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KENNECOTT COPPER CORPORATION
RAY MINES DIVISION
RAY, ARIZONA

April 22, 1959

Following is a copy of a story that is being released today by Ray Mines Division, Kennecott Copper Corporation, to Arizona newspapers:

Ray, April 22....Kennecott Copper Corporation today announced its plans to increase the surface of its Ray Mines Division pit as part of its previously announced $40 million expansion program.

The pit expansion, which is already underway, will necessitate the removal of 45 buildings in Sonora and Barcelona this year and evacuation of the entire business section of Ray within five years.

It will also mean the relocation of the Ray mine general shop area, including the machine shop, boiler shop, car repair shop, electrical shop and warehouse.

Before the end of this year, 37 buildings will have to be removed from their present sites in Sonora. These buildings lie within a 200-foot safety zone around the edge of the planned pit expansion.

Another eight buildings in the small community of Barcelona, south of Sonora, are now being removed since they lie within the expansion area.

The houses in Barcelona and Sonora were built on land owned by Kennecott. Although the company is under no legal obligation to reimburse the residents for the improvements they have made, Kennecott will give each resident a sum of money to be based on the size and condition of the house that is to be removed.

During the past two years, 54 buildings in Sonora have been moved or torn down under similar arrangements because of pit expansion.

Buildings in the Ray business section are owned by Kennecott and leased to the merchants. Because the planned expansion of the pit will leave this section dangerously close to future blasting operations, it will have to be evacuated before 1964.

Kennecott will provide business sites to the west in Ray for those merchants who wish to build new stores to continue to serve Ray. Some of the merchants have already announced plans to open stores in the new town of Kearny, 12 miles south of Ray.

The building of the town of Kearny is a private enterprise of the John W. Galbreath Development Corporation.

The Kennecott pit expansion will require the construction of new general shop facilities to the south near the intersection of State Highway 177 and the present road to Sonora.

The Arizona Highway Department is already working on plans to re-route Highway 177 to run west of Sonora rather than through Ray as it does now.

Kennecott is hauling waste material from the pit stripping operation and is providing fill for approximately three miles of this re-routing.

The enlargement of the pit area is the second announced phase of the $40 million expansion program in Ray-Sonora and Hayden.

The first phase of this program was completion of a modern multi-million dollar smelter in Hayden.

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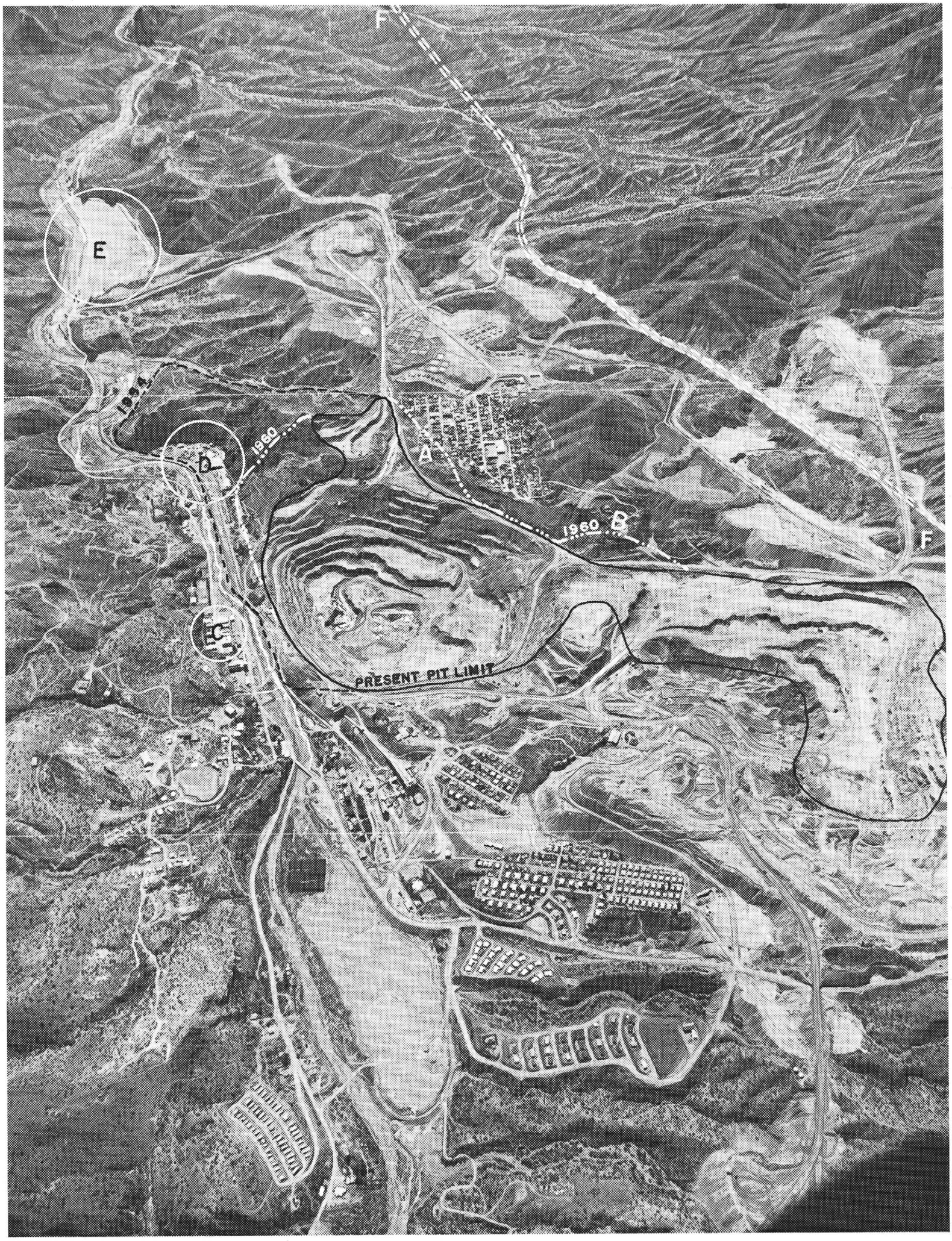
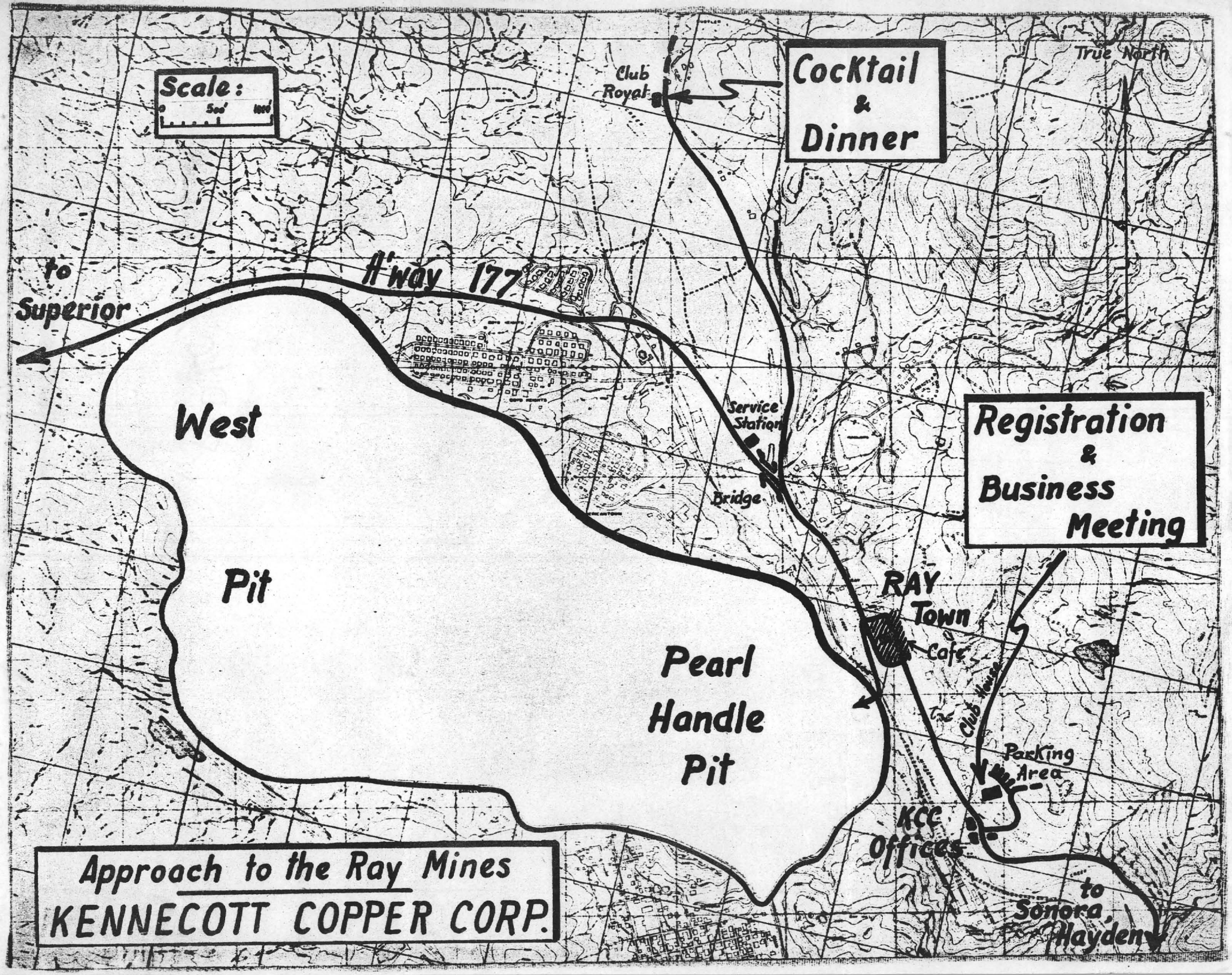
The accompanying aerial photograph shows the present outline of the Ray Mines Division pits and the projected outlines in 1960 and 1964. The expansion will necessitate the removal of 37 buildings in Sonora (A) and eight buildings in Barcelona (B). By 1964, the downtown section of Ray (C) will be evacuated and the general shops (D) will be relocated to the south (E). State Highway 177 will be re-routed (F-F) to bypass Ray.


NATIONAL


F
E
1960
D
1960
A
1960
B
F
C
PRESENT PIT LIMIT


Scale:
50'
100'
Club Royal
Cocktail & Dinner
True North
to Superior
H'way 177
West Pit
Service Station
Bridge
Registration & Business Meeting
RAY Town
Cafe
Club House
Pearl Handle Pit
Parking Area
KCC Offices
to Sonora, Hayden
Approach to the Ray Mines
KENNECOTT COPPER CORP.

RAY OREBODY

± 7000' E-W

± 2000' wide

Extends ± 2000' E of Mineral Creek

Structural Boundary on N. & W. Fades to S. Fades to E?

Possible escape trends to E:

Due east

N 60 E

A BRIEF HISTORY OF THE RAY DISTRICT

The Mineral Creek Mining District, which includes the Ray area, was organized by silver prospectors in 1873. In 1880 the Mineral Creek Mining Co. built a five-stamp mill, then in 1883 the Ray Copper Co. took over and built a 30-ton copper furnace. The ore of the area was described as principally native copper. There was little activity until 1898 when the claims were purchased by the Globe Mines Exploration Company, (Ltd.), of London. The following year the ground was acquired by the Ray Copper Mines, (Ltd.), another British Company.

During the first year of its existence the new company founded the town of Kelvin and erected a 250-ton mill there. Ray and Kelvin were connected by a 7 mile narrow gauge railroad, various shops and offices were erected, and a 344 ft. shaft was sunk at Ray. Supplies were transported by steam traction engine 43 miles from Red Rock, the nearest shipping point on the railroad. There was no mining activity between 1901 and 1905.

D. C. Jackling was attracted to the district in 1906. The Ray Copper Co. and Gila Copper Co. were organized to acquire the English Company's holdings; they were merged as the Ray Consolidated Copper Co. in 1910. Other companies to become active in the district in 1906 and 1907 were the Arizona Hercules Copper Mining Co., Kelvin Calumet Mining Co. and Ray Central Mining Co.

The properties of all these Companies were acquired by the Ray Consolidated Copper Co. through the years. A mill was placed in operation at Hayden during 1911 and production started from the mines at Ray. In 1912 a smelter was built by A.S.& R. at Hayden. In 1924 Ray Consolidated Copper acquired the Chino Copper Co. in New Mexico. In 1926 the Nevada Consolidated Copper Co. absorbed the Ray Consolidated holdings and these holdings were later absorbed by Kennecott Copper Corp.

Mining methods underground and metallurgical processes at the mill underwent a slow but constant improvement. The Ray Mines were the first underground operation to produce 8000 tons of ore per day by the block caving method.

There was a brief shut-down of mining operations in 1921. Operations were again shut down during the depression between 1933 and 1937.

In 1938 the first unit of a modern precipitating plant was placed in operation. The plant has now expanded to six units which handle 2000 gallons of solution per minute, from underground workings and waste dumps.

During 1948 it was decided to mine the remaining ore by open pit methods. The Isbell Construction Company stripped waste from the Pearl Handle Pit under contract from 1948 to 1952. First ore was mined by open pit methods in 1950. The capacity of the Mill at Hayden was increased to 15,000 tons a day. A new Crushing Plant was built at Ray to handle the pit ore. Ore from the pit was gradually increased and from the underground mine decreased, until February 1, 1955, when underground mining was discontinued.

To increase recovery of non-sulphide copper in the ore, a Leach-Precipitation-Flotation Plant (L-P-F Plant) has been built at Hayden at a cost of over $5,000.000. This involves a special flotation section for recovery of previously rejected pyrite. This is roasted to produce sponge iron and sulphuric acid. The acid is used to leach the ore in the Mill feed and remove the soluble copper which is then precipitated on the sponge iron and recovered by flotation.

During 1956, work was started on an expansion program to increase production capacity to 22,500 tons of ore a day. A new Smelter is being constructed at Hayden to treat the concentrates which have previously been treated by the American Smelting and Refining Company.

Reference: Ransome - U.S.G.S. Professional Paper #115
1919, 1923
Notes from Mr. Leroy Hoyt

The Ray Orebody

Foreword.

The geology of the area was first described by Ransome in 1919, later revised by him in 1923 in U.S.G.S. Professional Paper #115. It is a wonderful piece of work that still remains essentially correct. Valuable contributions to the Ray geology were later made by Spurr and Cox (private report, July 1909), C. L. Hoyt (private report, 1938) and Otis M. Clarke, (Arizona Geological Society Guidebook, 1952).

In the present work, the constant supervision of Mr. Donald D. Smythe, his continued advice and personal study of the deposit have largely increased our knowledge on the major structures with, as a result, a substantial increase in ore reserves.

The progressive policy observed by Mr. A. P. Morris, General Manager, keeps pace with the geological work by a well-planned and systematic drilling program, well worth mentioning.

Location.

Ray is located at the foothills of the Dripping Spring Mountains on Mineral Creek which flows South into the Gila River.

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The Stratigraphic sequence is first reviewed and the most important rocks are here briefly described. The basement consists of the Pinal Schist, old pre-Cambrian in age and contemporary to the Vishu Schist in the Grand Canyon. The formation generally shows a northeast-southwest schistosity, dipping to the NW from 30 to 60 degrees. Many local folds are observed in this formation which is composed of metamorphosed sedimentary rocks, generally showing an alternation of shaly and quartzose layers, and of intrusive rocks like rhyolite and what is locally called "amphibolite-schist".

The color of the Pinal Schist is generally gray with a bluish hue outside of the mineralized area turning naturally into different shades of brown within it.

The Apache group unconformably overlies the Pinal Schist and is also pre-Cambrian. The lower part of it is mainly composed of the Pioneer formation, generally a shale, the Barnes conglomerate, and the Dripping Spring quartzite. These rocks show in the vicinity of Ray a regional trend slightly east of north with a low dip, 10 to 20 degrees eastward.

The Pioneer formation, the Dripping Spring quartzite, and the Pinal Schist are at times quite difficult to differentiate, be it in the field on the surface geology, or in the examination of drill-core.

The tan-colored Mescal limestone is next in the sequence and is often seen in conjunction with dark brown basaltic flows that covered it.

The Troy quartzite, Cambrian in age, follows.

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Long before Laramide time, heavy faulting occurred and incompetent rocks such as the Dripping Spring quartzite, were broken and fractured. Diabase was intruded shortly after, lifting the separate masses of quartzite and filling all existing fissures.

A specific fracture trending NNW and SSE with a dip of 45 degrees to the East has been filled with diabase: it is now conspicuously visible in the pit. To the East of Mineral Creek there is considerable diabase, some existing as sills between members of the Apache group and other portions underlying the whole series as an extensive mass. Another series of irregular fractures exhibit the same trend but they occur more vertically; in this group we have the Ray fault and the Mineral Creek fault.

Porphyry next intruded the area. The Teapot Mountain porphyry came first, exhibiting well formed felspar and quartz phenocrysts, and it was followed by the Granite Mountain porphyry. It appears that this latter porphyry forced its way through fractures that trend in an opposite direction to those previously noted;

it is found along a NE-SW trend irregularly intruded but it also shows here and there as small stocks.

One interesting observation is the fact that the Teapot Mountain porphyry occurs North of an East-West line passing approximately through the pit, while the Granite Mountain porphyry definitely shows South of that line. Copper mineralization occurred simultaneously or slightly after the intrusion of the Granite Mountain porphyry.

After a presumably long interval of time, during which erosion and also secondary enrichment occurred, the country was covered by tertiary flows, tuffs, and conglomerates: Whitetail conglomerate, dacite flow, Gila conglomerate, then tuffs and volcanic breccias.

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2. Structure.

A major fault zone, particularly complex near Ray, extends along Mineral Creek exhibiting a Northwest-Southeast trend. It seems to show an en-echelon pattern with successive downthrows to the East, almost all steep.

The movement along this major fault area has been estimated by Ransome, Cox and Spurr, to amount to 1500 ft. and even 2000 ft. It started before Laramide time with a relative downthrow of the east block, later alternated with an upthrow and finally with a renewed and important downthrow again of the eastern area.

Recent Tertiary movement is well shown by the conspicuous offset observed in the dacite flow: some remnants occur on the Teapot Mountain to the Northwest at 4400 ft. elevation while a larger mass of dacite occurs near town (best seen at the bridge) at 2050 ft. elevation and more. Another obvious indication of this large offset is obtained from a look at the geologic map. It shows a solid area of Pinal schist west of the fault zone without any of the later sediments. This contrasts with later sediments found to the east, ranging from the Cambrian up to the Tertiary.

It is worth mentioning that while the west block has been disturbed relatively little, the eastern one shows a broken assemblage of formations that Ransome justly calls a mosaic. It is fortunate that stratigraphy can partially assist in deciphering this jumble; the Barnes conglomerate is of particular help here as a faithful and conspicuous marker.

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It will be difficult for a long time to determine for certain which are the faults that pre-date or post-date mineralization; most of them probably antidated mineralization then recurrence of movement during and/or after mineralization blurred the whole picture.

Without any doubt the later fault movements have influenced the supergene orebody: for instance, the oxidation zone in the eastern block is much deeper than in the western zone because the water-table has followed the downward movement of that bloc.

A major structure observable in the pit is an over-thrust fault oriented N20W, dipping 15 degrees East. This truncated the main diabase dike, displacing its upper body toward the west; no remnant of the upper body has been found yet as it is probably all eroded. The lower body has been dragged close to the fault and extends irregularly toward the west as an elongated tongue.

The westward displacement along this thrust fault is indicated in section by an offset (known from drill-hole data) of parts of the porphyry mass existing east of the pit. The amount of displacement might amount to a few hundred feet.

3. Mineralization.

The three formations seen in the pit are the diabase, a dark-gray color, the schist ranging from a light pink to a reddish brown and the porphyry often lighter in color.

Hypogene mineralization occurs more conspicuously in the diabase under the form of chalcopyrite and pyrite. The rock is fractured and broken, although fine-grained and dense. It is hard to break, hard to drill and hard to crush; however it crumbles easily by disintegration after a few months of exposure in the air. A hammer blow breaks it along pre-existing fractures and each new blow breaks it along more tiny fractures all of which are mineralized. This mineralization does not extend far away from the fracture, perhaps a tenth or 2 tenths of an inch. It is not truly disseminated therefore, and it could better be called reticulated for example, as E. N. Pennebaker labeled it (verbal communication).

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Gold and silver in minute quantity accompany the copper minerals with some molybdenum.

Native copper has been one of the copper minerals frequently found in the Ray ore zones. Cuprite sometimes under the form of chalcotrichite with its delicate hairlike crystals, is also abundant in places.

4. Alteration.

Little hydrothermal alteration as such seems to have affected the diabase. The schist, on the other hand, exhibits much more alteration although less than at other mines, such as Chino, etc. Sericitization is the main phenomenon and it occurs generally along with mineralization; it is well displayed in the whole western portion of the Pearl Handle Pit. Some silicification mainly along faults also shows at places. It has been repeatedly observed in field specimens from the pit and outside, that a small bleached zone of sericitization occurs on either side of pyrite veins but the phenomenon does not occur along quartz veins.

Another type of alteration connected with thermal metamorphism is seen in the pit west of the diabase: this is the occurrence of larger masses of a siliceous rock quite sericitic, grayish and fine-grained, occasionally still showing remnants of schistosity. It breaks, however, like diabase with a similar occurrence of mineralization, often then having a darker grayish color.

Two such occurrences have been found. One shows in the diabase, near its underface, north of the pit, where it looks more like a stoped mass of schist in the diabase. The other, quite extensive, shows on the west side of the pit below but adjacent to the diabase. The occurrence seems in this case to be more of a transitional type. The color is generally light gray, sometimes whitish gray showing a marked contrast with the dark diabase to the east and the brown reddish schist further west. Thin sections made from this rock showed it to be a sericitized quartzite.

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There is much speculation about this question. It appears, however, that one of the small stocks of Granite Mountain porphyry is much more broken and shattered than others; it is located east of the present pit and on the Ray fault within the ore body.

A well shattered porphyry stock in the middle of a heavy fault zone, accompanied by a general rustiness of the rocks in the area, seems a valid criteria for good porphyry copper. The presence of diabase, as is seen in other mines of the vicinity, is an additional favorable factor influencing the orebody.

J. Wertz

(Paper presented at the Spring Meeting AIME, Geology Division, Ray, Arizona on April 12, 1958).

① Study dist. of the 2 types of porph.
② Heights of intrus.

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5. Origin of the Ore.

There is much speculation about this question. It appears, however, that one of the small stocks of Granite Mountain porphyry is much more broken and shattered than others; it is located east of the present pit and on the Ray fault within the ore body.

A well shattered porphyry stock in the middle of a heavy fault zone, accompanied by a general rustiness of the rocks in the area, seems a valid criteria for good porphyry copper. The presence of diabase, as is seen in other mines of the vicinity, is an additional favorable factor influencing the orebody.

J. Wertz

(Paper presented at the Spring Meeting AIME, Geology Division, Ray, Arizona on April 12, 1958).

A BRIEF HISTORY OF THE RAY DISTRICT

The Mineral Creek Mining District, which includes the Ray area, was organized by silver prospectors in 1873. In 1880 the Mineral Creek Mining Co. built a five-stamp mill, then in 1883 the Ray Copper Co. took over and built a 30-ton copper furnace. The ore of the area was described as principally native copper. There was little activity until 1898 when the claims were purchased by the Globe Mines Exploration Company, (Ltd.), of London. The following year the ground was acquired by the Ray Copper Mines, (Ltd.), another British Company.

During the first year of its existence the new company founded the town of Kelvin and erected a 250-ton mill there. Ray and Kelvin were connected by a 7 mile narrow gauge railroad, various shops and offices were erected, and a 344 ft. shaft was sunk at Ray. Supplies were transported by steam traction engine 43 miles from Red Rock, the nearest shipping point on the railroad. There was no mining activity between 1901 and 1905.

D. C. Jackling was attracted to the district in 1906. The Ray Copper Co. and Gila Copper Co. were organized to acquire the English Company's holdings; they were merged as the Ray Consolidated Copper Co. in 1910. Other companies to become active in the district in 1906 and 1907 were the Arizona Hercules Copper Mining Co., Kelvin Calumet Mining Co. and Ray Central Mining Co.

The properties of all these Companies were acquired by the Ray Consolidated Copper Co. through the years. A mill was placed in operation at Hayden during 1911 and production started from the mines at Ray. In 1912 a smelter was built by A.S.& R. at Hayden. In 1924 Ray Consolidated Copper acquired the Chino Copper Co. in New Mexico. In 1926 the Nevada Consolidated Copper Co. absorbed the Ray Consolidated holdings and these holdings were later absorbed by Kennecott Copper Corp.

Mining methods underground and metallurgical processes at the mill underwent a slow but constant improvement. The Ray Mines were the first underground operation to produce 8000 tons of ore per day by the block caving method.

There was a brief shut-down of mining operations in 1921. Operations were again shut down during the depression between 1933 and 1937.

In 1938 the first unit of a modern precipitating plant was placed in operation. The plant has now expanded to six units which handle 2000 gallons of solution per minute, from underground workings and waste dumps.

During 1948 it was decided to mine the remaining ore by open pit methods. The Isbell Construction Company stripped waste from the Pearl Handle Pit under contract from 1948 to 1952. First ore was mined by open pit methods in 1950. The capacity of the Mill at Hayden was increased to 15,000 tons a day. A new Crushing Plant was built at Ray to handle the pit ore. Ore from the pit was gradually increased and from the underground mine decreased, until February 1, 1955, when underground mining was discontinued.

To increase recovery of non-sulphide copper in the ore, a Leach-Precipitation-Flotation Plant (L-P-F Plant) has been built at Hayden at a cost of over $5,000.000. This involves a special flotation section for recovery of previously rejected pyrite. This is roasted to produce sponge iron and sulphuric acid. The acid is used to leach the ore in the Mill feed and remove the soluble copper which is then precipitated on the sponge iron and recovered by flotation.

During 1956, work was started on an expansion program to increase production capacity to 22,500 tons of ore a day. A new Smelter is being constructed at Hayden to treat the concentrates which have previously been treated by the American Smelting and Refining Company.

Reference: Ransome - U.S.G.S. Professional Paper #115
1919, 1923
Notes from Mr. Leroy Hoyt

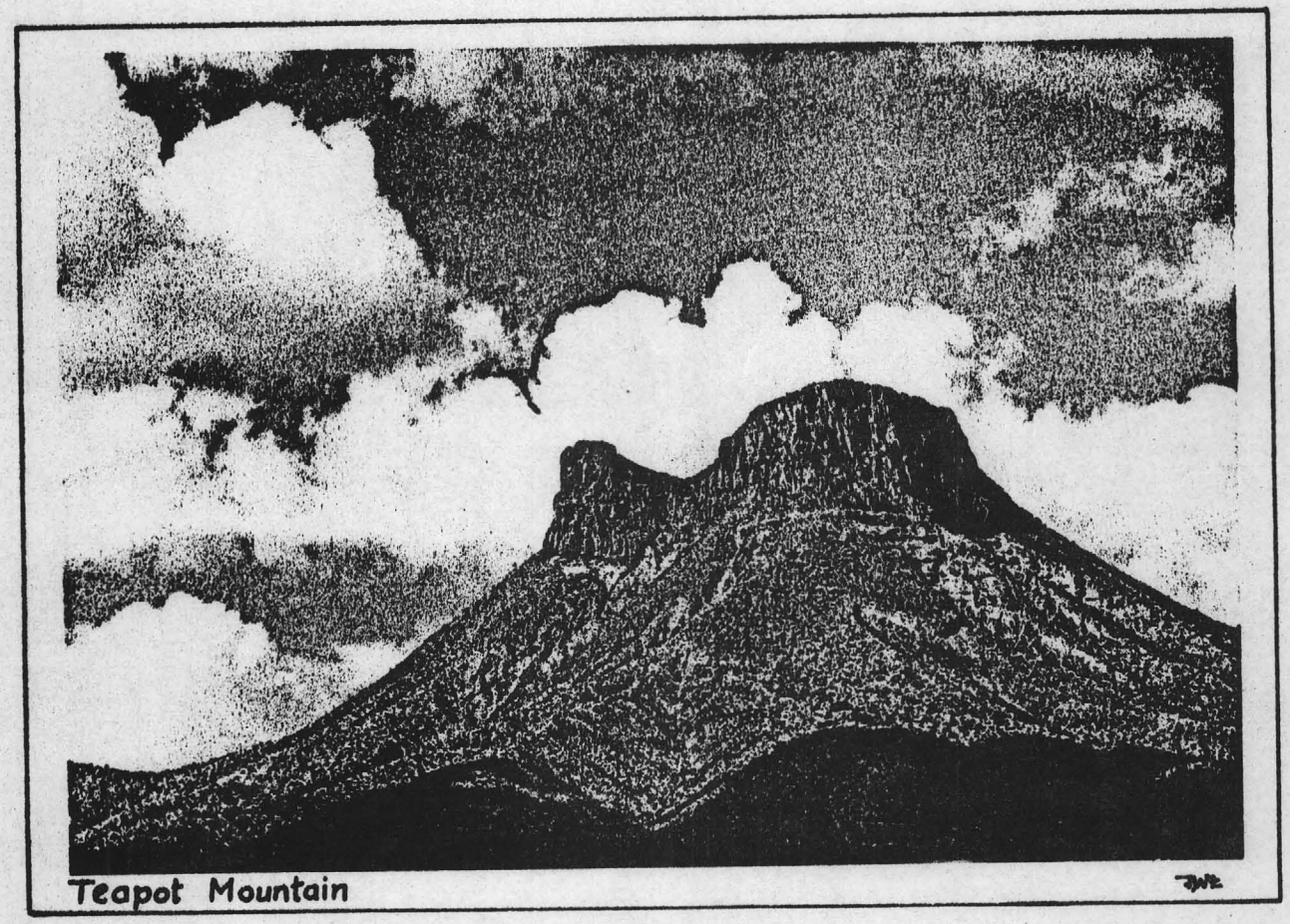
WELCOME

TO

KENNECOTT COPPER CORPORATION

RAY MINES DIVISION,
RAY, ARIZONA.

A. P. MORRIS
General Manager

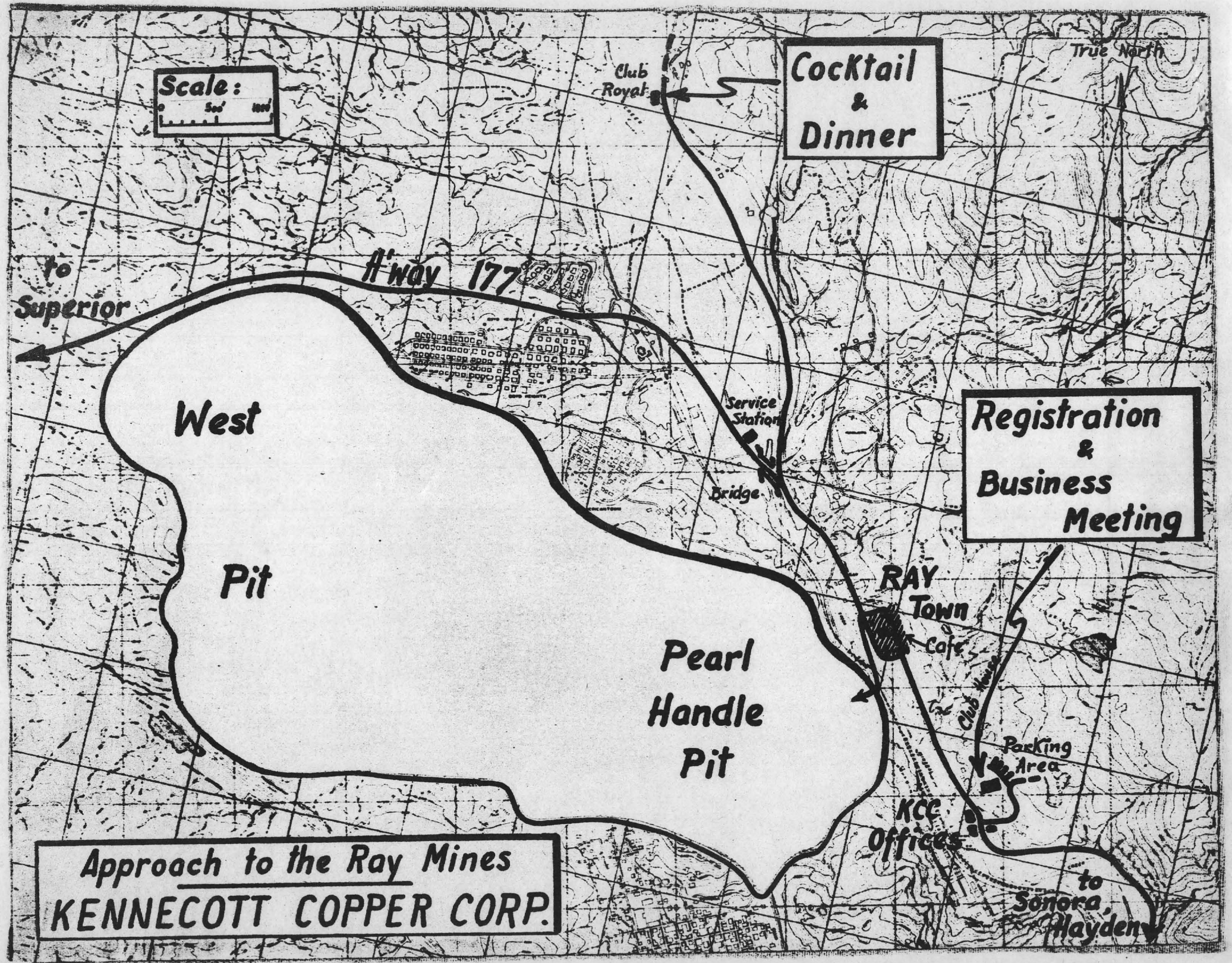


Teapot Mountain

SPRING MEETING

A.I.M.E. — GEOLOGY Division

APRIL 12, 1958


Scale:
0 500' 1000'
Club Royal
Cocktail & Dinner
True North
to Superior
H'way 177
West Pit
Service Station
Bridge
Registration & Business Meeting
RAY Town
Cafe
Club House
Parking Area
Pearl Handle Pit
KCC Offices
to Sonora, Hayden
Approach to the Ray Mines
KENNECOTT COPPER CORP.

Schedule of the Day.

9:00 - 10:00 AM Registration

10:00 - 12:00 AM Business Meeting

1. Welcome Address by Mr. A.P. Morris, General Manager, and Chairman of the Arizona Section A.I.M.E.

2. New Developments on the Geology of the Ray Deposit by Mr. Jacques B. Wertz, Chairman Geology Division.

3. A discussion on adjacent districts will be held next.

12:15 - 1:30 PM Lunch period (at or around the Club House)

It is advised to bring lunches, cokes and coffee being available at the Canteen. (The company will not intervene in the cost of this meal.)

1:30 - 2:00 PM Film (17 min.) at Club House:

"Four-Day Cycle from Ore to Copper"

Club House

2:00 - 3:30 PM Visit of the pit, by van.

(the cars are left parked near the Club House)

3:30 - 4:15 PM Final stop at the bottom of the pit; collecting of samples.

(The vans have left but will be back by 4:15 PM)

4:30 - 4:45 PM Back to the Club House by vans.

Drive to Club Royal by private cars.
(Wash-up period either at Club House or Club Royal)

Pit Tour

5:15 - 6:15 PM Cocktails.

6:15 - on Mexican dinner.

(Choice Mexican dinner or steak)
Dinner and cocktails on the Company.

Club Royal

COPPER

by Kennecott

A GOOD NEIGHBOR HELPING TO BUILD A BETTER ARIZONA

Kennecott COPPER CORPORATION RAY MINES DIVISION

A GOOD NEIGHBOR HELPING TO BUILD A BETTER ARIZONA

Kennecott COPPER CORPORATION RAY MINES DIVISION

ARIZONA is the "COPPER ORE" BIN . . . OF AMERICA

LONG FAMED as the copper state, Arizona produces 45 per cent of the nation's new domestic copper, and the production from new mines is expected to raise the total to nearly 50 per cent.

Arizona copper production dates to pre-colonial days. Indian artisans fashioned trinkets and crude implements from copper. Under the Spanish Conquistadors, copper was mined by methods used when Caesar's legions fought the stalwart Gauls.

The first copper mining in Arizona as U. S. territory was in 1854, the year the Gadsden Purchase added southern Arizona to the nation. But early lack of land transportation slowed development.

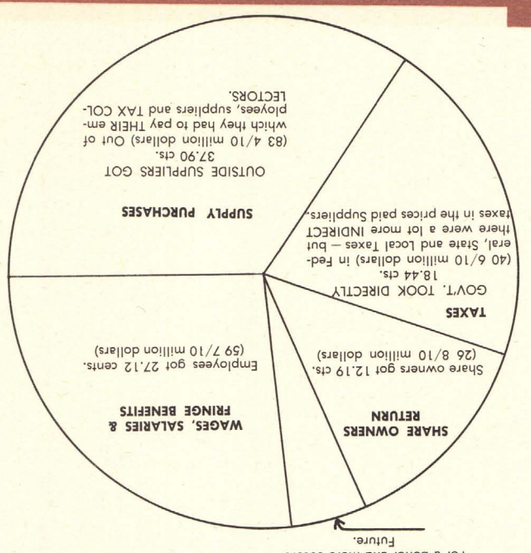
- KENNECOTT COPPER CORPORATION ..... RAY MINES DIVISION (RAY AND HAYDEN)
- PHELPS DODGE CORPORATION ..... MORENCI, AJO, BISBEE AND DOUGLAS
- MIAMI COPPER COMPANY ..... COPPER CITIES AND MIAMI
- INSPIRATION CONSOLIDATED COPPER COMPANY ..... INSPIRATION
- MAGMA COPPER COMPANY ..... SUPERIOR AND SAN MANUEL
- AMERICAN SMELTING & REFINING COMPANY ..... SILVER BELL
- BAGDAD COPPER COMPANY ..... BAGDAD
- PIMA MINING COMPANY ..... SAHUARITA

It was 1864 — while the war cries of Indian raiders still punctuated the rumble of wagon trains — that copper prospecting began in southeastern Arizona where the state's modern mining industry started. Ten years later, prospectors began working through the Mineral Creek area near Ray, and small scale mining operations were begun at Ray in 1883. In the Globe-Miami area work started in 1882, and the United Verde development in the mountainous country near present-day Jerome (a ghost town now) was started that year.

SIX COUNTIES — Greenlee, Gila, Pinal, Pima, Cochise and Yavapai — produce over 99 per cent of Arizona's output of more than three-quarters of a billion pounds of copper annually. Copper is mined in 12 of the state's 14 counties. The Arizona copper industry has produced approximately 28,500,000,000 pounds of copper since the first production reports began in 1874 — a veritable mountain of metal for American industry.

In 1943, after 69 years of carefully recorded production and exploration (and more than 70 years of actual production) Arizona had over twice as much known copper as was thought to have been in the ground in recoverable form in 1903! It has been more than 37 years since a large rich grade ore body has been found — but the state's taxable wealth has been steadily enriched — both immediately and for coming years — by the copper industry.

The chart below, based on work by the Arizona Department of Mineral Resources, shows the division of the dollar received by the copper mining industry of Arizona. The figures are based on 1953 reports.



IN 1954, THE WAGES OF ARIZONA COPPER MINERS were higher than those of any other industry in the state, and nearly 50 per cent higher than in the 1947-1949 period. In addition, employees now have fringe benefits valued at 20 per cent of their wages.

ARIZONA'S MAJOR COPPER PRODUCERS TODAY ARE:

ORE TO COPPER . . . . A 4 DAY CYCLE

KENNECOTT COPPER CORPORATION is creating new wealth for Arizona and providing a vital metal for America by making a molehill out of a mountain at Ray, Arizona, 80 miles southeast of Phoenix.

KENNECOTT'S RAY MINES DIVISION is continuing a large scale mining operation started more than 44 years ago. Despite the much lower copper content of the ore, modern technology and research have extended the life of the mine.

After more than 40 years of production from an underground mine at Ray, it became apparent by the end of World War II that the ore suitable for mining by underground methods soon would be exhausted. It was known that a mass of low grade ore existed, but the copper content was so low it could not be mined profitably from underground workings.

In 1946 Kennecott started a program of drilling to determine whether the Ray Mine could be converted into an open pit operation. The drilling disclosed enough low grade ore in the Ray ore body to make the conversion possible.

Between 1948 and 1952, 43 million tons of worthless rock was removed from on top of the ore body to make the ore available for mining.

The ore averages approximately one per cent copper, or about 20 pounds of copper to the ton. Of this, an average of 17½ pounds is recovered.

The mining operation begins when holes are drilled into the working levels of the mine, and the holes are loaded with 500 to 600 pounds of explosives each. A "shot" of eight to ten holes breaks 35,000 to 45,000 tons of ore and waste.

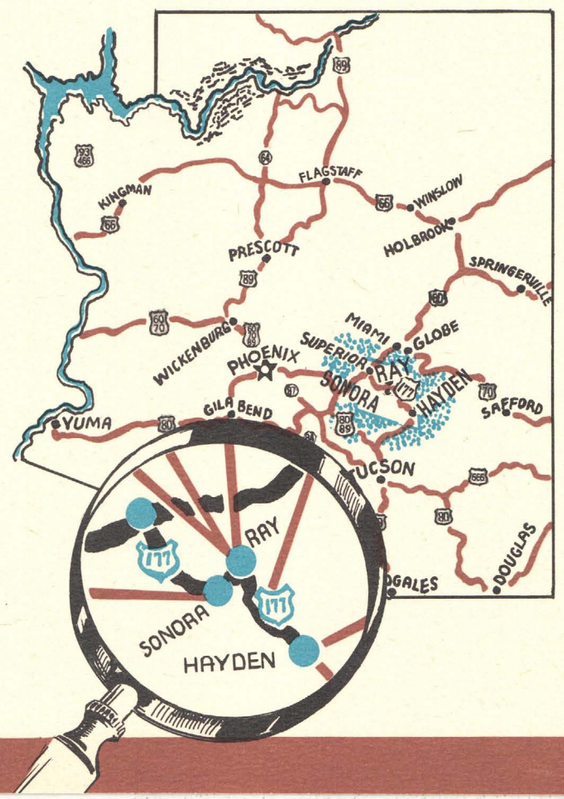
THE BROKEN MATERIAL is loaded into giant diesel-powered trucks of 35 and 50-ton capacity by electric shovels which scoop as much as 11 tons at a bite. The ore is taken to the crushing plant. The material containing less than four-tenths of one per cent copper, is hauled more than a mile to the waste dumps.

AT THE CRUSHING PLANT, the ore is broken to a maximum ¾ inch size, and loaded into 60-ton dump cars and hauled in 38-car trains to Ray Junction, six miles away. Here the cars are picked up by the Southern Pacific Railroad and hauled 15 miles to Kennecott's concentrator at Hayden.

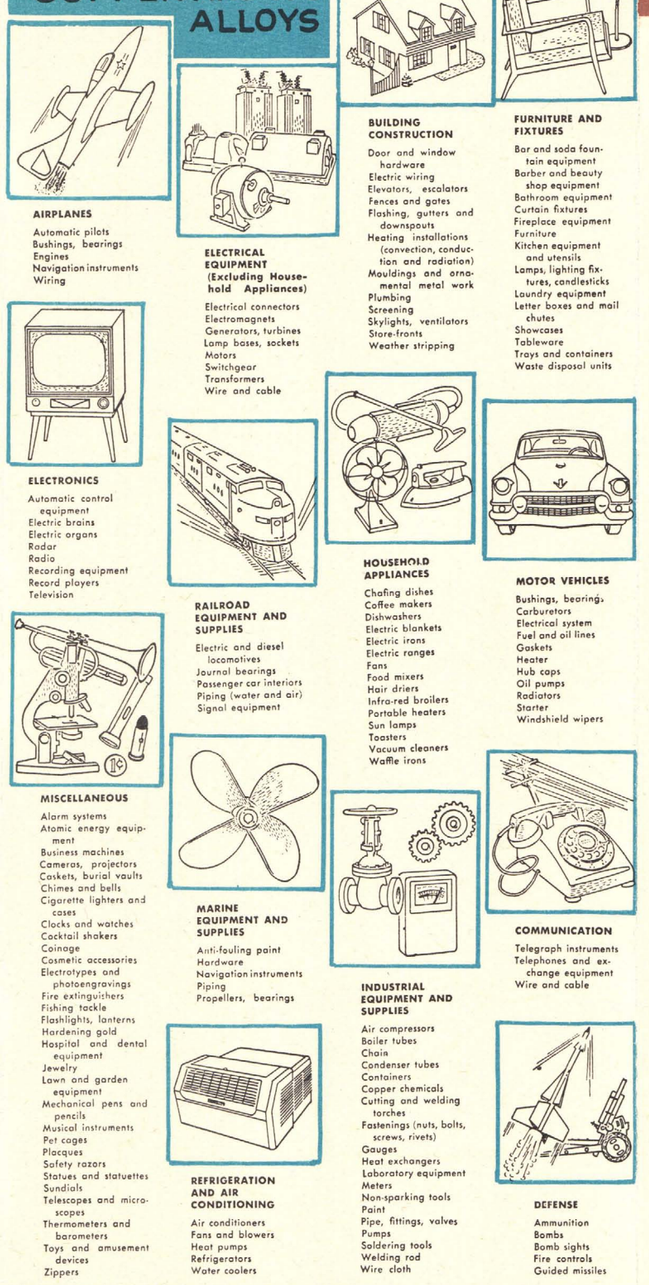
AT THE CONCENTRATOR, the ore is crushed to powder fineness and mixed with water and chemical reagents. A frothing agent is then added to the mixture, and the mineral particles attach themselves to the bubbles and ride them to the surface and over the top of the flotation cells. The waste particles remain at the bottom of the cells.

The material that floated over the top of the cells is a concentrate containing 20 to 30 per cent copper. When dried, it is smelted at the Hayden smelter and poured as 400 pound cakes of blister copper, 98-99.5 per cent pure. The copper is then shipped to electrolytic refineries at Baltimore, Md., and Perth Amboy, N. J., for further purification.

THE RAY MINES DIVISION works constantly on new methods of increasing the efficiency of copper recovery. The program of teaming research and investment helps maintain Arizona's position as the leading state in copper production, and conserves the resources of copper by getting maximum recovery from the ore.



USES OF COPPER AND ITS ALLOYS



AIRPLANES
Automatic pilots
Bushings, bearings
Engines
Navigation instruments
Wiring

ELECTRICAL EQUIPMENT (Excluding Household Appliances)
Electrical connectors
Electromagnets
Generators, turbines
Lamp bases, sockets
Motors
Switchgear
Transformers
Wire and cable

BUILDING CONSTRUCTION
Door and window hardware
Electric wiring
Elevators, escalators
Fences and gates
Flashing, gutters and downspouts
Heating installations (convection, conduction and radiation)
Mouldings and ornamental metal work
Plumbing
Screening
Skylights, ventilators
Store-fronts
Weather stripping

FURNITURE AND FIXTURES
Bar and soda fountain equipment
Barber and beauty shop equipment
Bathroom equipment
Curtain fixtures
Fireplace equipment
Furniture
Kitchen equipment and utensils
Lamps, lighting fixtures, candlesticks
Laundry equipment
Letter boxes and mail chutes
Showcases
Tableware
Trays and containers
Waste disposal units

ELECTRONICS
Automatic control equipment
Electric brains
Electric organs
Radar
Radio
Recording equipment
Record players
Television

RAILROAD EQUIPMENT AND SUPPLIES
Electric and diesel locomotives
Journal bearings
Passenger car interiors
Piping (water and air)
Signal equipment

HOUSEHOLD APPLIANCES
Chafing dishes
Coffee makers
Dishwashers
Electric blankets
Electric irons
Electric ranges
Fans
Food mixers
Hair driers
Infra-red broilers
Portable heaters
Sun lamps
Toasters
Vacuum cleaners
Waffle irons

MOTOR VEHICLES
Bushings, bearings
Carburetors
Electrical system
Fuel and oil lines
Gaskets
Heater
Hub caps
Oil pumps
Radiators
Starter
Windshield wipers

MISCELLANEOUS
Alarm systems
Atomic energy equipment
Business machines
Cameras, projectors
Caskets, burial vaults
Chimes and bells
Cigarette lighters and cases
Clocks and watches
Cocktail shakers
Coinage
Cosmetic accessories
Electrotypes and photoengravings
Fire extinguishers
Fishing tackle
Flashlights, lanterns
Hardening gold
Hospital and dental equipment
Jewelry
Lawn and garden equipment
Mechanical pens and pencils
Musical instruments
Pet cages
Placques
Safety razors
Statues and statuettes
Sundials
Telescopes and microscopes
Thermometers and barometers
Toys and amusement devices
Zippers

MARINE EQUIPMENT AND SUPPLIES
Anti-fouling paint
Hardware
Navigation instruments
Piping
Propellers, bearings

INDUSTRIAL EQUIPMENT AND SUPPLIES
Air compressors
Boiler tubes
Chain
Condenser tubes
Containers
Copper chemicals
Cutting and welding torches
Fastenings (nuts, bolts, screws, rivets)
Gauges
Heat exchangers
Laboratory equipment
Meters
Non-sparking tools
Paint
Pipe, fittings, valves
Pumps
Soldering tools
Welding rod
Wire cloth

COMMUNICATION
Telegraph instruments
Telephones and exchange equipment
Wire and cable

REFRIGERATION AND AIR CONDITIONING
Air conditioners
Fans and blowers
Heat pumps
Refrigerators
Water coolers

DEFENSE
Ammunition
Bombs
Bomb sights
Fire controls
Guided missiles

KENNECOTT . . . AN INDUSTRIAL CITIZEN . . . . . .

THE COPPER MINING INDUSTRY has been a cornerstone of Arizona's economy, and Kennecott's Ray Mines Division has been a cornerstone of the economy of Pinal County.

FOR 44 YEARS, the mine at Ray and the concentrating mill at Hayden have been in large scale production almost continuously. The last underground section of the Ray Mine was closed in January 1955, but the open pit section already was in production so that there was no interruption in the flow of ore to the concentrator.

BACK OF THE RAY MINES DIVISION is the combined investment of nearly 90,000 Kennecott Copper Corporation shareholders. This investment has provided more than $32,000 worth of tools, working equipment and plant installations for each of the nearly 1,000 employees of the Ray Mines Division.

THIS HEAVY INVESTMENT has enabled the division to treat the low grade copper ore on a mass production basis — the only way it could be handled economically. Thus, the investment has enabled the division to make an important economic contribution to Arizona and to Pinal County.

Since its beginning as a copper producer, the Ray Mines Division has paid into the economy of Arizona and the nation more than $275,000,000 in wages and salaries, purchases, and tax payments.

To Arizona, the growth of the Ray Mines Division has meant approximately $16,000,000 in tax benefits, plus annual payrolls now totalling more than $5,000,000. Purchases of supplies and equipment, which have, in recent years, amounted to more than $4,000,000 annually, have spread a widening ring of purchasing power throughout Arizona.

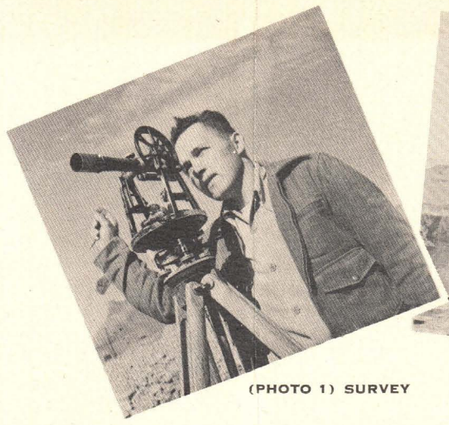
The Ray Mines Division's scholarship program provides four annual scholarships for graduates of the Ray and Hayden High Schools, plus an annual scholarship at the College of Mines of the University of Arizona, plus a matching grant to the University. The Division also makes available funds to the University and State Colleges which have been used for public lecture series and purchases of scientific equipment.

COPPER . . . . Your Metal Servant FOR LIFE!

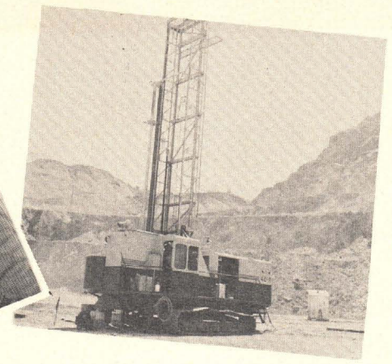
FROM ORE.....

Copper begins its four-day ore to copper cycle when a transitman (photo 1) and crew survey a series of blast holes; the holes, to be loaded with 500 to 600 pounds of dynamite each, are drilled with massive drills (photo 2), and then a blast moves 35,000 to 45,000 tons of material (photo 3). The broken material is loaded into giant trucks of 35 to 50 tons capacity, by electric-powered shovels of nearly 11 tons capacity (photo 4); the loaded ore is hauled (photo 5) to the nearby crushing plant (photo 6-7) where it is reduced by jaw and cone crushers and rolls to a maximum of ¾ inch size. The waste material is hauled approximately 1¼ miles to the waste dump (photo 8). (About 2½ tons of waste must be moved for each ton of ore.)

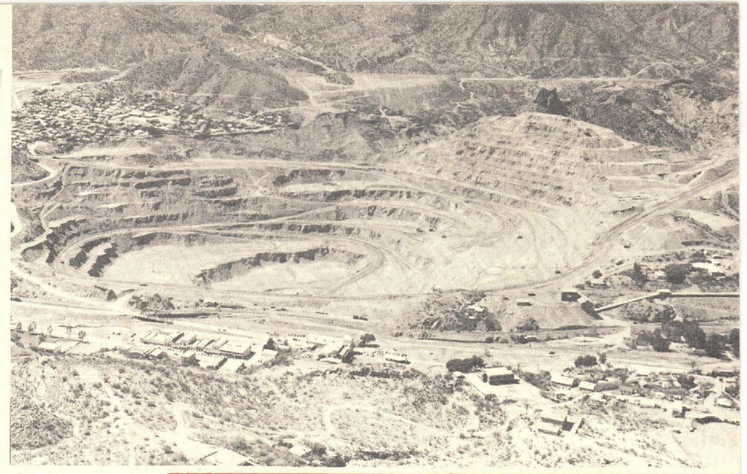
The crushed ore is now ready for shipment to the concentration mill at Hayden, 21 miles southeast of Ray. The ore is loaded into trains of 38, 60-ton cars each (photo 9). The trains are hauled on the Company's own industrial spur (photo 10) to Ray Junction, where the cars are picked up by the Southern Pacific Railroad.



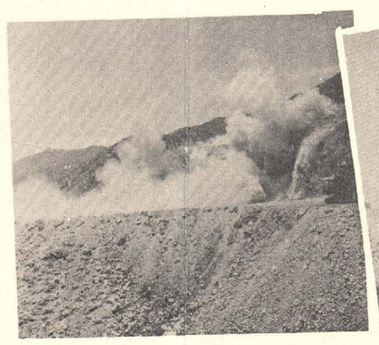
(PHOTO 1) SURVEY



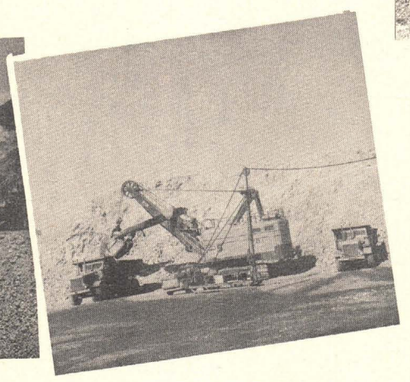
(PHOTO 2) ROTARY DRILL



RAY

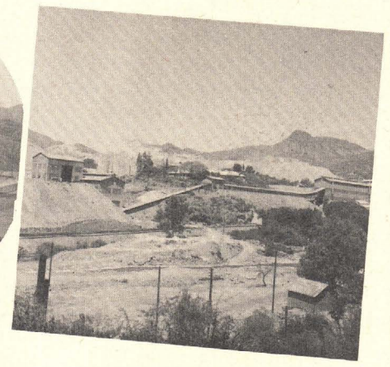


(PHOTO 3) BLAST

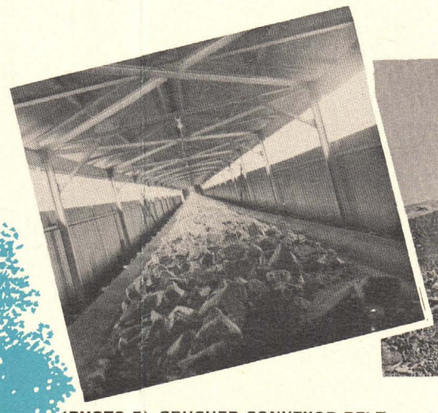


(PHOTO 4) LOAD

(PHOTO 5)
TRUCKS ON HAUL ROAD



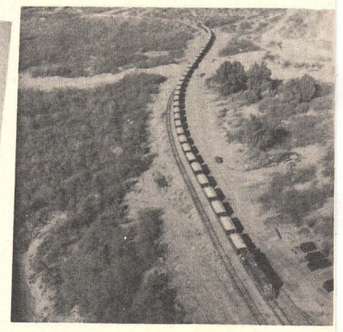
(PHOTO 6) EXTERIOR OF CRUSHER



(PHOTO 7) CRUSHER CONVEYOR BELT

(PHOTO 8) TRUCK AT WASTE DUMP

(PHOTO 9) LOADING TRAIN



(PHOTO 10) TRAIN ENROUTE

A "Ray" from the Past

FLOTATION LEGEND

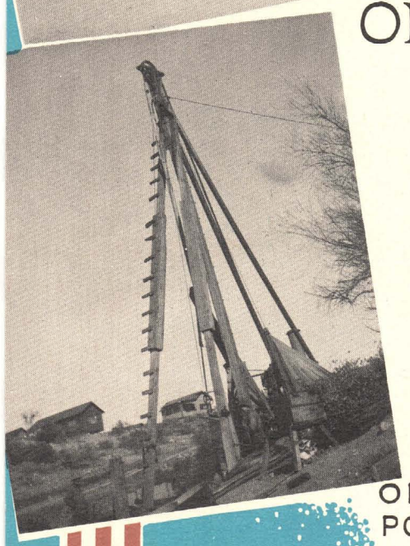
A mining legend, apparently based on historical fact, credits an observing woman with a primary role in the discovery of the flotation process of ore recovery which has made possible utilization of the West's low-grade copper deposits.

According to the story, the discovery was made by a Colorado woman, the wife of a doctor whose hobby was prospecting. She noticed when she washed some ore sacks in a tub that the heavy mineral particles floated on the surface. She began an investigation as to why the heavy mineral particles floated, while the lighter waste material sank.

The reason seemed to have been that the ore somehow had been oil-coated, and this coating caused the minerals to float. This discovery led the woman to take out the original patent on the flotation process in 1866.

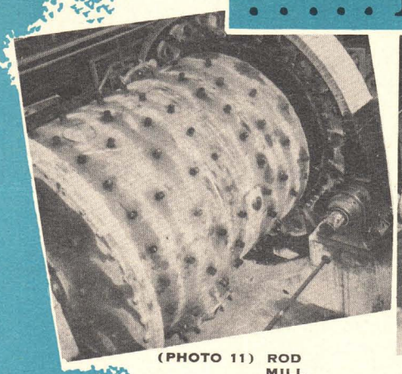
Today, the flotation processes developed by American engineering with the assistance of an observant woman help create new metal products from formerly worthless, low-grade deposits.

Old Ray

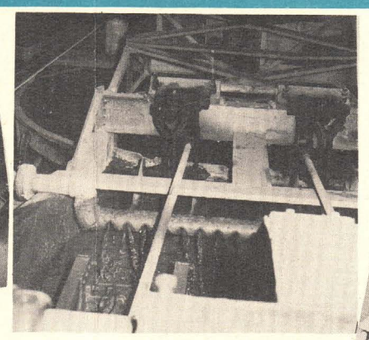


OLD STEAM POWERED DRILL CIRCA-1880-1915

.....TO COPPER

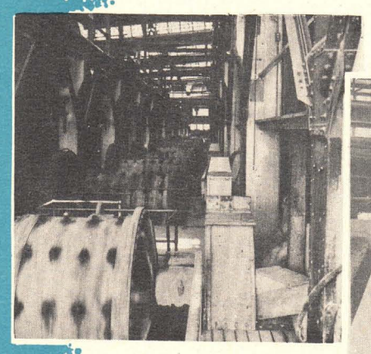


(PHOTO 11) ROD MILL



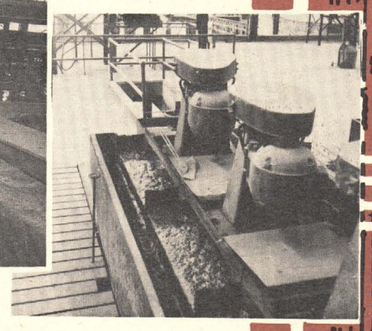
(PHOTO 12) CLASSIFIER

(PHOTO 13)
LABORATORY ANALYSIS



(PHOTO 14) BALL MILL

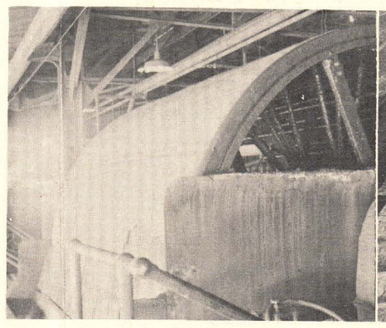
(PHOTO 15) CALLOW CELLS



(PHOTO 16) MECHANICAL CELLS

At the mill, the ore is mixed with water and placed in the giant rod mills (photo 11), where the ore is ground by steel rods. The material then passes to large ball mills where it is reduced by steel balls and discharged to large bowl classifiers (photo 12) which separate and return coarser material to the large ball mill and send fine material to small ball mills; during the entire milling process, constant laboratory checks follow the progress and condition of the ore (photo 13). In the smaller ball mills, the ore receives final grinding to powder-fineness (photo 14). The mineral particles are separated from the crushed rock in flotation cells (photo 15-16) where the coated mineral particles ride pine oil and air bubbles over the tops of tanks. The concentrated mineral, 20-30 per cent copper, is dried (photo 17) and subsequently smelted at the Hayden smelter. The finished blister copper, in the form of 400 pound cakes (photo 18) of 99.4 per cent pure copper, is shipped to electrolytic refineries at Baltimore, Md., and Perth Amboy, N. J., where it is refined to 99.9 per cent purity, for use in thousands of industrial products.

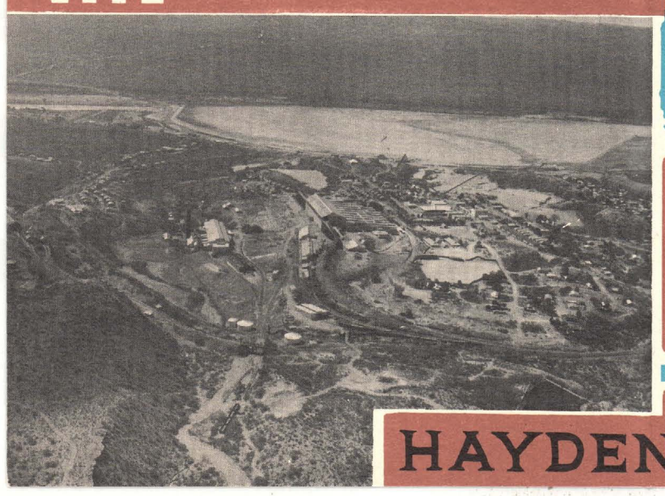
FLOTATION



(PHOTO 17) DRIER

(PHOTO 18)

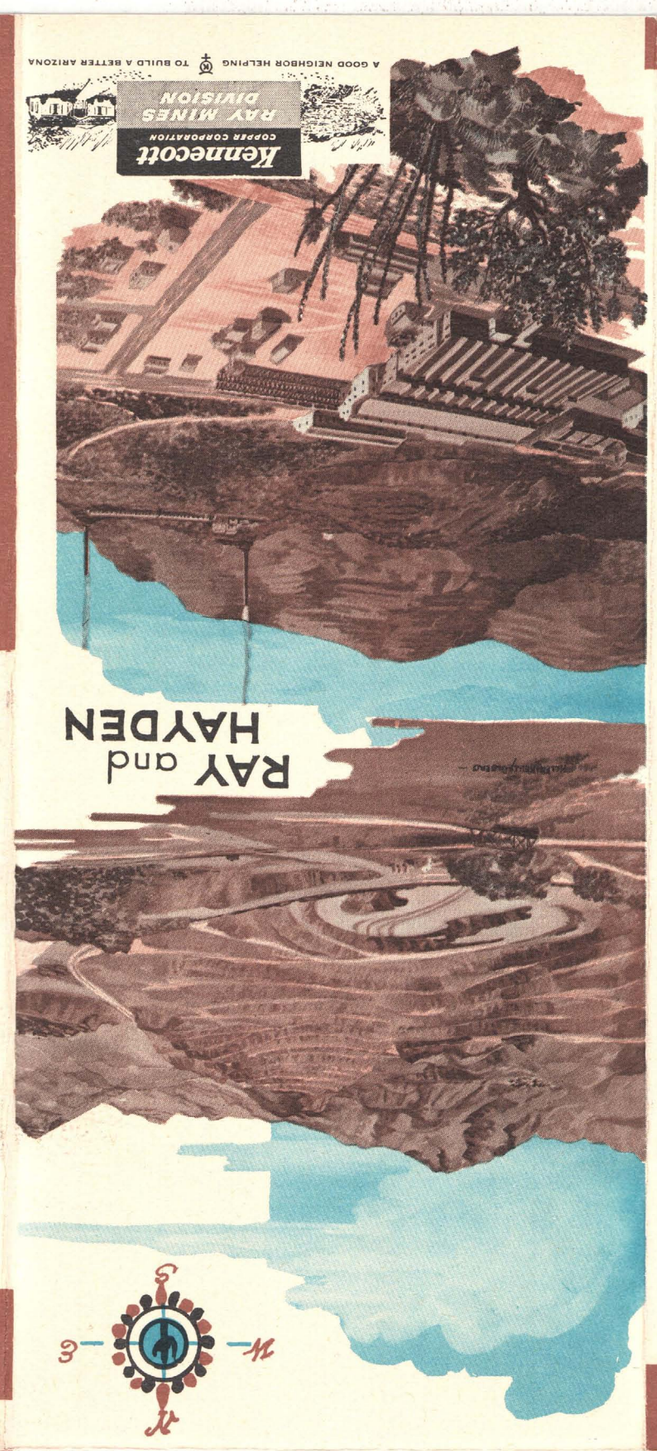
AFTER CONCENTRATION, THE ORE GOES TO THE NEARBY SMELTER. THE HAYDEN SMELTER PRODUCES BLISTER COPPER, WHICH IS POURED INTO 400 POUND CAKES FOR SHIPMENT.



HAYDEN

COPPER

by Kennecott



Kennecott
COPPER CORPORATION
RAY MINES DIVISION
A GOOD NEIGHBOR HELPING TO BUILD A BETTER ARIZONA

ORE TO COPPER . . . . A 4 DAY CYCLE

KENNECOTT COPPER CORPORATION is creating new wealth for Arizona and providing a vital metal for America by making a molehill out of a mountain at Ray, Arizona, 80 miles southeast of Phoenix.

KENNECOTT'S RAY MINES DIVISION is continuing a large scale mining operation started more than 44 years ago. Despite the much lower copper content of the ore, modern technology and research have extended the life of the mine.

After more than 40 years of production from an underground mine at Ray, it became apparent by the end of World War II that the ore suitable for mining by underground methods soon would be exhausted. It was known that a mass of low grade ore existed, but the copper content was so low it could not be mined profitably from underground workings.

In 1946 Kennecott started a program of drilling to determine whether the Ray Mine could be converted into an open pit operation. The drilling disclosed enough low grade ore in the Ray ore body to make the conversion possible.

Between 1948 and 1952, 43 million tons of worthless rock was removed from on top of the ore body to make the ore available for mining.

The ore averages approximately one per cent copper, or about 20 pounds of copper to the ton. Of this, an average of 17½ pounds is recovered.

The mining operation begins when holes are drilled into the working levels of the mine, and the holes are loaded with 500 to 600 pounds of explosives each. A "shot" of eight to ten holes breaks 35,000 to 45,000 tons of ore and waste.

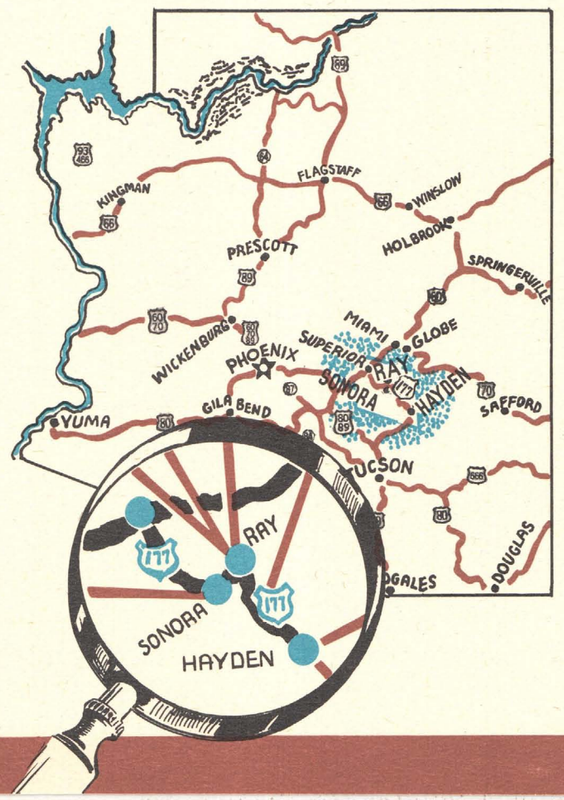
THE BROKEN MATERIAL is loaded into giant diesel-powered trucks of 35 and 50-ton capacity by electric shovels which scoop as much as 11 tons at a bite. The ore is taken to the crushing plant. The material containing less than four-tenths of one per cent copper, is hauled more than a mile to the waste dumps.

AT THE CRUSHING PLANT, the ore is broken to a maximum ¾ inch size, and loaded into 60-ton dump cars and hauled in 38-car trains to Ray Junction, six miles away. Here the cars are picked up by the Southern Pacific Railroad and hauled 15 miles to Kennecott's concentrator at Hayden.

AT THE CONCENTRATOR, the ore is crushed to powder fineness and mixed with water and chemical reagents. A frothing agent is then added to the mixture, and the mineral particles attach themselves to the bubbles and ride them to the surface and over the top of the flotation cells. The waste particles remain at the bottom of the cells.

The material that floated over the top of the cells is a concentrate containing 20 to 30 per cent copper. When dried, it is smelted at the Hayden smelter and poured as 400 pound cakes of blister copper, 98-99.5 per cent pure. The copper is then shipped to electrolytic refineries at Baltimore, Md., and Perth Amboy, N. J., for further purification.

THE RAY MINES DIVISION works constantly on new methods of increasing the efficiency of copper recovery. The program of teaming research and investment helps maintain Arizona's position as the leading state in copper production, and conserves the resources of copper by getting maximum recovery from the ore.

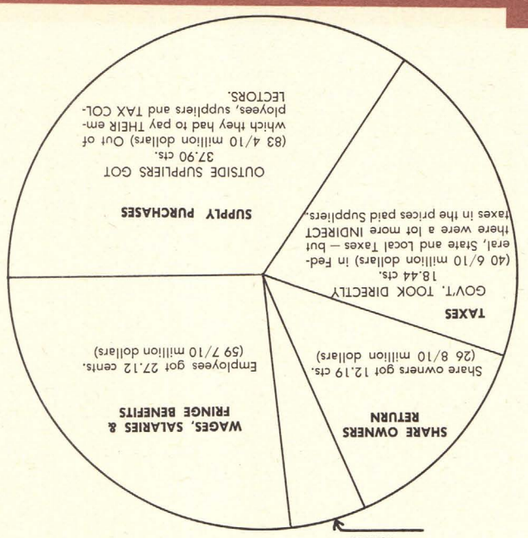


IN 1954, THE WAGES OF ARIZONA COPPER MINERS were higher than those of any other industry in the state, and nearly 50 per cent higher than in the 1947-1949 period. In addition, employees now have fringe benefits valued at 20 per cent of their wages.

ARIZONA'S MAJOR COPPER PRODUCERS TODAY ARE:

- KENNECOTT COPPER CORPORATION ..... RAY MINES DIVISION (RAY AND HAYDEN)
- PHELPS DODGE CORPORATION ..... MORENCI, AJO, BISBEE AND DOUGLAS
- MIAMI COPPER COMPANY ..... COPPER CITIES AND MIAMI
- INSPIRATION CONSOLIDATED COPPER COMPANY ..... INSPIRATION
- MAGMA COPPER COMPANY ..... SUPERIOR AND SAN MANUEL
- AMERICAN SMELTING & REFINING COMPANY ..... SILVER BELL
- BAGDAD COPPER COMPANY ..... BAGDAD
- PIMA MINING COMPANY ..... SAHUARITA

The chart below, based on work by the Arizona Department of Mineral Resources, shows the division of the dollar received by the copper mining industry of Arizona. The figures are based on 1953 reports.



Kennecott
COPPER CORPORATION
RAY MINES DIVISION
A GOOD NEIGHBOR HELPING TO BUILD A BETTER ARIZONA

ARIZONA is the "COPPER ORE" BIN . . . OF AMERICA

LONG FAMED as the copper state, Arizona produces 45 per cent of the nation's new domestic copper, and the production from new mines is expected to raise the total to nearly 50 per cent.

Arizona copper production dates to pre-colonial days. Indian artisans fashioned trinkets and crude implements from copper. Under the Spanish Conquistadors, copper was mined by methods used when Caesar's legions fought the stalwart Gauls.

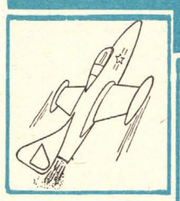
It was 1864 — while the war cries of Indian raiders still punctuated the rumble of wagon trains — that copper prospecting began in southeastern Arizona where the state's modern mining industry started. Ten years later, prospectors began working through the Mineral Creek area near Ray, and small scale mining operations were begun at Ray in 1883. In the Globe-Miami area work started in 1882, and the United Verde development in the mountainous country near present-day Jerome (a ghost town now) was started that year.

The first copper mining in Arizona as U. S. territory was in 1854, the year the Gadsden Purchase added southern Arizona to the nation. But early lack of land transportation slowed development.

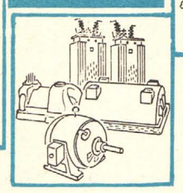
SIX COUNTIES — Greenlee, Gila, Pinal, Pima, Cochise and Yavapai — produce over 99 per cent of Arizona's output of more than three-quarters of a billion pounds of copper annually. Copper is mined in 12 of the state's 14 counties. The Arizona copper industry has produced approximately 28,500,000,000 pounds of copper since the first production reports began in 1874 — a veritable mountain of metal for American industry.

In 1943, after 69 years of carefully recorded production and exploration (and more than 70 years of actual production) Arizona had over twice as much known copper as was thought to have been in the ground in recoverable form in 1903! It has been more than 37 years since a large rich grade ore body has been found — but the state's taxable wealth has been steadily enriched — both immediately and for coming years — by the copper industry.

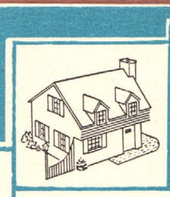
USES OF COPPER AND ITS ALLOYS



AIRPLANES
Automatic pilots
Bushings, bearings
Engines
Navigation instruments
Wiring

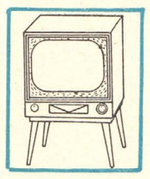


ELECTRICAL EQUIPMENT (Excluding Household Appliances)
Electrical connectors
Electromagnets
Generators, turbines
Lamp bases, sockets
Motors
Switchgear
Transformers
Wire and cable

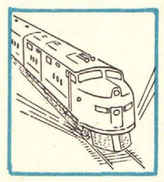


BUILDING CONSTRUCTION
Door and window hardware
Electric wiring
Elevators, escalators
Fences and gates
Flashing, gutters and downspouts
Heating installations (convection, conduction and radiation)
Mouldings and ornamental metal work
Plumbing
Screening
Skylights, ventilators
Store-fronts
Weather stripping

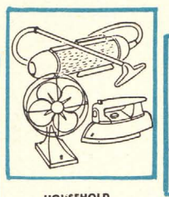
FURNITURE AND FIXTURES
Bar and soda fountain equipment
Barber and beauty shop equipment
Bathroom equipment
Curtain fixtures
Fireplace equipment
Furniture
Kitchen equipment and utensils
Lamps, lighting fixtures, candlesticks
Laundry equipment
Letter boxes and mail chutes
Showcases
Tableware
Trays and containers
Waste disposal units



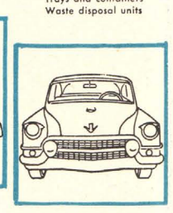
ELECTRONICS
Automatic control equipment
Electric brains
Electric organs
Radar
Radio
Recording equipment
Record players
Television



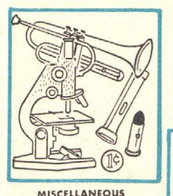
RAILROAD EQUIPMENT AND SUPPLIES
Electric and diesel locomotives
Journal bearings
Passenger car interiors
Piping (water and air)
Signal equipment



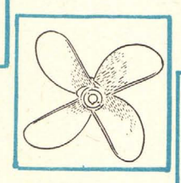
HOUSEHOLD APPLIANCES
Chafing dishes
Coffee makers
Dishwashers
Electric blankets
Electric irons
Electric ranges
Fans
Food mixers
Hair driers
Infra-red broilers
Portable heaters
Sun lamps
Toasters
Vacuum cleaners
Waffle irons



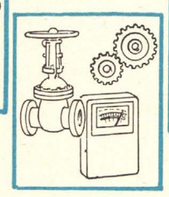
MOTOR VEHICLES
Bushings, bearings
Carburetors
Electrical system
Fuel and oil lines
Gaskets
Heater
Hub caps
Oil pumps
Radiators
Starter
Windshield wipers



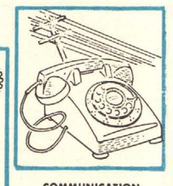
MISCELLANEOUS
Alarm systems
Atomic energy equipment
Business machines
Cameras, projectors
Caskets, burial vaults
Chimes and bells
Cigarette lighters and cases
Clocks and watches
Cocktail shakers
Coinage
Cosmetic accessories
Electrotypes and photoengravings
Fire extinguishers
Fishing tackle
Flashlights, lanterns
Hardening gold
Hospital and dental equipment
Jewelry
Lawn and garden equipment
Mechanical pens and pencils
Musical instruments
Pet cages
Plaques
Safety razors
Statues and statuettes
Sundials
Telescopes and microscopes
Thermometers and barometers
Toys and amusement devices
Zippers



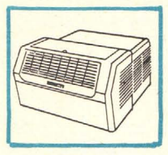
MARINE EQUIPMENT AND SUPPLIES
Anti-fouling paint
Hardware
Navigation instruments
Piping
Propellers, bearings



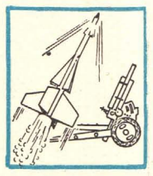
INDUSTRIAL EQUIPMENT AND SUPPLIES
Air compressors
Boiler tubes
Chain
Condenser tubes
Containers
Copper chemicals
Cutting and welding torches
Fastenings (nuts, bolts, screws, rivets)
Gauges
Heat exchangers
Laboratory equipment
Meters
Non-sparking tools
Paint
Pipe, fittings, valves
Pumps
Soldering tools
Welding rod
Wire cloth



COMMUNICATION
Telegraph instruments
Telephones and exchange equipment
Wire and cable



REFRIGERATION AND AIR CONDITIONING
Air conditioners
Fans and blowers
Heat pumps
Refrigerators
Water coolers



DEFENSE
Ammunition
Bombs
Bomb sights
Fire controls
Guided missiles

KENNECOTT . . . AN INDUSTRIAL CITIZEN . . . . . .

THE COPPER MINING INDUSTRY has been a cornerstone of Arizona's economy, and Kennecott's Ray Mines Division has been a cornerstone of the economy of Pinal County.

FOR 44 YEARS, the mine at Ray and the concentrating mill at Hayden have been in large scale production almost continuously. The last underground section of the Ray Mine was closed in January 1955, but the open pit section already was in production so that there was no interruption in the flow of ore to the concentrator.

BACK OF THE RAY MINES DIVISION is the combined investment of nearly 90,000 Kennecott Copper Corporation shareholders. This investment has provided more than $32,000 worth of tools, working equipment and plant installations for each of the nearly 1,000 employees of the Ray Mines Division.

THIS HEAVY INVESTMENT has enabled the division to treat the low grade copper ore on a mass production basis — the only way it could be handled economically. Thus, the investment has enabled the division to make an important economic contribution to Arizona and to Pinal County.

Since its beginning as a copper producer, the Ray Mines Division has paid into the economy of Arizona and the nation more than $275,000,000 in wages and salaries, purchases, and tax payments.

To Arizona, the growth of the Ray Mines Division has meant approximately $16,000,000 in tax benefits, plus annual payrolls now totalling more than $5,000,000. Purchases of supplies and equipment, which have, in recent years, amounted to more than $4,000,000 annually, have spread a widening ring of purchasing power throughout Arizona.

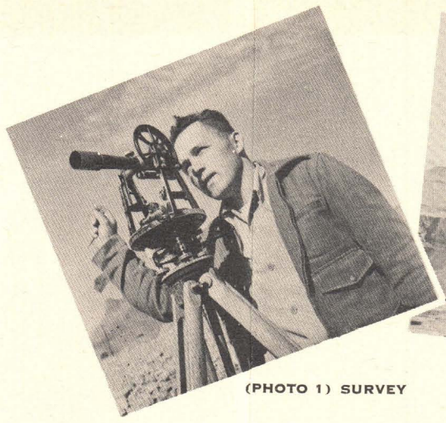
The Ray Mines Division's scholarship program provides four annual scholarships for graduates of the Ray and Hayden High Schools, plus an annual scholarship at the College of Mines of the University of Arizona, plus a matching grant to the University. The Division also makes available funds to the University and State Colleges which have been used for public lecture series and purchases of scientific equipment.

COPPER.... *Your Metal Servant* FOR LIFE!

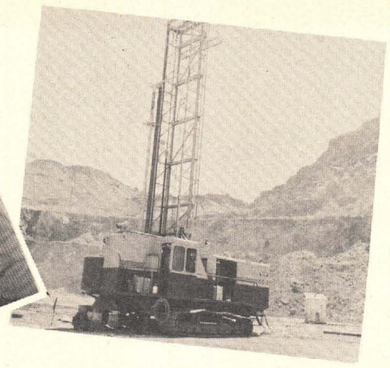
FROM ORE.....

Copper begins its four-day ore to copper cycle when a transitman (photo 1) and crew survey a series of blast holes; the holes, to be loaded with 500 to 600 pounds of dynamite each, are drilled with massive drills (photo 2), and then a blast moves 35,000 to 45,000 tons of material (photo 3). The broken material is loaded into giant trucks of 35 to 50 tons capacity, by electric-powered shovels of nearly 11 tons capacity (photo 4); the loaded ore is hauled (photo 5) to the nearby crushing plant (photo 6-7) where it is reduced by jaw and cone crushers and rolls to a maximum of ¾ inch size. The waste material is hauled approximately 1¼ miles to the waste dump (photo 8). (About 2½ tons of waste must be moved for each ton of ore.)

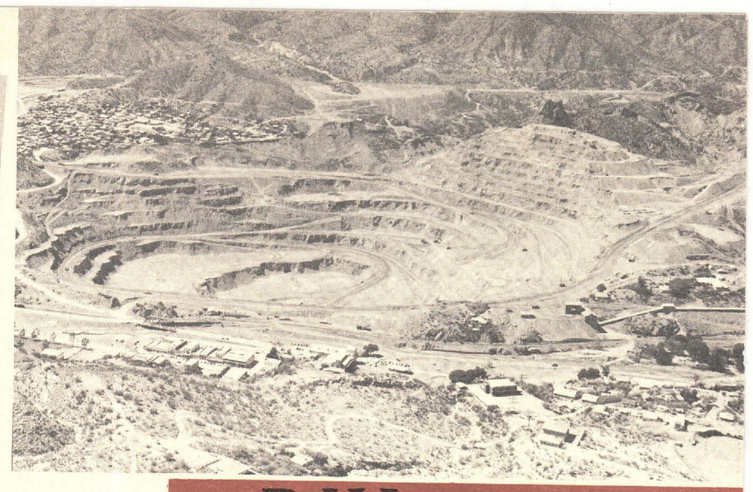
The crushed ore is now ready for shipment to the concentration mill at Hayden, 21 miles southeast of Ray. The ore is loaded into trains of 38, 60-ton cars each (photo 9). The trains are hauled on the Company's own industrial spur (photo 10) to Ray Junction, where the cars are picked up by the Southern Pacific Railroad.



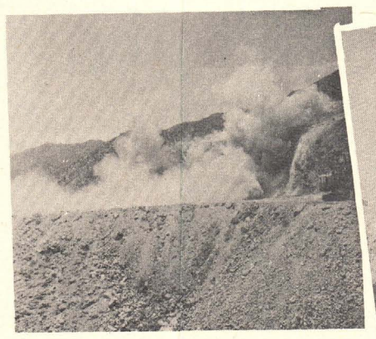
(PHOTO 1) SURVEY



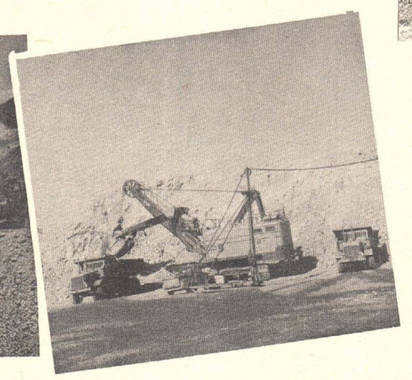
(PHOTO 2) ROTARY DRILL



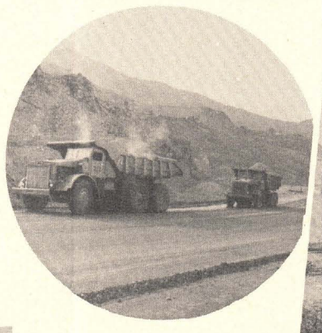
RAY



(PHOTO 3) BLAST

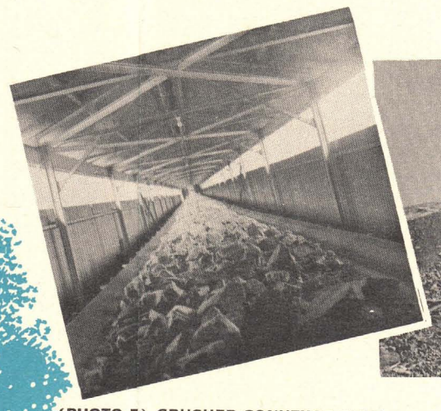


(PHOTO 4) LOAD



(PHOTO 5)
TRUCKS ON HAUL ROAD

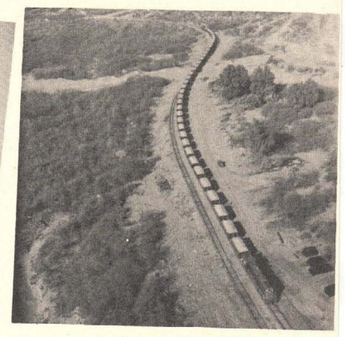
(PHOTO 6) EXTERIOR OF CRUSHER



(PHOTO 7) CRUSHER CONVEYOR BELT

(PHOTO 8) TRUCK AT WASTE DUMP

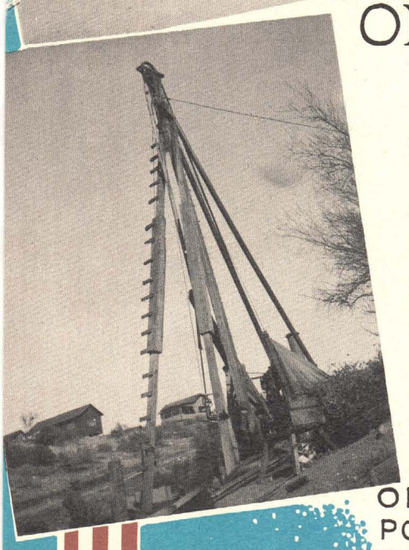
(PHOTO 9) LOADING TRAIN



(PHOTO 10) TRAIN ENROUTE

A "Ray" from the Past

Old Ray



OLD STEAM POWERED DRILL CIRCA-1880-1915

FLOTATION LEGEND

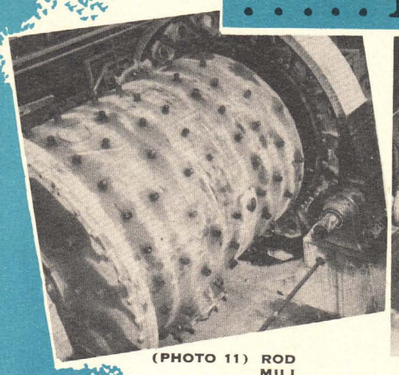
A mining legend, apparently based on historical fact, credits an observing woman with a primary role in the discovery of the flotation process of ore recovery which has made possible utilization of the West's low-grade copper deposits.

According to the story, the discovery was made by a Colorado woman, the wife of a doctor whose hobby was prospecting. She noticed when she washed some ore sacks in a tub that the heavy mineral particles floated on the surface. She began an investigation as to why the heavy mineral particles floated, while the lighter waste material sank.

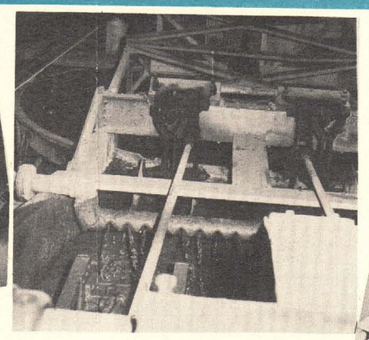
The reason seemed to have been that the ore somehow had been oil-coated, and this coating caused the minerals to float. This discovery led the woman to take out the original patent on the flotation process in 1866.

Today, the flotation processes developed by American engineering with the assistance of an observant woman help create new metal products from formerly worthless, low-grade deposits.

.....TO COPPER

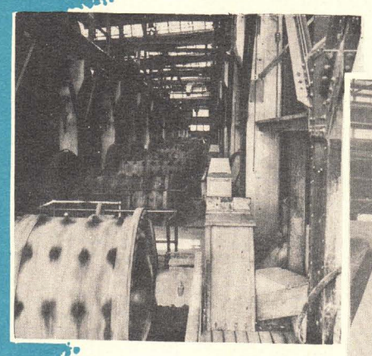


(PHOTO 11) ROD MILL

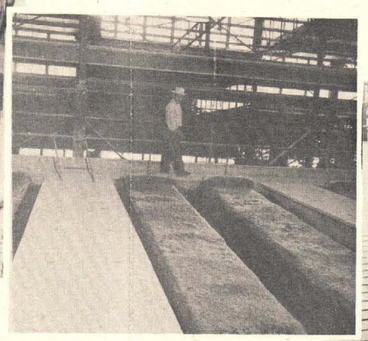


(PHOTO 12) CLASSIFIER

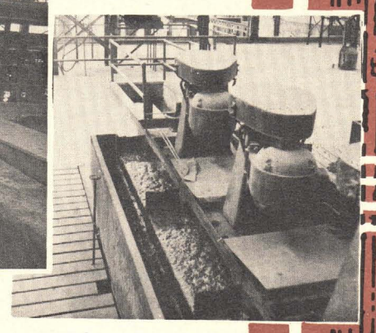
(PHOTO 13)
LABORATORY ANALYSIS



(PHOTO 14) BALL MILL



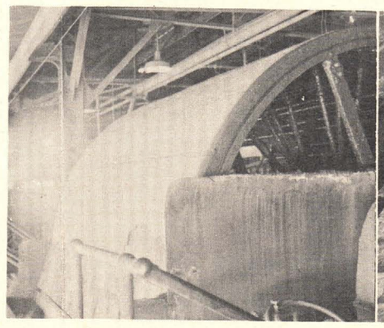
(PHOTO 15) CALLOW CELLS



(PHOTO 16) MECHANICAL CELLS

At the mill, the ore is mixed with water and placed in the giant rod mills (photo 11), where the ore is ground by steel rods. The material then passes to large ball mills where it is reduced by steel balls and discharged to large bowl classifiers (photo 12) which separate and return coarser material to the large ball mill and send fine material to small ball mills; during the entire milling process, constant laboratory checks follow the progress and condition of the ore (photo 13). In the smaller ball mills, the ore receives final grinding to powder-fineness (photo 14). The mineral particles are separated from the crushed rock in flotation cells (photo 15-16) where the coated mineral particles ride pine oil and air bubbles over the tops of tanks. The concentrated mineral, 20-30 per cent copper, is dried (photo 17) and subsequently smelted at the Hayden smelter. The finished blister copper, in the form of 400 pound cakes (photo 18) of 99.4 per cent pure copper, is shipped to electrolytic refineries at Baltimore, Md., and Perth Amboy, N. J., where it is refined to 99.9 per cent purity, for use in thousands of industrial products.

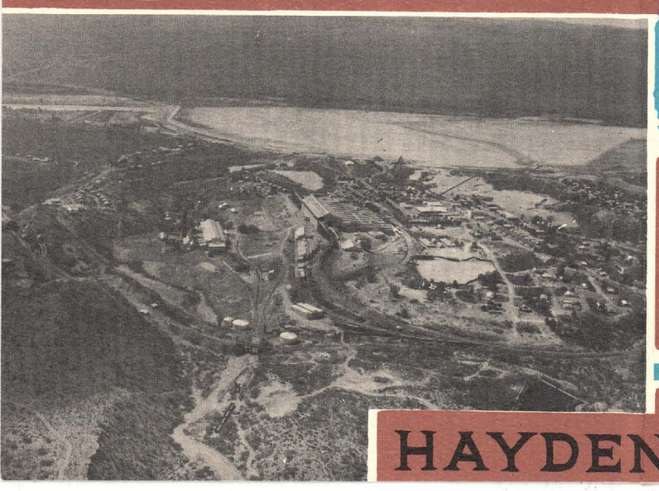
FLOTATION



(PHOTO 17) DRIER

(PHOTO 18)

AFTER CONCENTRATION, THE ORE GOES TO THE NEARBY SMELTER. THE HAYDEN SMELTER PRODUCES BLISTER COPPER, WHICH IS POURED INTO 400 POUND CAKES FOR SHIPMENT.



HAYDEN