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08/15/86

ARIZONA DEPARTMENT OF MINES AND MINERAL RESOURCES FILE DATA

PRIMARY NAME: EISENHOWER

ALTERNATE NAMES:
PALO VERDE
MISSION EXTENSION

PIMA COUNTY MILS NUMBER: 233

LOCATION: TOWNSHIP 16 S RANGE 12 E SECTION 36 QUARTER NE
LATITUDE: N 31DEG 59MIN 55SEC LONGITUDE: W 111DEG 04MIN 00SEC
TOPO MAP NAME: TWIN BUTTES - 7.5 MIN

CURRENT STATUS: PRODUCER

COMMODITY:
COPPER SULFIDE
MOLYBDENUM SULFIDE
SILVER

BIBLIOGRAPHY:
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BUILDER-ARCHITECT-CONTRACTOR ENGR. MAG. NOV. 1976, P. 22-26
AMAX SEC FORM 10-K, 1976, P. 9, APPENDIX D, H, H-1, I & L
MINING WORLD, NOV. 1961, P. 34-35
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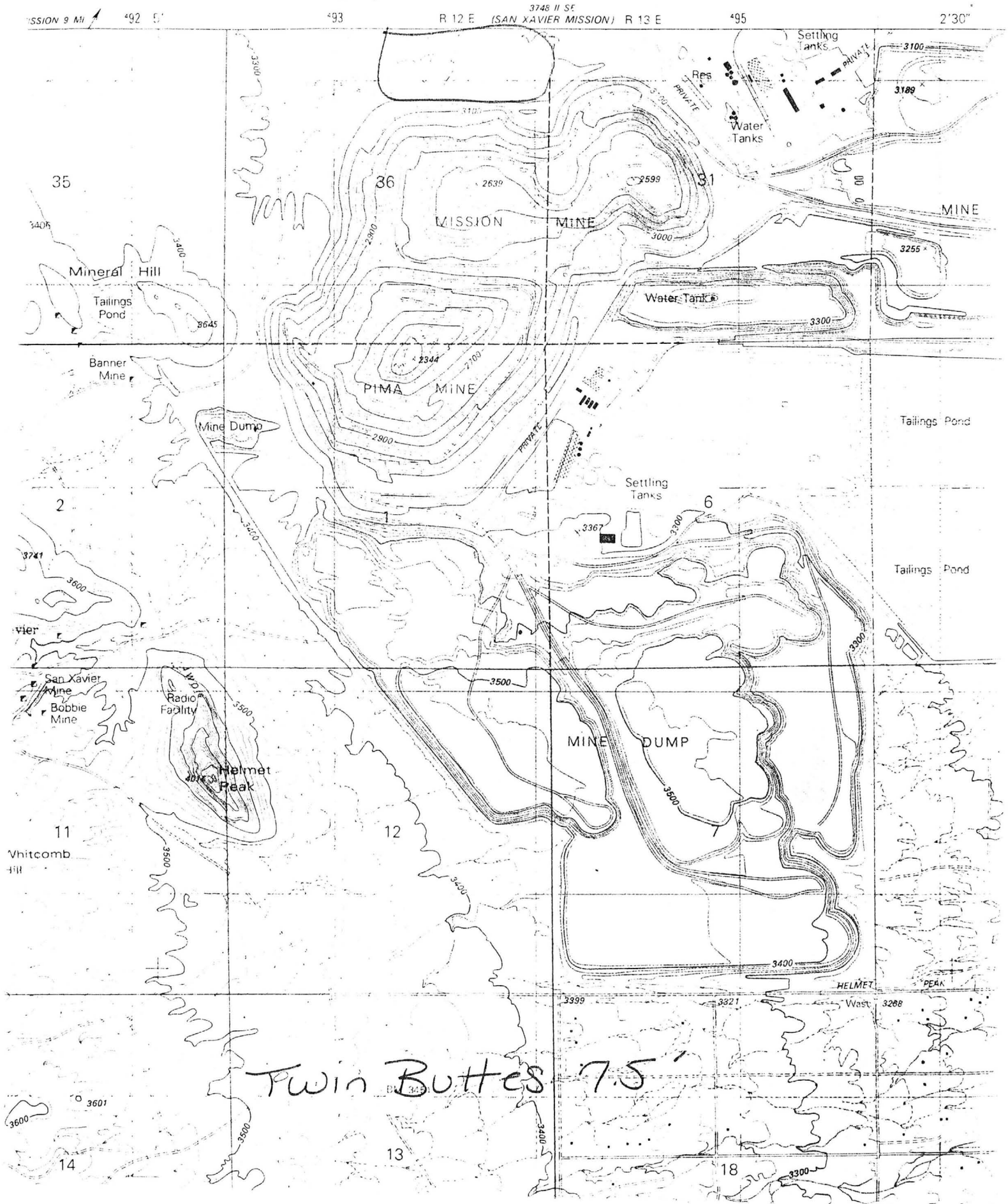
Eisenhower
T16S R12E Sec. 36 NE



PALO VERDE MINE

PIMA COUNTY

The Palo Verde Mine is under lease to Anaconda but is a smaller deposit than Helvetia. Both Palo Verde and Helvetia appear to be subject to open pit mining methods, says Allan Bowman, general manager of Banner Mining Co.
Taken from Denver Record 6-19-69

See: ABM Bull. 180, p. 163

WR MG 1/6/78 - The dynamite copper sulfide deposit is owned by the V. B. Smith Estate and lies, in part, beneath the new conveyor belt that will link the Palo Verde mine to the Twin Buttes mine. This deposit contains mineralization that has not been drilled sufficiently to determine continuity. 2/17/78 sef

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KAP WR 10/31/86: The 1985 preprint of the Lead chapter from the US Bureau of Mines' Mineral Yearbook reports that the Eisenhower (file) Pima County was the 21st largest producer of lead in the United States in 1985.

PALO VERDE MINE

Pima County,
Pima District

At Banner Mining Co.'s Palo Verde, the firm reported a 38% increase in tonnage of ore available to open pit mining. L. L. Travis, president of Banner, said in annual report that this open pit ore represented an extension of the orebody in the Mission project of American Smelting & Refining Co. As a result of core drilling, Banner officials said, "total indicated reserves of open pit type copper ore on Jan. 1, 1961 amounted to 58,231,848 tons, an increase for the year (1960) of over 15.5-million tons. Exploration drilling will continue in this area.

Mr. Travis said that within the next four years, Asarco's open cut "Mission Project" will have advancedpit limits to "the southeast boundary of Banner's Palo Verde property . . ."

Taken from ENGINEERING & MINING JOURNAL, May, 1961, p 120

COPPER ORE RESERVES INCREASED -

Banner Mining Co. during 1960 increased copper ore reserves at its Palo Verde property near Tucson, Ariz., by about 15,000,000 tons through core drilling operations. Total reserves amenable to open pit mining at the Palo Verde are now placed at about 58,000,000 tons by Banner. The company intends to continue its core drilling program at the property during 1961. Banner's Palo Verde ores are extensions of the Mission project ore body now under development by American Smelting & Refining Co.

Taken from MINING CONGRESS JOURNAL, May, 1961, p 86

See: MINING WORLD, July, 1961, page 41

This property Active October, 1961 - Allen B. Bowman, Mgr., Banner Mining Co. Box 5605, Tucson, Ariz.

See: MINING WORLD, November, 1961, p 34

Selected New Contracts, Investments, Expansions, and Exploration Activities: United States

Commodity and Company	Operation and/or Location	Notes
ALUMINUM		
Ball Corp.	Can-end production, Golden, CO.	Expansion to double aluminum can-end capacity to 2.5 billion ends annually for soft-drink customers throughout the West. The $16 million expansion will provide smaller can ends for assemblage with narrow neck cans at Ball's Fairfield, CA, can body plant, as well as for Ball's Golden can body plant.
Kaiser Aluminum & Chemical Corp.	Primary smelter, Spokane, WA.	Announced recall of about 60 workers and restart of 25,000-mt/yr potline at Mead smelter in August to supply the Trentwood rolling mill. The restart will increase capacity utilization of Mead to 67.5%. The additional line is needed because of increased production at Trentwood and a reduced aluminum ingot supply.
ANTIMONY		
U.S. Antimony Corp.	Antimony mill, refinery, Thompson Falls, MT.	Signed an open-ended contract to buy a minimum of 60 mt/month of antimony ore from a firm representing the Chinese Government. Contract has an option to increase shipments to 120 mt/month.
ASBESTOS		
Vermont Asbestos Group Inc.	Lowell, VT.	Reopened mine in June, recalling 50 workers. Based on current market conditions, the mine is expected to be in operation for 20 weeks and produce 3,000 st asbestos.
CLAY		
Anglo American Clay Corp., subsidiary of ECC America Inc.	Sandersville, GA.	Announced largest expansion in the company's history. Scheduled for completion in December 1986, the expansion will include a 65% increase in production facilities for opacifying pigment and a 25% increase in drying capacity for 3 grades of high-brightness coating clays.
COBALT		
Savanna Resources Ltd.	Turner-Albright deposit, Josephine County, OR.	Announced it has acquired a 72% interest in the polymetallic deposit. Rayrock Mines Inc. holds the remaining interest.
COPPER		
ASARCO Incorporated.	Tucson, AZ.	Will acquire Anamax Mining Co.'s interest in the Eisenhower Mine, held in joint venture since 1976. The $1 million purchase price is expected to be paid Apr. 30, 1987, the effective termination date of the partnership agreement.
Washington Corp.	Butte, MT.	Agreement reached between Washington Corp., which purchased Anaconda Minerals' Butte, MT, copper mining properties in September 1985, and Nippon Mining of Japan to sell its projected production of 150,000 mt/yr copper concentrates to Nippon on a long-term contract basis. Washington Corp. is expected to resume mining at the Berkeley pit by September 1986. Though Nippon Mining is the prime contractor, 6 Japanese smelters are expected to be recipients of the concentrates. Before closing in April 1982, Anaconda was selling its annual concentrate production of 240,000 mt to a consortium of 7 Japanese smelters. Washington Corp. has hired 130 workers and is preparing to reopen the mine.
FERROALLOYS		
Elkem Metals Co.	Alloy, WV, Marietta, OH.	The company will spend $10 million to modernize its power-generating facilities at Alloy's silicon metal plant and is contemplating a new $3 million briquetting facility at its Marietta manganese and chromium plants. The modernization of the power generating facility at Alloy should significantly lower the cost of electricity for smelting silicon metal. Construction of a new briquetting plant at Marietta would allow the company to put its chromium aluminum, manganese aluminum, and iron aluminum alloys into briquettes at its own facility.
GOLD		
Cobb Resources Corp.	Alma, CO.	Signed a $16 million joint venture agreement with Colosseum Colorado Inc., an Australian company, for resumption of production at the London Gold mine. Several year of exploration by Cobb Resources and former joint venture partner HNG InterNorth resulted in promising gold discoveries, but HNG withdrew from the project following its merger with Enron Corp., leaving Cobb Resources without the capital to proceed with production.

"Minerals + Materials" 3F June/July 1986
USBM.

DEPARTMENT OF MINERAL RESOURCES

STATE OF ARIZONA

FIELD ENGINEERS REPORT

Mine	Palo Verde Mine	Date	September 27, 1963
District	Pima District - Pima County	Engineer	Axel L. Johnson
Subject:	Field Engineer's Report. Information from F. D. MacKenzie, geologist		

References: Report of December 21, 1962 and previous reports.

Present Mining Activity: Closed down.

The Palo Verde Mine closed down about May 27, 1963 due to a strike at the property by the Mine and Mill union. This strike is still on as of this date.

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DEPARTMENT OF MINERAL RESOURCES
STATE OF ARIZONA
FIELD ENGINEERS REPORT

Mine Palo Verde Mine Date Dec. 21, 1962

District Pima District, Pima Co. Engineer Axel L. Johnson

Subject: Field Engineers Report. Information from F. D. MacKenzie, geologist.

References Report of July 20, 1962 and previous reports.

Present Mining Activity Mine production has been cut by more than one-half as of this date on account of the ~~xxxxxx~~ shutting down of one-half of the mill for repairs, and also on account of the large stockpile of ore now on hand. This lower production schedule will continue for 2 to 3 months, or until the mill repairs have been completed. About 115 underground miners have been temporarily laid off until the mine resumes normal production. The mine, reportedly, will continue to operate 3 shifts, but with less men on each shift.

G 18

The American Mining Congress RING BUILDING WASHINGTON 6, D. C.

MINING METHODS AT BANNER'S PALO VERDE MINE*

By

B. W. Venable, Gen. Mine Supt.
Banner Mining Company
Tucson, Arizona

The Banner Mining Company's Palo Verde copper mine is located 20 miles southwest of Tucson, Arizona, in the Pima Mining District. It is the only producing underground mine in the Pima District at the present time, although there are several large open pit copper mines** operating in the same locality. The Palo Verde is developed by a five-compartment shaft 1028 feet deep, with production levels at 700, 800 and 900 feet. Ore is of the contact-metamorphic type, consisting of copper sulfides distributed through a hard, strong garnet tactite which is offset at frequent intervals by faulting. The ore zone averages 46 feet in vertical thickness and stands with a stair-stepped dip averaging 35 degrees from the horizontal. 20,000 to 24,000 tons of ore per month are mined by room and pillar stoping, and concentrated at Banner's recently enlarged mill on the nearby Mineral Hill property.

History

The mine is situated on an alluvial plain which is totally devoid of bedrock outcrops. It was located by Banner in 1954, after having been recognized by A. B. Bowman, Vice President and General Manager of that company, as having potential for possible extension of known mineralization from nearby areas where mining was then in progress. Scout drilling in 1955 disclosed copper values beneath 200 feet of alluvial cover, and subsequent pattern drilling on 250 foot centers indicated the existence of a large low-grade copper deposit below the alluvium. Near the bottom of the low-grade deposit was found a persistent horizon of mineralized garnet tactite, with copper assay of drill cores from this horizon considerably higher than the average assay of the deposit as a whole. This garnet tactite horizon was chosen for underground mining because of its depth (from 650 feet to below 1200 feet), its relatively high assay grade and its apparent continuity. This higher grade portion of the deposit is the one now being mined in the Palo Verde Mine.

The mine was under construction and development from January, 1959, through October, 1961. During this period, the first phase of plant construction and shaft development was completed, and levels were extended into the ore zone on the 700 and 800 foot levels, exposing some 1600 feet of strike length in the ore. Development of the 900 level was delayed until 1962 because of shaft sinking delays caused by an inrush of water at the 950 foot level.

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* Presented at the 1962 Metal Mining and Industrial Minerals Convention and Exposition, American Mining Congress, San Francisco, California, September 23-27, 1962.

** Mission, Pima, Esperanza

Geology

Ore minerals chalcopyrite and bornite, in that order of importance, occur in a garnet tactite matrix between a weakly mineralized garnet or clay-garnet hangingwall and a barren white limestone footwall. The hangingwall of the ore is recognized visually as an extremely hard, red, nearly barren jasperoid garnet capping, sometimes replaced by other barren tactite forms which can also be visually distinguished from the ore zone. The footwall limestone is barren and is clearly recognizable by color contrast with the garnet ore. The ore is generally hard, strong and abrasive, and averages 184 pounds per cubic foot in place. It is faulted but not crushed, and both ore and walls stand well over moderate spans. The ore zone occupies the lower portion of a larger mineralized tactite-hornfels zone which marks the contact between graywacke or quartz-monzonite porphyry above and crystalline white limestone below. Within the ore zone, ore minerals occur in high grade lenses, in fracture veinlets, and in disseminated form. The dip and strike of lenses and veinlets of ore are often in random orientation with respect to the dip and strike of the walls of the ore zone, making selectivity of mining within the ore zone difficult; the ore horizon must necessarily be mined in its entirety in order to ensure recovery of all high grade lenses and veinlets. The strike of the ore zone as developed to date varies from east-west to N 45° E, depending on structural controls that are obscure at the present time. Ore zone wall dips vary all the way from horizontal to vertical due to stepfaulting and other discontinuities in the ore, but the average dip is to the north and northwest at an angle of 35 degrees from the horizontal.

Shaft and Plant

The shaft as noted previously, has five compartments: two skip compartments, a single large cage compartment, a manway, and one compartment containing the cage counterweight, a 20-inch ventilation pipe, and a submersible shaft pump. Production of ore and waste rock to the shaft is handled through six 125-ton shaft pockets, two on each level, so arranged with retractable car dumping blocks that motor trains of 60 cubic foot capacity Granby type cars can be dumped into either pocket at will. Each pocket is equipped with a 12-inch grizzly at the car dump, and a measuring pocket with pneumatically controlled gates for skip loading. Two 85-cubic foot bottom-dumping skips averaging a 6-ton payload are hoisted to surface in balance at a speed of 800 feet per minute, and dump their loads into either a 500-ton cylindrical steel ore bin or a similar 180-ton waste bin. These bins are arranged side by side and equipped with control gates so that the contents of either skip can be directed into either bin independent of the other. Both bins are equipped with hydraulic powered horizontal feeders for side loading into trucks.

A counterweighted man and supply cage capable of carrying 25 men is handled in the shaft at speeds up to 1000 feet per minute by a separate 375 h.p. double drum man hoist. The cage deck is sized to permit loading and unloading of overshot crawler loaders and 4-ton battery locomotives under their own power and without dismantling.

In addition to the shaft, four large diameter churn drill holes were put down for pumping, ventilation and emergency escapeway installations. The first hole was drilled 30 feet away from the shaft, 18 inches in diameter and 1217 feet deep, cased, and equipped with a 175 h.p. submersible pump for dewatering the area ahead of shaft sinking. This installation is now used with automatic controls for main mine drainage. Another 18-inch hole was drilled through to connect into the 700 foot level. It was then reamed to accommodate 38-inch I.D. casing, and fitted with steel ladders

and landings at 20-foot intervals, to be used as an emergency personnel exit. Drill cuttings from the reaming of this hole were removed from the bottom and hoisted through the shaft. The other two holes, which are 28 and 24 inches in diameter, are located about 1000 feet east of the shaft, connected through to the 700 level, and provide exhaust ventilation from the mine by means of high speed axial flow fans installed on surface.

Orebody Development

Development of the orebody for mining proceeds as follows:

(1) First, haulage drifts are driven in the ore zone along its strike, following the hangingwall of the ore as nearly as visual indentification of the hangingwall permits. These drifts are 11 feet high from the bottom of tract ties to the back of the drift, and have a minimum width of 10 feet to clear crawler jumbos and other equipment which must subsequently pass through. Drift and crosscut headings are usually drilled with one of two air-powered crawler-mounted hydraulic-boom type jumbos, and broken rock is mucked out with air-powered crawler-mounted overshot loaders, loading into 60 cubic foot capacity Granby type cars fitted with sideboards. Drift round blast holes are 2½ inches in diameter, drilled in one pass to the maximum depth permitted by the jumbo feed and boom construction, usually 8 to 10 feet. Drift rounds are loaded with 300 pounds of 60% semi-gelatin powder in 2" x 16" sticks, and fired using cap and fuse with igniter cord and connectors. Permanent rail is installed while headings are being driven, using 40 pound rail on 24-inch gauge.

(2) Next, in order to determine the orebody limits at the level, both walls of haulage drifts are prospected laterally by drilling 100-foot horizontal longholes into both sides of each drift at 50-foot intervals, using airleg drills, 1-3/4 inch bits, and sectional drill steel. Sludge assay samples are taken of each five-foot run, and furnish data on which further development is based. A longhole crew consists of a single driller, who rustles his own equipment, drills holes as marked by the engineers, catches all samples in 5-gallon milk cans, tags them and delivers them to the collar of the shaft, and makes a daily written report showing footages drilled and visual character of the sludge samples taken. Longholing is preferred to diamond drilling for this purpose because of its economy per foot of hole drilled, the speed and mobility of the longholing setup, permitting longholing to be done without delaying work in drift headings, ready availability of drilling equipment, and the small space required for a setup.

(3) After ore limits have been roughly determined by longhole drilling, cross cut rooms 11 feet high and 25 feet wide are driven at right angles from the drift to the footwall of the ore. These crosscuts are located on 40 foot centers, and are driven without installing track; broken rock is side-loaded into the cars of the motor train using crawler-type overshot loaders.

(4) From the footwall of the ore at the center of each crosscut room, untimbered inclined raises 6' x 7' in cross-section are driven up on a 40-degree slope to connection with level above. Where necessity has dictated the location of the haulage drift on the footwall instead of the hangingwall, inclined raises are started up directly from the side of the drift, without any crosscut. In such cases the drift is usually widened to double track width, or a second parallel drift can be driven later, after hangingwall limits have been determined by drilling. Connections between raises are made at approximately 40 foot intervals for ventilation. Broken

ore runs by gravity on this 40-degree slope, but on flatter inclinations 5 h.p. air-slushers are used to assist in moving the muck. There are four purposes for these raises, (a) to pre-determine the profile of the ore zone between levels, (b) to permit further longhole drilling into the footwall and hangingwall, (c) to establish ventilation for subsequent stoping, and (d) to provide down-service into the stopes. Airleg drills are used to drive these raises, with the 6-foot telescopic feed leg proving very satisfactory.

Stoping Method

After stope development raises and longhole drilling are completed, the ore is mined in a series of inclined rooms 25 feet wide and the full height of the ore, running approximately at right angles to the strike of the ore zone between levels. Rooms are separated from each other by vertical rib pillars 15 feet or more in thickness, rising from the footwall to the hangingwall of the ore zone. Connecting slots are cut through the pillars at approximately 40 foot center intervals, so as to bring the recovery of ore exclusive of pillars to 75% of the total. Part of the ore flows by gravity to the level below, and the remainder is slushed. Some of the ore is retained in stopes for a working platform, as in shrinkage stoping. Chutes are not used. Broken ore on the level floor is mucked or slushed directly into cars.

The sequence of mining is as follows:

(1) Inclined stope raises are widened by slabbing to 25 feet. This is done with airleg drills, and is sometimes performed concurrent with raising.

(2) Starting near the top of the stope, the full 25-foot width of ore is mined out to the hangingwall as determined by test drilling, visual observation and grab sample assays. Mining to the hangingwall is continued down the dip, retaining some of the ore in the stope for a working platform, down to a point where step-faulting in the hangingwall requires drawing the ore pile down in order to drill the next section of ore below.

(3) When a step-fault is encountered, or earlier if safety requirements so indicate, all exposed hangingwall and the upper part of both rib pillars are pinned by rockbolting on 4-foot centers, using 3/4-inch stud head bolts 6 feet long, with expanding shell type anchorage. After bolts are set, 2" x 2" x 9 ga. chain link fencing is installed clear across the stope back and a short distance down on the pillars, to provide a protective cover for subsequent mining operations underneath. The bolts currently in use have left hand threads so that they can be tightened up for a secure anchorage by using the same stoper drills used in drilling the 1-3/8-inch holes in which the bolts are set. They have 3/4-inch threaded stud 2 inches long forged onto each bolt head. The stud permits rockbolts to be installed independently of the fencing, which can then be installed later without loosening the bolts, simply by placing the fencing wire over the bolt studs and retaining it in place with small steel washers and hand tightened nuts.

(4) When rockbolting and fencing of the stope back is completed, broken ore is slushed down, and the remaining ore is mined out down to the footwall, using either airleg drills or crawler jumbo. When mining with airlegs, the ore is blasted each day as drilled, and kept slushed out as it is broken. When benching with a jumbo, the jumbo is backed up the slope, drilling down holes, at an angle of 65 degrees from the horizontal, into the floor of the stope and down to penetration of the

footwall. The footwall is recognized by jumbo drillers as a sharp change of color in the drill cuttings, and is penetrated two feet in order to ensure complete ore extraction. $2\frac{1}{2}$ inch holes are drilled 4 feet apart in rows spaced at 3 foot intervals, measured at right angles to the holes, and are left standing until bench drilling in the stope is completed. They are then blasted and the ore is slushed out while the jumbo is occupied elsewhere. Two all-electric crawler-mounted slusher slides, each carrying a 25-h.p. 3-drum slusher hoist, have proved useful in scraping ore out of the stopes and directly into cars on the main line. However, their limited mobility has prevented these scraper slides from being used to their full potential, and most stopes are slushed clean down to the level below with smaller double-drum slushers set strategically in stopes, and the ore is then re-loaded into motor trains using overshot crawler loaders.

Drilling and Blasting

Airleg Drills

Most stope drilling and part of the development drilling is done with 2-5/8-inch medium weight airleg drills fitted with 6-foot telescopic feed legs. All airleg drills now in use are a single model of one manufacturer, to simplify maintenance and spare parts supply. Tons of rock broken, per foot of 1-3/8-inch airleg hole drilled, averages 0.19 in development and 0.26 in stoping.

Drill Jumbos

Two crawler-mounted boom-type jumbos are used in drift and crosscut development, and to a smaller extent in stoping. Both jumbos are built with air motor track drive, built-on air hoists, hydraulic controls, chain feeds, reversible drill rotation, and remote drilling controls located at the operator's position on the tractor. One is a two-boom machine, mounting two 4-inch drifters on 10-foot feeds, and the other has a single boom mounting one $4\frac{1}{2}$-inch drifter on a 12-foot feed. All drills have closed chucks and use ring seal shanks for water pressure in the hole. Tons of rock broken, per foot of $2\frac{1}{2}$-inch jumbo drill hole, averages 0.56 in development and 1.06 in stoping.

A one-man crew operates either of the two jumbos when drilling one-pass holes from the drift level, and a two-man crew is required for drilling deep (sectional steel) holes or for operating the jumbo in steeply-dipping stopes. Entering, leaving, or maneuvering in stopes, the jumbo is usually suspended by means of four parts of $\frac{1}{2}$-inch wire rope, leading from the built-on air hoist on the jumbo through wire rope blocks, which in turn are anchored to a double loop of old hoisting cable wrapped around a pillar above, and to the jumbo towing clevis below. Coming up steep slopes of 40 degrees or more, the air hoist is often assisted with a 5-ton chain hoist.

Based on preliminary results, and bearing in mind that drilling procedures, especially with regard to the jumbos, are under constant review for possible improvement, the following tentative comparisons have been made with respect to jumbo vs. airleg drilling at the Palo Verde Mine:

There is a 50% saving in cost per ton of rock broken, in total combined drilling and maintenance cost, of jumbo vs. airleg, provided the drilling is done from the haulage level.

There is a minimum saving of 7% when the drilling is done in the stopes. The difference is due to time taken in traversing, which we believe will be improved upon as time goes on.

Mechanical maintenance of crawler jumbos per ton of rock broken is approximately twice as high as airleg drill maintenance. This difference is, however, more than compensated for when combined with the cheaper operating costs which are obtained with the jumbos, as indicated above.

Regarding the question of rock fragmentation when drilled with the 2½-inch jumbo holes, vs. 1-3/8-inch airleg drill holes, no difference in fragmentation has been observed, so long as the ratio of powder used per ton of rock blasted remained the same.

About four times the investment per daily ton of rock broken is represented by the jumbos as against the airleg machines. This ratio is also expected to improve with time and experience.

Stopers

Medium weight stopers are used in rockbolting, as noted previously. In line with a general policy of simplifying maintenance and spare parts supply, all stopers now in use are of the same model, a 2-3/4-inch 100-pound machine.

Drill Steel and Bits

7/8-inch hex carburized drill steel in 7-foot drilling lengths and with 6° 50' tapered bit connection is used in airleg machines. When broken, these drills are cut off and ground to a plain shank in sets for stoper use. Broken tapered tips are reground for further use as long as the shanks last. A single size of bit is used with this steel; a 1-3/8-inch cross bit with tungsten carbide inserts and tapered socket connection.

For the jumbos, the drill steel which has given the longest life and best overall cost has been 1¼-inch hex carburized alloy, with 1½-inch reverse buttress thread on an upset on each end of the 10- and 12-foot pieces. Bits in use at the present time are 2½-inch X-type with tungsten carbide inserts. Similar 3-inch bits are used for collaring bench holes so as to accommodate 2-7/8-inch collar casing pipes.

Explosives

At the present time, 60% semi-gelatin powder is used in all blasting, both development and stoping. 1" x 8" sticks are loaded in 1-3/8-inch holes, and 2" x 16" sticks for 2½-inch holes. All holes are fired using cap and fuse with igniter cord and connectors. Powder consumption averages 1.4 pounds of powder per ton of rock broken.

An experimental trial of air-loaded AN-Fuel blasting agent is currently under way, with results not yet available.

Mucking and Haulage

The workhorse of the mucking operation is the air-powered crawler-mounted overshot loader, three of which handle approximately 90% of all rock produced. A fourth loader is rotated with the other three as they come out to the shop for

overhaul. Up to 250 tons of rock are loaded per machine shift, with the average labor efficiency at 83 tons per man-shift, including all transportation and delays.

Twenty-four 60 cubic foot capacity Granby type ore cars fitted with automatic couplers and alloy steel liner plates are hauled by two 4-ton battery locomotives. Used with removable sideboards, the cars average $3\frac{1}{4}$ tons payload. Several $1\frac{1}{2}$-ton battery locomotives salvaged from a former mining operation have been converted to 24-inch track gauge and are used with these cars on development.

Conclusion

The foregoing report summarizes Banner's underground mining operations at the Palo Verde Mine as they are conducted at the present time. However, Palo Verde has only been in operation a short time, and the current practices are under continuous review for possible improvement. Our present thinking is in the direction of obtaining more output per man-shift by more emphasis on the use of jumbos, better scheduling of maintenance, and possible improvements in scheduling of blasting so as to permit more equipment time at working faces. These changes will also permit closer supervision by concentrating the work on fewer units less widely scattered, which it is believed will also benefit total output per man.

Acknowledgements

The writer wishes to gratefully acknowledge the assistance of Mr. A. B. Bowman, Vice President and General Manager of Banner Mining Company, for permission and assistance in preparing this report, Mr. A. P. Holzworth, and Mr. E. E. Bray, Mine Foreman and Master Mechanic, respectively, who devised many of the operating details mentioned herein, and Mr. F. D. MacKenzie, Chief Geologist, for providing geological information.

DEPARTMENT OF MINERAL RESOURCES
STATE OF ARIZONA
FIELD ENGINEERS REPORT

Mine: Palo Verde Mine — Date: July 20, 1962

District: Pima District, Pima County — Engineer: Axel L. Johnson

Subject: Field Engineers Report. Information from F. D. MacKenzie, geologist.

References: Report of Feb. 2, 1962 and previous reports.

Present Activity

Stoping ore from the 700, 800, & 900 ft. levels. Considerable development is also being done on the 900 ft. level, consisting of drifting crosscutting and raising.

The normal production is about 1,000 tons per day. Temporarily, the mine is producing only 700 tons per day on account of repairs being made to one of the ball mills at the Mineral Hill mill.

A total of 217 men are employed at the Palo Verde mine. Of these, 201 men are working underground, and 16 men on the surface.

See: MINING WORLD, August, 1962 p 35

Active 10-1962, 213 men working

DEPARTMENT OF MINERAL RESOURCES
STATE OF ARIZONA
FIELD ENGINEERS REPORT

Mine Palo Verde Mine Date Feb. 2, 1962

District Pima District, Pima Co. Engineer Axel L. Johnson

Subject: Field Eggineers Report. Information from F. C. Prince.

References Report of July 26, 1961, and previous reports.

Present Activity Stoping ore from the 700 and 800 ft. levels of the mine. Also a considerable amount of mine development --- drifting, crosscutting and raising.

About 1,000 tons per day is now produced from the mine, and milled at the Mineral Hill mill (January production was 25,000 tons).

A total of 201 men are employed at the Palo Verde. Of these, 186 men are working in the mine, and 15 men on the surface.

See: "GEOLOGICAL DEVELOPMENTS IN THE TWIN BUTTES DISTRICT", MINING CONGRESS JOURNAL, April 1962, p 62

DEPARTMENT OF MINERAL RESOURCES
STATE OF ARIZONA
FIELD ENGINEERS REPORT

Mine: Palo Verde Mine Date: July 26, 1961

District: Pima District, Pima County Engineer: Axel L. Johnson

Subject: Present Status. Information from F. C. Prince, Chief Accountant.

References Report of Sept. 28, 1960 and previous reports, & also report of Feb. 2, 1961.

Present Activity Mine development is continuing on the 700 and 800 ft. levels of the Palo Verde mine. This consists of drifting, cross cutting, raising and stope preparation. Stoping is schedule to start about Aug. 1st.

At the present time, about 600 tons of ore per day is produced from the mine and milled at the Mineral Hill mill. It is expected that mine production will be increased substantially after stoping operations get well under way. The Mineral Hill mill will be enlarged by adding larger crushing equipment and the addition of more flotation cells to take care of additional tonnage.

A total of 112 men are employed at the Palo Verde. Of these, 98 men are working underground on mine development work, , and 14 are working on the surface.

Development drilling is done from the surface on the Palo Verde property. This is done on contract to Glen Thatcher, Tucson, with one diamond drill working.

DEPARTMENT OF MINERAL RESOURCES
STATE OF ARIZONA
FIELD ENGINEERS REPORT

Mine Palo Verde Mine Date Feb. 2, 1961 & Feb. 27, 1961

District Pima District, Pima County Engineer Axel L. Johnson

Subject: Present Status. Information from F. D. MacKenzie on 2/2 & from F. C. Prince on 2/27

References Report of Sept. 28, 1960 and previous reports.

Present Activity Banner Mining Co. is developing the mine for future ore production. Stations have now been cut on the 700, 800, & 900 ft. levels, and drifting is now being done on all three levels. No stoping as yet. About 300 tons per day of development ore is obtained from these 3 levels, and is milled at the Mineral Hill mill.

62 men are working underground on the mine development work.
20 men are working on the surface, doing construction work.
Total of 82 men working at the mine.

Exploration Mr. MacKenzie reports development drilling on the Palo Verde, and exploration drilling on some of the company's claims adjacent to or near the Palo Verde.

Boyles Bros. are drilling on contract with 2 diamond drills.
Glen Thatcher, Tucson is drilling on contract with 2 diamond drills.

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DEPARTMENT OF MINERAL RESOURCES

STATE OF ARIZONA

FIELD ENGINEERS REPORT

Mine: Palo Verde Mine Date: Sept. 28, 1960

District: Pima Mining District, Pima Co. Engineer: Axel L. Johnson

Subject: Present Status. Information from F. C. Prince, Chief Accountant.

References: Reports of June 7, 1960 and Jan. 21, 1960

Present Activity The shaft sinking has been completed by the Centennial Development Co., and the contract with that company has been finished. The Banner Mining Co, is now continuing with the mine development work, consisting of cutting stations, drifting and cross cutting.

Stations have now been cut on the 700 and 800 ft. levels, and drifting and cross cutting has been started on those levels.

24 men are working underground on mine development work.

24 men are working on the surface, doing construction work & miscell. work.

Total of 48 men working.

DEPARTMENT OF MINERAL RESOURCES
STATE OF ARIZONA
FIELD ENGINEERS REPORT

Mine Palo Verde Mine Date June 7, 1960

District Pima Mining District, Pima County Engineer Axel L. Johnson

Subject: Present Status. Information from F. D. MacKenzie and personal visit.

References Reports of Jan. 21, 1960, Sept. 3, 1959, & May 29, 1959.

Present Activity Shaft sinking on contract is ~~being~~ being done by the Centennial Development Co. of Eureka, Nev. 22 men are working for Centennial on shaft sinking operations - 3 shifts, 6 days per week. In addition, 18 men are working for Banner Mining Co. on construction work at the Palo Verde shaft.

The shaft is now down to a depth of 950 ft., and will be sunk to a depth of 1020 ft. (1140 ft. reported on Jan. 21) It is expected that the shaft work will be finished in about 30 days, after which the Centennial Development Co. will have completed their contract. The Banner Mining Co. will then continue with the additional mine development work of drifting, cross cutting, etc. Earlier plans to have the Centennial Development Co. do the additional mine development work, apparently have been changed.

Future Operations According to Mr. MacKenzie, the Banner Mining Co. will take over the development of the mine by drifts, cross cuts, etc., after the Centennial Development Co. completes the shaft to a depth of 1020 ft.

Exploration Mr. MacKenzie reports development drilling on the east and west sides of the Palo Verde shaft, as follows:

Boyles Bros. are drilling under contract with one diamond drill and oneRotary.
Glen Thatcher, Tucson is drilling under contract, using two diamond drills.

See: E. & M. J., May, 1960, p 122

MINING WORLD, May, 1960, p 87

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DEPARTMENT OF MINERAL RESOURCES
STATE OF ARIZONA
FIELD ENGINEERS REPORT

Mine	Palo Verde	Date	Jan. 21, 1960
District	Pima Mining District, Pima Co.	Engineer	Axel L. Johnson

Subject: Present Status. Information from F. D. MacKenzie and personal visit.

References: Reports of Sept. 3, 1959 and May 29, 1959.

Present Activity: Shaft sinking on contract by Centennial Development Co. of Eureka, Nevada. Drilling of a ventilation drill hole on contract, by O.C. Robinson, Tucson, Arizona. 24 men working on the shaft sinking operations - 3 shifts, 6 days per week.

Shaft sinking operations were started in Oct. 1959 and the shaft is now down to a depth of 340 ft. The average progress is now about 6 ft. per day. Very little blasting is required on account of the soft ground. A Cryderman Mucking Machine, run by compressed air, is used in the operations. On account of the soft and broken ground, it has been necessary to concrete the shaft all the way so far, although bed rock was encountered at a depth of 200 ft., the shaft now being in low grade protore. About 650 gal. per minute water is being pumped out of the shaft, through the drainage drill hole. The shaft will be sunk to a depth of 1140 ft.

A ventilation churn drill hole is being put down, about 600 ft. east of the shaft, which will be 700 ft. in depth. A 16" pilot hole has been completed to the full depth of 700 ft., and the 28" reamed hole is now down to a depth of 600 ft.

Future Operations: According to present plans, the Centennial Development Co. will also do the mine development work (drifting and crosscutting) on the first three levels to be developed - the 700, 800 and 900 ft. levels. Since my report of May 29, 1959, these levels were lowered 7 ft. so as to make them come on the even hundred feet below the shaft collar, and will be designated as such instead of by elevations.

Later on, two additional levels, the 1000 ft. and 1100 ft., will be developed.

Exploration: No exploration drilling is now being done on the Palo Verde property. However, diamond drilling to cover assessment work is in progress on some of the company's claims about 3 miles east of the Palo Verde. This is done under contract to Glen Thatcher, Tucson, Arizona.

Additional: Mr. MacKenzie reports that the Banner Mining Co. purchased the San Xavier Mine from McFarland and Hullinger in November, 1959.

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DEPARTMENT OF MINERAL RESOURCES
STATE OF ARIZONA
FIELD ENGINEERS REPORT

Mine Palo Verde **Date** September 3, 1959

District Pima, Pima County **Engineer** Axel L. Johnson

Subject: Present Status -- Information from F.D. MacKenzie and personal visit.

Reference: Report of May 29, 1959.

Present Activity: Installing headframe and hoist, erecting mine buildings, including change room, mine office and first aid room. 12 men working.

No work has been done on the sinking of the new 5 compartment shaft since my last visit of May 29. A contract has been given to the Centennial Development Company of Eureka, Nevada, for the balance of the shaft sinking. This will start as soon as the installation of the hoist and headframe is completed.

The drainage churn drill hole referred to in my report of May 29 under the heading of "Present Mining Operations," has now been finished to a depth of 1217 feet and has been reamed out to 16" diameter at bottom and 20" diameter at the top.

DEPARTMENT OF MINERAL RESOURCES

STATE OF ARIZONA

FIELD ENGINEERS REPORT

Not for publication

Mine Palo Verde Mine — Date May 29, 1959

District Pima Mining District, Pima County — Engineer Axel L. Johnson

Subject: Field Engineers Report. Information from F. D. MacKenzie, Geologist & Personal Visit.

T16S, R12E

Location N 1/4 - Sec. 36 on State Lease, about 1 1/2 miles NE of Mineral Hill Mine. From the Mineral Hill Mine, drive 1.1 miles N. to the Pima Mine road. Turn right (east) nad drive 1.0 mile. Turn right (south) and drive about 0.3 mile to the mine.

Owners and Operators Banner Mining Co., Twin Buttes Road, Tucson, Ariz. For company officials, see report of Mineral Hill Mine under date of July 8, 1958.

Principal Minerals Copper ore.

Present Mining Activity Sinking new 5 compartment shaft. Erecting headframe. Drilling of drainage hole. Exploration by means of diamond drilling. Number of men working for the Banner Mining Co. ---- 20 men -- 1 shift. Additional men working for the drilling companies, drilling under contract. No mine production.

Milling & Marketing Facilities Ore from this mine will be milled at the Mineral Hill mill.

Past History and Production None. This is a new development.

New Mine Workings A 10'- 6" x 17' - 10" 5 compartment vertical shaft is being sunk, which is now down to depth of 15'.

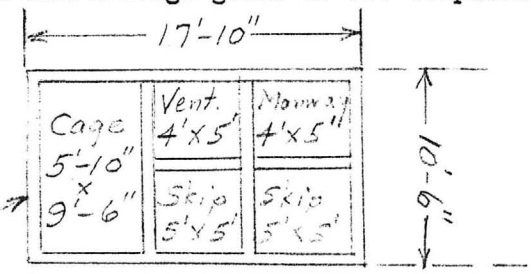
Present Mining Operations The company is now sinking a 5 compartment vertical shaft, 10' - 6" x 17' - 10", which is now down to a depth of 15 ft. and concreted to that depth. The shaft collar set is in, but no other sets as yet. The excavation dimensions are 11' - 2" x 18' - 6" (allowing 4" on all sides for concrete) The sets will be 6" x6" H beams on 5 ft. centers. Company is also erecting a headframe, which is now about 1/2 completed. This headframe was bought second hand, and was brought in from Ruth, Nev. A hoist (used) was also purchased at Ruth, Nev., and will be installed soon.

Company is also drilling a drainage churn drill hole, about 25 ft. south of the shaft. This will provide drainage for the water encountered in the shaft sinking operations. It is being drilled on contract by O. C. Robinson of Tucson, Ariz. The churn drill hole will be 1140 ft. deep (same depth as the shaft) with a 24 " casing. The drill hole is now down to a depth of 15 ft.

Diamond drilling on the property is being done by Boyles Bros. Drilling Co., and also by Glenn Thatcher of Tucson. The assessment work on the claims is being done by diamond drilling.

The Palo Verde ore body was discovered and explored by means of diamond drilling. The drill holes were put down on 250 ft. centers with an equilateral triangle drilling pattern, and the tonnage and average grade of ore computed from these.

PALO VERDE SHAFT



6" H Beams on 5' centers

4 " concrete all around.

Excavation dimensions ----- 11' - 2" x 18' - 6".

DEPARTMENT OF MINERAL RESOURCES
STATE OF ARIZONA
FIELD ENGINEERS REPORT

Not for Publication

Mine Palo Verde Mine (continued) Date May 29, 1959

District Engineer

Subject:

Proposed Plans

(1) To finish installation of the headframe.

(2) To install hoist.

(3) As soon as the headframe is completed and the hoist installed (about 4 weeks), a contract will be let to the Centennial Development Co. of Eureka, Nev. for the balance of the shaft sinking, the terms evidently have already been agreed on.

It is planned to sink the shaft to a depth of 1140 ft., and to develop 3 levels to start with, with 2 more levels to be developed later. The first three levels to be developed will be the 2550, 2450, and the 2350 ft. levels at the corresponding elevations of 2550, 2450, and 2350 ft. The levels to be developed later will be the 2250 and 2150 levels. The elevation at the collar is 3243. The highest level, the 2550, is, therefore, 693 ft. below the collar, and the bottom level will be 1093 ft. below the collar.

(4) The drainage churn drill will be drilled to a depth of 1140 ft. (same as shaft This is being drilled on contract to O. C. Robinson of Tucson.

(5) Diamond drilling on contract to Boyles Bros. and Glenn Thatcher of Tucson will be continued on the Palo Verde property, and also on the other adjoing properties owned or leased by the Banner Mining Co.

Remarks

Banner Mining Co. officials request no publication of the above information.

See: E. & M. J. July, 1959, p 19

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