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ARIZONA DEPARTMENT OF MINES AND MINERAL RESOURCES AZMILS DATA

PRIMARY NAME: INSPIRATION MINE

3 of 8

ALTERNATE NAMES:

RED HILL
JOE BUSH
THORNTON
LIVE OAK
PHELPS DODGE MIAMI OPERATIONS
MIAMI (PHELPS DODGE)
MIAMI (CYPRUS)
MIAMI SMELTER
CYPRUS MIAMI OPERATIONS
GMC LEACH FACILITY
KEYSTONE VEIN
BL LEACH FACILITY

GILA COUNTY MILS NUMBER: 136

LOCATION: TOWNSHIP 1 N RANGE 14 E SECTION 25 QUARTER NE
LATITUDE: N 33DEG 24MIN 30SEC LONGITUDE: W 110DEG 54MIN 00SEC
TOPO MAP NAME: INSPIRATION - 7.5 MIN

CURRENT STATUS: PRODUCER

COMMODITY:

COPPER SULFIDE
COPPER OXIDE
SILVER

BIBLIOGRAPHY:

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PP 12, 160-161; 1903
PETERSON, N.P. "GEOL. & ORE DPSTS GLOBE-MIAMI
DIST" USGS PP 342, P 137; 1962
AZBM BULL 145 "AZ ORE DPSTS" P 66-72; 1938
USBM IC 8154
ALSO IN SEC. 14, 26
ADMMR INSPIRATION SMELTER FILE
BL LEACH FACILITY IN SEC. 21, 22
GMC LEACH FACILITY IN SEC. 13, 14
TONTON N'TL FOREST, BLM, ARMY CORPS OF ENGRS,
1997, CYPRUS MIAMI LEACH FACILITY EXPANSION
PROJECT; DRAFT EIS, APRIL 1997, 295 P.
TONTON FS, BLM, USCOE, FINAL EIS, 6/1998

GILA - Table Records

NUMBER 136	FILE F	CONT 0	CONT1 Y	PRNAME INSPIRATION MINE				
ALTNAME1 RED HILL				ALTNAME2 JOE BUSH				
ALTNAME3 THORNTON				ALTNAME4 LIVE OAK				
ALTNAME5 PHELPS DODGE MIAMI OPERATIONS				ALTNAME6 MIAMI (PHELPS DODGE)				
CURSTAT PRODUCER		MNAME INSPIRATION - 7.5 MIN		NLATDEG 33		NLATMIN 24		
NLATSEC 30	WLONGDEG 110	WLONGMIN 54	WLONGSEC 00	TOWN 1 N	RANGE 14 E	SECTION 25	QUARTER NE	
MODI1 SULFIDE	COM2 CU	MODI2 OXIDE	COM3 AG	MODI3	COM4	MODI4	COM1 CU	
COM5	MODI5	COM6	MODI6	COM7	MODI7			
BIB1 ADMMR INSPIRATION MINE FILE								
BIB2 AZ MNG JNL, 2/1/22, P 16; 11/19, P 43								
BIB3 RANSOME, F.L. "GEOL GLOBE COPPER DIST" USGS								
BIB4								

Mine Condo.

INSPIRATION CONSOLIDATED COPPER COMPANY

Inspiration, Arizona

HISTORY

Inspiration, like most mines in Arizona, owes its discovery to the old-time prospector and his burro. The beginning of mining operations on the Inspiration property dates back to the turn of the century.

The earliest exploratory working was known as the Woodson Tunnel. This tunnel, driven by hand, went into the hillside for 1,000 feet. By 1908, local owners had consolidated claims and groups of claims into a single holding and had induced outside capital to form the Inspiration Mining Company. This name was later changed to that of Inspiration Copper Company. Following this, through a long series of events and negotiations which saw a merger of the Inspiration Copper Company with the Live Oak Development Company, the Inspiration Consolidated Copper Company came into being in the year 1911. Later the Warrior Copper Company and the New Keystone Copper Company, as well as other properties, were acquired by Inspiration.

Plans were soon formulated to engage in a large-scale copper mining operation. The mine was developed and made ready for operations. A complete surface plant, railroad, and concentrator were constructed. This concentrator was the first large-scale plant of its kind to make use of the Flotation Process to recover the copper minerals from the ground-up rock. In all, even at that time, it was necessary to spend close to \$20,000,000 before one pound of copper was produced. Construction was completed and Inspiration went into production in 1915.

USES OF COPPER

Copper is one of the oldest known metals. The word copper originated many thousand years ago when half savage tribes living on the island of Cyprus called it "Cyprian Metal." It has kept the name through all ages. Our tongues have changed it to Copper. Copper plays an important part in the industry of the United States. In fact, it is the backbone of the electrical industry, as it is second only to silver as a conductor of electricity. Because of this, 60% of the annual output of metallic copper in the United States goes into electrical machinery, power transmission lines and telegraph, telephone, radio and television communication lines and equipment.

Other typical uses of copper include sheet for roofing, tubing for gas, steam, water and oil lines, extruded shapes for industrial equipment, drawn shapes for molding, and all types of brass. It is also used in the coins of many nations and for jewelry and household articles. One use for copper which is not well known is as an insect-destroyer for which one of its compounds Copper Sulphate is used.

LOCATION

The Inspiration Consolidated Copper Company's operations are entirely in the Globe-Miami mining district in Gila County, Arizona. Inspiration is one of the large copper producers in the State, producing approximately 11% of the State's output. The Globe-Miami district produces approximately 24% of the State's output. In comparison with the Nation's copper production, Inspiration produces approximately 5% of all the copper produced in the United States, while the Globe-Miami district produces approximately 10%, and the State 43%. The Mine, the town of Inspiration with its U.S. Post Office, and the Company's plants and offices are just north of the town of Miami and are reached by turning off Highway 60-70 about three-fourths of a mile east of Miami and following the paved road past the International Smelter for a distance of about two miles. It is approximately eleven miles around the property.

THE ORE BODY

Inspiration is designated as one of the "Porphyry Coppers." Such an ore body is one in which the copper minerals are widely distributed throughout a large rock mass. At Inspiration the distribution is such that one ton of ore contains less than twenty pounds of copper. Peculiar to Inspiration is the fact that about half of the copper minerals are present in the oxidized form, the other half being sulphide minerals, mainly Chalcocite (Cu_2S). It is the presence of the oxide minerals which gives the green coloration to much of Inspiration ore.

MINING UNDERGROUND

From the start of operations in 1915 up until 1948, all of Inspiration's production came from Underground mining in which a mining method, known as "Block Caving," was utilized for the extraction of the ore.

"Block Caving" is a method particularly adapted to the mining of large low-grade ore bodies. The rate of production is high and the cost of breaking and handling ore from the "block" or "stope" can be kept relatively low. Largely, the force of gravity is used, both to break the ore and to deliver it to the ore trains operating on the haulage level under the block.

Ore trains made up of twelve to twenty-four five-ton cars haul the ore from the stope areas to the shaft where it is hoisted to the surface in twelve-ton skips.

Inspiration Main Shafts go to a depth of 850 feet and the Live Oak Main Shaft goes to a depth of 1,200 feet, with stations at various levels. From the Live Oak Main Shaft bins, ore is hauled in train loads of sixty-ton railroad cars to the Coarse Crushing Plant at the Main Shaft.

OPEN PIT MINING

In recent years the rapid development of modern methods and equipment for moving earth coupled with the steady increase in Underground mining costs made it necessary to investigate the possibility of mining much of Inspiration's remaining ore tonnage by Open Pit methods. The decision to go to Open Pit mining followed, and stripping of overburden was started in 1947. The first Open Pit ore was mined in March, 1948. The adoption of Open Pit methods required the expenditure of several million dollars to meet the cost of construction and equipment of new plant facilities, and stripping of waste rock.

Ore and waste are mined by large electric shovels and transported by 30 to 40-ton Diesel powered haulage trucks. Considerable equipment in the way of Bulldozers and Carryalls is also required.

Open Pit ore is delivered to a large 42-inch gyratory crusher, where it is crushed down to five-inch size for delivery to the main Coarse Crushing Plant. At this point the Open Pit ore joins the Underground ore for final crushing prior to delivery to the Treatment plants.

However, not all of the Open Pit ore is so hauled. To deliver ore by truck from the lower benches of the Thornton Pit to the Primary Crusher would involve a long and difficult truck haul. Accordingly, advantage is taken of the fact that the original 600-foot level main haulage way of the Inspiration division of the mine is practically under the Thornton Pit. A special transfer block was installed in the bottom of the Pit and neighboring ore is moved into the open block by bulldozers, carryalls, and/or trucks. From this transfer block, the ore is drawn out into trains of mine cars on the underground haulage level and hauled to the main shaft where it is hoisted and dumped into storage bins. In this way the long, difficult truck haul over the mountain is avoided by going under the mountain.

ORE TREATMENT

Early in Inspiration's operations it was recognized that large reserves of copper were available in the oxide forms, which could not be recovered by treatment in a Concentrator. Years of experimental and test plant work evolved a leaching process which would successfully treat the major portion of Inspiration's ore. A leaching plant was erected at a cost of six million dollars. This plant, put into operation in 1926, has since accounted for all but a minor amount of Inspiration's production.

The Inspiration Leaching Plant is the only one of its kind in the world today. In this treatment process, copper in both the oxide and sulphide form is recovered by leaching, utilizing as a solvent a solution containing both sulphuric acid and ferric (iron) sulphate. This leaching operation is carried on in large leaching vats, each of which holds 10,000 tons of ore. In all, the Plant treats some 4,000,000 tons of ore per year.

After leaching, the copper dissolved from the ore is recovered from the solution in the Electrolytic Tank House. In this process an electric current is passed through the solution breaking it down and precipitating the copper on thin copper starting sheets suspended in the Electrolytic Cells. In the course of six days, these starting sheets, made at the Plant and weighing thirteen pounds are built up to a weight of 100 pounds. Then the sheets are withdrawn and shipped as Electrolytic Copper. Such copper is 99.9% pure. However, the copper sheets, or cathodes as they are known, still must be melted up and cast into commercial shapes as required by the market. In the Electrolytic Plant the electrolytic power utilized would supply that needed by a good-sized city.

A vital cog in the Leaching Plant operation is the Iron Launder system. In these Iron Launderers, the last trace of dissolved copper picked up in wash solutions, used to wash the ore after leaching, is precipitated out on iron precipitating material. This iron precipitation material is made up of processed "tin cans." The so-called tin can is in reality an iron can coated with a very thin film of tin.

Tin cans are cleaned, burned, and shredded and in this processed form make an excellent material on which to precipitate dissolved copper from solutions. Most of the "tin cans" used by Inspiration come from the Pacific Coast areas. Total consumption of processed cans amounts to better than 2,000 tons per month.

To provide sulphuric acid for leaching, Inspiration operates a Sulphuric Acid Plant which can produce up to 200 tons per day of sulphuric acid, using Crude Sulphur shipped in from east Texas or Wyoming mines.

POWER PLANT

Requirements for electric power at Inspiration are quite large. To meet the original need, a 20,000 KW Power Plant was constructed. In this plant, natural gas piped from New Mexico is burned under boilers to provide the steam to operate the Turbo Generators.

At the same time the power system is tied into that of the Salt River Valley Water Users' Association. On many occasions the entire Inspiration load has been carried by the Water Users' system which derives much of its power from generator stations along the Salt River.

SHOPS AND SERVICE

The Company has built its own shops, warehouse, and service departments. The shops are fully equipped and are capable of handling almost everything in the way of repairs and maintenance which may be required.

RAILROAD

The Inspiration Company operates seventeen miles of standard gauge railroad. This railroad delivers ore to the treatment plants and handles tailings from the Leaching Plant to the waste dumps. It also handles all outgoing shipments of copper from the Plant to the Southern Pacific Railroad at the foot of the hill. All incoming freight is also handled by this Railroad.

TOWNSITE AND STORE

The Warrior Cooperative Mercantile Company operates a general store at Inspiration. This store is operated to serve the needs of Inspiration employees.

Operations are on a non-profit basis and profits earned are returned twice yearly to employee customers in proportion to their purchases throughout the period.

HOSPITAL

The Miami-Inspiration Hospital is maintained jointly with other companies in the district. It is a modern fifty-bed hospital, fully approved by the American College of Surgeons. It not only serves industrial cases but the employee and his family are provided medical care at exceptionally low rates. In all, the families of some 3,000 mining company employees in the district are served by this Hospital.

STATISTICS

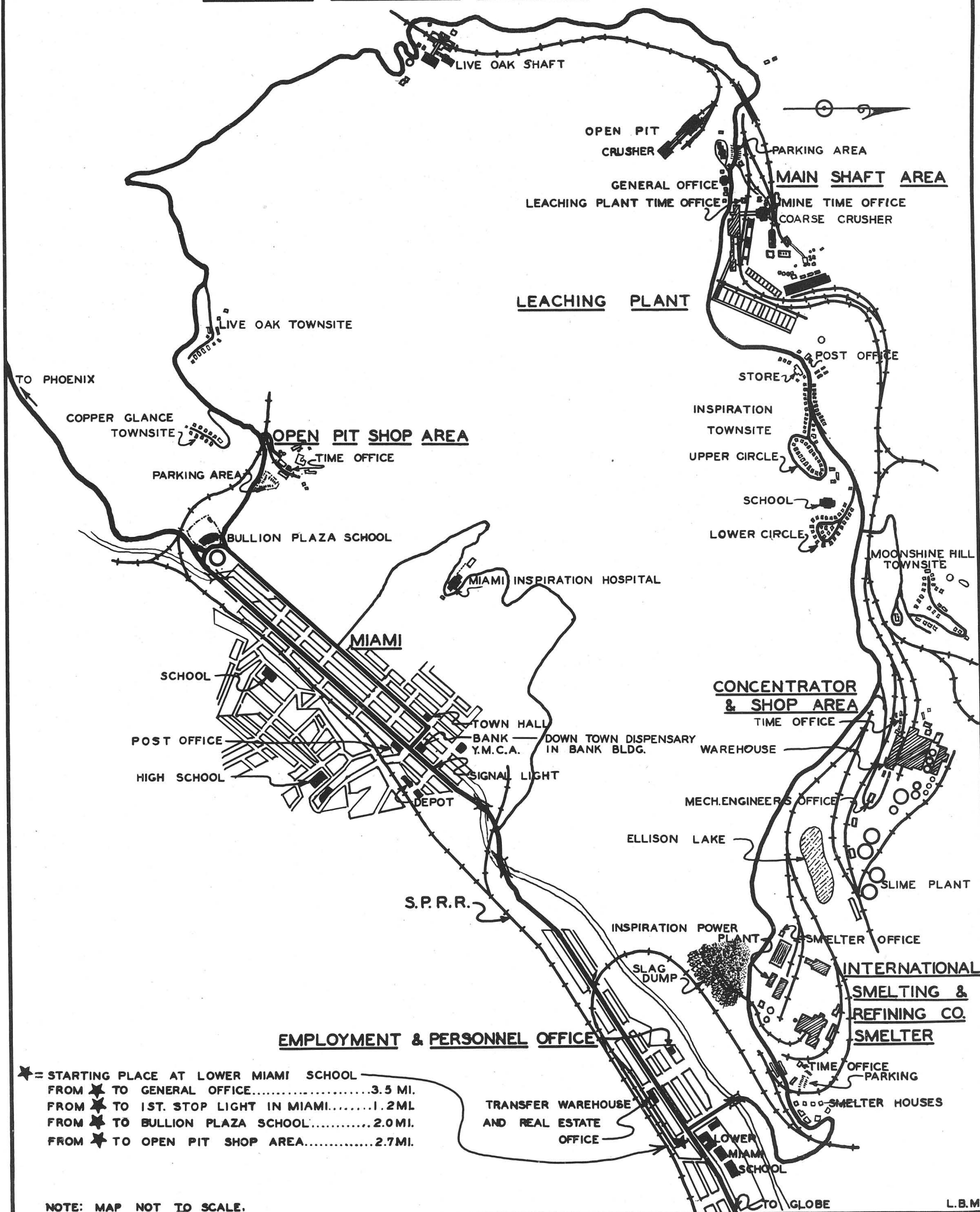
Tons ore mined and treated - 1915 to 1954	139,930,000	
Pounds copper produced - 1915 to 1954	2,695,250,000	± 19.3 lbs/ton.
Tons of ore and waste moved from Open Pit in normal 24-hour work day	50,000	
Wages and salaries paid in 1953	\$5,025,000	
Supplies purchased in 1953	\$5,910,000	
State, County, and District Property Taxes, 1953	\$ 580,675	
Number of employees	1,000	
Number of stockholders	9,144	

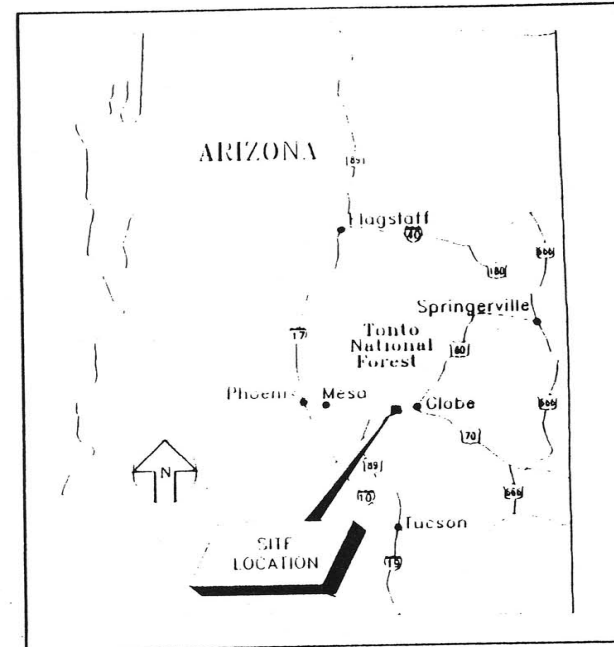
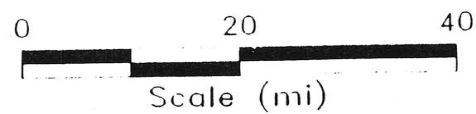
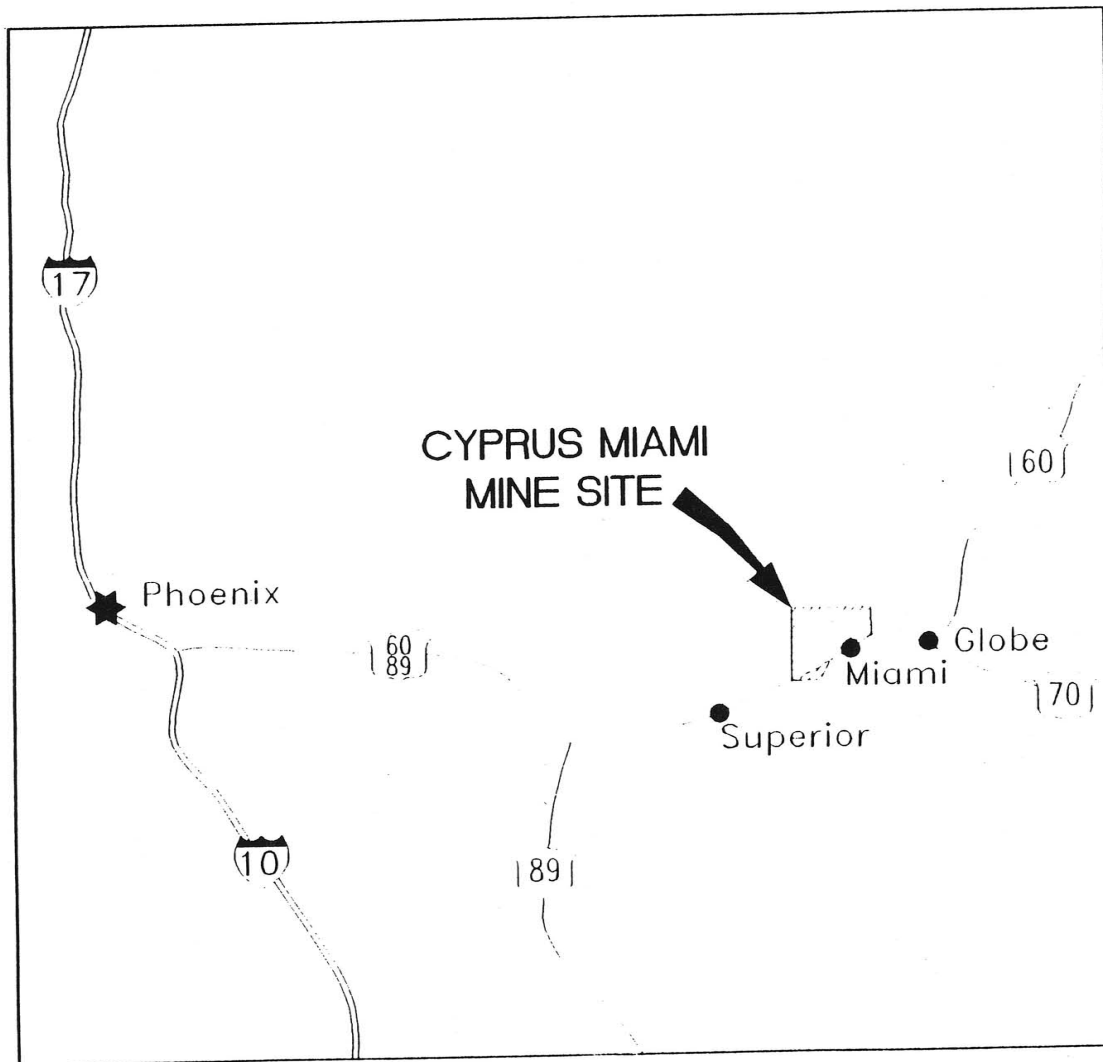
Issued January, 1954

ICCCo.

Revised May, 1954

INSPIRATION CONSOLIDATED COPPER CO. INSPIRATION, ARIZONA





SITE LOCATION MAP



MIAMI OPERATION

Scale: As shown

Date: 10/94

Figure 1

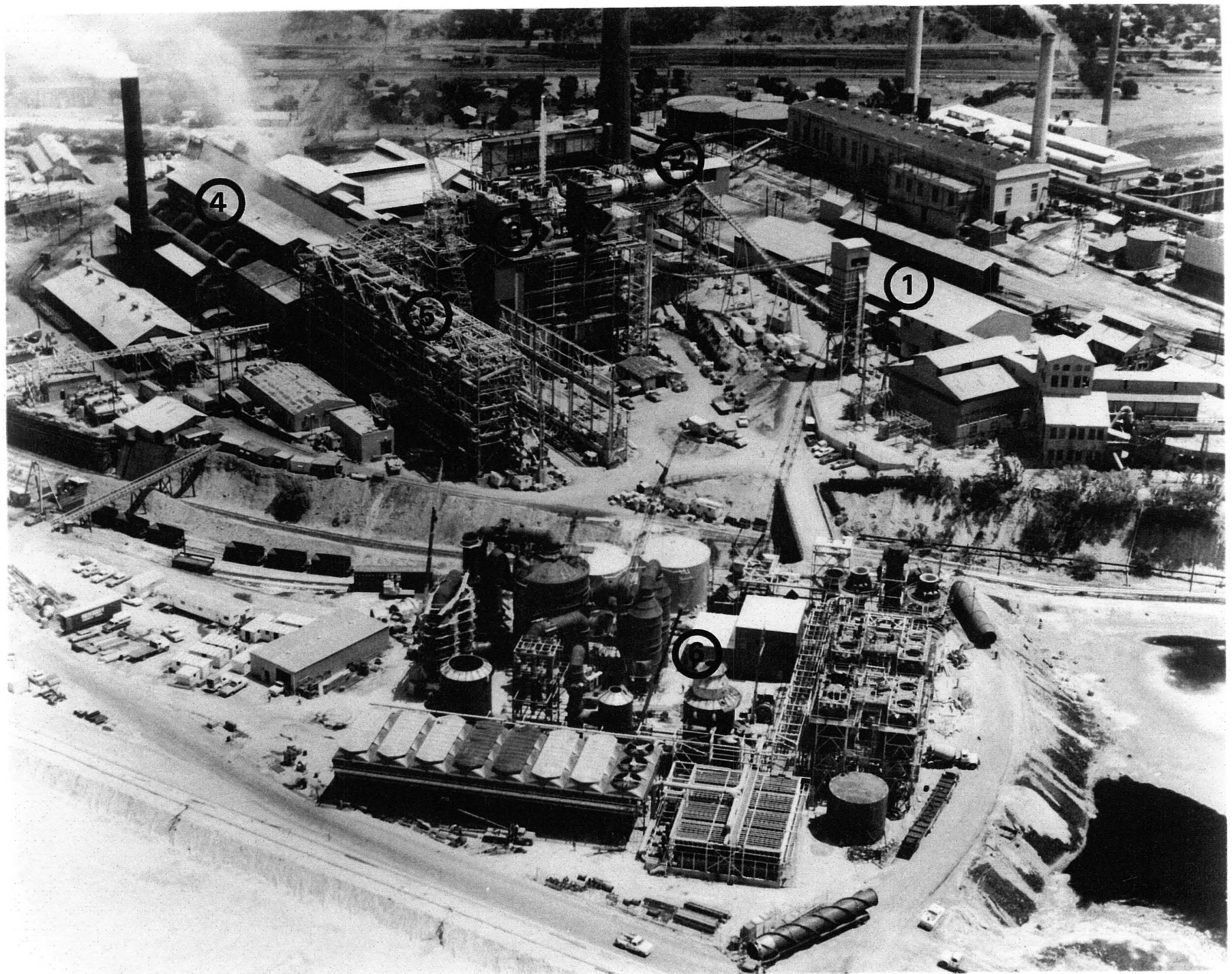


CYPRUS
Island Mining

Leach Pad
Expansion Project

PROPOSED PROJECT

Figure 2

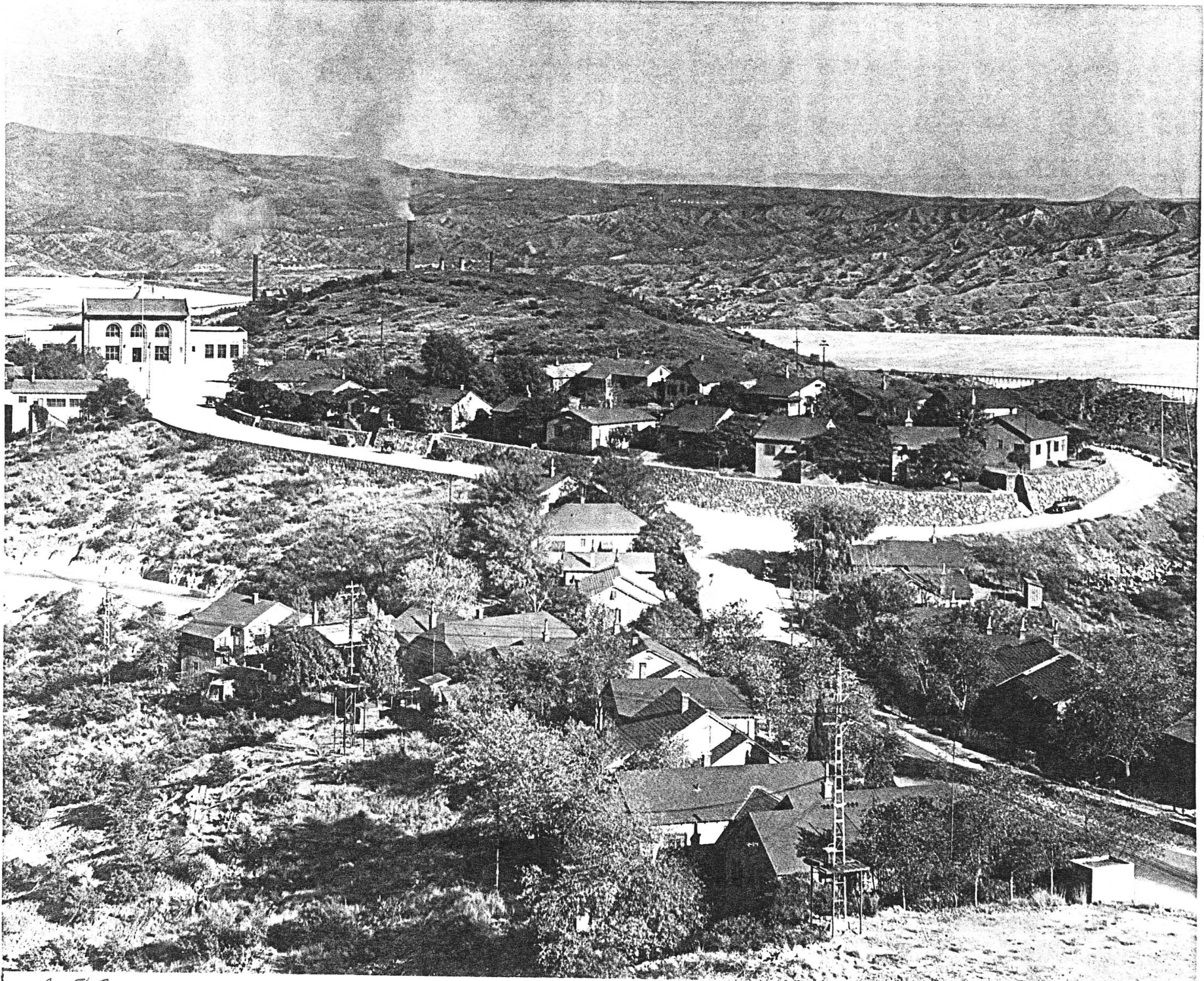


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(Molly Fosburgh)

FOR: INSPIRATION CONSOLIDATED COPPER COMPANY

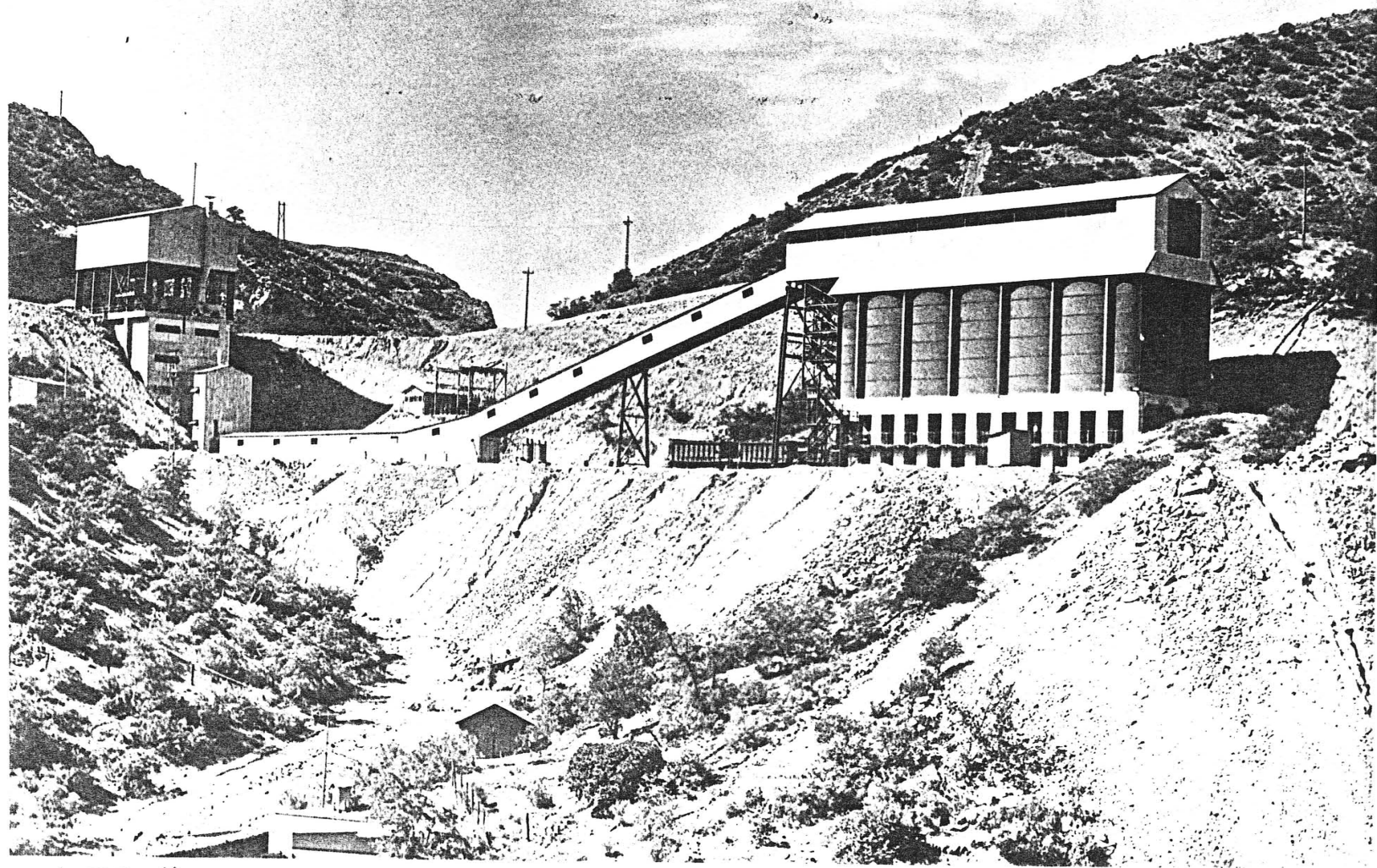
Aerial view of Inspiration Consolidated Copper Company's \$54 million air pollution control project in late stage of construction at the company's smelter in Inspiration, Arizona. When the project is completed in early 1974, Inspiration's copper smelting operations will be as pollution free as is possible under existing technology. (1) Existing concentrate, unloading and storage facilities. (2) Gas fired rotary concentrate dryer. (3) Electric furnace structure. Furnace has inside dimensions, 36' x 118' x 21' high -- largest such copper furnace yet built. (4) Existing converter aisle. (5) Converter aisle extension houses five new gas-tight syphon converters, also largest of type. (6) 1400 ton-per-day double-absorption acid plant.

#



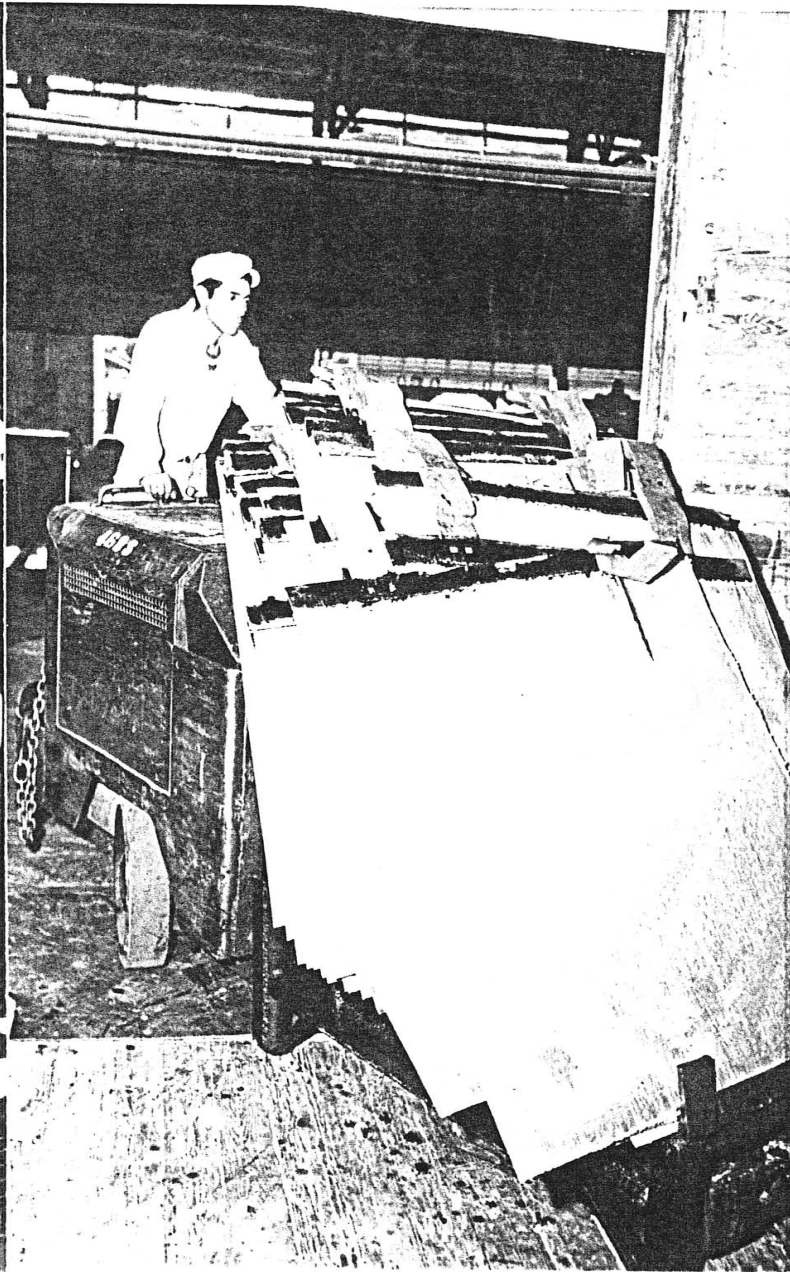
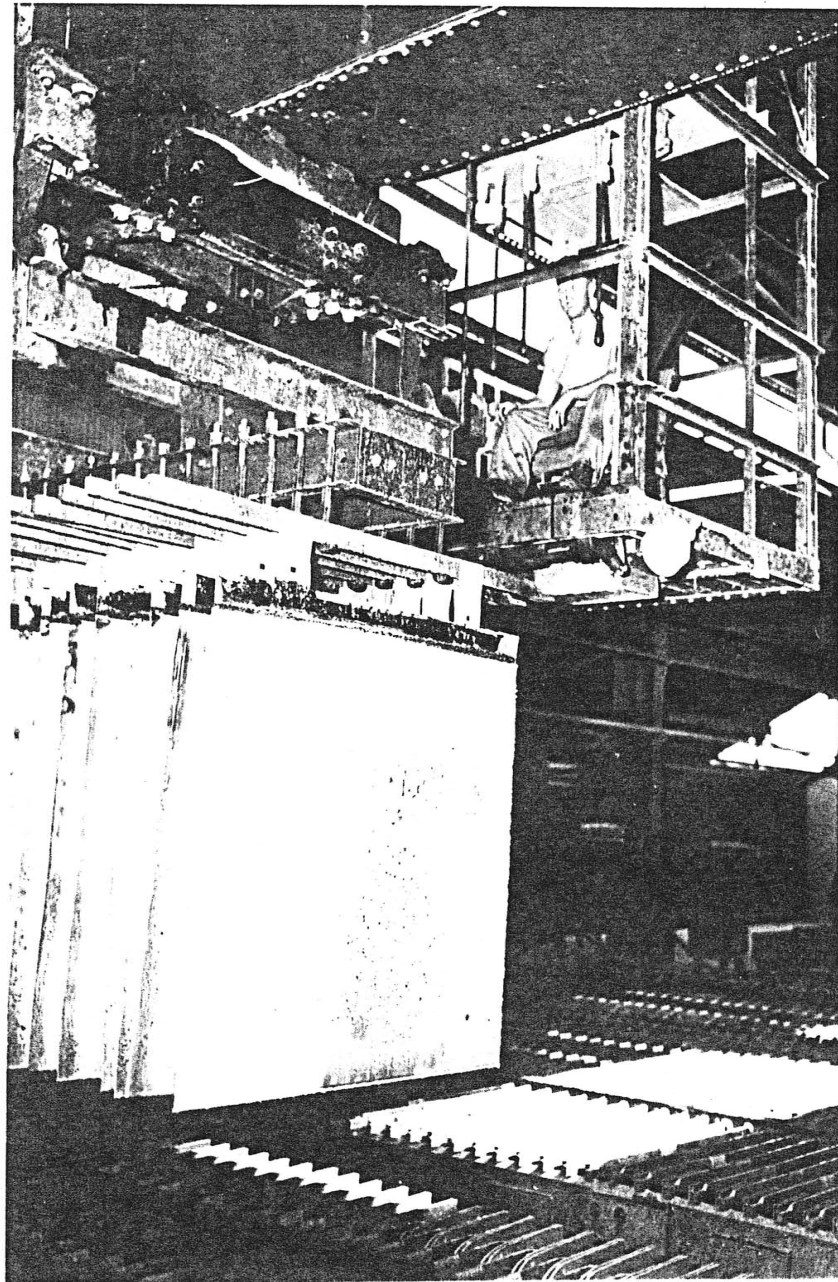
A-82-1

1950

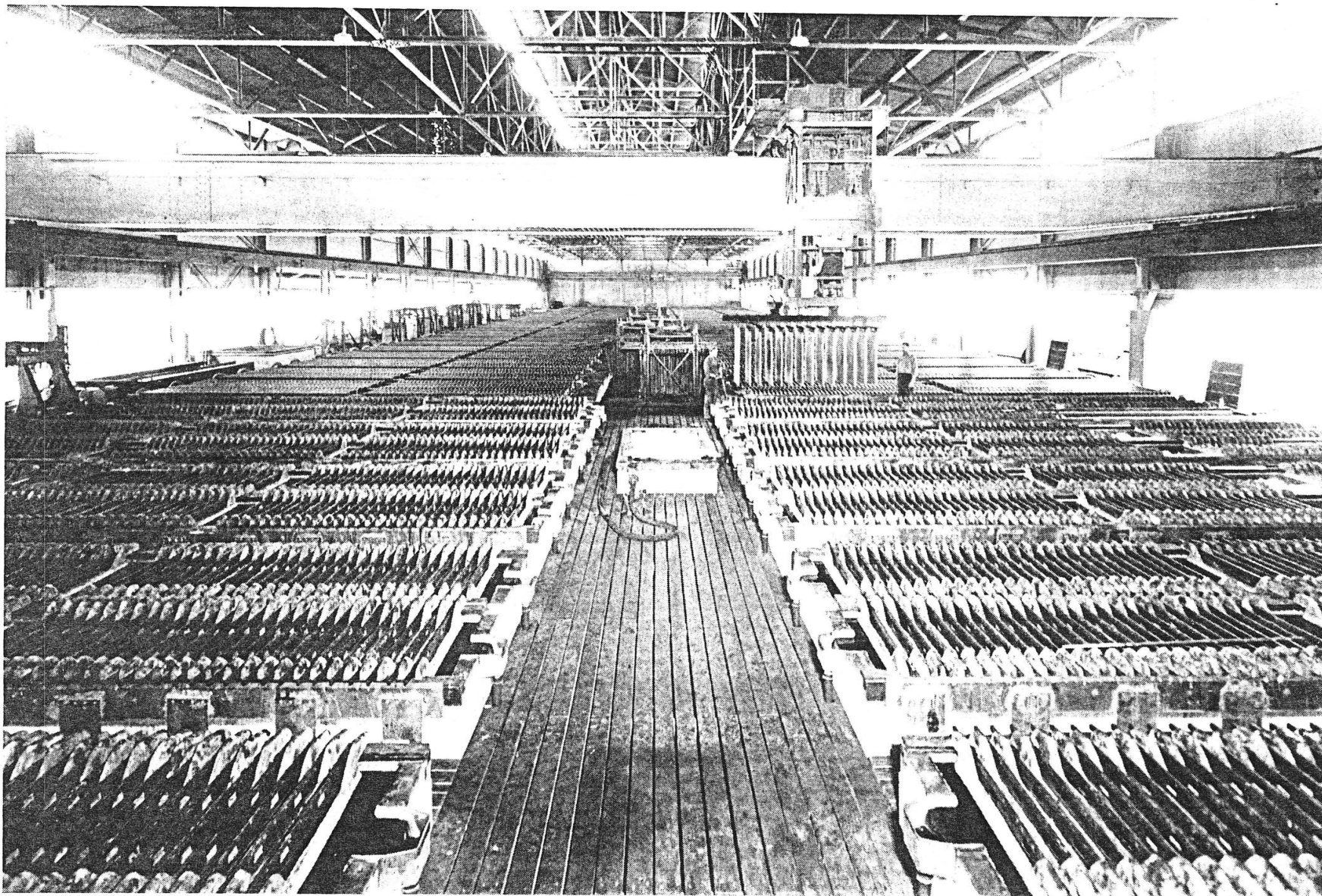


A-82-11

C-1950



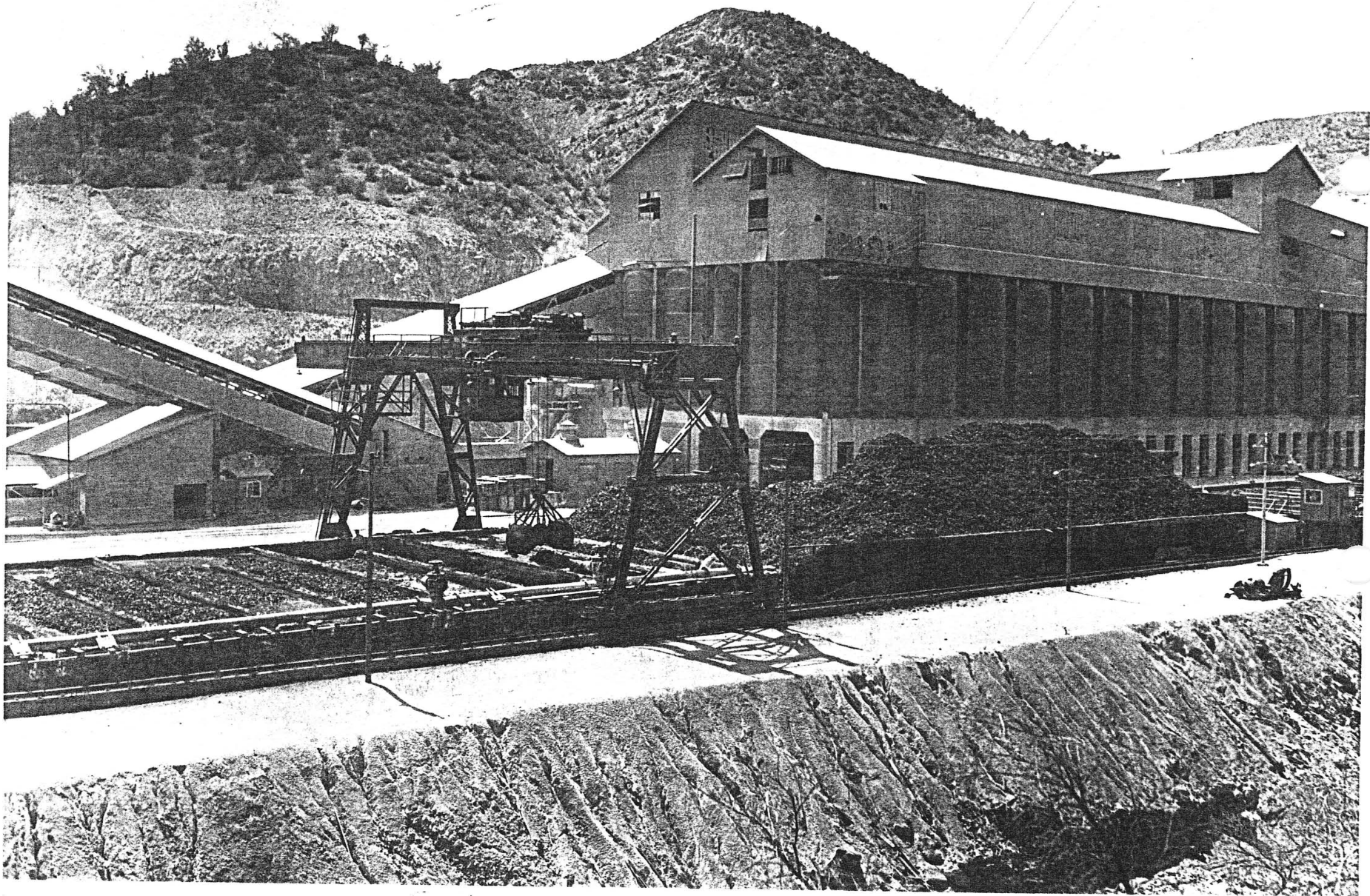
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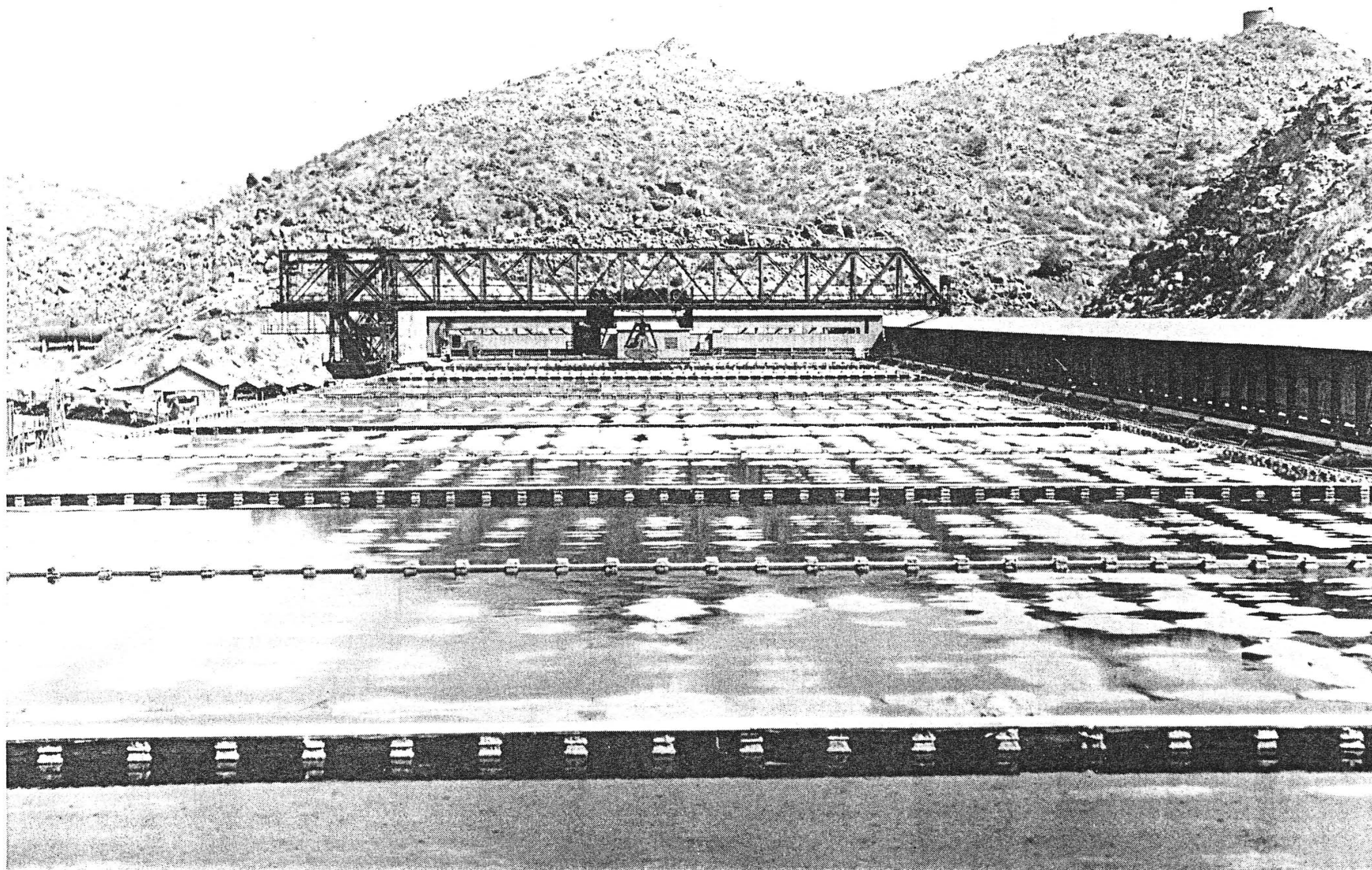
Inspiration Consolidated Copper Company - Electrolytic Precipitation Plant.

A-82-9

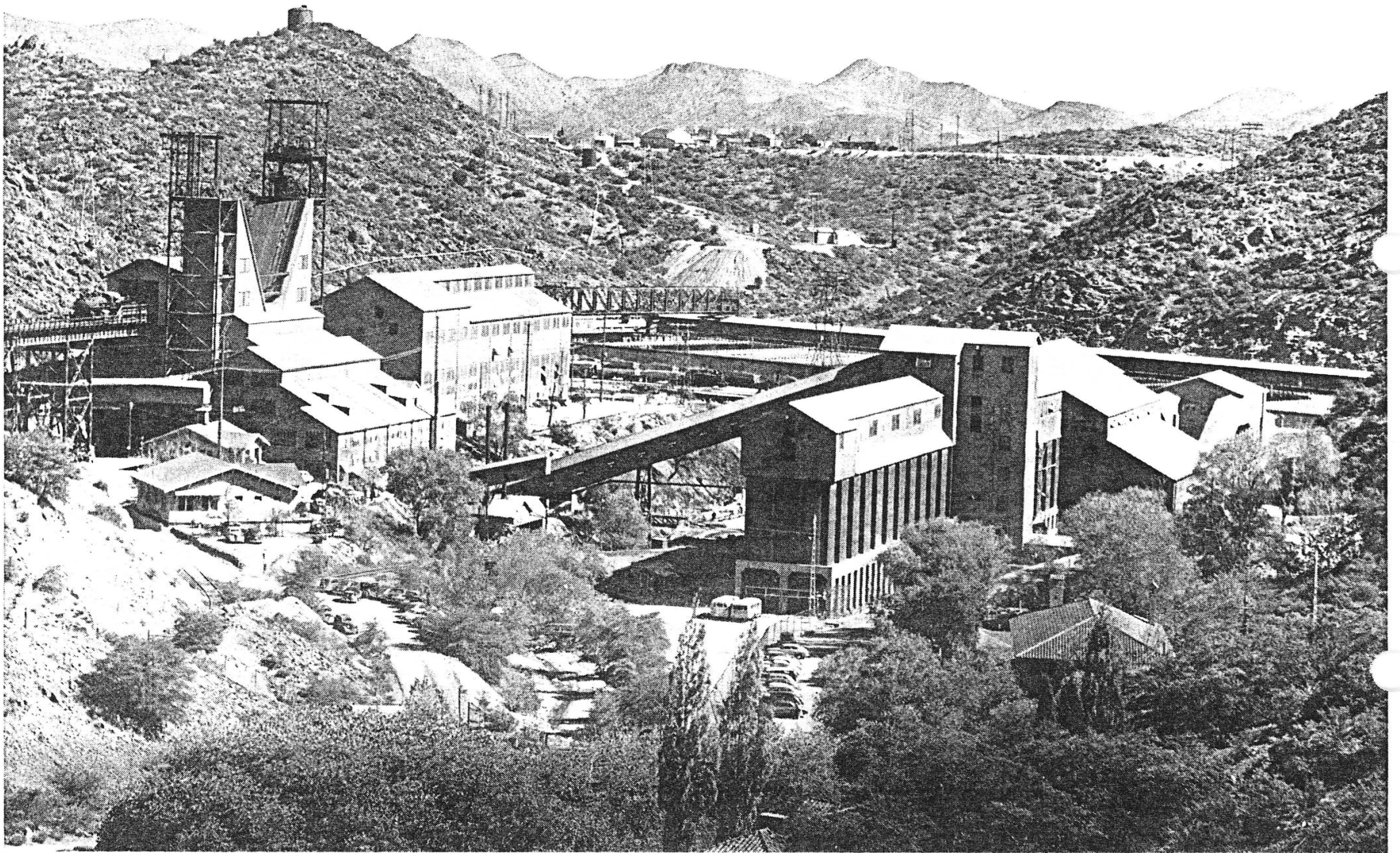
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A-82-7

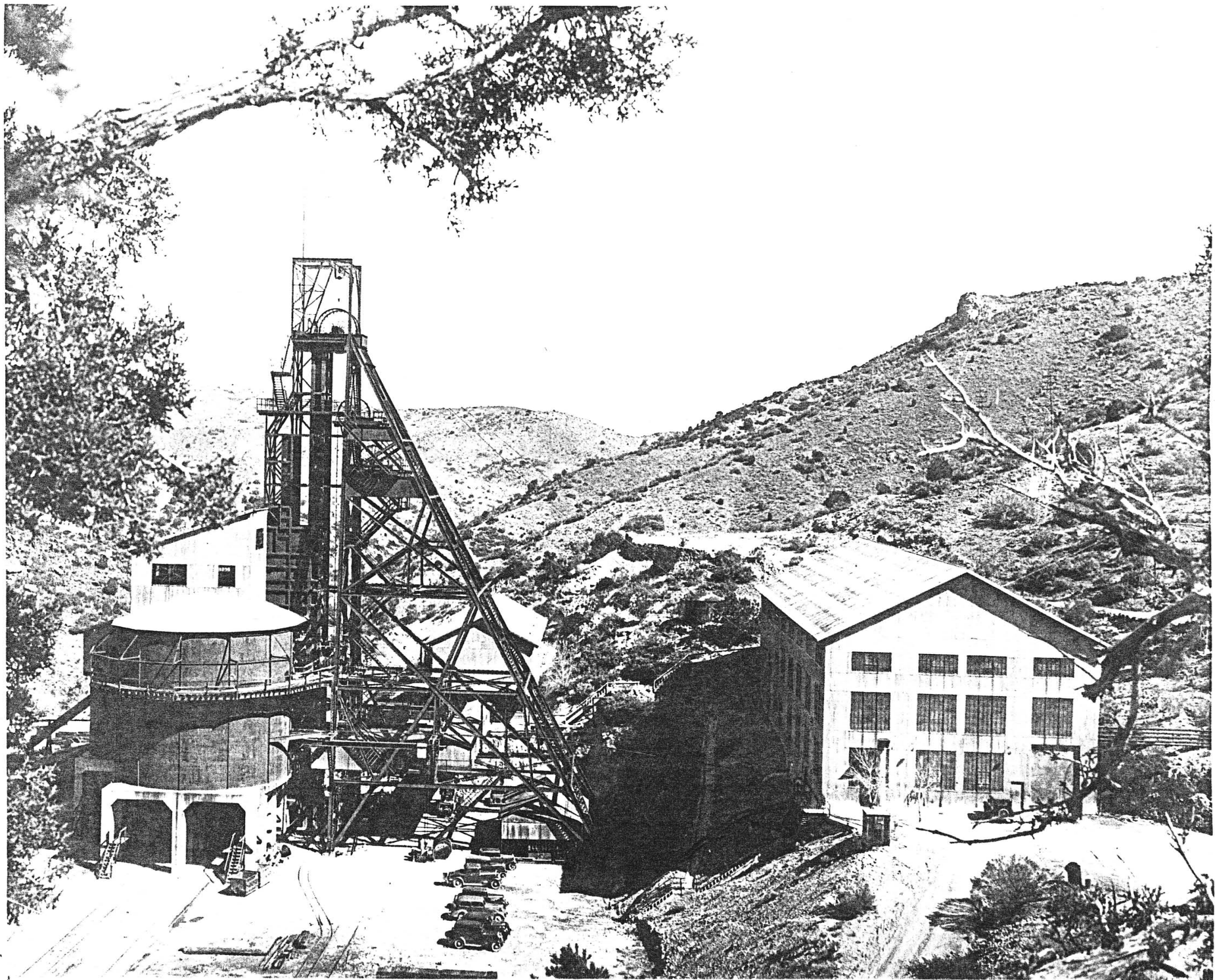


Inspiration Consolidated Copper Company - Leaching Tanks.



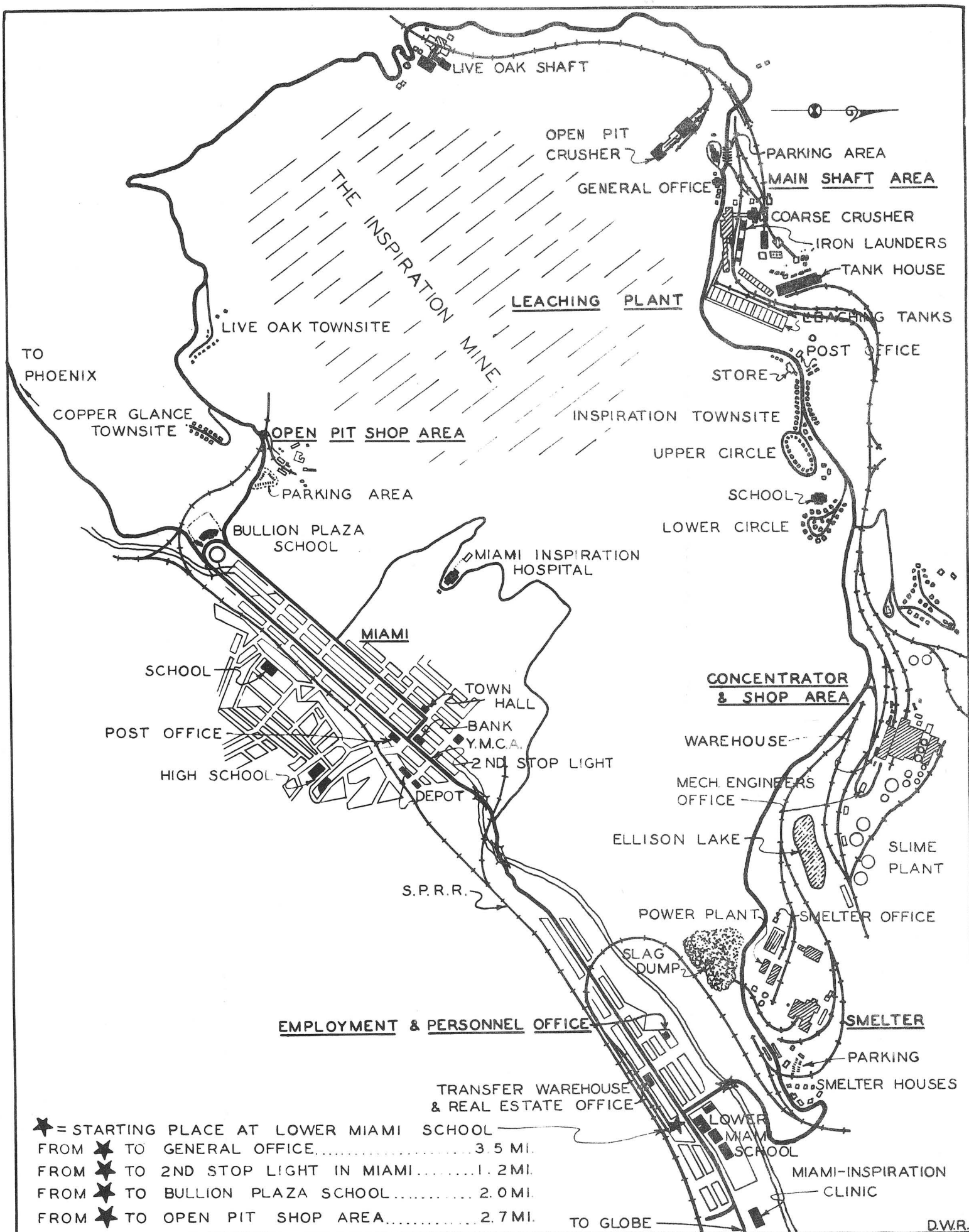
A-82-6

Inspiration Consolidated Copper Company - Main Shafts in Leaching Plant Area.



A-82-5

INSPIRATION CONSOLIDATED COPPER CO. INSPIRATION, ARIZONA



THE METALLURGICAL STORY AT INSPIRATION

BY

C. B. KETTERING and K. L. POWER

DEPARTMENT MINERAL RESOURCES
MINERAL BUILDING
FAIR GROUNDS
PHOENIX 7, ARIZONA

THE METALLURGICAL STORY AT INSPIRATION

By

C. B. KETTERING* and K. L. POWER**

In the early operations of the Inspiration Consolidated Copper Company, which extended from 1914 to 1926, the ore as mined contained principally sulphide copper minerals, mainly chalcocite (Cu_2S). This ore was milled in a 20,000-ton concentrator and the copper was recovered as a flotation concentrate, which was smelted at the nearby plant of the International Smelting and Refining Company. In those days no attempt was made to recover copper from any oxide minerals present.

As mining operations progressed it soon became evident that the proportion of oxide minerals present would steadily increase, and it was realized that some method of treatment would have to be developed, whereby copper could be recovered from both oxide and sulphide minerals contained in the ore. A research program was instituted and after some years of experimental and pilot plant work a new hydro-metallurgical process was developed, whereby it became possible to extract copper from both the oxide and sulphide minerals in a single leaching operation. The solvent adopted consisted of a mixture of sulphuric acid and ferric sulphate. Following dissolution, the dissolved copper would be recovered by electrolysis. Also in the process of electrolyzing, spent solutions of sulphuric acid, H_2SO_4 , and ferric sulphate, $\text{Fe}_2(\text{SO}_4)_3$, would be regenerated and so made available for continuous re-use. The process appeared to be a success and the decision was made to build a full-sized leaching plant for the future treatment of Inspiration mixed ore. Construction was started and the leaching plant was completed in 1926. With the start of ferric-sulphate leaching the Inspiration Concentrator was shut down and, with the exception of a few short-time runs, has not operated since that time.

The ferric sulphate leaching process served Inspiration well for some 30 years and during that time won a name for itself as a classic example of hydro-metallurgical treatment of mixed sulphide-oxide ores. Originally the plant was designed to process some 7,500 tons per day of a mixed ore containing about 1.2% copper, of which 60% was present as oxide and 40% as sulphide. Down through the years various improvements were made for the purpose of increasing plant capacity, and as well to change the limiting factor of sulphide-oxide ratio. The final result was a leaching capacity of 9,600 tons per day when treating a 1% copper ore with a reversal of the sulphide-Oxide ratio to 60% sulphide and 40% oxide.

SLIMES SEPARATION

Very early it was recognized that satisfactory leaching could only be carried on if free percolation of solutions through the bedded ore was maintained. Such free percolation was seriously interfered with by the presence of colloidal fines. Accordingly, additional plant was constructed to "de-slime" the ore prior to bedding. Wet classification of the primary screen undersize

*C. B. Kettering, Plant Superintendent
**K. L. Power, Concentrator Superintendent
Inspiration Consolidated Copper Company

accomplished this purpose and resulted in a separation of about 7.5% of the total feed. This classified product contained about 85% minus 200 mesh material. The "slimes" so separated are given a dual process treatment in the "Slimes Plant", wherein the sulphide minerals are recovered by flotation and oxide minerals are dissolved in an agitation leach, the copper being subsequently precipitated as cement copper in a suitable series of iron launders.

Present-day operations at increased tonnage rates have called for expansion of both screening and classifying plants. Rake classifier capacity has been increased and, at the same time, "cyclone classifiers" are being added to the circuit to further physically improve the products going to both leaching and slimes plant circuits.

De-sliming of the ore to be leached was the first great forward step to be taken in the working out of this ferric sulphate leaching process. This has been followed by many another change. Such changes made down through the years involved methods of bedding ore, physical and chemical control of leaching solutions, improvement of contact time, methods of washing and draining leached ore. All such steps were to lead to improved metallurgy and copper extraction, gained in spite of a steady and constant change in the character of the ore, both in grade and in sulphide-oxide ratio.

CEMENT COPPER LEACHING

Increase of sulphide ratio in the ore posed a serious problem, which called for heroic measures. Successful leaching of the sulphide mineral chalcocite (Cu_2S) calls for the presence of ample ferric sulphate in the leaching solvent. In this process ferric sulphate is manufactured, or regenerated, by the oxidation of ferrous salts contained in the electrolyte. However, the rate of such regeneration is strictly a function of the rate of copper precipitation in the electrolytic cell. In due time it became obvious that if the necessary concentration of ferric sulphate for the dissolution of increased amounts of chalcocite in the ore was to be maintained, more copper than was currently contained in leaching solutions, coming off the ore, would have to be supplied to the tank house electrolyte.

In the leaching process the final wash waters contain copper in solution. The concentration is too low to permit electrolytic recovery, so these wash waters are sent to an iron launder system, where the dissolved copper is recovered as cement copper. The quantity of cement copper produced is quite material and amounts to better than 1,000,000 pounds per month, or around 20% of the copper input to leaching. Such cement copper for years has been subsequently treated by smelting. Now it was realized that if cement copper could be re-dissolved and the copper delivered in concentrated solution to the tank house electrolyte, then the electrolysis of this additional amount of copper would furnish all the ferric sulphate necessary for the expanded leaching of sulphide copper. After a considerable period of testing and experimental work, a successful method of dissolving cement copper was developed. A cement copper leaching unit was built and successfully operated. Through this means it became possible to maintain the ferric iron balance, and so leach increasing amounts of chalcocite. In recent years, at times up to 70% of the copper content of the ore has been present as chalcocite.

At the present time, having electrolytic capacity available, the Cement Copper Leaching Plant is being expanded so that in the future all cement copper produced from the several sources of Leaching Plant wash waters, Slime Plant

cement, and Leaching in Place cement, may be dissolved and re-precipitated as cathode copper directly, thus eliminating the expensive steps of smelting and anode refining.

THE DUAL PROCESS

In 1947 Inspiration began the change-over from underground block caving to Open Pit mining. This change made possible the future mining of low-grade fringe ore. It was also known that in the bottom levels of the mine there would be an increasing amount of copper present as chalcopyrite. Chalcopyrite cannot be recovered by leaching and so a new problem presented itself.

In leaching sulphide ores the time element is all-important and a satisfactory extraction cannot be obtained without ample contact time. This in itself would limit the tonnage treatment rate and the rate of copper production would be seriously affected when the time came to treat the lower grade ores. Also, there was the before-mentioned complication of the increasing presence of the mineral chalcopyrite, from which copper could not be recovered by leaching.

Thus, after extensive studies initiated in 1954, it was decided to abandon the well-tried ferric sulphate leach and to convert Inspiration's metallurgical operations to the "Dual Process". In this process ore is first acid leached to recover the oxide copper and the residue from this leach is delivered to the Concentrator, where, after grinding, the sulphide minerals are recovered by flotation. Such a process would enable a treatment rate up to 16,000 tons per day, would insure the maximum recovery of all sulphide mineral, and would assure the maintenance of an adequate increased copper production rate.

NEW CONCENTRATOR BUILT

The year 1956 was devoted to re-building of the old concentrator. The rehabilitation was complete and the new mill was equipped with the most modern of milling equipment. To point this up, it is notable that in the new plant seven 10-1/2' x 14' ball mills replaced 40 of the original 8' x 6' mills for approximately the same grinding capacity. Modern mechanical flotation machines replaced the obsolete canvas-bottom Inspiration type of flotation cells. Within the limits of the mill building there remained ample floor space for repair areas, a complete self-contained electrical substation, together with sufficient room for future possible expansions or modifications. Only the main building, the ore bins, modified to suit, and existing cranes remained from the old plant.

Layout and design of the new plant was done under the direction and supervision of the Inspiration mechanical and metallurgical staffs. Construction was by contract.

The September, 1957, issue of The Mining World contained a very excellent article on the completed concentrator, written by Mr. Stanley Dayton, Associate Editor of that paper. In the interest of brevity many details of plant description mentioned in that article will be omitted in this paper. Incidentally, a complete description of the original 20,000-ton mill was published in the AIME Transactions of 1916, Volume 55. The original Leaching Plant was described in Volume 106, published in 1933.

CHANGE TO DUAL PROCESS

Early in January, 1957, the change to Dual Process operations was made. The change-over involved the stripping of copper from all ferric sulphate leaching solutions, with a final discard of stripped solutions. At the same time, it was necessary to build up fresh iron-free acid solutions for subsequent oxide leaching. This change-over was accomplished without material difficulties and the Dual Process was "ready to roll". Within a short time operations were stepped up to a rate of 15,000 tons per day.

In this Dual Process operation, after leaching the bedded ore, the leached residue is excavated and transported to the Concentrator in 60-ton bottom dump railroad cars. As would be expected the increased rate of operations called for a complete revision of crushing, bedding, excavation, and railroad haul schedules.

LEACHING OPERATIONS

Leaching operations for the recovery of oxide copper have proceeded in a satisfactory manner. From preliminary studies made it had been estimated that iron would be dissolved from the ore and thus solutions would contain some ferrous iron, which, during electrolysis, would be converted to ferric sulphate. It was anticipated that, as a result, the leaching operation, in spite of low ferric iron concentration and short contact time, would recover about 20% of the sulphide copper. However, surprisingly enough, it was found the iron concentration of solution gradually worked up to as high as 7 grams per liter, and, of this total, as much as 4 G/L was oxidized to the ferric state. Thus, it turned out that sulphide extraction at times has run as high as 50%. In the beginning oxide extraction was not as good as had been hoped for. Lately this has improved and it is possible to make an oxide tail not to exceed 0.03% Cu.

The result of this somewhat surprising and mixed-up metallurgy is that an extraordinarily low "head" is sent to the Concentrator. However, economic studies made have demonstrated that, within reason, the more copper extracted by leaching the better will be the overall outcome.

Typical leaching data are as follows:

<u>(October, 1957)</u>	<u>Tons</u>	<u>% Cu Total</u>	<u>% Cu Oxide</u>	<u>% Cu Sulphide</u>
Ore as mined	407,426	0.857	0.465	0.392
Slimes removed	32,571	1.298	0.835	0.463
Ore bedded	374,855	0.816	0.433	0.383
Leached Residue	374,200	0.228	0.033	0.195
Extracted		0.588	0.400	0.188
% Extraction		72.059	92.379	49.086

Solution Analyses

	<u>Grams per liter</u>					
	<u>* Copper</u>		<u>Acid</u>	<u>Iron</u>	<u>Ferric Iron</u>	
	<u>In</u>	<u>Out</u>	<u>Out</u>	<u>Total</u>	<u>In</u>	<u>Out</u>
Leaching solvent and Tank House Electrolyte	25	20	17	6.5	0.7	3.7

*In or out figures refer to solution flow to and from the Tank House.

ELECTROLYTIC PRECIPITATION

Original Dual Process planning indicated that the electrolysis of leaching solutions would require only about 50% of the cell capacity of the Tank House. With this in mind, plans were made to utilize the remaining capacity for anode refining. In this way it was hoped it would be possible to turn out Inspiration's entire production as refined cathode copper. To further this purpose a new anode casting plant was built, which went into service in October of 1957.

As things have turned out, because of the higher extraction of copper by leaching, only about 35% of Tank House capacity has so far been made available for refining. The remaining capacity is still required to precipitate copper from leaching, or, as they are known, "commercial solutions". This fact, in itself, has an important bearing on, and, in fact, becomes the control of Tank House operations.

COMMERCIAL SECTION OPERATION

Commercial solutions, the analyses of which have been previously mentioned, are distributed from a center launder to the required number of electrolytic cells. In these cells use is made of 8% antimonial lead anodes. Starting sheets produced in the stripper section weigh 13 pounds. The final seven-day cathode produced weighs 125 pounds.

Because of the nature of the solutions and the use of lead anodes, cathode efficiency is low and power consumption is relatively high. The electrolytic cells are operated with a 4" electrode spacing. Mechanics of the operation have to be very carefully watched and controlled. Special additives are made use of to control "sprouting" and short circuiting in the cells. In spite of all such precautions, current density must be held down and it is seldom that a figure of 13.5 amps per square foot can be exceeded.

TYPICAL COMMERCIAL SECTION DATA (October, 1957)

Rate of solution flow	100 GPM/Cell
Average weight cathode	125 Lbs.
Average voltage between anode and cathode . . .	2.51
Average current density	13.6
Average ampere efficiency	76.30
KWH per Pound Copper Precipitated	1.386
Number cells in service	96

REFINING SECTION OPERATION

The anode refining operation has proved to be a most satisfactory one. However, since the Tank House has one single electrical circuit, so far it has not been possible to separate commercial cell operation from refining cell operation. Thus, since current density on the commercial section is more or less fixed, it is not possible to increase the current on the refining cells. This, to some extent, limits the refined cathode output.

The copper anodes are very large and weigh 1,300 pounds. They are placed in the cells with a 6" spacing. Starting sheets are the same as those used in the commercial section and come from the stripper section of the Tank House.

Electrolytic efficiency averages well over 90% and a very satisfactory cathode, weighing 220 pounds, is produced. To the maximum extent possible, all handling of anodes and cathodes is mechanical, using overhead cranes for loading anodes to, and unloading cathodes from the cells to mechanical tilting racks. Cathodes are baled into 4,000-lb. bundles and loaded to box cars by lift trucks.

Anode Slimes are carefully collected and delivered to the anode Slime Plant, where they are filtered, dried and packaged for delivery to the Raritan Copper Works for final treatment.

It is expected that as the ore changes in character and less copper is leached and more is concentrated and smelted, the refining capacity of the Tank House will be increased, as the need for commercial cell operation falls off. Ultimately it is expected that the entire output of copper from Inspiration will be shipped as refined electrolytic copper.

TYPICAL REFINING SECTION DATA (October, 1957)

Rate of flow of electrolyte	10-15	GPM/Cell
Copper content of electrolyte	45.0	G/L
Acid content of electrolyte	160.0	G/L
Average weight of cathode	225	Lbs.
Average voltage between anode and cathode . .	0.35	Volts
Average current density	19.5	
Average ampere efficiency	93.4	%
KWH-AC per Pound Copper	0.158	
Number of cells in service	30	

CONCENTRATOR OPERATIONS

The Dual Process involves treating the ore twice, in two separate plants, to obtain maximum recovery of both oxide and sulphide copper values. The oxide copper is recovered in the Leaching Plant by acid leaching and electro-deposition from the solutions. The leached ore is then sent to the Concentrator, where the sulphide copper is liberated by grinding and recovered by flotation as a concentrate, which is shipped to the Smelter.

Leached ore, previously crushed to 3/8", is excavated from the leaching tanks and hauled by railroad to the Concentrator, about one mile distant. There, the 60-ton gable-bottom cars are dumped into 15,300-ton capacity catenary ore bins. Although the leached material is 9 to 11% moisture, and contains some residual acid, as well as copper and iron salts, there has been little evidence of attack on the steel of the bins.

The presence of the high moisture, however, dictated one of the several novel design features of the Concentrator. In order to draw the wet, sticky material from the bin, twenty-one inverted pyramidal hoppers were attached to the bottom; three for each ball mill. The slope of the sides is 60° and the mouth of each hopper is 4-1/2 feet square inside the wear plates. There has been no tendency for the wet ore to bridge over the openings. Under each hopper is a 60-inch belt feeder, which draws the ore from the outlet. With some modifications of the original design, this type of feeder has been very satisfactory. A vertical gate regulates the depth of the ore ribbon on the belt feeders to give virtually a metered rate of feed to the ball mills for each gate setting.

Three of the above 60-inch feeders discharge onto one 18-inch collector belt, which, in turn, transfers to a 24-inch belt conveying the ore to the ball mill scoop box.

BALL MILLS

Grinding units consist of seven 10-1/2 x 14 ft. diaphragm ball mills driven by 1,000 horsepower synchronous motors. Each mill is in closed circuit, with a 16 by 38 foot rake classifier, which is equipped with a 42 inch by 16 foot spiral conveyor for returning the classifier sands to the scoop box.

A unitized control panel is provided for each grinding unit. Located on it, in the direction of ore flow, are push-buttons for the control of feeders, conveyor belts, classifier, spiral conveyors, ball mill and exciters. These controls are tied together with electrical interlocking to prevent spillage of ore, should any unit fail. On the same panel is a weightometer recorder and along-side is the panel of the pH recorder.

The Concentrator was designed to handle 15,000 tons per day, using six grinding units at 2,500 tons each, leaving one unit to serve as a spare. This spare unit was necessary since all mill repairs must be done in place. The steel structure of the building was not strong enough to support a crane large enough to lift a loaded ball mill and carry it to a repair bay.

In actual practice, the mills are capable of grinding more than the 2,500 tons called for in the original design plans. As shown in the table of grinding data, the tonnage rate has been increased to better than 2,600 tons per day. Therefore, in order to maintain the 15,000 tons per day total, it is only necessary to run five units continuously and start and stop a sixth section as needed to keep up with the train haulage from the Leaching Plant.

In operation, each ball mill operator has charge of three mills. The operator is responsible for putting as much tonnage as possible through the mills, consistent with maintaining the specified mesh of grind and percent solids in the classifier overflows. To aid in controlling the mesh of grind, a wet screen analysis of each classifier overflow is run every two hours. Generally, enough water is added to the classifier to make a pulp of 33% solids in the overflows, which will contain about 3% plus 48 mesh.

Adjacent to the grinding bay is the lime grinding section, which consists of two 6 foot by 48 inch ball mills in closed circuit, with two 6-inch cyclone classifiers. The lime slurry produced in the cyclone overflows is stored in three agitated storage tanks. From these tanks the slurry is circulated through the Concentrator in a looped piping system along the line of columns near the ball mill scoop boxes. The ball mill operators add a sufficient quantity of lime into each scoop box to maintain a pH of 9.5 in the classifier pools. pH is measured and recorded automatically.

Despite the acidic character of the ore, only about 5 to 6 pounds of lime per ton of ore are required to attain the pH value.

Both the collector and frother reagents for the subsequent flotation are added in the classifier overflow boxes. The frother reagent feeder is located at the overflow end and the collector feeder is located at the sand end of the classifier, with piping provided to allow the collector to be added either to

the classifier overflow or to the ball mill scoop box. This gives the necessary flexibility to handle those reagents which might require additional conditioning of being passed through the ball mill.

BALL HANDLING

Grinding balls are directly unloaded and stored in four concrete bins of 300 tons capacity each. These bins are located on a hillside below a railroad spur, about a quarter of a mile from the Concentrator. They can be loaded with balls either from railroad cars or from trucks. From the dispensing gates on each bin, the balls roll down a launder to the hopper of a recording scale, where they are weighed in specified charges and the weight is printed on a scale ticket. Each charge is then dropped into one of six separate compartments on the bed of a 12-ton truck, which is parked directly below. The truck hauls the balls to small concrete bunkers, which are located outside the mill behind the ore bins and at an elevation about ten feet above the center line of the ball mills. Each weighed charge is unloaded from the truck compartments into one of 21 of these bunkers, which allows for three days of ball storage for each mill. When the gates of the bunkers are lifted, the balls roll by gravity into the drum feeder on the front of each ball mill scoop.

Present consumption of 2-inch balls is between 1.25 and 1.35 pounds per ton of ore. The weighed charges, added each day, are, therefore, about 3,400 pounds. Ball load level in each mill is inspected about every five or six weeks and is maintained as nearly as possible to 45% of the mill volume.

TYPICAL GRINDING DATA

	<u>March through July, 1957</u>	<u>October 1957</u>
Days operated	149	27
Wet Tons of Feed	2,018,195	421,523
% Moisture	10.16	10.57
Dry Tons of Feed	1,812,232	376,957
Dry Tons per Day	12,169	13,961
Avg. Number Sections Running	4.836	5.296
Avg. Tons per Section/Day	2,516	2,636
% +48 Mesh	3.1	2.8
Ball Consumption Lbs. per Ton	1.27	1.34

ROUGHER FLOTATION

The rougher flotation cells are divided into two sections, each consisting of six rows of twelve Fagergren flotation machines. Ahead of each section of roughers is a rectangular pulp distributor, which receives the overflows of three classifiers, combines the pulp into a single stream for feed sampling, and then splits it into six portions for the individual rows of roughers.

As mentioned previously, always one and possibly two of the seven grinding units may be shut down at any particular time. Therefore, the overflow of classifier number 4 is provided with a junction box from which the pulp (when that grinding unit is in operation) may be diverted to either, or split to both, of the distributors, and thereby equalize the load on the two flotation sections.

For ease and safety in starting and stopping the rougher machines, individual push-buttons for all roughers are centralized in one control console at the end of the rougher bay. On the same platform is a smaller console with push-buttons

for cleaner cells and hydroseparators, which are located on the floor below. From this one control platform, excellent visibility is afforded to all the machines of both the rougher and cleaner floors.

CLEANER FLOTATION

All rougher concentrates from each rougher section are combined and then split to the cleaner cells. Cleaners consist of two rows of five 66" Fagergren cells for each rougher section.

Cleaners are likewise arranged in a single-stage circuit, making a final concentrate, which flows by gravity to the concentrate thickeners and a cleaner tail, which is pumped back to the distributors ahead of rougher flotation.

The final concentrate is thickened to 50 to 60% solids in a 60-foot thickener and filtered by a 6-foot diameter 8-disc filter. Filtered concentrate is conveyed to a loading station, where it falls into a railroad car for transport to the International Smelter, about one mile away.

TEST SECTION

Since the flowsheet is simple and uncomplicated, it was an easy matter, in design, to provide for a test section which can be isolated from the rest of the mill circuit. This test section consists of one grinding unit, a two-way distributor, two rows of rougher cells, a four-cell row of cleaners, and a cleaner tailings pump for re-cycling to the test section distributor.

The advantages of this test section in evaluating reagents, alkalinities, pulp densities, feed rates, etc., are obvious. It is particularly useful in reagent testing, giving a four-step procedure. In the first step, the reagent is tested on small batches in the Testing Laboratory. If it shows promise, it can then be tested on 2,600 tons per day in the mill test section. Then, if results justify, the reagent can be tried on 7,500 tons per day in an entire rougher section. The final step would be adoption for the entire mill.

ELECTRICAL CONTROL ROOM

Push-button consoles in the grinding bay and flotation bay are actually only remote control stations for the switches which control the flow of power to the various motors. Switches, circuit breakers, transformers and electrical recorders and meters are all located in a separate sub-station building within the Concentrator. This is constructed of hollow concrete blocks and is cooled in the summer by an air washer and a 90,000 cubic foot per minute fan.

From the control room, the wiring is carried in overhead cable trays to the motors and control panels in the grinding bay. Wiring to the flotation machines, hydroseparators and push-button consoles is led on cable trays through a tunnel, which runs the length of the building under the flotation bay.

The use of cable trays reduced the need for buried conduit, with its attendant difficulties, to a minimum. Further, cable trays have the advantages of neatness, flexibility, and easy circuit tracing in replacement of faulty wiring.

TYPICAL FLOTATION DATA

	<u>March through July, 1957</u>	<u>October 1957</u>
<u>Assay - Concentrator Feed</u>		
% Oxide Cu.	0.054	0.033
% Sulphide Cu.	.239	.193
% Total Cu.	.293	.226
<u>Assay - Tails</u>		
% Oxide Cu.	0.041	0.020
% Sulphide Cu.	.055	.046
% Total Cu.	.096	.066
<u>Assay - Concentrates</u>		
% Copper	29.723	22.043
% Moisture	14.75	14.04
% Insoluble	12.70	9.14
% Iron	17.44	32.27
<u>Concentrator Recoveries</u>		
Tons Concentrates	12,067	2,757
Lbs. Total Copper	7,173,431	1,215,331
Ratio of Concentration	150.264	136.727
% Cu. Recovered	67.433	71.244
Lbs. Cu. per Ton Feed	3.956	3.224

RECOVERY OF SILVER AND MOLYBDENUM

Another salient feature of the Concentrator operations is the recovery of two valuable metals, which were formerly left untouched in the Leaching Plant tailings, namely, silver and molybdenum. While silver is not present in the ore in large quantities, its recovery in the copper concentrates in the amount of one to three ounces adds at least a small extra margin of profit for the Concentrator operations. Gold values are negligible.

While it was known that molybdenum occurred to some extent in the ore body, the extent of its occurrence was indefinite. However, it was quickly noted that the copper concentrate produced had a substantial and, more or less, consistent molybdenite content. Early in the year a program of test work for the recovery of this valuable mineral was inaugurated. As a result of this work a molybdenite recovery plant has been designed and is now under construction.

TAILINGS DISPOSAL

At Inspiration, the maximum recovery of mill water is of vital importance. To further this purpose, it was necessary to install two 275-ft. diameter tailing thickeners to provide for adequate settling. However, because of lack of space, below the mill site, it was necessary to locate these thickeners on a site,

which is 105 feet above the mill. This involved pumping to the thickeners. To decrease the burden of pumping, two 32-ft. Hydroseparators were installed in the tailings circuit.

Rougher flotation tails flow through the Hydroseparators. Hydroseparator overflow running 25% solids, with about 3 to 5% plus 100 mesh material, flows by gravity to a concrete sump. From the sump the thin pulp is pumped to the thickeners on the hillside above. Pump installation consists of three 12" centrifugal pumps, two of which are constant speed, the third being driven through a variable speed coupling, which is automatically controlled. In normal operation, one fixed speed pump and the variable speed pump adequately handle the pumping load.

Clarified overflow water from the two 275-foot traction thickeners flows by gravity to a 1,000,000-gallon reservoir, which serves as the head tank for the Concentrator. Make-up water is added in this reservoir and blended with all reclaimed waters before flowing to the grinding bay through a 20-inch transite line.

Thickeners are constructed partly on solid ground and partly on tailings, but the center piers of both are on solid ground. To prevent leakage and water-logging of the old tailings, the bottoms are of reinforced gunite.

The thickened underflow pulp at 48 to 50% solids is carried back down the hill to the Hydroseparator floor through an 18-inch transite pipe. Inside the mill building, the Hydroseparator sands at 58 to 60% solids are recombined with the thickened slimes to give a final tailings pulp of 52 to 54% solids, which flows to the tailings dams through an 18-inch transite line.

The present main tailings dam has an area of about 105 acres and had been developed by previous operations. It was made ready for use by building up an initial level berm about ten feet high on three sides. The fourth side lies against an older and higher dam. The pulp from the Concentrator crosses this higher dam and can be diverted to fall through concrete drop-boxes into either leg of a horseshoe-shaped loop of 18-inch transite pipe located on top of the initial berm.

This tailings disposal system is a modification of the Morenci system. The pulp is discharged into the pond through 3-inch plug valves, which are spaced along the header pipe every 26 feet. A short length of rubber hose and a 20-foot length of 3-inch light gauge steel pipe carry the pulp into the pond.

When the tailings have filled to the top of the initial berm, a new berm 5 feet high will be erected along the inside of the header pipe and extra lengths of steel pipe will carry the tailings up and over the new berm. It is expected that by extending these riser pipes and building new berms, a total lift of 20 to 25 feet may be made before it will become necessary to raise the main 18-inch header to a new elevation.

In addition to the main dam, a new dam with a potential area of about 150 acres is being developed adjacent to it on the north. Here the system is the same, except that the loop of header pipe is 12-inch transite instead of 18-inch. The tailings stream is split to feed both ends of the loop simultaneously.

Water is reclaimed from the tailings dams by means of decant chimneys and

buried decant lines, which carry the water to a settling basin below the dams. From there the water flows by gravity to one of the main pumping stations, where it is combined with other industrial waters and returned to the main plant reservoir.

As shown in the table of water data, the recovery at the tailings dam had averaged better than 25% of the water in the tailings pulp until October, when considerable tonnage was diverted into the new tailings dam. Most of the water in this pulp was lost to seepage.

TYPICAL WATER DATA

	March through July, 1957		October 1957	
	Gals./Ton Ore	% of Total	Gals./Ton Ore	% of Total
Total Make-up Water	165	70.7	179	86.4
Tailings Dam Return Water	68	29.3	28	13.6
Total Water Used	233	100.0	207	100.0

DISCUSSION OF METALLURGY

The design of the Concentrator has several novel and unique features, but certainly the most unusual thing about the operation is the metallurgy itself. As described in the discussion of Leaching Plant metallurgy, up to the present time the extraction of sulphide copper in the Leaching Plant has been higher than had been anticipated. At times this higher extraction does not leave much copper in the leached ore for the Concentrator to work on. Such a situation may vary within wide limits, depending on the amount of oxide and of chalcopryrite contained in the ore.

The mill ratio of concentration is fairly consistent and has remained between 130 and 145 to 1. Obviously, then, the grade of final concentrate made varies from day to day with the assay of sulphide in the feed.

The reasons why the ratio of concentration seems to have an upper limit are not fully known, but it is thought that they would include:

(1) The ready floatability of both the chalcocite and pyrite at the present pH of 9.5 in the flotation pulps. Efforts to depress the pyrite at higher pH values have not as yet been successful, as in so doing the tailings loss is increased. Rougher cells make nearly the final grade of concentrate and leave little work for the cleaner cells to do. The concentration ratio of the cleaners is only about 1.2 to 1.5 to 1.

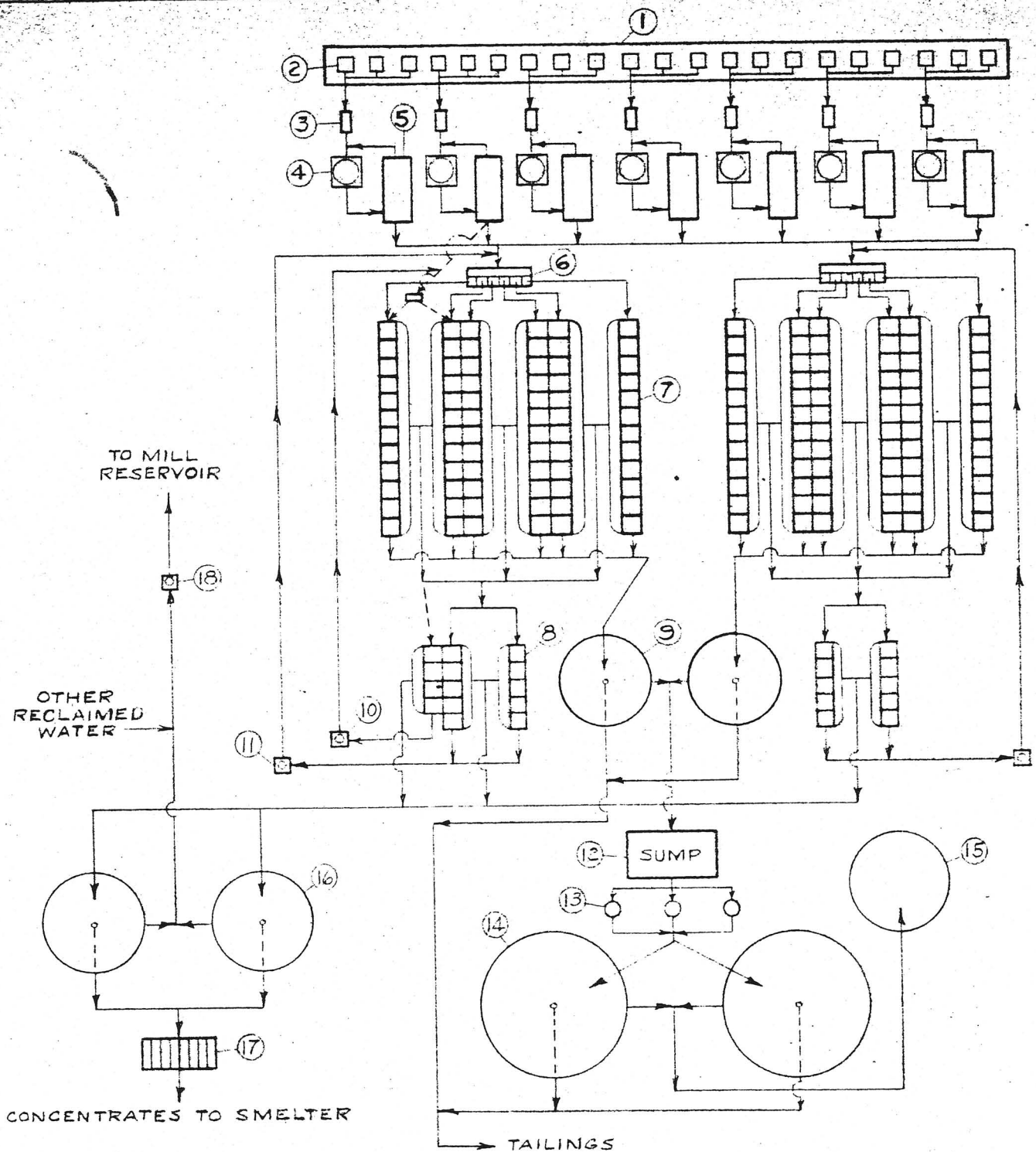
(2) The absence of a regrind mill in the cleaner circuit. In the design discussions, the subject of a regrind mill was given full consideration, but was ruled out on the basis of test work, which had shown that a marketable concentrate could be made with only a single-stage roughing and single-stage cleaning circuit. It is still not felt that a regrind mill would pay for itself in further upgrading the concentrates. Microscopic examination of

various mill products has revealed little interlocking of the copper with iron or gangue minerals.

(3) The lack of selectivity of the present collector reagent. During the design and construction period, exhaustive laboratory flotation tests were conducted on most of the collectors and frothers now in commercial use. All reagents were judged solely on their ability to minimize the loss of copper in the tailings. On this basis, Xanthate for the collector and Pine Oil for the frother were chosen as the start-up reagents. The problem of final upgrading of concentrates was left for actual operations. In fact, until the low heads of recent months, there was little or no problem in maintaining a satisfactory grade of concentrates.

Now that operational difficulties of starting up the new mill are fairly well straightened out, the test section of the circuit will be used more continuously in an effort to learn more about the present flow sheet and just what modifications and changes are necessary to improve it. Early in this test work, will be a reappraisal of other collector reagents to try to find one of equal promoting power, but greater selectivity than the Xanthate being used.

FLOW SHEET OF THE IN PIRATION CONSOLIDATED CO. ER -O. CONCENTRATOR



1. 15,300 ton capacity, steel catenary fine ore bin.
2. 21 Belt feeders, 60 inches wide.
3. Transweigh belt scales.
4. 7 Allis Chalmers 10-1/2 x 14 foot ball mills; 6 in service, 1 standby.
5. 7 Dorr HX, 16 x 38 foot classifiers.
6. Galigher sampler and pulp distributors; 3 in the circuit, 1 for test section.
7. 12 banks of 12-cell, Fagergren 66 inch flotation machines, roughers.
8. 4 banks of 5-cell and 1 bank of 4-cell Fagergren 66" flotation machines, cleaners
9. 2 Dorr, 32 foot diameter hydroseparators.
10. 1 Hazleton, 3 inch, twin-volute pump; test cleaner tails.
11. 6 Hazleton, 5 inch, twin-volute pumps; cleaner tails; 2 in service, 4 standby.
12. Concrete sump, 36 x 25 x 16 feet deep.
13. 3 Hazleton, 12 inch, centrifugal pumps; two in service, one standby.
14. 2 Dorr, 275 foot traction thickeners.
15. 1,500,000 gallon capacity mill reservoir; mill head tank.
16. 2 Dorr, 60 foot diameter, concentrate thickeners.
17. Rimco, 8 disc, 6 foot filter.
18. 1 Hazleton, 8 inch, twin-volute pump.

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PRESENTS

THE 1989 SPRING HYDROMETALLURGICAL SESSION

ARIZONA SECTION of A.I.M.E.

MAY 20, 1989

CYPRUS MIAMI MINING CORPORATION

presents

"HYDROMETALLURGY AT CYPRUS"

For Presentation at the

Spring Meeting

Arizona Section SME-AIME

Hydrometallurgy Division

May 20, 1989

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CYPRUS

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REPORT TO
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Three Months
Ended March 31, 1984

INSPIRATION
RESOURCES
CORPORATION

250 Park Avenue
New York, NY 10177



Inspiration Resources Corporation

Consolidated Statement of Retained Earnings
(Unaudited)

	Three Months Ended March 31,	
	1984	1983
	(in thousands)	
RETAINED EARNINGS AT BEGINNING OF YEAR	\$ 93,627	\$ 183,031
Net loss	(15,235)	(16,248)
RETAINED EARNINGS AT END OF PERIOD	<u>\$ 78,392</u>	<u>\$ 166,783</u>

Consolidated Statement of Changes in Financial Position
(Unaudited)

	(in thousands)	
USES OF CASH		
Operations	\$ (26,416)	\$ (41,460)
Capital expenditures	(14,099)	(13,879)
Other, net	(1,048)	(823)
Total	<u>(41,563)</u>	<u>(56,162)</u>
FINANCING ACTIVITIES		
Proceeds from long-term borrowings	111,035	63,674
Reduction of long-term debt	(112,017)	(10,321)
Increase (decrease) in debt due within one year	35,316	(7,775)
Cash realized from (used for) investments	(373)	2,385
Net Proceeds	<u>33,961</u>	<u>47,963</u>
DECREASE IN CASH AND SHORT-TERM INVESTMENTS	<u>\$ (7,602)</u>	<u>\$ (8,199)</u>

Notes to the Consolidated Financial Statements
(Unaudited)

1. In the opinion of management, the accompanying unaudited consolidated financial statements and notes thereto contain all adjustments necessary to summarize fairly the financial position of Inspiration Resources Corporation (the Corporation) for the periods presented.

Certain prior period amounts have been reclassified to conform with current period presentation. In addition, prior period loss per share has been restated to reflect the 2% stock dividend paid December 21, 1983.
2. Loss per share data is based on the weighted average number of Common Shares which would become outstanding after allowing for the full exchange of Hudson Bay Mining and Smelting Co., Limited Special Shares and conversion of Class A Shares of the Corporation.
3. On April 3, 1984, the Corporation and Danville Resources Inc. (Danville) each transferred to Madison Fund, Inc. (Madison) certain oil and gas interests in exchange for which 53% of the common stock of Madison was issued to Danville and 62% (58% on a fully-diluted basis) of the common stock of Danville was issued to the Corporation (subject, in each case, to certain post-closing adjustments) (the Danville/Madison Acquisition). Madison will submit the Danville/Madison Acquisition for ratification by its stockholders at a meeting scheduled to be held June 4, 1984. Should the Danville/Madison Acquisition fail to be ratified, the Danville/Madison Acquisition will be rescinded.

Report to Stockholders

For the three months ended March 31, 1984, the Corporation incurred a net loss of \$15,235,000, or \$0.50 per share, on revenues of \$187,863,000, compared to a net loss of \$16,248,000, or \$1.00 per share, on revenues of \$144,311,000 in the comparable quarter a year ago.

Although the results for the first quarter of 1984 show some improvement over those for the first quarter of 1983, the improvement resulted mainly from a one-time payment received in settlement of a copper concentrate smelting contract, offset by reduced income tax recoveries. Except for petroleum, all segments showed increased sales volumes in the first quarter as compared to the first quarter of 1983, but extremely disappointing copper prices continued to affect the Corporation adversely.

The New York Commodity Exchange (Comex) copper price averaged only 64.8 cents per pound in the first quarter, versus 73.9 cents per pound in the first quarter of 1983. Zinc prices, however, showed some firming, and the average London Metal Exchange cash price was 45.3 cents per pound, up 45.7% from an average of 31.3 cents per pound in the first quarter of 1983.

As previously reported, the Corporation has exchanged its petroleum interests for a 58% interest (on a fully-diluted basis) in Danville Resources, Inc., which has in turn used these and other assets to acquire a 53% interest in Madison Fund, Inc. (Madison). This transaction, which is subject to ratification by Madison shareholders, closed on April 3, 1984, and thus the financial results for the first quarter of 1984 do not reflect the transaction.

The table below provides the operating income or loss by our various businesses.

	Three Months Ended March 31	
	1984	1983
	(in thousands, except loss per share)	
Revenues	\$ 1,889	\$ (3,739)
Petroleum	5,235	6,137
Agricultural Chemicals	(5,908)	(5,671)
Coal	(1,014)	(2,350)
Operating Income (Loss)	202	(5,623)
Interest, Taxes and Unallocated Expenses	(15,437)	(10,625)
	<u>\$(15,235)</u>	<u>\$(16,248)</u>
Weighted Average Shares Outstanding	<u>30,249</u>	<u>16,272</u>
Loss per Share	<u>\$ (0.50)</u>	<u>\$ (1.00)</u>

In the first quarter of 1984, Hudson Bay Mining in Canada reported a small operating profit as compared to a loss of approximately \$2.5 million in the same period last year.

This improvement resulted mainly from higher zinc prices and increased interest income as a result of the invested proceeds of the 1983 equity financing. The net copper price received in the first quarter fell below the 1983 level; however, this adverse effect was counteracted by increased zinc sales from purchased concentrate in order to maximize the benefit of the improved zinc selling prices. The Flin Flon mining and metallurgical complex operated throughout the first quarter, although tonnage mined lagged 10% behind that mined in the first quarter of 1983, resulting in lower production of domestic copper and zinc. Cost containment programs continued to keep unit production costs below those incurred in the comparable period in 1983.

First-quarter operations at Inspiration Copper in Arizona were favorably affected by a lump-sum payment received from a toll-smelting customer in settlement of its obligations under a tolling contract that would otherwise have expired at the end of August, 1984. The gross price received for copper sold was significantly below that received in the comparable period in 1983, but the negative impact was largely offset by reductions in unit costs resulting from continuing cost reductions.

Amoco Minerals Company and Inspiration Copper terminated negotiations for Amoco to acquire an interest in Inspiration Copper's smelter in accordance with an agreement in principle signed in December, 1983, because the parties were unable to reach agreement on certain key issues. The smelter resumed production on January 9 and, during the quarter, was switched to a continuous mode of operation with two hot converters from an intermittent operating basis with four hot converters, with very satisfactory results in terms of productivity and sulfur dioxide containment. Sufficient copper concentrate is now available to sustain the two-converter smelter operation until well into the fourth quarter of 1984.

Inspiration Mines, which has a mandate to increase the Corporation's interest in precious metals, and also manages other small mines, brought the first of its recently-acquired Tennessee Zinc properties into production during the first quarter of 1984, showing propitious timing in view of the current strength of zinc prices. Zinc concentrate sales from this new source commenced in the second quarter. The Black Pine mine in Montana produced 355,661 ounces of silver in the first quarter, as compared to 277,739 ounces produced in the first quarter of 1983.

The petroleum operations of Trend International and Trend Exploration continue to be profitable, albeit at a lower level than in 1983. In Indonesia, average daily production and liftings declined by 21.9% and 16.3%, respectively, as compared to the first quarter of 1983, and this production decline, combined with some price weakening, resulted in a fall of 25.8% in total production income as compared to the first quarter of 1983. The negative impact was partly offset, however, by higher crude oil production in the United States, which yielded a 6.1% im-

provement in U.S. production income. The Indonesian production reduction was due to normal production decline and delayed liftings in Salawati in the first quarter of 1984, so that although the Trend group's operating earnings were 14.7% below those of the comparable period in 1983, much of the shortfall is expected to be recouped during the remainder of the year. This is the last quarterly report in which the discussion of the Corporation's petroleum operations will be confined to the activities of Trend International and Trend Exploration, which became part of Madison from the beginning of the second quarter.

Iowa-based Terra Chemicals is still expecting a recovery year in 1984, following repeal of the Government's "Payment-In-Kind" program for all subject grains but wheat. Increased demand in the first quarter was very evident with Terra's sales revenues exceeding sales revenues in the first quarter of 1983 by 44% despite inclement early spring weather. Sales gains were achieved in both nitrogen-based "wholesale" products manufactured by Terra, where margins also showed some improvement, and in "retail" fertilizer, crop protection chemicals and seed products, which Terra buys and resells. Margins in the retail business, however, were eroded by competitive price discounting. Terra's operating earnings in the first quarter, therefore, were limited to an improvement of approximately \$2.1 million over those of the first quarter of 1983, before taking into account \$2.3 million in nonrecurring, favorable expense adjustments in 1983.

First-quarter coal sales by Inspiration Coal, at 571,000 tons, almost tripled those of the first quarter of 1983, and although sales prices were substantially below 1983 levels, reductions in unit operating costs enabled Inspiration Coal to halve its loss in the first quarter from that suffered in the comparable period in 1983. Coal was produced at six of the seven operations of Inspiration Coal (the exception being Bailey, which remains shut down) and 40% of total

production came from the Harman operation. As part of its intensive program to reduce unit operating costs, Inspiration Coal was successful in negotiating a reduction in contractor mining costs at Wheelwright. Inspiration Coal is projecting full-year 1984 sales in excess of 2 million tons, or double the 1983 level, and although the company should materially reduce its full-year loss, currently-anticipated sales prices are still insufficient to return it to profitability in 1984.

The increase in "interest, taxes and unallocated costs" reflects lower U.S. and Canadian tax recoveries in the first quarter of 1984 and the inclusion in 1983 of a \$2.5 million Indonesian tax refund. Interest expense in the quarter was less than that incurred in the same period last year, due to the Corporation's improved debt position following its equity issues in August, 1983.

The first quarter of 1984 has not been a good one for your Corporation. Whereas all of the mining operations deserve considerable praise for the cost reductions that they have effected, prices for their products remain the negative and uncontrollable factor. As stated above, the year could still prove to be a good one for our agricultural division. With respect to petroleum, in entering into the Danville/Madison transaction, your management is confident that it has taken a major step towards restoring the Corporation to financial strength and profitability.



Reuben F. Richards
Chairman and Chief Executive Officer

May 14, 1984

Inspiration Resources Corporation

Consolidated Statement of Operations

(Unaudited)

**Three Months
Ended March 31,**

1984 1983

(in thousands, except loss per share amounts)

REVENUES:		
Net sales	\$ 181,471	\$ 139,495
Interest and other income	6,392	4,816
	<u>187,863</u>	<u>144,311</u>
 COSTS AND EXPENSES:		
Cost of sales	163,024	124,349
Depreciation, depletion and amortization	16,648	17,957
Exploration expense	1,909	1,145
General and administrative expense	8,853	7,537
Interest expense	11,115	12,798
	<u>201,549</u>	<u>163,786</u>
 Loss before taxes	(13,686)	(19,475)
Benefit of (provision for) income taxes, mining taxes and royalties	(1,549)	3,227
	<u>\$ (15,235)</u>	<u>\$ (16,248)</u>
NET LOSS		
	<u>30,249</u>	<u>16,272</u>
Weighted average number of shares		
	<u>\$ (0.50)</u>	<u>\$ (1.00)</u>
Loss per share		

Inspiration Resources Corporation

Consolidated Statement of Financial Position

(1984 unaudited)

	March 31, 1984	Dec. 31, 1983
	(in thousands)	
CURRENT ASSETS:		
Cash and short-term investments	\$ 66,449	\$ 74,051
Accounts receivable, net	110,740	107,585
Inventories	184,077	130,352
Income taxes recoverable	6,006	5,496
Total Current Assets	367,272	317,484
OTHER ASSETS:		
Investments	110,278	110,406
Property, plant and equipment, net	642,633	650,592
Other assets	34,520	32,649
Total Assets	<u>\$1,154,703</u>	<u>\$1,111,131</u>
CURRENT LIABILITIES:		
Accounts payable	\$ 98,475	\$ 83,568
Debt due within one year	90,357	55,041
Accrued liabilities	56,215	40,695
Income and other taxes payable	5,155	5,039
Total Current Liabilities	250,202	184,343
OTHER LIABILITIES:		
Long-term debt	349,919	350,901
Deferred income taxes	38,913	41,352
Other liabilities	16,914	16,524
Total Liabilities	655,948	593,120
STOCKHOLDERS' EQUITY:		
Capital stock	74,016	74,495
Paid-in surplus	368,132	367,654
Currency translation adjustment	(21,785)	(17,765)
Retained earnings	78,392	93,627
Total Stockholders' Equity	498,755	518,011
Total Liabilities and Stockholders' Equity	<u>\$1,154,703</u>	<u>\$1,111,131</u>

Inspiration Resources Corporation

Consolidated Statement of Retained Earnings

(Unaudited)

	Three Months Ended March 31,	
	1984	1983
	(in thousands)	
RETAINED EARNINGS AT BEGINNING OF YEAR	\$ 93,627	\$ 183,031
Net loss	(15,235)	(16,248)
RETAINED EARNINGS AT END OF PERIOD	<u>\$ 78,392</u>	<u>\$ 166,783</u>

Consolidated Statement of Changes in Financial Position

(Unaudited)

	(in thousands)	
USES OF CASH		
Operations	\$ (26,416)	\$ (41,460)
Capital expenditures	(14,099)	(13,879)
Other, net	(1,048)	(823)
Total	<u>(41,563)</u>	<u>(56,162)</u>
FINANCING ACTIVITIES		
Proceeds from long-term borrowings	111,035	63,674
Reduction of long-term debt	(112,017)	(10,321)
Increase (decrease) in debt due within one year	35,316	(7,775)
Cash realized from (used for) investments	(373)	2,385
Net Proceeds	<u>33,961</u>	<u>47,963</u>
DECREASE IN CASH AND SHORT-TERM INVESTMENTS	<u>\$ (7,602)</u>	<u>\$ (8,199)</u>

Notes to the Consolidated Financial Statements

(Unaudited)

1. In the opinion of management, the accompanying unaudited consolidated financial statements and notes thereto contain all adjustments necessary to summarize fairly the financial position of Inspiration Resources Corporation (the Corporation) for the periods presented.

Certain prior period amounts have been reclassified to conform with current period presentation. In addition, prior period loss per share has been restated to reflect the 2% stock dividend paid December 21, 1983.
2. Loss per share data is based on the weighted average number of Common Shares which would become outstanding after allowing for the full exchange of Hudson Bay Mining and Smelting Co., Limited Special Shares and conversion of Class A Shares of the Corporation.
3. On April 3, 1984, the Corporation and Danville Resources Inc. (Danville) each transferred to Madison Fund, Inc. (Madison) certain oil and gas interests in exchange for which 53% of the common stock of Madison was issued to Danville and 62% (58% on a fully-diluted basis) of the common stock of Danville was issued to the Corporation (subject, in each case, to certain post-closing adjustments) (the Danville/Madison Acquisition). Madison will submit the Danville/Madison Acquisition for ratification by its stockholders at a meeting scheduled to be held June 4, 1984. Should the Danville/Madison Acquisition fail to be ratified, the Danville/Madison Acquisition will be rescinded.

To the Shareholders:

Our earnings continued to improve during the first quarter, continuing the positive trend that began during the second quarter of 1978. Net earnings totalled \$3.3 million, equal to 33¢ per share, compared with a loss of \$1,640,000, or 16¢ per share, for the first quarter of 1978. Net sales totalled \$121,488,000, compared with \$85,883,000 a year ago.

The improved results reflect profits from the metals, petroleum and industrial products sectors and a loss in the fertilizer sector. These results are after taking into account a currency translation loss of \$1.3 million applicable to the working capital of foreign subsidiaries, resulting from the appreciation of the Canadian dollar against the U.S. dollar, compared with a gain of \$1,265,000 for the comparable quarter of 1978.

As a result of the substantially better prices for base metals, gold and silver, the Canadian Metals Division continued to show a profit and Inspiration Consolidated Copper, of the U.S., moved into a profit position. The Canadian Metals Division made the largest contribution to profits and sharply reduced its stockpile of refined zinc. Inspiration Copper, despite heavy rains that curtailed production, increased its deliveries of copper at higher prices. Inspiration's Christmas Mine, an open-pit operation which was shut down during the strike in 1977, resumed operations late in April but it will take about 10 weeks to reach full production.

The new mill and concentrator at Stall Lake Mine, near Snow Lake in northern Manitoba, began operations on Thursday, April 26. Labor disputes in the construction trades in Manitoba prevented the general contractor from meeting his original work deadlines and certain alterations to the original design further delayed construction and also contributed to the higher cost, which now stands at \$33,000,000, some \$7,000,000 higher than originally estimated. Nevertheless, the Company will have an excellent concentrator which will realize considerable cost savings when it is fully operational. The savings will result from the lower cost of railing concentrates rather than substantially

larger quantities of raw ore to Flin Flon for treatment, as well as from the elimination of the cost of hauling backfill material from Flin Flon for use in the mines in the Snow Lake area.

On the exploration front, your Company and Inspiration Development Company, of the U.S., are actively pursuing new opportunities in Canada and the U.S. Agreement in principle has been reached on the following prospects: prospective tungsten properties in Idaho, California and in the Yukon; a prospective silver property in Colorado; and prospective base-metal properties in Manitoba and the Yukon. Furthermore, a reappraisal of our Tom Claims, a lead-zinc-silver deposit in the Yukon, is underway to determine the additional exploration requirements on this property.

As you are aware, the Government of Saskatchewan has informed the Company that it will not renew our licence to operate our hydro-electric plant at Island Falls on the Churchill River in Saskatchewan when it expires after 50 years on April 1, 1981. The Saskatchewan Power Corporation has been designated as the agency to represent the Government of Saskatchewan in discussions to determine compensation according to a formula in the Water Power Act. Preliminary discussions with the Saskatchewan Power Corporation have been held and separate evaluations have been completed. Detailed discussions are scheduled to begin in the near future.

The Company's two public petroleum subsidiaries Canadian Merrill Ltd. and Francana Oil & Gas Ltd., performed satisfactorily, despite an oversupply of natural gas in Western Canada. In Indonesia, Francana's subsidiary Trend International Limited benefited from higher oil prices which offset lower production due to natural reservoir decline.

Francana and Canadian Merrill have announced that they are studying the feasibility of a merger and evaluations by each company and by independent consultants will be submitted to the respective Boards of Directors. An announcement

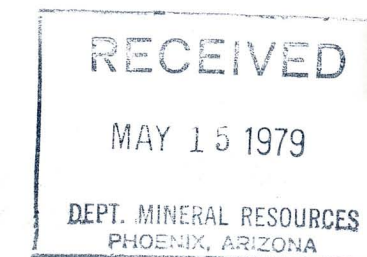
concerning the proposed merger will be likely made in midsummer.

Terra Chemicals International, Inc., of the U.S., incurred a substantial loss for the first quarter, the result of low fertilizer prices, a delayed spring planting season due to unfavorable weather, and manufacturing costs that were higher than planned. It should be noted that the first quarter is normally a loss period in the fertilizer industry in the U.S.

In view of the improved financial results for the first quarter and the generally better outlook for your Company for the remainder of the year, the Board of Directors on April 27 declared a dividend of 20¢ per share payable in Canadian funds on June 1 to shareholders of record May 15. We are confident that, having resumed payment of dividends, we will be able to maintain them, even under less buoyant conditions.

April 27, 1979

E. P. GUSH
President



Hudson Bay Mining and Smelting Co., Limited



Interim Report
To Shareholders

3 Months
Ended March 31, 1979

Hudson Bay Mining and Smelting Co., Limited
Consolidated Statement of Earnings

	For the three months ended March 31	
	1979	1978
Net sales.....	\$121,488,000	\$ 85,883,000
Interest and other income (Note 1).....	4,933,000	4,667,000
	<u>126,421,000</u>	<u>90,550,000</u>
Cost of sales.....	96,063,000	68,557,000
Depreciation, depletion and amortization.....	9,864,000	8,361,000
General administrative.....	3,897,000	3,468,000
Interest.....	4,074,000	3,360,000
	<u>113,898,000</u>	<u>83,746,000</u>
Earnings before taxes.....	12,523,000	6,804,000
Taxes and royalties.....	7,831,000	5,799,000
Earnings from operations.....	<u>4,692,000</u>	<u>1,005,000</u>
Other items:		
Minority interest in earnings of subsidiaries.....	(1,471,000)	(2,393,000)
Share of earnings (losses) of associated companies.....	83,000	(197,000)
Provision for future write-offs of investments.....	—	(55,000)
	<u>(1,388,000)</u>	<u>(2,645,000)</u>
Earnings (loss) for the period.....	<u>\$ 3,304,000</u>	<u>\$ (1,640,000)</u>
Shares outstanding.....	10,101,739	10,101,739
Earnings (loss) per share.....	<u>\$ 0.33</u>	<u>\$ (0.16)</u>

Consolidated Statement of Financial Position

	As at March 31	
	1979	1978
Current assets	\$309,389,000	\$322,339,000
Current liabilities.....	142,526,000	103,060,000
Working capital.....	166,863,000	219,279,000
Investments.....	74,454,000	44,779,000
Property, plant and equipment.....	315,012,000	265,879,000
Other assets.....	19,129,000	21,167,000
Capital employed.....	<u>575,458,000</u>	<u>551,104,000</u>
Deduct:		
Long-term debt.....	125,031,000	125,804,000
Deferred income taxes.....	94,419,000	84,188,000
Minority interest in subsidiaries.....	93,866,000	87,997,000
	<u>313,316,000</u>	<u>297,989,000</u>
Shareholders' investment.....	<u>\$262,142,000</u>	<u>\$253,115,000</u>
Investment represented by:		
Share capital.....	\$ 71,247,000	\$ 71,247,000
Retained earnings.....	190,895,000	181,868,000
Total shareholders' investment.....	<u>\$262,142,000</u>	<u>\$253,115,000</u>

Hudson Bay Mining and Smelting Co., Limited
Consolidated Statement of Changes in Financial Position

	For the three months ended March 31	
	1979	1978
Working capital provided:		
Earnings from operations.....	\$ 18,997,000	\$ 9,709,000
Proceeds from long-term debt.....	340,000	17,557,000
Decrease in other assets.....	529,000	—
	<u>19,866,000</u>	<u>27,266,000</u>
Working capital applied:		
Dividends.....	1,010,000	—
Dividends paid by subsidiaries to minority interests.....	1,994,000	1,422,000
Other investments.....	4,580,000	2,104,000
Property, plant and equipment.....	15,631,000	15,278,000
Reduction of long-term debt.....	163,000	2,747,000
Increase in other assets.....	—	1,974,000
	<u>23,378,000</u>	<u>23,525,000</u>
Increase (decrease) in working capital.....	(3,512,000)	3,741,000
Working capital at beginning of period.....	170,375,000	215,538,000
Working capital at end of period.....	<u>\$166,863,000</u>	<u>\$219,279,000</u>

NOTES:

- (1) Interest and other income for the three months includes interest income of \$2,697,000 and currency translation gains (losses) of \$(1,300,000) applicable to foreign subsidiaries' working capital (1978 – \$2,755,000 and \$1,265,000).
- (2) Earnings in the first quarter of 1979 include the 50.0% equity interest in Inspiration Consolidated Copper Company, compared with 23.4% in 1978, and 100% of Whitehorse Copper Ltd., compared with 41.2% in 1978.
- (3) The financial statements are stated in Canadian currency and are subject to year-end audit.

The Shareholders:

Net earnings for the second quarter were \$14,527,000 (\$1.44 per share), compared with \$4,356,000 (43¢ per share) for the second quarter of 1978. Net sales totalled \$231,670,000, compared with \$173,923,000.

The substantially improved performance for the second quarter results from the continued high level of earnings in the metals sector, consistently satisfactory earnings from the petroleum and industrial sectors, and the seasonally high contribution from the fertilizer sector.

The results for the first six months are as follows (1978 results in brackets): net earnings - \$17,831,000, or \$1.77 per share (\$2,716,000, or 27¢ per share); net sales - \$353,158,000 (\$259,806,000).

The greatly improved results for the first half of 1979 reflect the continued high levels of metal prices and positive contributions to earnings from all sectors of the Company's business.

In the U.S., Inspiration Consolidated Copper's Christmas Mine, which resumed operations in April, began stripping operations in mid-June and the first ore was mined on July 1. Construction of the \$14-million solvent extraction plant is on schedule and within budget; completion is expected by October 30. Although the new facility will not increase production of copper, it will provide significant cost savings compared with the current process of copper recovery from dump leach solutions by cementation, smelting and refining. The smelter was shut down during the last three weeks of July for annual maintenance.

Although Terra Chemicals International, Inc. made a positive contribution to earnings in the second quarter, the margins earned on sales are still too low.

The Canadian Metals Division reduced its stockpile of refined zinc to normal levels during the first half of 1979. Output from the metallurgical plants at Flin Flon was down during the second quarter due to lower-than-planned production at the Snow Lake-area mines and the short strike at Sherritt

Gordon Mines Ltd. which interrupted shipments of concentrates. The full effect of this disruption will be reflected in the results for the third quarter.

The Snow Lake concentrator was officially opened on June 28, 1979, and is operating satisfactorily. There have been no new developments in the compensation negotiations with Saskatchewan Power Corporation in connection with the impending sale of the Island Falls power plant to the Government of Saskatchewan.

Tantalum Mining Corporation of Canada Limited, in which the Company holds a 37.5% interest, had a very successful first half largely because of the sharp increase in world tantalum prices, and the operation continued to improve its production performance. However, the full benefit of the higher prices will not be realized until the third quarter. Additional exploration at the mine and a reassessment have increased the reserves of tantalum and they now are sufficient to last until 1986 at the current mining rate.

Although production of ore at Whitehorse Copper Mines Ltd. was satisfactory, the contribution to the Company's net earnings was less than expected because ore grades were lower than anticipated.

The feasibility of merging Francana Oil & Gas Ltd. and Canadian Merrill Ltd. is still being studied and an announcement will be made in the near future.

The Board of Directors declared a dividend of 20¢ per share on July 26, 1979, payable in Canadian funds September 1 to shareholders of record August 15.

July 26, 1979

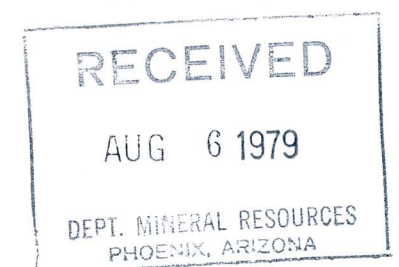
E. P. GUSH
President

Hudson Bay Mining and Smelting Co., Limited



Interim Report
To Shareholders

6 Months
Ended June 30, 1979



Hudson Bay Mining and Smelting Co., Limited

Consolidated Statement of Earnings

	For the quarter ended June 30		For the six months ended June 30	
	1979	1978	1979	1978
Net sales.....	\$231,670,000	\$173,923,000	\$353,158,000	\$259,806,000
Interest and other income (Note 1).....	7,859,000	3,958,000	12,792,000	8,625,000
	<u>239,529,000</u>	<u>177,881,000</u>	<u>365,950,000</u>	<u>268,431,000</u>
Cost of sales.....	187,744,000	143,594,000	283,807,000	212,151,000
Depreciation, depletion and amortization.....	9,910,000	8,204,000	19,774,000	16,565,000
General administrative.....	4,246,000	3,929,000	8,143,000	7,397,000
Interest.....	4,704,000	3,832,000	8,778,000	7,192,000
	<u>206,604,000</u>	<u>159,559,000</u>	<u>320,502,000</u>	<u>243,305,000</u>
Earnings before taxes.....	32,925,000	18,322,000	45,448,000	25,126,000
Taxes and royalties.....	14,197,000	7,283,000	22,028,000	13,082,000
Earnings from operations.....	<u>18,728,000</u>	<u>11,039,000</u>	<u>23,420,000</u>	<u>12,044,000</u>
Other items:				
Minority interest in earnings of subsidiaries...	(6,887,000)	(6,568,000)	(8,358,000)	(8,961,000)
Share of earnings (losses) of associated companies.....	2,708,000	(39,000)	2,791,000	(236,000)
Provision for future write-offs of investments..	(22,000)	(76,000)	(22,000)	(131,000)
	<u>4,201,000</u>	<u>(6,683,000)</u>	<u>(5,589,000)</u>	<u>(9,328,000)</u>
Earnings for the period.....	<u>\$ 14,527,000</u>	<u>\$ 4,356,000</u>	<u>\$ 17,831,000</u>	<u>\$ 2,716,000</u>
Shares outstanding.....	10,101,739	10,101,739	10,101,739	10,101,739
Earnings per share.....	<u>\$ 1.44</u>	<u>\$ 0.43</u>	<u>\$ 1.77</u>	<u>\$ 0.27</u>

Consolidated Statement of Financial Position

	As at June 30	
	1979	1978
Current assets.....	\$305,945,000	\$312,930,000
Current liabilities.....	132,640,000	103,650,000
Working capital.....	173,305,000	209,280,000
Investments.....	77,329,000	52,313,000
Property, plant and equipment.....	326,827,000	277,270,000
Other assets.....	19,994,000	23,535,000
Capital employed.....	<u>597,455,000</u>	<u>562,398,000</u>
Deduct:		
Long-term debt.....	123,990,000	125,032,000
Deferred income taxes.....	98,522,000	86,792,000
Minority interest in subsidiaries.....	100,294,000	93,103,000
	<u>322,806,000</u>	<u>304,927,000</u>
Shareholders' investment.....	<u>\$274,649,000</u>	<u>\$257,471,000</u>
Investment represented by:		
Share capital.....	\$ 71,247,000	\$ 71,247,000
Retained earnings.....	203,402,000	186,224,000
Total shareholders' investment.....	<u>\$274,649,000</u>	<u>\$257,471,000</u>

Hudson Bay Mining and Smelting Co., Limited

Consolidated Statement of Changes in Financial Position

	For the quarter ended June 30		For the six months ended June 30	
	1979	1978	1979	1978
Working capital provided:				
Earnings from operations.....	\$ 32,740,000	\$ 21,847,000	\$ 51,737,000	\$ 31,556,000
Proceeds from long-term debt.....	184,000	—	524,000	17,557,000
	<u>32,924,000</u>	<u>21,847,000</u>	<u>52,261,000</u>	<u>49,113,000</u>
Working capital applied:				
Dividends.....	2,021,000	—	3,031,000	—
Dividends paid by subsidiaries to minority interests.....	464,000	1,462,000	2,458,000	2,884,000
Other investments.....	171,000	7,653,000	4,751,000	9,757,000
Property, plant and equipment.....	21,725,000	19,595,000	37,356,000	34,873,000
Reduction of long-term debt.....	1,226,000	772,000	1,389,000	3,519,000
Increase in other assets.....	875,000	2,364,000	346,000	4,338,000
	<u>26,482,000</u>	<u>31,846,000</u>	<u>49,331,000</u>	<u>55,371,000</u>
Increase (decrease) in working capital.....	6,442,000	(9,999,000)	2,930,000	(6,258,000)
Working capital at beginning of period.....	166,863,000	219,279,000	170,375,000	215,538,000
Working capital at end of period.....	<u>\$173,305,000</u>	<u>\$209,280,000</u>	<u>\$173,305,000</u>	<u>\$209,280,000</u>

Notes:

- (1) Interest and other income for the six months ended June 30, 1979, include interest income of \$5,790,000 and currency translation gains (losses) of \$(383,000) applicable to foreign subsidiaries' working capital (1978 - \$5,523,000 and \$1,204,000).
- (2) Earnings for the six months ended June 30, 1979, include the 50% equity interest in Inspiration Consolidated Copper Company compared with 23.4% for 1978, and 100% of Whitehorse Copper Mines Ltd., compared with 41.2% for 1978. The ownership in Whitehorse Copper increased to 92.1% at June 30, 1978, and commencing July 1, 1978, that company was treated as a subsidiary. In addition, earnings include 37.5% of the earnings of Tantalum Mining Corporation of Canada Limited which was acquired in November, 1978.
- (3) The financial statements are stated in Canadian currency and are subject to year-end audit.

to the Shareholders:

Net earnings of \$969,000 (9¢ per share) for the third quarter of 1978 increased net earnings for the first nine months to \$3,685,000 (36¢ per share) from \$2,716,000 (27¢ per share) for the first half of this year.

The results for the comparable periods of 1977: a loss of \$2,384,000 (23¢ per share) for the third quarter and net earnings of \$5,012,000 (50¢ per share) for the first nine months, before extraordinary items. The extraordinary items, which occurred in the second quarter of 1977 and consisted mainly of the gain on the sale of the potash division assets, totalled \$52,355,000 and increased the net earnings for the first nine months of 1977 to \$57,367,000 (\$5.68 per share).

Net sales in 1978 (with comparable 1977 figures in brackets): \$103,447,000 for the third quarter (\$66,542,000) and \$363,253,000 for the first nine months (\$261,614,000).

Profits from the Canadian Metals Division and from the Company's oil and gas subsidiaries were slightly larger than the losses incurred by our copper and fertilizer interests in the U.S. during the third quarter.

It should be noted that our results for the first nine months include \$4,249,000 (\$2,521,000 after deducting minority interest) of unrealized exchange gains arising from the translation of U.S. subsidiaries' accounts into Canadian dollars.

The Board of Directors met on November 10 and decided to omit the quarterly dividend. The Board took the view that the earnings and cash flow for the third quarter and for the first nine months were still unsatisfactory and at a level that did not justify a dividend.

The Canadian Metals Division's results for the third quarter showed a significant improvement compared with the same quarter in 1977 and the first six months of this year due to a strengthening of the prices for copper, zinc and gold. The lower value of the Canadian dollar against the U.S. dollar also contributed to the Division's higher earnings. Production of copper during the third quarter was less than in the same quarter of 1977 due to the planned shutdown of the smelter at Flin Flon for maintenance purposes. Whitehorse Copper Mines Ltd. made a contribution to the Division's net earnings for the third quarter due to the fact that our Company's share of Whitehorse Copper's earnings was increased from 41% to approximately 95% as a result of our acquisition of additional shares of Whitehorse Copper. In the oil and gas sector, Canadian Merrill Ltd. and

Francana Oil & Gas Ltd. continued to contribute to the Company's earnings although gas curtailments reduced sales volumes and hence profits somewhat, although they were slightly higher than a year ago. Our industrial operations – Francana Minerals Ltd., Zochem Limited and Hudson Bay Diecastings Limited – all had positive results and the group as a whole made a contribution to our net earnings.

Terra Chemicals International, Inc., of the U.S., reported a loss for the third quarter and lower earnings for the first nine months of 1978, on record revenues for both periods. The results for the first nine months, compared with the same period in 1977, were adversely affected by lower prices and higher operating costs – largely natural gas costs. Although the third quarter is usually Terra's poorest quarter, the higher loss for this quarter is attributable to the current oversupply of ammonia and derivative nitrogen products, accompanied by increased imports into the U.S., which depressed prices, in some cases below production costs.

Although deliveries of copper by Inspiration Consolidated Copper Company, of the U.S., during the third quarter were approximately 33% higher than a year ago, the average price received was only marginally higher but production costs were considerably higher. In addition, the effect of higher copper prices on third-quarter results was limited because the increases occurred late in the quarter. The higher production costs resulted in a loss for the quarter which, however, was less than a year ago. Repairs and maintenance costs incurred during the scheduled shutdown from July 10 to August 7 contributed to the adverse results. Our Company's share of Inspiration's loss for the third quarter was increased, reflecting our acquisition of additional shares and the fact that the third-quarter loss was larger than for the first half.

The Company's offer to purchase International Chemalloy Corporation's interest in Tantalum Mining Corporation of Canada (Tanco) has been approved by the Federal Government's Foreign Investment Review Agency. Tanco's other shareholders are Kawecky Berylco Industries Inc., of New York (24.99%) and the Manitoba Development Corp. (25%). Hudson Bay Mining acquired 50.01% of Tanco's 1,000,000 issued and outstanding shares but under a prior agreement sold a 12.51% interest in Tanco to Kawecky, thus giving each company an interest of 37.5%, with the Manitoba Development Corp. holding the remaining 25%. Hud-

son Bay Mining paid \$6,525,000 for Chemalloy's interest but following the sale to Kawecky the net cost to Hudson Bay Mining was \$4,892,445. In addition, our Company paid \$137,500 to Chemalloy for its interest in a cesium royalty payable by Tanco.

In the Interim Report to Shareholders for the first six months of 1978, I reported that the Company made offers to the shareholders of two companies in which the Company has held an equity interest for some years: Inspiration Consolidated Copper Company and Whitehorse Copper Mines Ltd.

A holding company owned equally by the Company and Minerals and Resources Corporation Limited increased its equity interest in Inspiration Copper to 73% from 39% under an offer that expired on July 31. On October 23, the Board of Directors of Inspiration Copper approved a Plan of Merger whereby the holding company, Inspiration Holdings Inc., would be merged with and into Inspiration Copper. The Plan of Merger will be submitted for the approval of Inspiration Copper's shareholders at a special meeting on December 14, 1978, and, if approved, the merger would take place at year-end. The proposed Plan of Merger would convert Inspiration Copper's common shares not held by them into a new class of voting Preferred Stock with a cumulative annual dividend of \$1.80 per share and would offer redemption options that could be exercised by shareholders prior to the end of 1981 and by Inspiration Copper thereafter. The redemption price is U.S. \$33 per share plus accumulated unpaid dividends.

The Company's offer of \$4 cash per share to shareholders of Whitehorse Copper expired on September 26 by which time Whitehorse Copper shareholders had deposited sufficient shares to increase the Company's holding from 41% prior to the offer to more than 94% of the 3,442,502 shares outstanding. As the number of shares tendered exceeded 90% of the outstanding shares not owned by the Company when the offer was made on May 29, 1978, the Company is now qualified to proceed under Section 199 of the Canada Business Corporations Act to acquire the remaining outstanding shares. The Company intends to proceed under the Act and all holders of Whitehorse Copper shares have been notified of this decision.

November 15, 1978

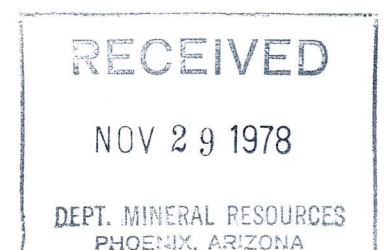
E. P. GUSH
President

Hudson Bay Mining and Smelting Co., Limited



Interim Report
To Shareholders

9 Months
Ended September 30, 1978



Hudson Bay Mining and Smelting Co., Limited
Consolidated Statement of Earnings

	For the quarter ended September 30		For the nine months ended September 30	
	1978	1977	1978	1977
Net sales.....	\$103,447,000	\$ 66,542,000	\$363,253,000	\$261,614,000
Interest and other income (Note 1).....	9,382,000	4,761,000	18,007,000	13,120,000
	112,829,000	71,303,000	381,260,000	274,734,000
Cost of sales.....	84,947,000	54,729,000	297,098,000	184,082,000
Depreciation, depletion and amortization.....	9,450,000	4,802,000	26,015,000	24,492,000
General administrative expenses.....	3,536,000	3,106,000	10,933,000	9,530,000
Interest.....	3,856,000	2,974,000	11,048,000	8,877,000
	101,789,000	65,611,000	345,094,000	226,981,000
Earnings before taxes.....	11,040,000	5,692,000	36,166,000	47,753,000
Taxes and royalties.....	5,519,000	4,678,000	18,601,000	28,499,000
Earnings from operations.....	5,521,000	1,014,000	17,565,000	19,254,000
Other items:				
Provision for future write-offs of investments.....	(83,000)	(40,000)	(214,000)	(389,000)
Minority interest in earnings of subsidiaries....	(3,252,000)	(2,317,000)	(12,213,000)	(13,633,000)
Equity in earnings (losses) of associated companies.....	(1,217,000)	(1,041,000)	(1,453,000)	(220,000)
	(4,552,000)	(3,398,000)	(13,880,000)	(14,242,000)
Earnings (loss) before extraordinary items.....	969,000	(2,384,000)	3,685,000	5,012,000
Extraordinary items.....	—	—	—	52,355,000
Earnings (loss) for the period.....	\$ 969,000	\$ (2,384,000)	\$ 3,685,000	\$ 57,367,000
Shares outstanding.....	10,101,739	10,101,739	10,101,739	10,101,739
Earnings (loss) per share:				
Before extraordinary items.....	\$ 0.09	\$ (0.23)	\$ 0.36	\$ 0.50
After extraordinary items.....	\$ 0.09	\$ (0.23)	\$ 0.36	\$ 5.68

Consolidated Statement of Financial Position

	As at September 30	
	1978	1977
Current assets.....	\$275,433,000	\$292,958,000
Current liabilities.....	85,871,000	74,432,000
Working capital.....	189,562,000	218,526,000
Investments.....	65,002,000	43,666,000
Property, plant and equipment.....	291,738,000	242,804,000
Other assets.....	21,075,000	19,124,000
Capital employed.....	567,377,000	524,120,000
Deduct:		
Long-term debt.....	125,453,000	106,754,000
Deferred income taxes.....	87,686,000	76,297,000
Minority interest in subsidiaries.....	95,797,000	85,936,000
	308,936,000	268,987,000
Shareholders' investment.....	\$258,441,000	\$255,133,000
Investment represented by:		
Capital stock.....	\$ 71,247,000	\$ 71,247,000
Retained earnings.....	187,194,000	183,886,000
Total shareholders' investment.....	\$258,441,000	\$255,133,000

Hudson Bay Mining and Smelting Co., Limited
Consolidated Statement of Changes in Financial Position

	For the quarter ended September 30		For the nine months ended September 30	
	1978	1977	1978	1977
Funds provided:				
Earnings from operations before non-cash outlays.....	\$ 15,866,000	\$ 7,304,000	\$ 47,422,000	\$ 46,639,000
Proceeds from long-term debt.....	158,000	888,000	17,715,000	10,730,000
Working capital of Whitehorse Copper Mines.....	3,025,000	—	3,025,000	—
Realization of investments.....	—	—	—	2,498,000
Sale of potash division assets.....	—	—	—	140,764,000
Decrease in other assets.....	2,459,000	—	—	—
	21,508,000	8,192,000	68,162,000	200,631,000
Funds applied:				
Dividends.....	—	2,021,000	—	6,061,000
Dividends paid by subsidiaries to minority interest.....	1,442,000	1,370,000	4,326,000	4,726,000
Working capital deficiency of Canadian Merrill.....	—	—	—	2,895,000
Other investments.....	17,771,000	2,704,000	27,528,000	6,051,000
Property, plant and equipment.....	21,986,000	12,474,000	56,859,000	41,872,000
Reduction of long-term debt.....	27,000	—	3,546,000	4,904,000
Increase in other assets.....	—	155,000	1,879,000	1,354,000
	41,226,000	18,724,000	94,138,000	67,863,000
Increase (decrease) in working capital.....	(19,718,000)	(10,532,000)	(25,976,000)	132,768,000
Working capital at beginning of period.....	209,280,000	229,058,000	215,538,000	85,758,000
Working capital at end of period.....	\$189,562,000	\$218,526,000	\$189,562,000	\$218,526,000

NOTES:

- (1) Interest and other income for the nine months includes interest income of \$8,529,000 and currency translation gains of \$4,249,000 applicable to foreign subsidiaries' working capital (1977 - \$6,500,000 and \$3,371,000).
- (2) The tender offer made in May, 1978, for shares of Whitehorse Copper Mines Ltd. resulted in the ownership in that company increasing from 41.2% to 92.1% at June 30 and subsequently to 94.7% at September 30. Therefore the Company has treated Whitehorse Copper as a subsidiary effective July 1, 1978, and its accounts have been consolidated with those of the Company from that date; prior to that date the investment was accounted for by the equity method.
- (3) Extraordinary items in 1977 consist primarily of the gain on sale of the potash division assets, less estimated income taxes.
- (4) Certain of the 1977 figures have been reclassified to conform with the 1978 presentation.
- (5) The financial statements are stated in Canadian currency and are subject to year-end audit.



PRELIMINARY PROGRAM

AMERICAN WATER RESOURCES ASSOCIATION THIRTEENTH AMERICAN WATER RESOURCES CONFERENCE

"Assessment, Management, and Politics of Water"
and

SPECIAL SYMPOSIUM "River-Quality Assessments"

Tucson Community Center, and
Marriott Hotel, Headquarters

Tucson, Arizona

October 31 to November 3, 1977

"ASSESSMENT, MANAGEMENT, AND POLITICS OF WATER"

General Conference Chairman: Daniel D. Evans
Department of Hydrology & Water Resources
University of Arizona, Tucson, AZ 85719
Phone: (602) 884-2739

Co-sponsoring Agencies and Societies:

American Society of Agricultural Engineers
Soil and Water Division
American Society of Civil Engineers
Water Resources Planning and Management Division
Arizona Water Commission
Arizona Water Resources Committee
University of Arizona
Western Political Science Association

HOSTS: Arizona State Section, AWRA
University of Arizona Student Chapter, AWRA

"RIVER-QUALITY ASSESSMENTS"

General Symposium Chairman: Phillip E. Greeson
U.S. Geological Survey, WRD
National Center, Mail Stop 419, Reston VA 22002
Phone: (703) 860-6834

Co-sponsoring Agencies and Societies:

American Water Works Association
Water Pollution Control Federation
U.S. Geological Survey

"ASSESSMENT, MANAGEMENT, AND POLITICS OF WATER"

SUNDAY, OCTOBER 30

4:00 p.m. — 8:00 p.m. REGISTRATION (continued through November 3)
6:00 p.m. — 10:00 p.m. ROUNDUP & ICEBREAKER

MONDAY, OCTOBER 31

8:30 a.m. — 12:00 noon CALL TO ORDER

KEYNOTE ADDRESS

NATIONAL WATER ASSESSMENT

Chm.: Bruce J. Blanchard, Office Env. Review, USDI
V.C.: John F. Ficke, USGS, USDI
Disc.: Ronald M. North, U. of Georgia

12:00 noon

U. OF ARIZONA FORMER STUDENT LUNCHEON

1:30 p.m. — 5:00 p.m.

FLOOD PLAIN MANAGEMENT (co-sponsored by ASCE-WRPM Div.)

Chm.: James E. Goddard, Consultant
V.C.: William K. Johnson, Army Corps of Engineers
Disc.: L. Douglas James, Utah State U.

WORLD HUNGER AND WATER DEVELOPMENT

Chm.: Raleigh Barlow, Michigan State U.
V.C.: Leo V. Mayer, Lib. of Congress
Disc.: Jan van Schilfgaarde, ARS-USDA

HYDROLOGIC MODELING (co-sponsored by ASCE-WRPM Div.)

Chm.: Jerry R. Rogers, U. of Houston
V.C.: Ernest M. Weber, Colo. River Bd. of Calif.
Disc.: Roger Betson, TVA

WATER QUALITY MANAGEMENT

Chm.: Jonathan W. Bulkley, U. of Michigan
V.C.: Noel Larson, USFS-USDA
Disc.: William Whipple, Jr., Rutgers U.

CAREER OPPORTUNITIES

Chm.: Daniel B. Stephens, UA student
V.C.: Chris G. Kisiel, UA student
Disc.: Thomasine Hill, UA student

6:30 p.m. — 10:00 p.m. WATER FILM FESTIVAL

Chm.: Peter E. Black, Syracuse U.
V.C.: Kenneth E. Foster, U. of Arizona

6:30 p.m.

STUDENT GET-TOGETHER AND DINNER

TUESDAY, NOVEMBER 1

8:30 a.m. — 12:00 noon WATER RESOURCES ENHANCEMENT ✓
(co-sponsored by AWRC)

Chm.: Peter F. Ffolliott, U. of Arizona
V.C.: Curtis C. Cooper, Retired Rancher
Disc.: James Goff, Boyle Eng. Corp.

HYDROLOGIC MODELING

Continued from Monday p.m.

WATER QUALITY MANAGEMENT ✓

Continued from Monday p.m.

WATER AND ENERGY

Chm.: Lorne G. Everett, Tempo-General Electric
V.C.: Paul A. Rechard, U. of Wyoming
Disc.: George Davis, USGS-USDI

WATER BASED RECREATION

Chm.: Carl D. Settergren, U. of Missouri
V.C.: William H. Honore, Bur. of Outdoor Rec., USDI
Disc.: David A. King, U. of Arizona

POSTER SESSION

Chm.: Kenneth L. Bowden, Northern Illinois U.
V.C.: Glenn Thompson, U. of Arizona

12:00 noon

AWRC LUNCHEON

Speaker: CONGRESSMAN MORRIS K. UDALL
(tentative)

1:30 p.m. — 5:00 p.m.

WATER AND ENERGY

Continued from Tuesday a.m.

WATER REUSE AND CONSERVATION (with AWRC) ✓

Chm.: Fred J. Nobbe, Fred Nobbe and Assoc.
V.C.: Malchus B. Baker, USFS-USDA
Disc.: A. F. Vondrick, City of Phoenix

WATER RESOURCE PLANNING
(co-sponsored by ASCE-WRPM Div.)

Chm.: A. J. Fredrich, Army Corps of Engineers
V.C.: Robin Reynolds, Calif. Dept. Water Res.
Disc.: Richard Tucker, Dames and Moore

URBAN AND INDUSTRIAL WATER PROBLEMS

Chm.: John W. Harshbarger, Harshbarger and Assoc.
V.C.: Marvin Murray, City of Flagstaff
Disc.: Charles E. Downs, Arizona State U.

POSTER SESSION

Continued from Tuesday a.m.

5:00 p.m.

BUSES LEAVE FOR NOGALES, MEXICO

6:30 p.m. – 10:00 p.m. **FILM FESTIVAL CONTINUED**

WEDNESDAY, NOVEMBER 2

8:30 a.m. – 12:00 noon **WATER RESOURCE PLANNING**

Continued from Tuesday p.m.

IRRIGATION (co-sponsored by ASAE-SW Div.)

Chm.: Robert M. Hagen, U. of California – Davis
V.C.: C. E. Franzoy, Agric. Tech. Co.
Disc.: James A. Bondurant, ARS-USDA

WATER LAW

Chm.: Porter A. Tower, Calif. Dept. Water Res.
V.C.: R. Dennis Ickes, Private Attorney
Disc.: Wayne A. Pettyjohn, Ohio State U.

12:00 noon

AWRA BUSINESS MEETING

1:30 p.m. – 5:00 p.m.

WATER CONSERVATION
(co-sponsored by ASAE-SW Div.)

Chm.: Kenneth G. Renard, ARS-USDA
V.C.: Howard P. Johnson, Iowa State U.
Disc.: Marvin E. Jenson, ARS-USDA

DECISION MAKING

Chm.: John C. Frey, Penn. State U.
V.C.: Donald R. Davis, U. of Arizona
Disc.: Raymond E. Seltzer, Dev., Planning and Res. Assoc.

LIMNOLOGY

Chm.: John Cairns, Jr., Virginia Polytec. Inst.
V.C.: Simon Ince, U. of Arizona
Disc.: Howard E. Westerdahl, Army Corps of Engineers

Wednesday Evening

EVENING AT OLD TUCSON

THURSDAY, NOVEMBER 3

8:30 a.m. – 12:00 noon **POLITICS OF WATER** (co-sponsored by WPSA)

Chm.: Warren Viessman, Lib. of Congress
V.C.: Harold Tso, Navajo Tribal Council
Disc.: Peter Lupsha, U. of New Mexico

CLIMATIC CHANGE

Chm.: Charles W. Stockton, U. of Arizona
V.C.: Helmut Landsburg, U. of Maryland
Disc.: J. Murray Mitchell, Jr., Env. Data Serv., NOAA

1:00 p.m. – 5:00 p.m. **FIELD TRIP, TUCSON AREA**

FRIDAY, NOVEMBER 4

All Day

FIELD TRIP, PHOENIX AREA

SYMPOSIUM PROGRAM
“RIVER-QUALITY ASSESSMENTS”

WEDNESDAY, NOVEMBER 2

8:30 a.m. – 12:00 noon

“CONCEPTS OF RIVER-QUALITY ASSESSMENTS AND RESULTS OF PILOT STUDIES”

Call to Order: Phillip E. Greeson, General Chairman of Symposium

Moderator: Robert A. Canham, Executive Secretary, Water Pollution Control Federation, Washington, DC

Speakers:

Clarence J. Velz, Professor Emeritus, University of Michigan, Longboat Key, FL
David A. Rickert, Project Chief, Willamette River Assessment, U.S. Geological Survey, Portland, OR
Rodney A. Cherry, Project Chief, Chattahoochee River Assessment, U.S. Geological Survey, Doraville, GA
Timothy D. Steele, Project Chief, Yampa River Assessment, U.S. Geological Survey, Lakewood, CO

1:15 p.m. – 2:00 p.m.

“SELECTED METHODS FOR ADDRESSING RIVER-QUALITY PROBLEMS”

Moderator: John A. Roller, Superintendent of Water Division, Department of Public Utilities, Tacoma, WA

Speakers:

Joseph V. Hunter, Rutgers University, New Brunswick, NJ – “Dissolved Oxygen and Biochemical Oxygen Demand”
William M. Brown III, California Institute of Technology, Pasadena, CA – “Erosion Potential”
Richard R. Petersen, Portland State University, Portland, OR – “Algal Growth Potential”
Harvey E. Jobson, U.S. Geological Survey, Bay St. Louis, MS – “Thermal Modeling”
Thomas J. Tuffey, Roy F. Eston, Inc., Westchester, PA – “Nitrification”
Ivan C. James II, U.S. Geological Survey, Reston, VA – “Residuals Management”

THURSDAY, NOVEMBER 3

8:30 a.m. – 12:00 noon

“APPLICATION AND POTENTIAL FOR RIVER-QUALITY ASSESSMENTS”

Moderator: Ival V. Goslin, Executive Director, Upper Colorado River Commission, Salt Lake City, UT

Discussion Panel:

Chris L. Wheeler, State Engineer, State of Oregon, Salem, OR
Thomas C. Leslie, Environmental Engineer, Atlanta Regional Commission, Atlanta, GA
Charles D. Mosher, U.S. General Accounting Office, Seattle, WA
James J. Reisa, Executive Office of the President, Council on Environmental Quality, Washington, DC
David P. Green, Technical Advisor to the Director, Water Planning Division, Environmental Protection Agency, Washington, DC

1:15 p.m. – 4:30 p.m.

“THE NEED FOR RIVER-QUALITY ASSESSMENTS”

Moderator: James B. Coulter, Secretary, Department of Natural Resources, State of Maryland, Annapolis, MD

Discussion Panel:

Walter A. Lyon, Director, Bureau of Water Quality Management, State of Pennsylvania, Harrisburg, PA
John E. Kinney, Sanitary Engineer, Ann Arbor, MI
Clarence J. Velz, Professor Emeritus, University of Michigan, Longboat Key, FL
William E. McCracken, Sanitary Engineer, Michigan Department of Natural Resources, Lansing, MI
Kenneth L. Bowden, Assistant Professor, Northern Illinois University, DeKalb, IL

TITLE AND SPEAKER LISTING

Approximately 200 papers will be presented during the 1977 AWRA Conference. Several will be presented with posters and other visual aids so an author may discuss the paper's content in greater detail. A sampling of the paper titles follows:

A Study of Coastal Pollution and Agency Interface
River Recreation: Public Access vs. Riparian Rights
Preserving the American Falls at Niagara
A New Challenge for Western Water Supplies
Water and Energy in Western Coal Lands
Water Resources Management for New Energy Technology Development
Simulation of Hydrologic Processes for Surface Mined Lands
Flash Desalination Project Using Solar Energy in the Texcoco Lake Region, Mexico
Advantages and Disadvantages of Regional Sewerage Systems
208 Planning from a Metropolitan Perspective
Some Problems in Local Water Quality Management Planning
A Rational Alternative for Surface Water Quality Management
Analysis of Implementation of State Scenic River Programs
Flood Plain and Flood Channel Management by Legislative Means
United States vs. California: The Continuing Federal-State Conflict Over the Operation of the Central Valley Project
Environmental and Legal Aspects of Deep-Well Injection of Thermal Effluents
Water Policy for the Future - Regional and State Implications
The National Water Commission Revisited
Recommendations for a National Water Policy
Legislative Constraints on the Development of Water Policy
Demand Projections Considering Conservation
Reducing Phreatophyte Transpiration Without Eradication
Potential Urban Runoff Disposal in Urban Forests
Modeling Phytoplankton Growth in Small, Entrophic Ponds with Catastrophe Theory
Emerging National Policy for Flood Plain Management
Flood Peak Estimation at Ungaged Sites, State-of-the-Art
Master Planning for Storm Water Retention
Utilization and Restoration of Brackish Coastal Aquifers by Water Reuse and Partial Desalination
Simplified Approach to Predicting Nonpoint Source Loads in Urban Watersheds
Management of Urban Nonpoint Pollution

Some of the scheduled speakers are:

Lucien Duckstein, University of Arizona
Warren D. Fairchild, Mission Leader, Indus Basin Planning Project, World Bank
R. Frank Gregg, Chairman, New England River Basins Commission
Kenneth D. Kauffman, Asst. Chief, Division of Planning Coordination, Bureau of Reclamation
Richard Lanyon, Metropolitan Sanitary District of Chicago
Jack Pfister, General Manager, Salt River Project
Steven Plotkin, Office of Energy, Minerals and Industry, Environmental Protection Agency
Theodore M. Schad, Executive Secretary, Environmental Studies Board, National Academy of Science
Steven Simmons, Head, Environmental Department, Harza Engineering Co.
Frank H. Thomas, U. S. Water Resources Council
L. D. Walker, U.S. Water Resources Council

SPOUS PROGRAM

The Spouses' program includes a Mexican luncheon and style show; luncheon and show at the Flandreau Planetarium; visits to DeGrazia Gallery in the Sun, Desert Museum, San Xavier Mission, University of Arizona Campus, Sabino Canyon, Sahuaro National Monument, and walking tours of historic Tucson. Registration fee of \$20.00 covers transportation, luncheons and admission fees.

Baby sitters available \$1.25/hr. or less depending on age and number of children. Arrangements for tennis, golf, horseback riding and hiking can be made individually.



FINANCIAL CONTRIBUTORS TO THE 1977 AWRA MEETING

American Ground Water Consultants	Ed L. Reed and Associates
John Carollo Engineers	Kenneth D. Schmidt
Dames and Moore	Trans World Airlines
William F. Guyton and Associates	Tucson Convention and Visitors Bureau
Harshbarger and Associates	James C. Warman
Harza Engineering Company	Water Development Corporation
Manera and Associates	Water Resources Associates
John F. Mann, Jr.	



SPECIAL EVENTS

ROUNDUP AND ICEBREAKER (Sunday Evening) – Registrants are cordially invited to this reception. Refreshments are to be provided by private contributors.

FORMER U OF A STUDENT LUNCHEON (Monday Noon) – All former and present students and faculty of the U. of Arizona are invited to a reunion luncheon. Homecoming at the University is November 3-5.

ALL STUDENT GET-ACQUAINTED DINNER (Monday Evening) – The UA Student Chapter of AWRA invites all student registrants to an informal evening with dinner and entertainment.

WATER FILM FESTIVAL (Monday and Tuesday Evenings) – Recent films pertaining to water will be presented and judged by a panel.

AWRC LUNCHEON – All registrants are invited to a luncheon arranged by the Arizona Water Resources Committee. The Honorable Morris K. Udall has tentatively accepted to be the speaker.

NOGALES, MEXICO TRIP (Tuesday Evening) – For those wishing to visit Nogales, Mexico, chartered buses have been arranged.

EVENING AT OLD TUCSON (Wednesday Evening) – Transportation, admission, dinner and show package has been arranged at a reduced cost. AWRA awards will be presented following the dinner.

FIELD TRIP (Thursday p.m.) – Trip to water related activities in the Tucson area including water-use activities of irrigated farmlands, municipal water systems, and an open pit copper mining operation, all dependent on a common groundwater source.

FIELD TRIP (Friday, all day) – Trip to the Phoenix area to visit the Salt River Project, the Central Arizona Project construction sites, the USDA Water Conservation Laboratory and other sites. Lunch will be provided by the Salt River Project.

INSPIRATION HISTORY . . .

Inspiration's history is a story of leadership among the major Arizona Mines and Smelters. Its solid growth has resulted in the development of the most complete plant in the State of Arizona. Operations now include Mining, Leaching, Electrowinning, Concentrating, Smelting, Refining and Fabricating.

The Inspiration Consolidated Copper Company was organized in 1911 by the consolidation of the Inspiration Company and the Live Oak Development Company.

Its mines were developed for underground extraction by block caving. A large mill was built to use the then revolutionary Flotation Process. First copper was produced in 1916.

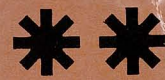
In 1926, completed facilities for ferric-sulphate leaching of mixed oxide-sulphide ore and the production of electrolytic copper.

In 1946, planning began for open pit mining and pit development.

In 1947, electric shovels and diesel trucks were purchased and the stripping of waste material began.

Production of open pit ore started in March of 1948. Capacity of the leaching plant was increased so that low grade ores from the pit could be treated economically.

In 1954, plans were made for use of dual process, i.e. leaching followed by concentration. Rehabilitation of concentrator was begun.



Also, during 1954, development of the Christmas mine was started. Recovery of molybdenum from copper concentrates commenced in 1958.

In 1960, Inspiration purchased the nearby International Smelting and Refining Smelter and built a new refinery.

In Late 1962, production from Christmas underground mines began.

1966 saw virtual completion of Inspiration Division plant expansion to raise ore treatment capacity from 16,500 to 20,000 tons per day.

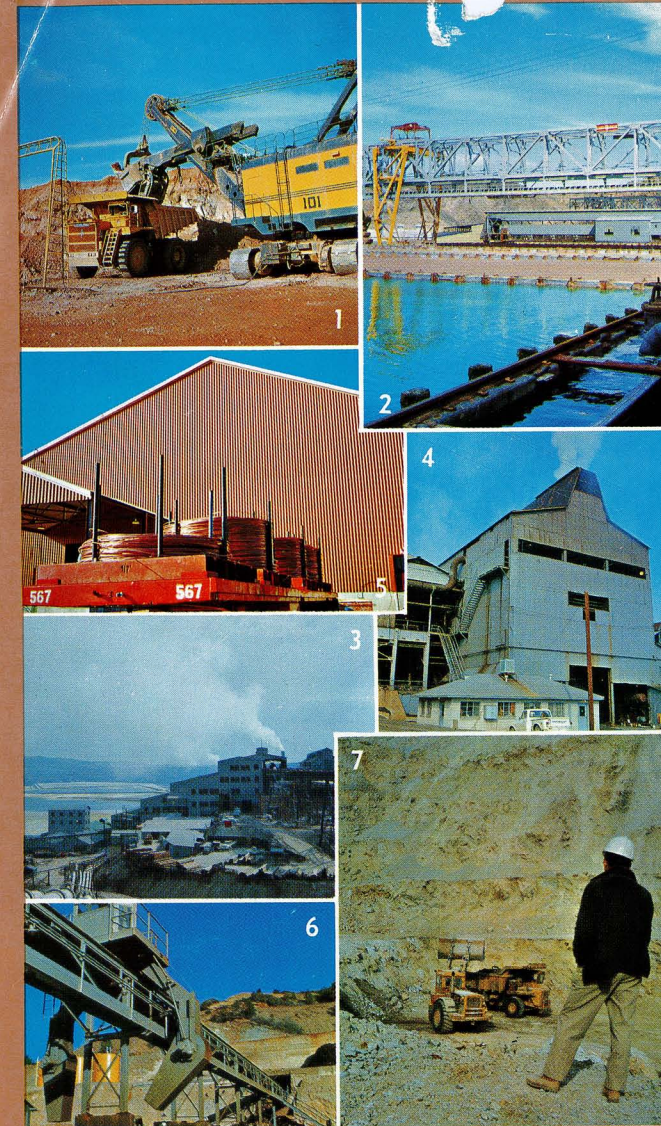
In 1967 and 1968, Inspiration treatment capacity was raised to 25,000 tons of ore per day.

- Smelter was expanded and modernized.
- Christmas mining was converted to open pit.
- First "Univac" third-generation computer delivered in U.S. programmed and installed.
- Ox-Hide mine was developed.

Also Fabricating Division was established and Rod Plant built. This employs the newest concept in continuously casting and rolling copper to produce rod for wire-makers in continuous lengths up to 15,000 pounds per coil.

Inspiration is now fully integrated within Arizona — from mining, through smelting and refining and on into fabricating.

AND THERE'S MORE TO COME HERE AND ELSEWHERE



INSPIRATION CONSOLIDATED COPPER COMPANY



THE MOST COMPLETE OPERATION IN ARIZONA

INSPIRATION'S PRODUCTION DIVISION

1 OPEN PIT — Ore production averages 25,000 tons per day.

2 LEACHING — Vat Leaching removes soluble content of copper. Copper is removed from strong solutions by electrowinning in the form of marketable cathodes, no smelting required. Weak solutions and solutions from leaching waste dumps, stripped of copper by iron precipitation resulting in cement copper, is either up-graded for direct sale or smelted and then electrolytically refined.

3 CONCENTRATOR fine-grinds ore to liberate metallic particles from waste, separates values from waste by flotation producing concentrates which require smelting and refining.

4 SMELTER melts concentrates and other copper-bearing materials to separate metal values from waste, produces impure copper requiring electrolytic refining, treats materials produced by all Inspiration Divisions and other producers.

5 FABRICATING DIVISION — Plant is located on Highway 60-70 east of Miami. The new facility processes cathodes from Inspiration's refinery into 5/16" copper rod for wire makers.

6 OX-HIDE MINE is three miles west of Inspiration. This new operation mines a very low grade oxide ore at a rate of about 12,000 tons per day. Ore is placed on dumps and leached with acid. Cement copper, produced by precipitation on scrap iron, is sent to Inspiration for smelting and refining.

7 CHRISTMAS DIVISION — Open Pit Mine and Concentrator, thirty-eight miles south of Inspiration, treats an average of 5,000 tons of ore per day. Concentrate is shipped to Inspiration for smelting and refining.

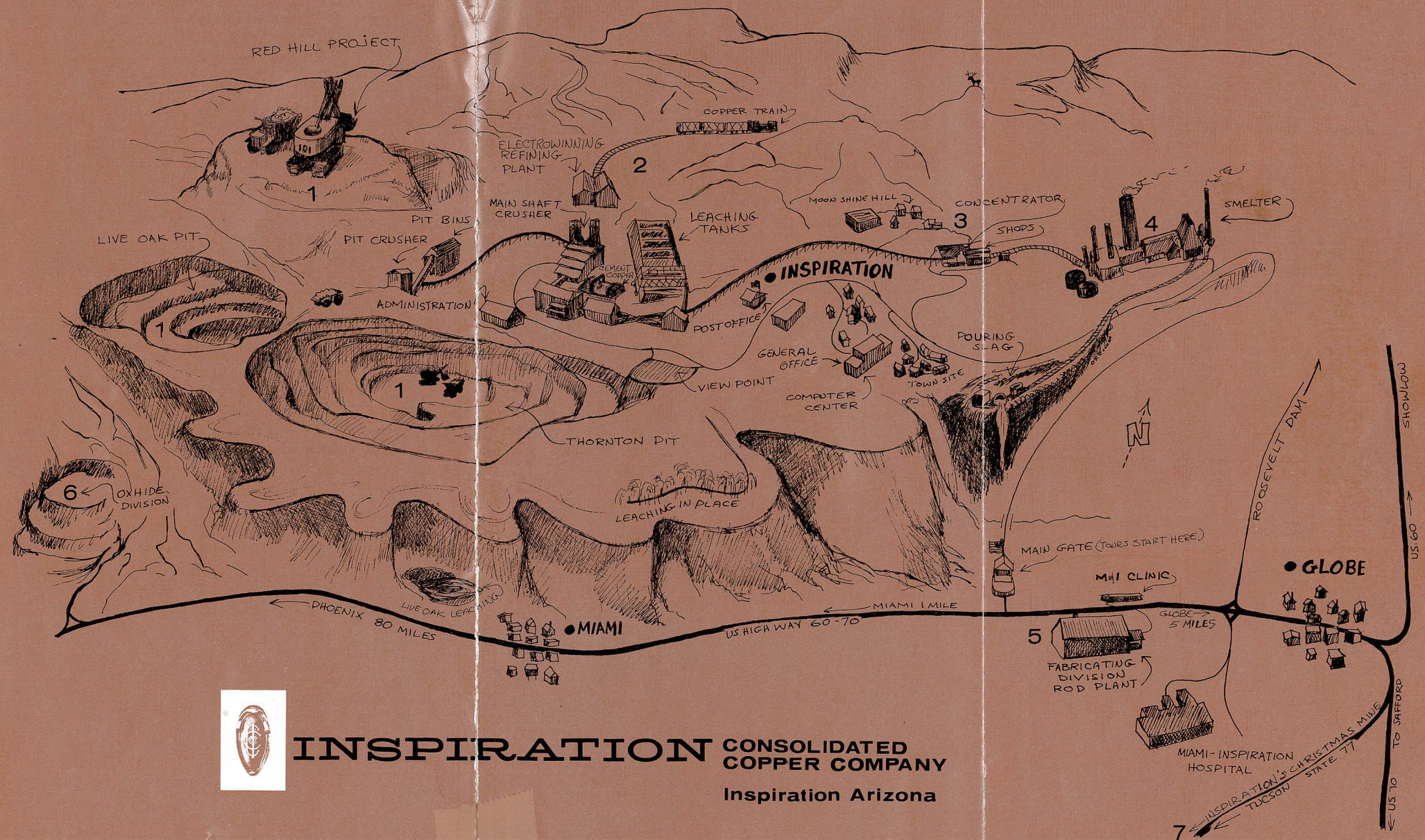
OPPORTUNITIES . . .

We're growing. Want to grow with us? Inspiration has the most complete copper mining and refining operation in Arizona, mining at three locations—Inspiration, Christmas, and its new development, Ox-Hide. Operations include open pit mining, leaching, electrowinning, concentrating, smelting and refining, also heap leaching, processing of cement copper for direct sale and production of molybdenum. To these now add a brand-new facility for continuous melting, casting and rolling of rod for wire makers. Support activities include geological study and exploration, metallurgical research, industrial engineering and computerized accounting.

Expansion has created opportunities for all types of professional personnel—metallurgical engineers, mining engineers, mechanical engineers, chemical engineers, and industrial engineers, as well as industrial management, business management, and specialists in accounting and data processing. An unusual opportunity awaits the young engineer who can qualify for professional employment by the Inspiration Consolidated Copper Company. Inspiration employees have personal security and the most liberal of fringe benefits—insurance, complete hospital and medical care, and retirement.

Arizona has long been noted for its pleasant, temperate climate and outdoor living. Hunting, fishing, boating, camping, golf, and swimming are a few of the activities to be found at the doorsteps of Inspiration employees. Arizona is the place to raise a family and Inspiration Consolidated Copper Company is the organization in which to build your future! For additional information write to: The Director of Industrial Relations, Inspiration Consolidated Copper Company, Inspiration, Arizona 85537.

INSPIRATION CONSOLIDATED COPPER COMPANY



**INSPIRATION CONSOLIDATED
COPPER COMPANY**
Inspiration Arizona

ence on both sides were responsible for this situation. The moving of the Agency from near the base of Coolidge Dam to a site nearer Globe may have helped some, but the offer of a chance to raise cattle for themselves did more. Sparked by this chance to have something of their own, those who took advantage of it soon showed that it meant better living conditions. A truck was often the first purchase. This meant freedom and a wider range. Then furniture and other conveniences followed. Today those who own cattle operate one of the largest Hereford cattle ranches in the United States. Their cattle sales are well attended, their animals bringing top prices.

Reservation life is much changed. Now they have their own charter and constitution; they manage their own affairs with some government assistance, particularly in land management, health, and agriculture. Most important of all is the fact that those parents who were often truants from school now insist that their own children attend. These people have also shown talent in many fields. No longer do they turn shyly away from strangers but welcome and invite visitors to their community. Their All-Indian Fair in the fall, their rodeos, and crown dances are all open to visitors. Although they still have problems, they are facing and meeting them well.

Gila County— one of Arizona's finest

Gila County proudly enjoys a solid economic growth with undiminishing cattle ranges, and large resources of underground copper being worked under modern day methods. Open-pit mining of the underground copper, a delightful climate and numerous scenic and historic attractions attract countless tourists into the area yearly, adding extra dollars to the economic growth. This is complemented by the many desirable features for retirement living.

Along with copper, Gila County is now rated the most important asbestos-producing area in the United States.

Texas long has claimed the largest cattle ranch in the world with its famous King Ranch, but Texas is wrong; for the great 1,620,000 acre San Carlos Indian Reservation cattle range far exceeds the King Ranch of Texas.

Much of the old West is still apparent in the Globe-Miami area, and excellent accommodations coupled with a warm western hospitality make it a fine place to stop.

The Salado Indians were the first inhabitants of the great valley, being recorded as living in the area from 1225 A.D. through 1400 A.D. Many of the old ruins in the County are extremely interesting and well worth a visit.

Courtesy of

Gila County Advertising Committee

Distributed by

Chamber of Commerce at Miami, Arizona

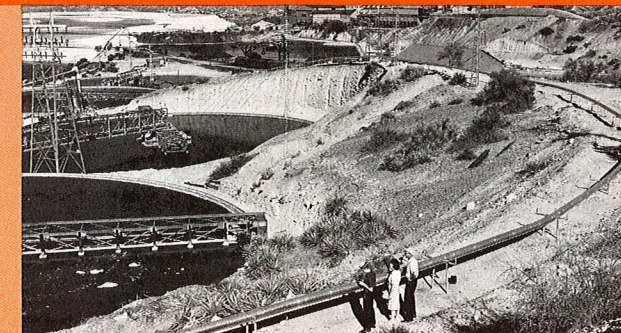
Chamber of Commerce at Globe, Arizona



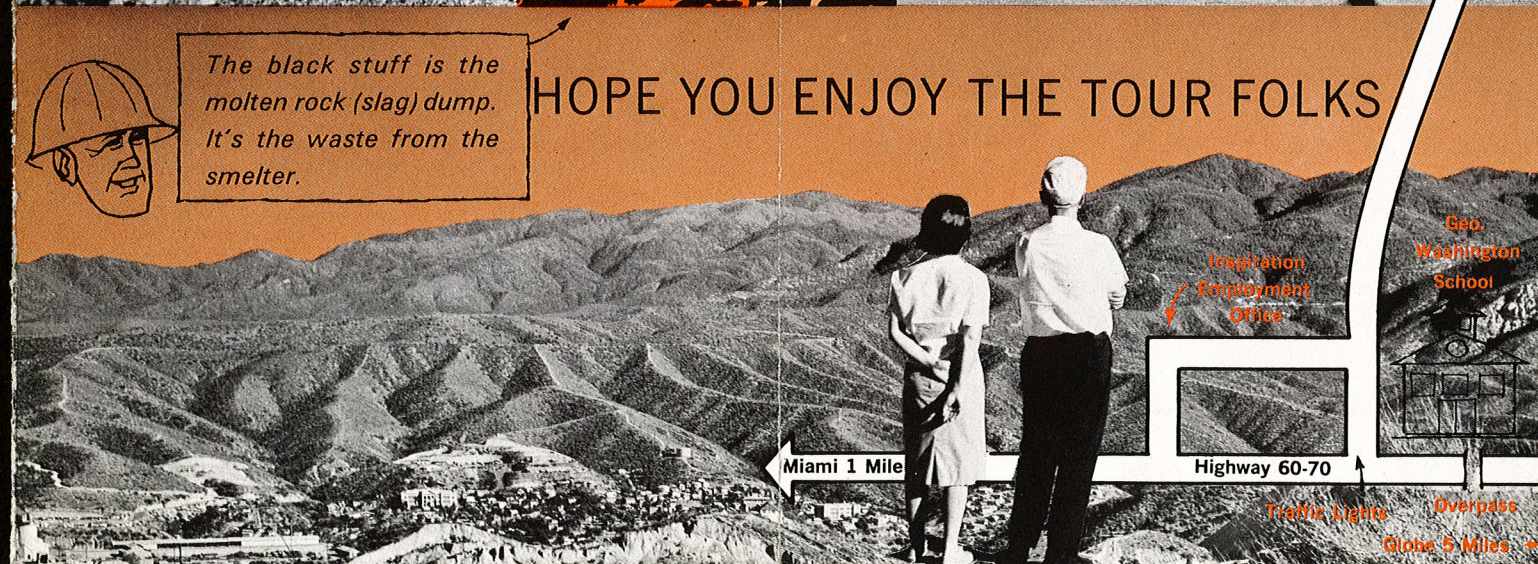
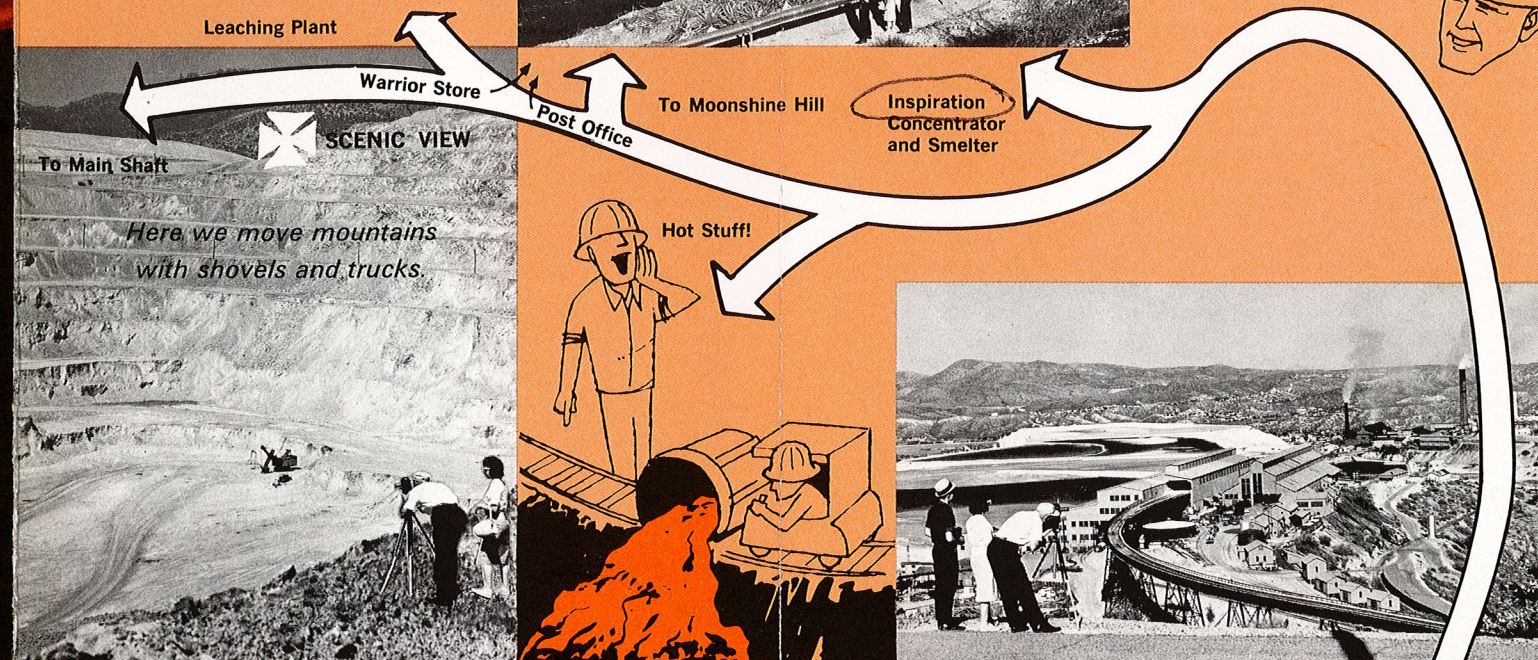
FREE COPPER MINE TOUR ON TUESDAYS and FRIDAYS

MAKE THE SCENIC TOUR ANYTIME!

YOU must register before noon Tuesdays and Fridays at the Inspiration Copper Company Employment Office. Tour is from 1:00-3:30.



This white stuff is tailings (or waste). All copper has been removed.



HOPE YOU ENJOY THE TOUR FOLKS

The black stuff is the molten rock (slag) dump. It's the waste from the smelter.

The Romance of Copper

Legend of the Mines at Miami, Arizona

Welcome to "copper country" . . . and spectacular Gila County, land of rugged mountains and center of the lore and romance of copper, both past and present. This district has contributed a heavy percentage of the copper produced in Arizona, which ranks first among all the states in U.S. production of copper.

Whether you come into the Pinal Mountain country from the East, now better known as the Globe-Miami mining district, or from the West, the Miami Copper Center, you will see evidence of mining operations. From the East you will see the asbestos mills, as Gila County is producing the only low-iron content asbestos in the United States. Passing through Globe, you will see the remains of the Old Dominion Copper mine which was closed in 1931 because of newer methods and the high cost of keeping the mine from flooding. A portion of this water is now used by the Miami Copper Company and its subsidiary mines.

Turning from Pinal Creek, which flows through the town and below the Old Dominion Mine, you come to the junction of U.S. Highway 60-70 with the Apache Trail, the huge tailings pile of the Inspiration Consolidated Copper Company, and at the East end of Miami the smaller tailings dump of the Miami Copper Company mine — 38 million tons of it. Tailings are the residue after the copper minerals have been removed. Altogether the Miami Company has mined and hauled to the surface for processing, in a half century, 151 million tons of ore from which were produced over two billion three hundred million pounds of copper. The Miami mine later flumed its tailings back into the foothills where they are not so noticeable from the highway.

Between these two tailings piles you will see the Inspiration Consolidated Copper Company's smelter and power house. Nearby is the smelter's black slag dump.

Coming in from Phoenix, you see first a huge pile of earth, the waste — 90 million tons of it — from the open pit workings of the Inspiration Consolidated Copper Company. The tailings from this mine contain 158 million tons of waste, which meant that 160 million tons of ore were hauled up and processed to secure 3,619 million pounds of copper, as well as some other metals in varying amounts.

Work on the Miami mine began to develop soon after the railroad reached Globe in 1907. The operation was helped when Daniel Jackling in Bingham, Utah, proved to skeptical mining engineers that the low grade, widely scattered ores of that area could be profitably worked if handled in immense quantities. There then began a hunt for similar ore, for the area around



Miami was known to prospectors to contain such ore, which could not be mined profitably under wagon freighting, nor by any previously known methods of extracting copper ore of such low grades. True, there was a small showing of better grades, but not enough to warrant large expenditures for development.

Two men, prominent in the opening of the Miami mine, were J. Parke Channing, noted mining engineer, and Black Jack Newman, uneducated alien, with a name too difficult for English tongues. The time-keeper at the Globe mine marked him on the book as "new man Jack." The miners were soon calling this swarthy man "Black Jack" to distinguish him from the numerous Cornish "Jacks" who then worked in the local mines. Later he made the name legal and taught himself to write his name "John Newman."

Channing came to Globe ostensibly to visit his friend, Dr. Louis D. Ricketts, then general manager of the Old Dominion mine. He may well have had a secret intention of looking over the mining in the district, for when Dr. Ricketts proposed a field trip, he quickly assented.

After looking over the mines in the district, he bargained with John D. Coplen, then in charge of the Inspiration Copper Company. Failing to make a deal for Coplen's high priced claims, Channing talked with Black Jack Newman, whose claims lay adjacent to, and somewhat within, a semi-circle of what later became the Inspiration Consolidated Copper Company. In 1909 he took an option on the Newman claims for the General Development Company, the firm for whom he was then working. The company agreed to do some exploration of the claims and to sink a shaft. When a second shaft was down nearly 200 feet, the company, because of the financial panic of 1907, wired to discontinue the work. The foreman showed the telegram to Newman, who promptly tore it up and announced, "We got no damn telegram." He did, however, agree to pay the miners' wages if the work was continued a short time longer. At only 220 feet they struck the ore Jack was so sure was there and success of this mine was assured.

By 1909 the railroad extended from Globe to Miami, going down Pinal Creek a few miles and turning back up the West branch of the creek at its junction with the main creek, thus securing easy grades and a shipping station for points in the north section of the county.

The Miami Company spent millions of dollars before any copper was produced and even then production started on only two million tons of 2% ore. This was the richest ore, for from then on the percentage went steadily downward; fortunately, however, each time the percentage of copper declined, efficiency in the mine went up to meet the change, and profitable mining continued until the 1930 depression forced for many months the closing of all mines in the area. Minor amounts of gold, silver and molybdenum were found in the ores, gold and silver particularly, in the upper levels.

In addition to the original mine this company has managed two subsidiary companies. The first, the Castle Dome property whose pyramid is visible to the north of Highway 60-70 from the Pinto Creek bridge, was begun in 1942. Milling began in 1943. This operation removed forty-eight and a half million tons of waste to get at the ore, which provided the company 12 pounds of copper per ton, plus more than nine thousand ounces of gold and over a half million ounces of silver.

In 1953 the company began to plan for a second open pit mine. After extracting all the ore possible from the Castle Dome property, it began leaching the dumps to recover the copper which was too low in grade to send to the mill. Equipment from Castle Dome could then be moved to the new mine, the Copper

Cities, a distance of fifteen miles. This mine is north of both Miami and Inspiration main plants, under a mountain, known locally as "Sleeping Beauty," so called by early explorers.

At the new mine, started in December of 1953, the company began partial production by August of the following year, and by November the last section of the Castle Dome mill was in place and in operation. Both the quality and quantity of ore at the two subsidiary mines are similar. Water for the Castle Dome project was pumped from underground at the Old Dominion mine fifteen miles across country. When the Copper Cities work began, a line was extended from the Miami Copper pumping station at Burch on the Apache Trail up to the Copper Cities mine. By the end of 1962, the company had mined 27,825,000 tons of ore producing 338,900,000 pounds of copper, with some gold and silver credits in ounces.

A couple of years after the Miami Copper mine development began, the Inspiration Copper Company was formed in 1909 and began work to create another great mine in the district. A group of Globe men who held claims northeast of the Miami mine, under the leadership of Coplen, began to get control of claims. They then met to organize a company to develop a mine. Adjoining their Globe office on the second floor of a business building was the office of a fortune teller, Madame Inspiration. One of the group suggested that "Inspiration" would be a good name for the mine; and since the name seemed to be just right, it was accepted.

By 1908 the local owners had consolidated the claims into a single holding and induced outside capital to form the Inspiration Mining Company, a name that later was changed to Inspiration Copper Company. After a long series of negotiations which saw a merger of the Inspiration Copper Company with the Live Oak Development Company, the name became the Inspiration Consolidated Copper Company in the year 1911. Later still other properties were added to the company holdings.

Due to the problems surrounding the development of the ore body, it was 1915 before Inspiration began actual production. Inspiration ores are known as porphyry in which the copper minerals are widely distributed throughout a large rock mass. To further complicate its handling, about half the ores are in oxidized form, the other half being sulphide minerals. It is the presence of the oxide minerals which give the green coloration to much of Inspiration ore.

With two big mines in the district a new smelter was needed and the International Smelting Company built one. This plant was purchased in 1960 by the Inspiration Consolidated Copper Company. These big mines and their smelter came into production just in time to meet the increased demand for copper, originating with the war in Europe.

From 1915 to 1948 Inspiration mining was underground. "Block Caving" was the method used in mining the low grade ore bodies. This is a method which largely used the force of gravity both to break the ore and to deliver it to the ore trains on a haulage level under the block. This was discontinued in 1954. The main shaft is down 850 feet and the Live Oak main shaft is down 1200 feet, both with stations at various levels.

With improved earthmoving equipment and increased underground mining costs, the companies have turned to open pit mining. Inspiration began the work of stripping the overburden from its proposed open pit in 1947, the first open pit ore being mined in March of 1948. As with all changes in methods of operation several million dollars went into new equipment. Electric shovels mine the ore in open pits and 40-ton diesel-powered trucks move the ore. Other equipment includes rotary blast hole

drills, bulldozers, cars, endloaders, and various types of service trucks.

Methods of ore treatment, too, have changed over the years to take advantage of many new types of equipment and things learned by the constant experimentation which all the mines conduct regularly. Since 1957, the company has used what is known as "dual process." Its ores, crushed to less than 3/8-inch size, are first leached with a weak sulphuric acid solution at the leaching plant. That portion of the Copper which dissolved is precipitated as electrolytic copper in the company's electrolytic tank house.

The remainder is washed, drained and sent to the concentrator where it is finely ground, after which process the copper sulphides are recovered by flotation. Also, it was noted that such concentrate contained a small amount of molybdenum. A section was added to the concentrator to recover the sulphide "moly." This is a difficult and involved process.

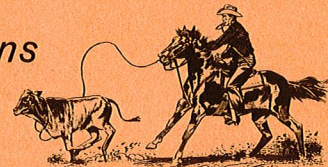
The copper concentrate is sent to the company's smelter. Here it is smelted, refined to fire-refined copper and cast in the form of 1,250 lb. anodes. These anodes are returned to the refining section of the electrolytic tank house and the copper is further refined to electrolytic copper. This is pure copper and needs only to be re-melted and cast into commercial shapes. Inspiration's Smelter is a "custom smelter." It not only treats Inspiration's products but those of others on a toll or purchase basis.

The electrolytic refinery at Inspiration is the only one in Arizona. Inspiration also operates an underground mine at Christmas, Arizona, some forty miles from Miami. The ore from this mine is treated in a concentrator at the mine site. The concentrate is trucked to Miami, loaded into railroad cars and hauled to the smelter.

Tons ore mined and treated by Inspiration	
1915-1962	180,926,750
Pounds Copper produced	3,426,710,876
Tons of ore and waste moved in the	
open pit in a normal day	25,000 to 35,000
Wages and salaries paid in 1962	\$ 9,871,088
Supplies and equipment purchased in 1962	\$13,373,187
State, county and district property taxes in 1962	\$ 941,548
Approximate number of employees — Inspiration	1,400
Christmas	300
Number of stockholders	7,121

In the forty-five years since large scale production began in these mines, millions of pounds of copper have been taken from this area to be widely distributed through the hundreds of articles using copper, and only the steady testing and research have kept these mines ahead of production costs, with the steadily declining percentage of copper in the ores now, except at Christmas. The percentage is less than 0.9 of 1%

San Carlos Indians



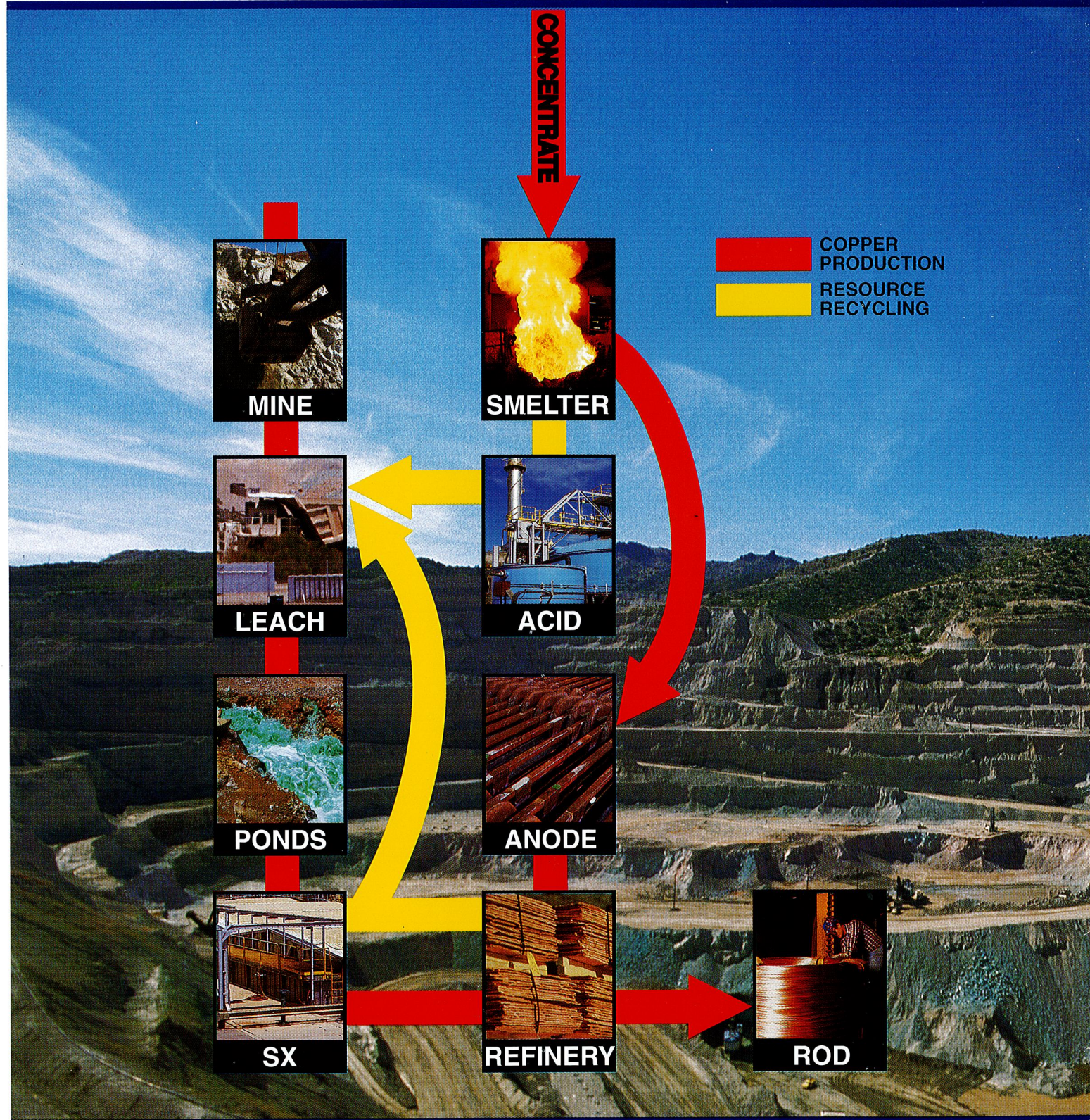
The San Carlos Apache Agency, thirty miles southeast of the village of Globe, had little contact with the townspeople of Miami and Globe. A language barrier, poor roads, and indiffer-

CYPRUS

M I A M I

*INSPIRATION MINE
file*





99.99 percent pure copper is produced through mining, leaching, solvent extraction, smelting, refining, and rod manufacturing. Many in-process

materials are recycled. SPC techniques are being introduced throughout.

Cyprus Miami continues to lead with high environmental and occupational

safety standards and is widely recognized as among the most efficient and safest copper producing operations in the United States.

In 1988, Cyprus Copper Company acquired the assets of Inspiration Consolidated Copper Company, naming it Cyprus Miami Mining Corporation.

Cyprus Miami is an integrated copper producing and processing operation, encompassing more than 18 square miles in Arizona's Gila County. Our multi-faceted operation includes mining, leaching, solvent extraction, electrowinning, smelting, refining, rod production, and resource recovery.

Large scale copper mining began here around the turn of the century when a group of prospectors consolidated their claims and formed Inspiration Consolidated Copper Company. By 1915, it was a major underground mining operation.

During the mid-50's, the underground mines were closed; technological improvements had made open pit mining more cost-effective. While the mining technique had changed, copper ore continued to be concentrated at Cyprus

Miami until 1986.

Cyprus Miami pioneered copper leaching and electro-won technology. Underground vat leaching began in 1926; heap leaching in the 1950's. In 1979, we introduced Solvent Extraction (SX) technology to improve the quality of both our leach solution and cathode.

Today ore is hauled from the Live Oak, Bluebird and Ox Hide pits to various adjacent leach dumps, where it is sprinkled with a dilute acid. As the acid percolates through the ore, it "leaches out" the copper. This copper laden solution flows to the collection ponds where it is pumped to the S/X Plant for up-grading, and then to the Refinery for copper recovery.

Our Smelter is fed by concentrated copper ore from Cyprus mines and other sources. The copper anodes produced here are moved to the Refinery or toll refined elsewhere.

The Refinery produces pure copper cathodes, using electrolytic processes. The cathodes feed our Rod Plant where we produce continuous cast copper rod.

Cyprus Miami is recognized as one of the safest and most efficient copper mining operations in the United States. Our annual production yields more than 250 million pounds of copper anode, 220 million pounds of copper cathode, and 260 million pounds of copper rod.





Our largest shovel holds 32 cubic yards of ore, approximately 60 tons. Each of our haul trucks handles up to 190 tons per load.

Copper laden solution from the 500 acres of leach pads flows into the collection ponds. The S/X Plant includes two extraction

"trains," producing 360,000 pounds of copper per day. Copper containing electrolyte is pumped to the Refinery at a rate of 2,200 gallons per minute.

Leaching

Cyprus Miami uses a patented ferric cure process to separate copper from raw ore. Low operating costs are inherent in this multi-step process principally because both the concentrator and the smelter are eliminated.

The leaching process involves numerous steps. One: 74,000 tons of ore per day containing an average copper content of 0.4 percent is mined and hauled via 170 and 190 ton trucks to one of several leach pads. Two: The pads are sprinkled with a dilute sulfuric acid solution. Three: About 18,000 gallons per minute of solution flows through the man-made mountain of ore, extracting copper while neutralizing the acid. Four: The copper laden solution collects in specially engineered reservoirs. Five: The solution, which contains approximately 3.5 grams per liter of copper, is pumped to the Solvent Extrac-

tion (S/X) Plant. Six: In the S/X Plant, special reagents and organic compounds are used to draw the copper out of the leach solution, which is then recycled back to the leach pads. Seven: The copper is removed from the reagent/organic compound with an acidic solution. Eight: The resulting electrolyte solution, which is approximately 46 grams of copper per litre, is then pumped to the electrowinning section.

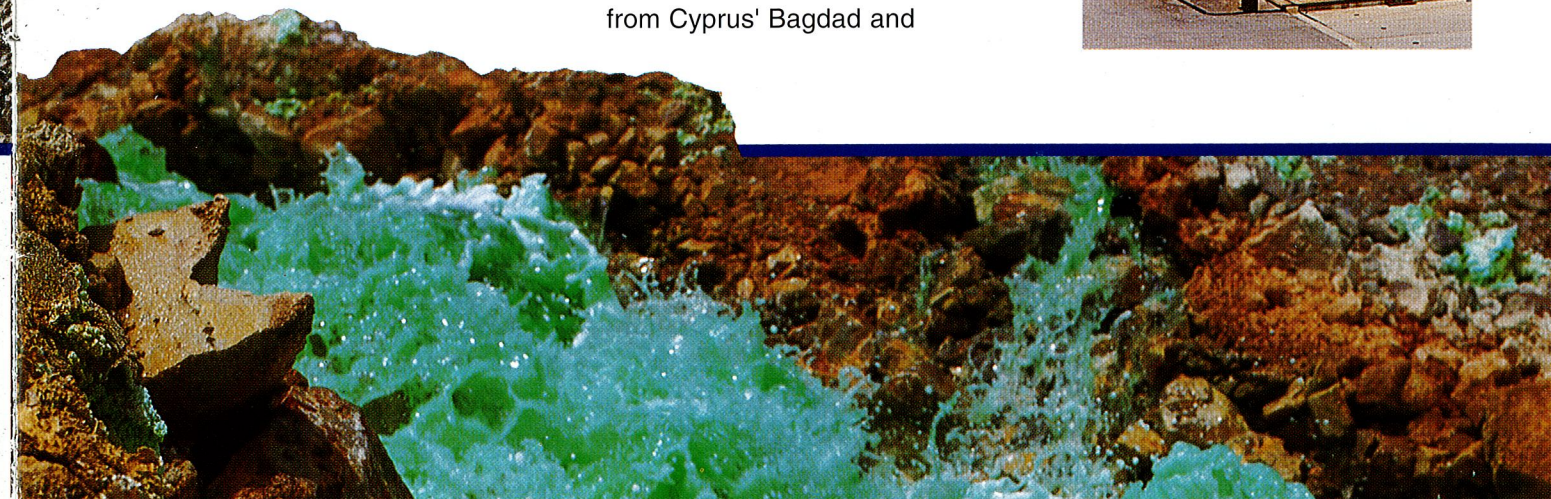
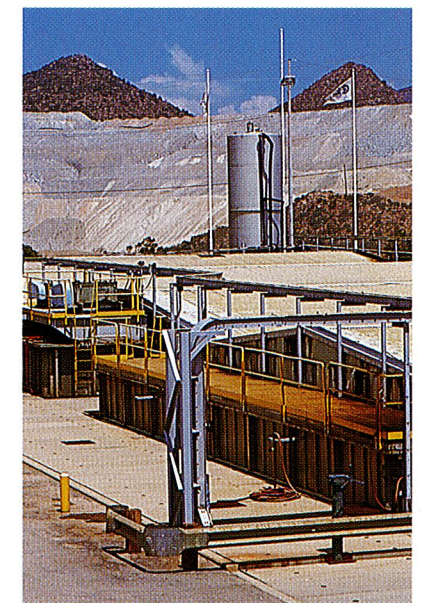
At nearly nine thousand gallons per minute, it takes about three months to complete the S/X circuit. Ninety four percent of the copper in the leach solution is extracted, producing 360,000 pounds of copper per day. Virtually all of the raw materials are recycled, following extraction of the copper.

Concentrates

Concentrates are shipped to the Cyprus Miami Smelter from Cyprus' Bagdad and

Sierrita mines as well as from other operations. Cyprus Miami no longer produces copper concentrates.

Copper concentrates, converted at the Smelter, are produced by successively grinding raw ore into powder and immersing the powder in a reagent bath. The reagents cause the copper to separate from the ore and float in a froth. The froth is collected, thickened and filtered, yielding a concentrate with 25 to 35 percent copper content.



S M E L T E R

Copper concentrates arrive from Cyprus' Bagdad and Sierrita mines. In addition, we purchase concentrates and other copper containing raw materials from a variety of sources. We also toll smelt for other copper producers – that is, under contractual arrangements, we make anodes for their refineries using their raw materials.

The Smelter operation is a sophisticated orchestration of complex systems designed to maximize product quality, employee safety, environmental protection, resource recovery and conservation. Basically, this is how our Smelter works. Concentrates are heat dried and mixed with flux. The mixture is fed into an electric furnace, melted at 2250° F. The flux combines with non-copper impurities and iron oxides which float to the top of the furnace and are poured or "tapped" off. The remaining material, principally copper and iron sulfides, goes to special-

ized vessels, called converters, where oxygen enriched air is introduced through the liquid material. The sulfur is oxidized, forming sulfur dioxide and trioxide which are captured, processed into sulfuric acid and trucked to the leaching operation. Now 99.8 percent pure, the copper is cast into anodes.

Our smelter control systems have been significantly upgraded. Plus, in 1991-92, we invested nearly 100 million dollars in a new smelting technology, called IsaSmelt, which will improve not only our processing capabilities but also our cost efficiency.

The annual anode production capacity of the Miami Smelter has been about 250 million pounds. With IsaSmelt, we will increase smelting production by about fifty percent while reducing costs and improving resource recovery.

The Isamelt technology incorporates a specially engineered vessel which accepts an undried flux/concentrate



mixture; this eliminates the costly drying function. The melting is accomplished by injecting air and natural gas directly into a heated feed mixture; significant amounts of the sulfur are oxidized in this vessel, making the furnace and converters more energy and time efficient.

Isamelt and other concurrent improvements will reduce fuel and maintenance costs, simplify operations, enhance copper recovery and purity, increase production, and improve plant safety.

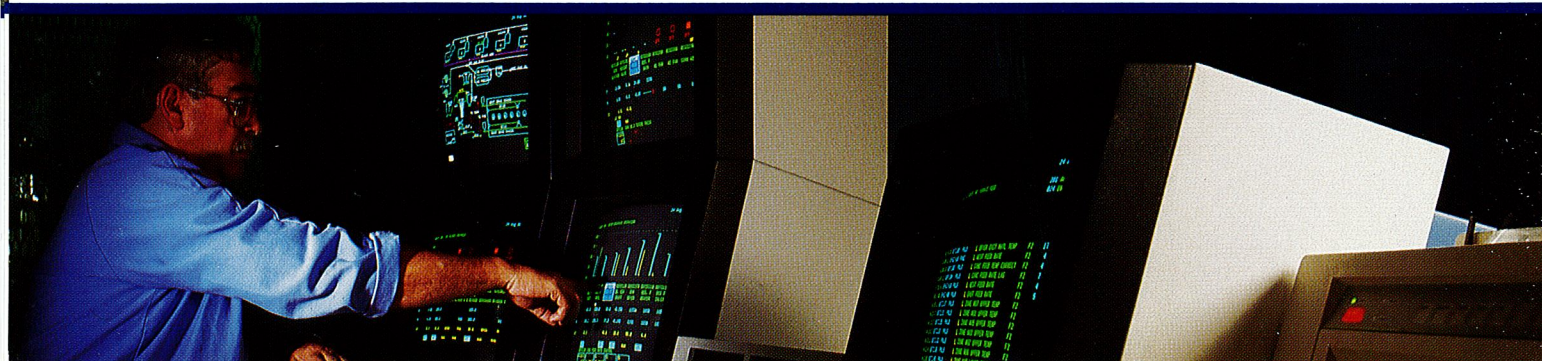


Our new computer control center monitors and manages all smelter functions with highly sophisticated software and user-friendly, touch

screen controls.

With the addition of IsaSmelt technology, anode production will approach 400 million pounds annually.

The smelting operation creates slag – waste material chemically bonded to silica – which is environmentally safe for land disposal.



REFINERY

Our Refinery uses two types of electrochemical systems to produce pure copper cathodes: electrolytic refining (or electrorefining) and electrowinning.

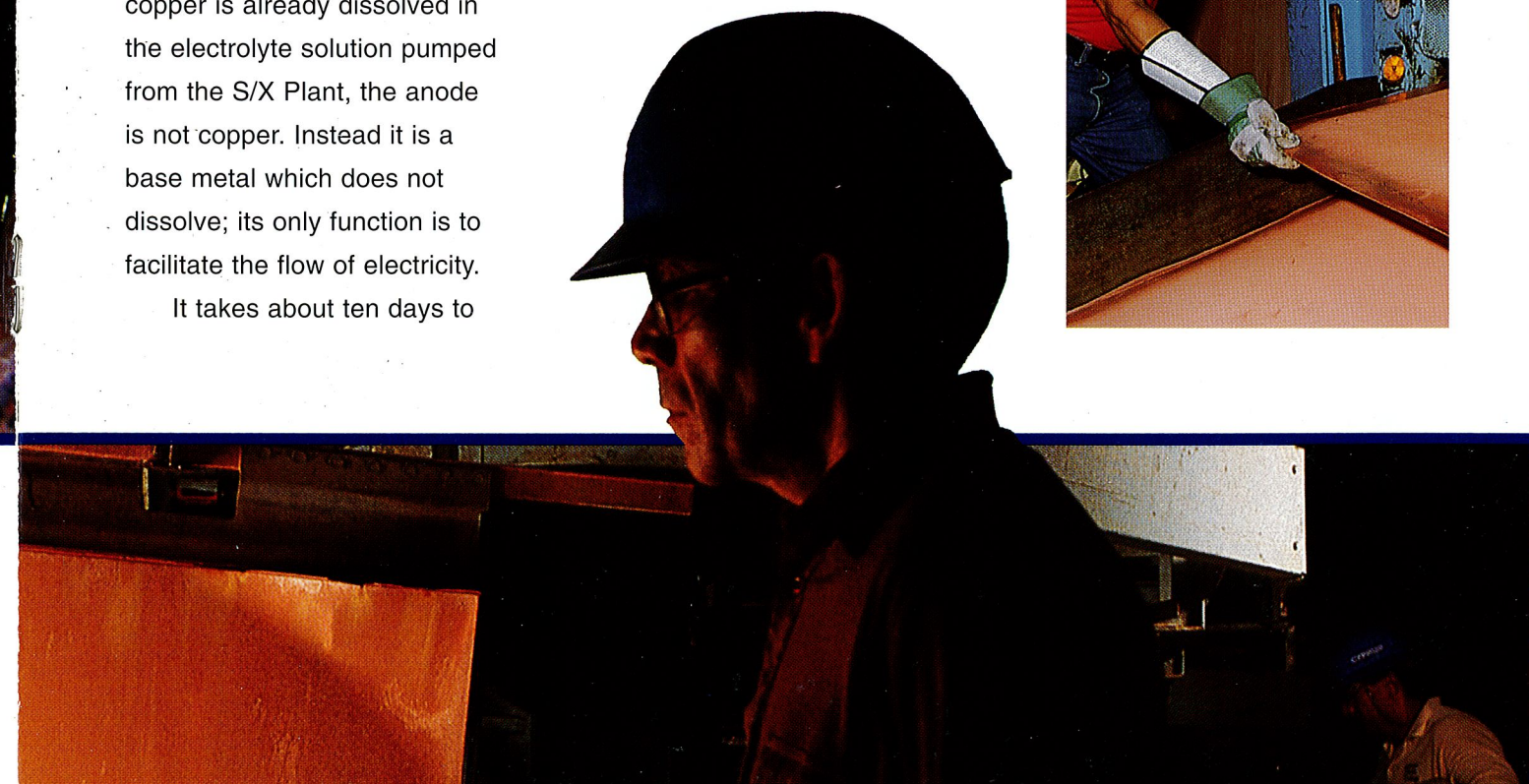
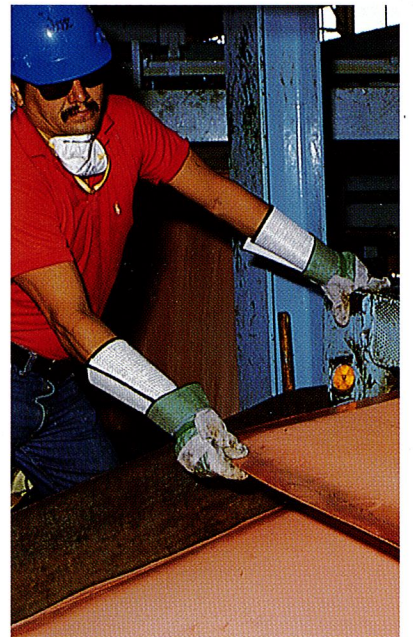
In the electrorefining process, 99.8 percent copper anodes (which we produce in our smelter) and 99.99 percent copper cathode starter sheets (which we produce here in the Refinery) are placed in an electrolyte solution. As current passes from the positive anode to the negative cathode, the anode copper dissolves in the electrolyte and subsequently deposits on the negative cathode. Impurities do not deposit on the cathode; they settle out or remain in solution. The electrowinning process is similar. However, since the copper is already dissolved in the electrolyte solution pumped from the S/X Plant, the anode is not copper. Instead it is a base metal which does not dissolve; its only function is to facilitate the flow of electricity.

It takes about ten days to

produce a 300 to 350 pound cathode with electrowinning, about two weeks for a 400 to 500 pound cathode with electrorefining.

In both processes the cathodes begin as "starter sheets" which are made by electroplating titanium cathodes. When the copper deposited on the titanium reaches a thickness of roughly an eighth of an inch, the copper sheet is stripped off. Since titanium and copper do not chemically bond, the starter sheets are 99.99 percent pure copper.

The Cyprus Miami Refinery produces more than 220 million pounds of pure copper cathodes annually, about 85 million through electrorefining, 135 million through electrowinning.



The Refinery has 80 electrorefining cells and 140 electrowinning cells. A starter sheet is first stripped from a

recyclable titanium cathode. After flattening the sheet, pure copper loops are affixed and a copper covered steel

hanger bar inserted.

Cathodes are moved by rail to our Rod Plant.

R O D P L A N T

In 1969, a continuous cast rod production plant was built at the Cyprus Miami mine site; it was the first of its kind to be located at a mine site, yielding transportation cost advantages as well as improved quality controls. Over the years, we have upgraded our processing system and invested in new technology and equipment. Currently, our Rod Plant capacity exceeds 260 million pounds of high quality 5/16 inch rod.

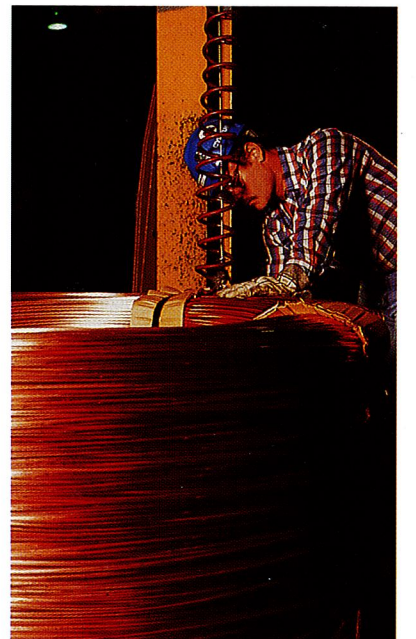
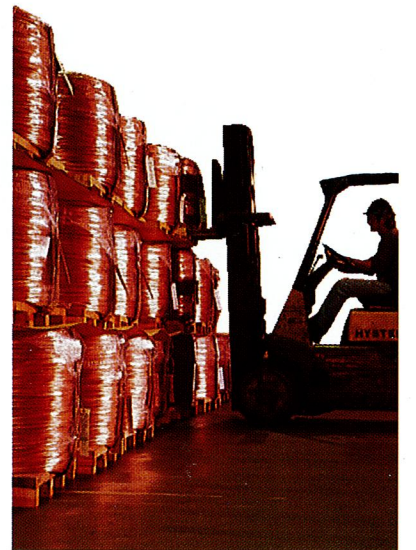
The rod fabrication process begins with a vertical shaft furnace where cathodes from our Refinery and others are melted. The molten copper flows to a 2040°F holding furnace where any residual slag or gases are eliminated. The copper is poured from the furnace and cast into a continuous bar with a height of 2 inches and a cross area of 5.2 square inches. As it begins to cool, the bar passes through a trim die before being fed through a series of 12 pairs of grooved rollers, reshaping and

reducing its size to a 5/16 inch rod.

At the end of the production line, the rod is pickled to reverse oxidation, cooled and coiled. The coils are placed on pallets, strapped, stretch-wrapped and warehoused for shipment. Nominal weights are 6,000; 8,000; or 15,000 pounds (actual weights range from 5,800 to 6,100; 7,900 to 8,100; and 14,500 to 15,200 pounds respectively). Shipping is available by truck, rail and container.

Our customers use our rod to manufacture telecommunications cable, building wire, magnet wire, power cable, and other products. Conductivity, ductility, annealability and tensile strength are just four of many critical factors which lead to efficient manufacturing and superior performance.

Cyprus Miami rod, with a very high level of acceptance in the North American wire market, is known for its excellent quality.



As the continuous cast bar cools, it is reduced in our mill to 5/16 inch diameter rod.

When the rod leaves the automatic coiler, it is banded with steel. It is then stretch wrapped in clear plastic.

Production capacity in our Rod Plant is about 260 million pounds per year.





Our Acid Plant, adjacent to the Smelter, converts sulfur dioxide gas into 1,150 tons of sulfuric acid per day. The acid is pumped to the leach pads.

In the Smelter's converters, copper is purified by bonding waste material to flux (creating slag) and oxidizing sulfur

(creating sulfur dioxide gas). The slag, which floats to the top of the converter, is poured off.

Occupational Safety

We recognize that a key reason for Cyprus Miami's success is our commitment to employee safety and health. Our firm conviction is that thorough and proper preparation prevents accidents.

We back this up with strict equipment maintenance regimens, with immediate on-line problem resolution, with extensive job and safety training, with individual responsibility for safe activity, with emergency preparedness, and with monetary incentives for consistently safe performance.

The result has been an exemplary overall safety record. Plus, in 1991, for the third consecutive year, our Smelter and Rod Divisions were recognized as the safest in Arizona.

Environmental Safety

Environmental protection and cost-effective operations go hand in hand at Cyprus Miami because we recycle

many of our raw materials.

In the leach-solvent extraction and refinery circuits, sulfuric acid solutions are continuously "reactivated" and recycled as are the reagents and organic compounds in the S/X Plant. In the Smelter, sulfur dioxide, created in the smelting process, is captured. After an electrostatic precipitator removes particulates and cools, cleans and dries the gas, it is converted into sulfuric acid and trucked to tanks feeding the leach pads.

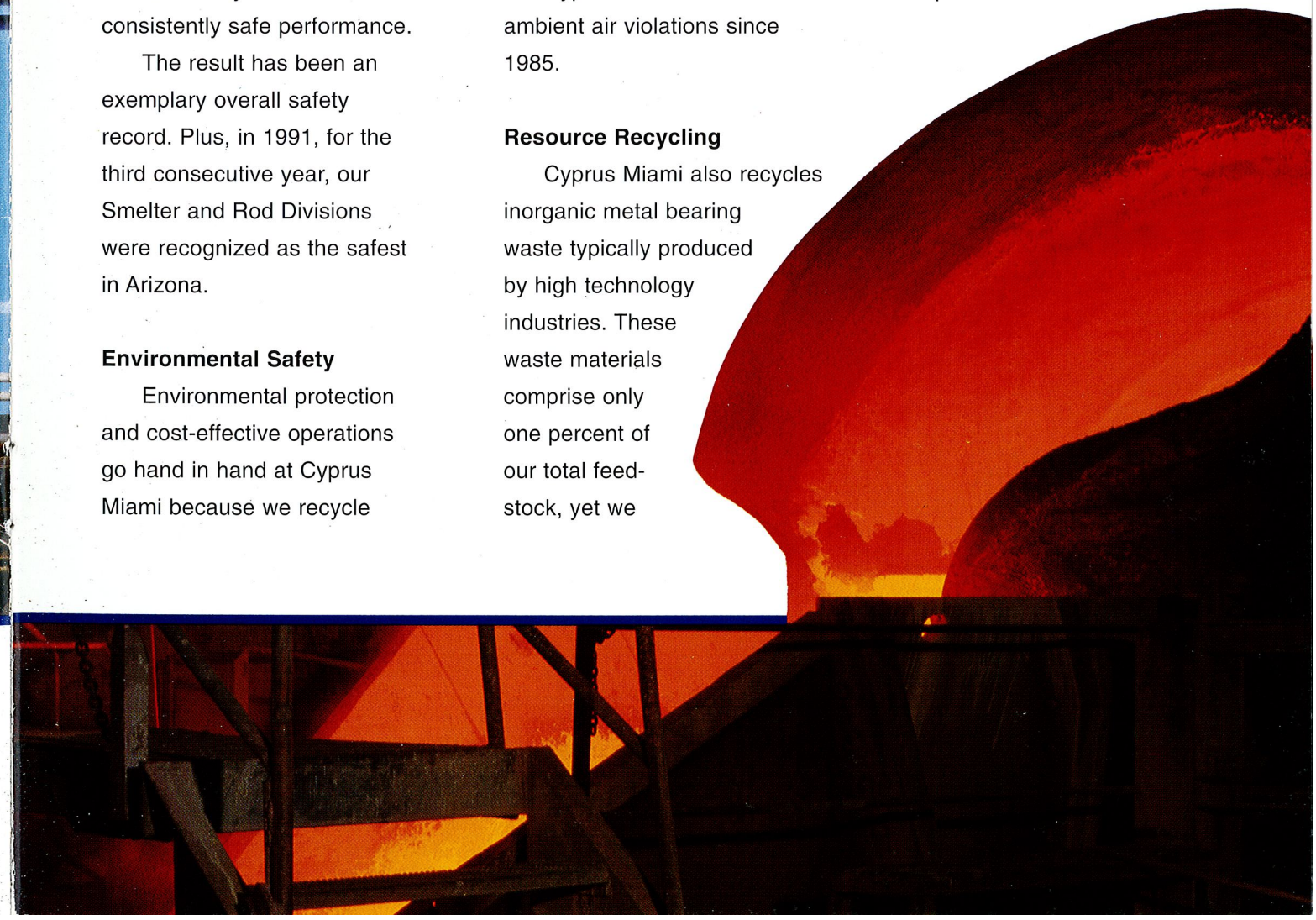
Cyprus Miami has had no ambient air violations since 1985.

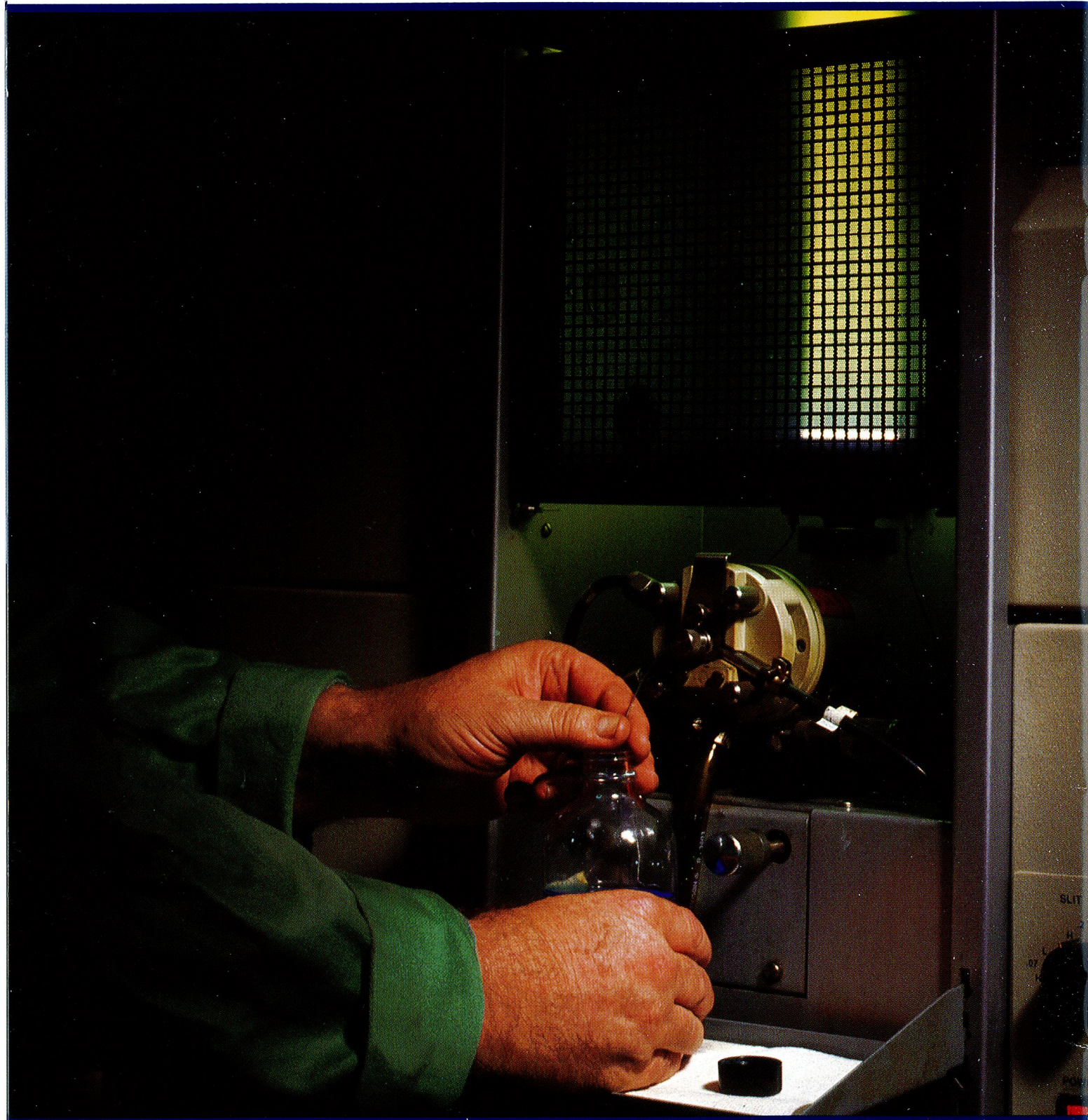
Resource Recycling

Cyprus Miami also recycles inorganic metal bearing waste typically produced by high technology industries. These waste materials comprise only one percent of our total feed-stock, yet we

currently accept material from more than 100 companies. Copper and precious metals are extracted in our smelting process. Also in the smelting process, non-metallic waste is chemically bonded to silica slag, making it "unleachable" and safe for disposal.

Our resource recycling program not only complies with environmental and regulatory concerns but also extends the useful life of valuable metals and contributes to the nation's effort to minimize landfill disposal methods.





Cyprus Miami rod performs exceptionally well, principally because of our attention to quality. Rod production is tested for all critical parameters prior to shipment. We use the electro-

lytic reduction technique to determine surface oxide levels.

Emission spectrometry is our principal assaying technique. Our standard tests measure in parts per million: silver,

arsenic, bismuth, cadmium, cobalt, chromium, iron, manganese, nickel, lead, antimony, selenium, tin, tellurium, zinc, oxygen, and sulfur.

Our Quality Assurance Program is aimed at one final goal – total customer satisfaction. Our technical skills, our engineering capabilities and processing capacities, our resource management and marketing services, our financial strength ... all are targeted to achieve this.

Since, within Cyprus Miami, one operation's output is another's input, we have established objectives, duties and responsibilities throughout each of our operations. We employ Statistical Process Control (SPC) techniques to optimize each processing stage, prevent mistakes and assure predictable inter-operation materials.

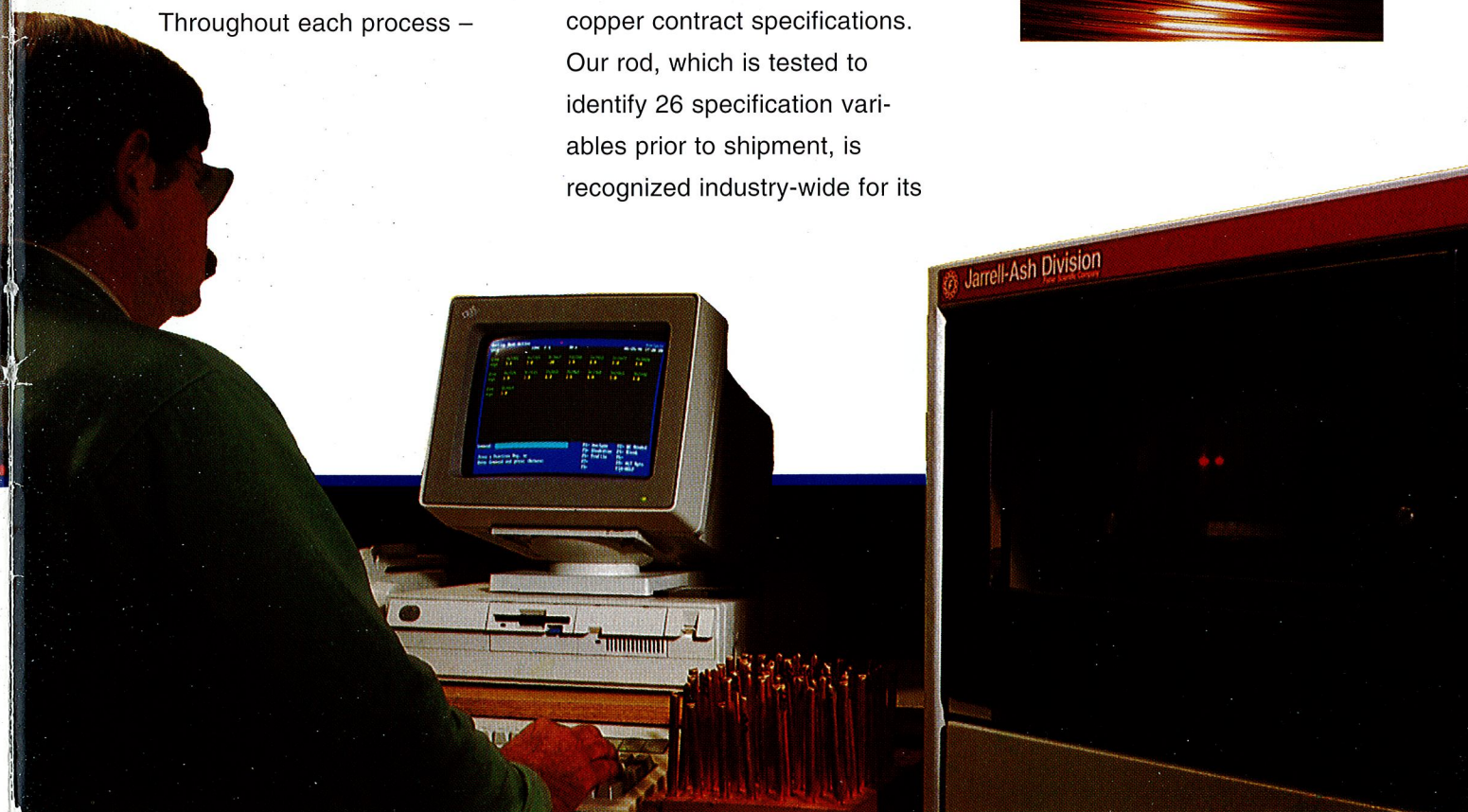
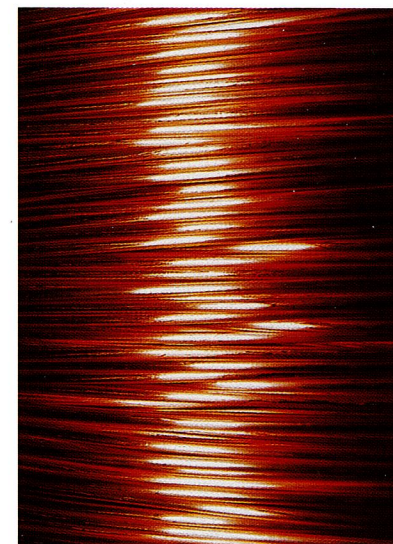
Throughout each process –

mining, leaching, smelting, solvent extraction, refining, rod conversion, and resource recovery – we monitor equipment, material throughput and all critical product variables. Where appropriate, we draw in-process samples and construct X-bar and R charts and frequency histograms to assure continuous in-spec performance. We also test each operation's final product, verifying acceptability for the next operation. The benefits of "doing it right the first time" are enormous.

Our commitment to quality has yielded measurable results. Cyprus Miami rod consistently exceeds ASTM and COMEX High Grade copper contract specifications. Our rod, which is tested to identify 26 specification variables prior to shipment, is recognized industry-wide for its

exceptional performance in the manufacture of wire.

Our Quality Assurance Program not only works to minimize our costs, it guarantees products that perform predictably and conform consistently to our customers' highest specifications.



Cyprus Copper Company,
part of Cyprus Minerals
Company, is one of the
world's leading producers of
copper products. Our mines
contain reserves of more
than one billion tons of cop-
per ore plus nearly one half
billion tons of copper/molyb-
denum ore. We operate
smelters, electrolytic and
electrowinning refineries as
well as two continuous cast
rod plants. Production ap-
proaches three quarters of a
billion pounds of copper an-
nually.

Cyprus Copper Company

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PO Box 22015
Tempe, AZ 85285-2015
602-929-4441

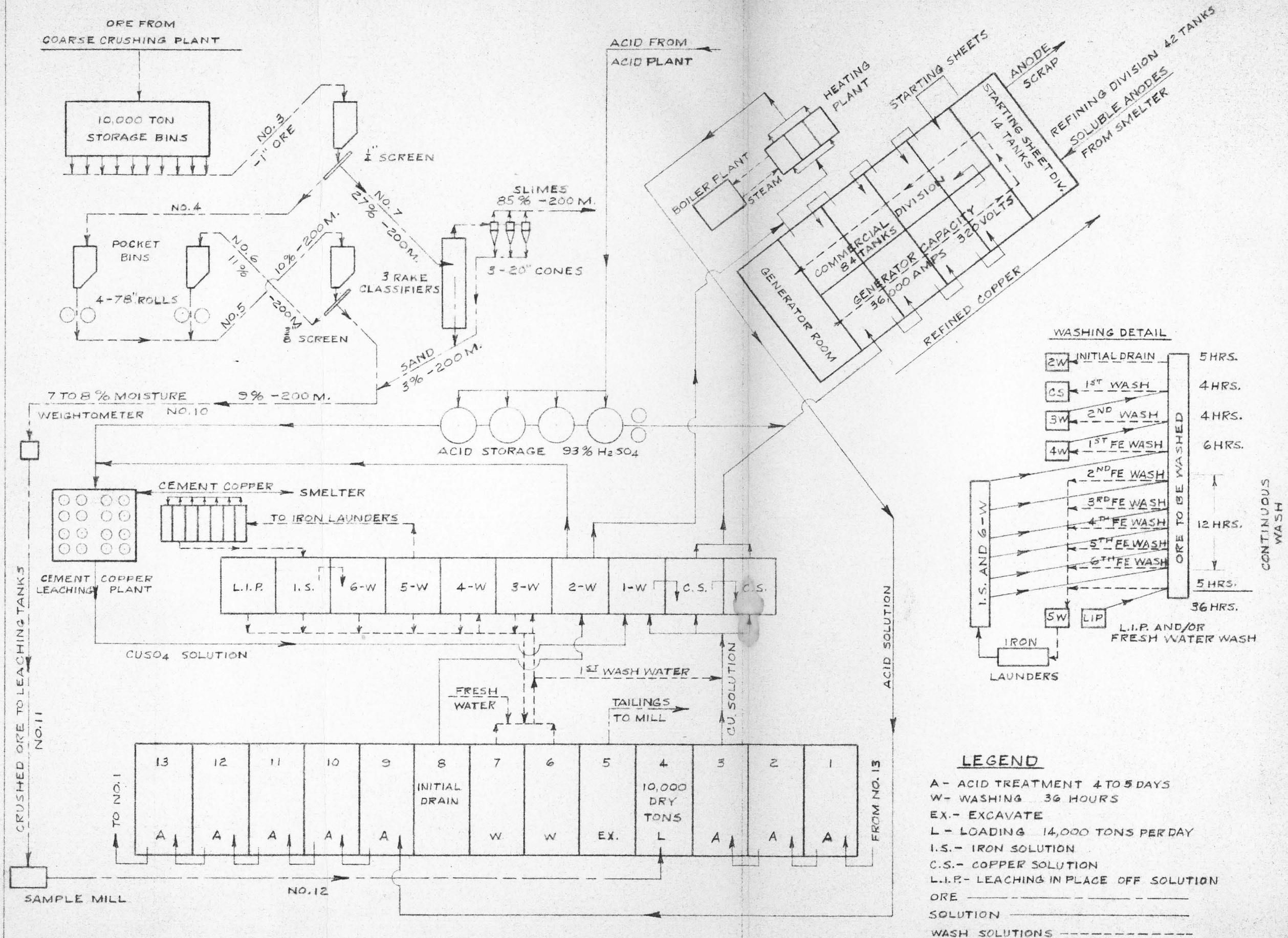
Cyprus Miami Mining Corp.

P.O. Box 4444
Claypool, AZ 85532
602-473-7080



FLOW SHEET OF THE INSPIRATION CONSOLIDATED COPPER CO. LEACHING PLANT

DRG. NO. X-1292



FLOW SHEET OF THE INSPIRATION CONSOLIDATED COPPER CO. LEACHING PLANT

DRG. NO. X-1292

