diamond Drill Holes Numbers 16 to 201

Core Rec Range	No. of Samples	Core Assay Sum	Average Core Assay	Sludge Assay Sum	Average Sludge Assay	Average Sludge Recovery	Ratio of Sl. Assay to Core Assay
96-100	525	672.41	1.28	574.27	1.09	60	85%
91-95	245	311.37	1.27	259.20	1.06	60	83%
86-90	121	133.83	1.11	126.36	1.04	55	94%
81-85	64	49.74	.78	42.46	.66	65	85%
76-80	45	36.03	.80	34.50	.77	68	96%
71-75	39	23.09	.59	19.19	.49	70	83%
66-70	31	31.14	1.00	26.26	.85	82	85%
61-65	17	15.45	.91	13.45	.79	83	87%
56-60	17	8.50	.50	8.85	.52	75	104%
51-55	15	17.46	1.16	12.17	.81	59	70%
46-50	10	5.91	.59	5.44	.54	69	92%
41-45	4	4.10	1.02	3.43	.86	52	84%
36-40	9	6.78	.75	6.57	.73	90	97%
31-35	15	9.20	.61	8.83	.59	54	97%
26-30	4	2.01	.50	1.98	.50	76	100%
21-25	5	3.51	.70	2.51	.50	58	71%
16-20	5	5.13	1.03	3.36	.67	58	65%
11-15	7	4.13	.59	3.49	.50	59	85%
6-10	3	.77	.26	1.46	.49	100	188%
1-5	2	1.83	.92	1.43	.72	50	78%
103439 ÷ 1183						73,133 ÷ 1183	
Av. 87%	1183	1342.39	1.13	1155.21	.98	Av. 62	87%

Attachment O

Table II

COMPARISON OF CORE AND SLUDGE ASSAYS, MISSION PROJECT
Diamond Drill Holes Numbers 16 to 201

Core Samples in 96% - 100% Recovery Range

Range of Sludge Rec.	No. of Samples	Average Sludge Rec in Range	Average Core Assay	Average Sludge Assay	Ratio of Sludge Assay to Core Assay	% Of Difference
100 - 120	36	108	1.72	1.45	84%	- 16%
90 - 99	21	96	1.32	1.10	83%	- 17%
80 - 89	36	84	1.10	.93	85%	- 15%
70 - 79	39	74	1.32	1.25	95%	- 5%
60 - 69	53	64	1.31	1.17	89%	- 11%
50 - 59	59	54	.98	.99	101%	+ 1%
40 - 49	97	44	1.01	.93	92%	- 8%
30 - 39	59	35	1.33	1.53	115%	+ 15%
20 - 29	38	25	1.28	.96	75%	- 25%
10 - 19	21	15	2.82	1.61	57%	- 43%
1 - 9	9	7	1.68	1.10	65%	- 35%
Average	468	56	1.30	1.15	88%	- 12%

Core Samples in 91% - 95% Recovery Range

Range of Sludge Rec.	No. of Samples	Average Sludge Rec in Range	Average Core Assay	Average Sludge Assay	Ratio of Sludge Assay to Core Assay	% Of Difference
100 - 120	10	112	1.66	1.37	83%	- 17%
90 - 99	9	95	.97	1.04	107%	+ 7%
80 - 89	14	84	.90	.82	91%	- 9%
70 - 79	16	74	.91	.83	91%	- 9%
60 - 69	22	64	.96	.89	93%	- 7%
50 - 59	37	54	1.28	1.27	99%	- 1%
40 - 49	38	45	1.01	.95	94%	- 6%
30 - 39	38	35	1.04	.98	94%	- 6%
20 - 29	14	26	1.82	1.58	87%	- 13%
10 - 19	12	16	1.72	1.40	81%	- 19%
1 - 9	5	7	3.01	1.62	54%	- 46%
Average	215	53	1.21	1.09	90%	- 10%

TAB

P

Attachment P 1

CHECK ASSAYS
Individual Core Intervals
Silver Bell Re-Runs

Code	Hole	Interval	Silver Bell Assay	Silver Bell Re-Assay	Difference
C2	C2	430.0-435.0	.83	.85	.02
C4	C5	785.0-790.0	1.66	1.61	.05
D-1	14	298.6-302.3	1.58	1.60	.02
C6	18	280.7-286.5	.91	.88	.03
D2	18	388.0-398.5	.11	.10	.01
C7	19	211.2-228.3	1.33	1.25	.08
C8	20	297.5-305.4	1.45	1.45	0
D3	20	375.4-385.4	.28	.21	.07
C9	21	371.0-377.1	1.42	1.48	.06
D4	22	661.0-671.0	.50	.44	.06
C10	23	406.3-414.7	1.07	1.04	.03
C11	24	544.6-557.4	.70	.73	.03
-	26	260.3-268.2	.45	.48	.03
-	26	286.1-294.7	.44	.42	.02
-	26	294.7-304.8	.52	.51	.01
-	26	304.8-314.8	.39	.38	.01
-	26	371.8-376.7	.44	.45	.01
-	26	382.1-392.1	.57	.59	.02
C12	26	423.0-433.0	.82	.80	.02
-	26	442.4-451.2	.45	.42	.03
C13	27	454.5-460.2	.97	1.03	.06
D5	27	663.0-666.8	.94	.98	.04
C14	28	431.8-442.0	2.38	2.63	.25
C15	29	482.0-495.1	1.07	1.07	0
D6	29	567.6-574.9	.13	.12	.01
D7	30	288.3-296.3	.30	.29	.01
D8	32	255.1-264.3	.20	.21	.01
C16	32	533.4-543.0	.82	.72	.10
C17	33	280.0-290.7	.60	.57	.03
D9	34	336.8-350.4	.91	.97	.06
D10	36	456.3-465.2	.45	.43	.02
C18	36	617.0-621.8	.76	.79	.03
C19	37	391.9-395.7	.79	.79	0
C20	41	535.6-543.9	1.04	1.06	.02
C21	43	347.9-351.9	3.38	3.66	.28
C22	46	396.2-405.8	1.01	1.02	.01
-	48	220.5-227.7	.43	.41	.02
-	48	227.7-234.3	.59	.56	.03
-	48	234.3-241.8	.60	.60	0
-	48	241.8-249.4	.45	.42	.03
-	48	249.4-255.1	.49	.48	.01
-	48	287.9-294.9	.62	.55	.07
-	48	294.9-302.6	.46	.45	.01
-	48	311.5-315.0	.48	.47	.01
-	48	315.0-323.3	.57	.56	.01
-	48	345.4-355.3	.51	.54	.03
C23	48	512.8-521.4	1.06	1.05	.01
-	48	521.4-528.2	.49	.50	.01

Code	Hole	Interval	Silver Bell Assay	Silver Bell Re-Assay	Difference
-	49	210.0-221.0	.49	.47	.02
-	49	231.5-243.3	.38	.41	.03
-	49	519.1-523.4	.42	.47	.05
-	49	527.8-540.5	.38	.41	.03
-	49	540.5-549.3	.35	.41	.06
-	49	549.3-558.6	.45	.50	.05
C24	49	590.2-597.2	2.50	2.53	.03
C25	53	462.2-470.0	.48	.35	.13
C26	55	515.3-525.5	.81	.80	.01
C27	56	426.2-433.3	6.95	6.91	.04
C28	58	405.0-408.5	.62	.64	.02
C29	60	398.0-406.9	1.18	1.18	0
C30	62	503.0-512.3	1.84	1.84	0
C34	66	374.8-386.7	11.03	11.24	.21
C35	68	478.7-488.7	1.72	1.73	.01
C37	75	361.8-368.5	8.94	9.12	.18
C40	80	369.3-379.3	.86	.89	.03
C41	83	597.9-613.3	1.00	1.00	0
C44	89	291.4-301.1	1.09	1.12	.03
C45	91	319.2-329.2	.77	.79	.02
C49	97	329.2-338.3	1.68	1.70	.02
C52	104	290.6-303.2	1.92	1.91	.01
C54	107	495.1-506.0	2.98	3.27	.29
C70	128	749.4-759.4	9.02	9.56	.54
C77	142	702.9-713.0	1.92	1.90	.02
C78	143	573.2-578.3	2.70	2.86	.16
C80	148	343.0-353.1	3.00	3.05	.05
C82	151	437.5-442.8	4.39	4.45	.06
C83	152	364.4-374.0	.82	.85	.03
C85	155	508.2-518.2	1.64	1.68	.04
C87	157	289.1-294.5	5.07	5.12	.05
C89	159	328.1-336.7	3.28	3.38	.10
C91	161	389.7-404.3	1.41	1.40	.01
D11	162	510.4-520.6	1.26	1.21	.05
D12	166	409.7-417.9	1.02	.99	.03
C95	166	560.1-569.5	.66	.67	.01
D13	167	315.2-322.1	.23	.22	.01
D14	171	368.1-378.2	.05	.05	0
C96	171	398.6-407.3	3.74	3.95	.21
D15	172	573.5-582.2	1.05	1.05	0
D16	174	233.0-238.2	.25	.24	.01
D17	175	219.6-224.9	.16	.16	0
D18	176	617.3-625.4	.72	.75	.03
D19	178	356.9-367.1	1.87	1.81	.06

Attachment P 2

CHECK ASSAYS
Individual Core Intervals
Jacobs vs. Silver Bell

Code	Hole	Interval	Jacobs Assay	Silver Bell Assay	Difference
C1	C1	625.0-630.0	.85	.87	+.02
C2	C2	430.0-435.0	.88	.83	-.05
C3	C3	405.0-410.0	.90	.87	-.03
C4	C5	785.0-790.0	1.72	1.66	-.06
C5	C6	455.0-460.0	1.03	.96	-.07
C7	19	211.2-228.3	1.27	1.25	-.02
C9	21	371.0-377.1	1.46	1.48	+.02
C13	27	454.5-460.2	1.10	.97	-.13
C14	28	431.8-442.0	2.67	2.63	-.04
C16	32	533.4-543.0	.87	.72	-.15
C21	43	347.9-351.9	3.64	3.66	+.02
C-25	53	462.2-470.0	.34	.35	+.01
-	62	200.3-207.8	.99	1.01	+.02
-	62	207.8-211.9	.04	.08	+.04
-	62	289.1-294.3	.56	.62	+.06
-	62	410.5-417.4	.52	.54	+.02
-	62	437.7-447.8	.42	.48	+.06
C30	62	503.0-512.3	1.90	1.84	-.06
C31	63	447.3-457.2	1.23	1.23	0
C32	64	388.3-405.1	.79	.78	-.01
C33	65	287.5-297.7	.91	.93	+.02
C34	66	374.8-386.7	11.36	11.03	-.33
C35	68	478.7-488.7	1.79	1.72	-.07
C36	74	414.6-419.7	2.28	2.25	-.03
C37	75	361.8-368.5	9.15	8.94	-.21
C38	76	407.8-417.7	1.30	1.26	-.04
C39	78	283.8-300.3	1.51	1.49	-.02
C40	80	369.3-379.3	.92	.86	-.06
C41	83	597.9-613.3	1.09	1.00	-.09
C42	87	283.7-294.0	3.00	2.98	-.02
C43	88	735.6-745.7	1.04	1.09	+.05
C44	89	291.4-301.1	1.01	1.09	+.08
C45	91	319.2-329.2	.99	.77	-.22
C46	92	350.8-357.1	.97	.98	+.01
C47	93	306.4-318.4	1.47	1.44	-.03
C48	96	436.9-442.4	1.03	1.01	-.02
C49	97	329.2-338.3	1.73	1.68	-.05
C50	99	227.0-236.0	.70	.68	-.02
C51	100	396.5-414.0	1.07	1.07	0
C52	104	290.6-303.2	2.02	1.92	-.10
C53	106	380.3-390.3	2.54	2.55	+.01
C54	107	495.1-506.0	3.26	2.98	-.28
C55	108	442.8-452.2	1.42	1.38	-.04
C56	111	516.5-525.5	1.12	1.13	+.01
C57	112	235.3-245.3	1.02	1.03	+.01
C58	113	309.1-323.6	1.24	1.22	-.02
C59	116	302.1-309.5	1.27	1.24	-.03
C60	117	461.9-471.1	1.00	1.01	+.01
C61	118	492.0-500.9	5.72	5.71	-.01

Code	Hole	Interval	Jacobs Assay	Silver Bell Assay	Difference
C62	120	215.6-224.5	2.27	2.25	-.02
C63	121	533.5-543.6	4.44	4.40	-.04
C64	122	519.4-527.4	1.24	1.24	0
C65	123	399.7-409.2	.43	.47	+.04
C66	124	419.5-424.7	.74	.70	-.04
C67	125	458.4-468.5	1.55	1.58	+.03
C68	126	421.9-428.0	1.06	1.05	-.01
C70	128	749.4-759.4	7.75	9.02	+1.27
C-71	129	573.3-583.0	1.66	1.70	+.04
C72	130	361.9-370.2	3.05	3.06	+.01
C73	131	453.6-463.6	1.36	1.33	-.03
C74	134	423.5-433.1	.80	.83	+.03
C76	138	325.8-332.5	1.00	1.05	+.05
C77	142	702.9-713.0	1.85	1.92	+.07
C78	143	573.2-578.3	2.51	2.70	+.19
C79	147	587.1-593.1	2.91	2.90	-.01
C80	148	343.0-353.1	3.15	3.00	-.15
C81	149	270.3-280.5	1.32	1.31	-.01
C82	151	437.5-442.8	4.55	4.39	-.16
C83	152	364.4-374.0	.90	.82	-.08
C84	154	383.2-393.5	2.77	2.73	-.04
C85	155	508.2-518.2	1.37	1.64	+.27
C86	156	337.9-345.5	5.03	5.03	0
C87	157	289.1-294.5	5.18	5.07	-.11
C88	158	348.4-358.6	1.14	1.13	-.01
C89	159	328.1-336.7	2.95	3.28	+.33
C90	160	312.0-318.5	.98	.97	-.01
C91	161	389.7-404.3	1.32	1.41	+.09
C92	162	500.6-510.4	1.39	1.34	-.05
C93	163	403.0-412.9	..71	.70	-.01
C94	164	420.7-430.9	.94	.90	-.04
C95	166	560.1-569.5	.60	.66	+.06
C96	171	398.6-407.3	4.00	3.74	-.26
J-2	172	624.5-634.5	1.37	1.31	-.06
J-3	173	378.4-388.6	.92	.92	0
J-6	176	638.3-648.4	.27	.24	-.03
J-4	178	256.1-270.3	.37	.31	-.06
J-7	178	280.6-288.9	.32	.31	-.01
J-8	178	502.5-511.9	.45	.42	-.03
J-10	179	452.1-460.5	.31	.31	0
J-1	183	208.6-222.4	.44	.43	-.01
J-12	183	290.0-304.8	.46	.42	-.04
J-13	185	366.3-377.5	.36	.34	-.02
J-16	188	251.8-261.3	.37	.38	+.01
J-14	189	208.7-214.3	.37	.36	-.01
J-15	189	214.3-220.3	.30	.30	0
J-17	189	281.1-287.1	.42	.43	+.01

CHECK ASSAYS
Composites

Jacobs vs. Silverbell

Hole No.	Interval	Jacobs Calc. Composite Assay	Silverbell Comp. Assay	Difference
18	590.0-678.8	.77	.74	-.03
62	225.8-280.6	.05	.06	+.01
	280.6-330.5	1.32	1.32	0
	330.5-512.3	1.22	1.21	-.01
63	229.8-332.7	.10	.10	0
	353.1-457.2	.72	.72	0
	509.7-573.7	1.45	1.50	+.05
	614.2-632.9	1.21	1.21	0
64	210.0-227.2	.10	.10	0
	227.2-332.6	.13	.13	0
	340.9-363.3	.81	.79	-.02
65	232.6-297.7	.76	.72	-.04
	297.7-328.1	.22	.19	-.03
66	221.4-324.0	.06	.06	0
	357.6-400.8	6.28	6.17	-.11
	225.0-261.8	.04	.08	+.04
	261.8-278.5	.84	.80	-.04
	278.5-305.7	.02	.02	0
68	199.7-235.6	.94	.93	-.01
	235.6-338.4	1.51	1.48	-.03
	338.4-544.1	1.28	1.22	-.06
69	230.0-333.4	.05	.05	0
	337.9-384.3	3.49	3.49	0
70	228.8-329.3	.08	.09	+.01
71	170.0-209.3	.05	.03	-.02
	209.3-288.7	.03	.10	+.07
72	211.5-245.5	.28	.23	-.05
	245.5-344.0	.14	.13	-.01
73	200.0-232.6	.12	.09	-.03
	232.6-334.8	.12	.04	-.08
74	216.3-313.2	.33	.29	-.04
	325.5-444.6	1.60	1.58	-.02
76	200.0-226.1	.22	.18	-.04
	226.1-328.8	.10	.09	-.01
	381.2-417.7	1.04	1.06	+.02
	447.7-555.3	1.31	1.40	+.09
77	199.2-225.7	.22	.21	-.01
	225.7-328.3	.22	.21	-.01
	483.8-588.0	.77	.74	-.03
	649.2-788.9	1.45	1.40	-.05
78	189.4-235.4	.84	.79	-.05
	235.4-337.1	.85	.84	-.01
	337.1-408.6	.92	.90	-.02
	493.2-664.9	1.02	.99	-.03
	703.5-752.5	1.65	1.62	-.03

Hole No.	Interval	Jacobs Calc. Composite Assay	Silverbell Comp. Assay	Difference
79	190.0-231.1	.05	.04	-.01
	231.1-326.7	.03	.04	+.01
80	205.5-231.5	.25	.20	-.05
	231.5-331.9	.20	.21	+.01
	359.2-395.7	.85	.84	-.01
81	195.8-226.6	.14	.15	+.01
	226.6-333.2	.19	.18	-.01
82	209.6-237.5	.03	.01	-.02
	237.5-339.6	.02	Nil	-.02
83	200.0-244.9	.30	.28	-.02
	244.9-342.8	.65	.64	-.01
	471.2-514.5	.58	.59	+.01
	588.0-623.8	1.96	2.00	+.04
87	204.7-222.2	.62	.52	-.10
	222.2-294.0	1.70	1.68	-.02
	294.0-325.5	.08	.09	+.01
88	192.7-238.5	.38	.37	-.01
	238.5-260.4	.70	.69	-.01
	260.4-340.0	.31	.28	-.03
	340.0-481.3	.99	.97	-.02
	620.0-699.5	.77	.77	0
	735.6-756.0	.70	.83	+.13
89	190.3-225.6	.20	.13	-.07
	225.6-250.5	.52	.51	-.01
	250.5-281.5	.26	.24	-.02
	281.5-330.6	.70	.68	-.02
90	206.2-225.6	.54	.51	-.03
	225.6-323.9	.14	.16	+.02
91	200.6-219.5	.36	.30	-.06
	219.5-234.5	.54	.51	-.03
	234.5-282.1	.12	.09	-.03
	282.1-319.2	.46	.41	-.05
	319.2-335.8	.87	.83	-.04
92	195.7-221.7	.33	.33	0
	221.7-259.9	.48	.45	-.03
	259.9-310.6	.30	.29	-.01
	310.6-454.2	.61	.58	-.03
93	211.9-240.2	.52	.50	-.02
	240.2-251.5	.73	.75	+.02
	251.5-291.2	.23	.22	-.01
	291.2-337.9	.77	.74	-.03
	337.9-460.1	.73	.73	0
	494.7-527.5	1.21	1.24	+.03
Code A-1				
125,128,130				
134, 143	11 Intervals	1.56	1.55	-.01
A-4 134	243.0-396.1	1.20	1.21	+.01
C-4 129,142	3 Intervals	1.28	1.30	+.02
E-2 63, 74				
87,131,166	5 Intervals	.67	.65	-.02
I-3 96	391.9-488.0	.50	.47	-.03
I-4 93,97	2 Intervals	.72	.68	-.04
J-1 73,88	3 Intervals	1.16	1.18	+.02

Attachment P 4

CHECK ASSAYS

Composites

Silver Bell vs. Silver Bell

Code	Hole No.	Interval	SilverBell Calc. Composite Assay	Silver Bell Comp. Assay	Difference
	18	203.0-233.7	.44	.50	+.06
		233.7-306.9	.98	.98	0
		306.9-335.6	.30	.23	-.07
		237.5-335.4	.86	.84	-.02
		394.4-521.2	.83	.85	+.02
	21	221.0-227.1	1.36	1.32	-.04
		227.1-266.9	1.69	1.67	-.02
		266.9-328.1	.28	.27	-.01
		366.3-377.1	1.57	1.59	+.02
	22	222.0-255.2	.51	.50	-.01
		255.2-287.9	.47	.47	0
		287.9-353.3	.30	.27	-.03
		455.4-680.3	1.02	1.19	+.17
	24	195.0-240.6	.41	.42	+.01
		240.6-257.4	.51	.51	0
		257.4-345.0	.39	.35	- 04
		534.1-577.0	.77	.78	+.01
		615.8-714.3	.49	.50	+.01
	26	230.0-286.1	.33	.36	+.03
		286.1-382.1	.41	.42	+.01
		382.1-469.8	.58	.58	0
	25	224.0-248.3	.04	.03	-.01
		250.3-351.8	.10	.09	-.01
	27	224.0-250.0	.53	.57	+.04
		250.0-287.7	.98	.95	-.03
		287.7-350.0	.22	.22	0
		396.7-502.8	.78	.80	+.02
	29	230.0-248.9	.32	.34	+.02
		248.9-345.5	.21	.21	0
		361.7-383.7	.48	.46	-.02
		460.0-501.4	.73	.73	0
		599.9-653.7	.61	.61	0
	31	236.6-319.8	.25	.22	-.03
		319.8-340.0	.70	.71	+.01
		409.9-446.7	1.10	1.14	+.04
	32	219.0-230.9	.41	.40	-.01
		230.9-333.3	.20	.19	-.01
		359.6-400.5	.54	.55	+.01
		513.2-570.5	.62	.59	-.03
	33	231.0-240.4	.38	.36	-.02
		240.4-271.3	.34	.33	-.01
		271.3-345.9	.52	.50	-.02
	34	231.0-246.1	.02	.03	+.01
		246.1-288.8	.18	.18	0
		288.8-350.4	.79	.79	0
	36	220.0-237.8	.30	.27	-.03
		237.8-340.2	.73	.71	-.02
		340.2-475.8	.92	.92	0
		539.2-635.2	1.22	1.14	-.08

Silver Bell vs. Silver Bell - Continued

Attachment P 4

Code	Hole	Interval	SilverBell Calc. Composite Assay	Silver Bell Comp. Assay	Difference
	37	227.0-233.4	.54	.53	-.01
		233.4-335.4	.28	.27	-.01
	38	233.0-239.4	.08	.05	-.03
		239.4-337.8	.09	.08	-.01
	39	261.0-362.3	.14	.14	0
	41	270.0-339.8	.14	.16	+.02
		380.9-455.4	.98	.98	0
	42	227.5-331.2	.16	.16	0
	43	217.5-236.7	.08	.08	0
		236.7-311.3	.58	.60	+.02
	44	221.0-238.6	.06	.08	+.02
		238.6-341.2	.15	.15	0
	47	200.0-234.5	.33	.32	-.01
		234.5-335.2	.10	.12	+.02
	48	220.5-234.3	.48	.52	+.04
		234.3-336.0	.51	.49	-.02
		336.0-400.6	.60	.59	-.01
		495.8-528.2	1.04	1.02	-.02
		700.6-775.0	1.39	1.41	+.02
	49	210.0-243.3	.53	.40	-.13
		409.1-645.4	.95	.92	-.03
	50	200.2-247.7	.13	.14	+.01
		247.7-352.0	.15	.11	-.04
	51	230.4-334.7	.13	.12	-.01
		334.7-344.9	.72	.58	-.14
		378.0-398.0	2.07	2.05	-.02
	52	136.0-226.0	.05	.03	-.02
		226.0-319.5	.05	.04	-.01
	53	212.0-233.0	.32	.39	+.07
		233.0-310.1	.45	.44	-.01
		310.1-335.3	.19	.19	0
		448.0-532.0	.50	.52	+.02
		629.5-678.7	1.45	1.42	-.03
		709.9-745.6	.93	.93	0
		788.9-827.2	.90	.87	-.03
	54	208.0-215.0	1.40	1.41	+.01
		244.0-315.0	.02	.02	0
	55	231.0-263.7	.18	.20	+.02
		263.7-277.9	.59	.59	0
		277.9-366.3	.14	.14	0
	56	225.0-274.0	.08	.08	0
		274.0-370.4	.28	.28	0
		401.0-481.0	1.33	1.44	+.11
		602.6-615.0	.87	.95	+.08
		660.6-671.0	1.78	1.87	+.09
		743.0-820.8	.97	.98	+.01
	57	208.8-225.0	.11	.12	+.01
		225.0-322.9	.19(?)	.16	-.03
	60	206.0-235.8	.23	.23	0
		235.8-284.1	.43	.44	+.01
		284.1-332.2	.26	.25	-.01
		367.6-406.9	.85	.84	-.01
	62	200.3-225.8	.46	.43	-.03
	63	225.5-229.8	3.30	3.29	-.01
H-4	20,23	2 Intervals	.50	.48	-.02

Attac... ...nt P 5

CHECK ASSAYS
Composites

Silver Bell and Jacobs vs. Silver Bell

Code	Hole	Interval	Jacobs & Silver Bell Calc. Comp. Assay	Silver Bell Comp. Assay	Difference
	43	347.9-410.5	.83	.82	-.01
	45	240.0-339.9	.14	.14	0
B-1	62, 116, 126, 136, 148, 178	9 Intervals	1.74	1.61	-.13
C-1	46, 60, 122, 124, 129, 142, 149, 151	17 Intervals	.99	1.00	+.01
C-2	120, 124, 175	3 Intervals	1.09	1.21	+.12
D-1	54, 80, 121, 138, 154, 204	6 Intervals	1.53	1.45	-.08
E-1	63, 74, 76, 87, 104, 107, 118, 127, 155, 166, 171	14 Intervals	1.62	1.61	+.01
F-2	21, 109, 158	3 Intervals	1.07	1.06	-.01
G-1	32, 36, 43, 68, 83, 92, 113, 162, 163	12 Intervals	1.01	1.00	-.01
G-2	36, 43, 68, 83, 89, 92, 113, 162, 163	11 Intervals	.82	.82	0
G-4	36, 68, 162	4 Intervals	.86	.83	-.03
I-2	18, 19, 96	4 Intervals	.94	.95	+.01
J-4	29, 78	2 Intervals	.67	.68	+.01