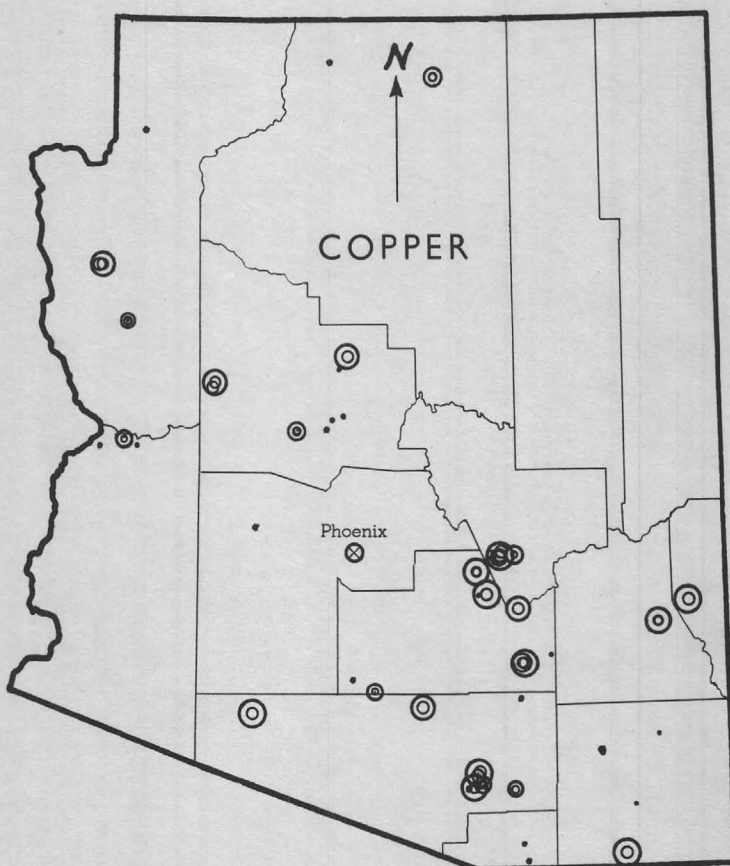


**DEPARTMENT OF MINERAL RESOURCES  
STATE OF ARIZONA  
PHOENIX, ARIZONA**

**FRANK P. KNIGHT, DIRECTOR**

**OFFICIAL FILE**



**28TH ANNUAL REPORT  
FOR  
YEAR ENDING JUNE 30, 1967**

Honorable Jack Williams  
Governor of Arizona  
Capitol Building  
Phoenix, Arizona

Dear Sir:

The Annual Report of the Department of Mineral Resources, covering the fiscal year July 1, 1966 to June 30, 1967, is submitted herewith.

The report contains, as formerly, a review of mining activity in the State and of this department's activities, which are directed towards the development of Arizona mining and the maintenance of the health of the present industry.

Very truly yours,

*Frank P. Knight*

FRANK P. KNIGHT,  
Director.

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## ARIZONA MINERAL PRODUCTION

The value of Arizona's mineral production in 1966, was \$620,565,000, again an all-time record. It was 27.8 percent above the record in 1956, a year of abnormally high copper prices, and 16.1 percent above the record year of 1964. Copper accounted for \$535,004,000 or 86.2 percent of the 1966 total. The tonnage of copper produced in Arizona in 1966 was 739,569 short tons or 5.1 percent above that for 1965. Record tonnages of copper have been produced by Arizona in each year since 1959.

The total value of Arizona's mineral production to the end of 1966 is more than \$11.1 billion, of which approximately 84.3 percent has come from copper, Arizona mined 51.7 percent of the Nation's copper production in 1966, and so ranked first among the United States, as it has done since 1910. It ranked 3rd in silver, 4th in gold, 6th in lead, 12th in zinc and 3rd in molybdenum production. Although Arizona ranked 9th in total value of all minerals produced in 1965, it was first in value of metal production. Arizona has at San Manuel the largest underground copper mine; at Morenci, the second largest open pit copper mine, and at the Iron King mine one of the largest lead-zinc producers in the Nation.

Details of mineral production are to be found in the following tables of the appendix to this report:

- I. Arizona production and Value of the Five Principal Metals in 1966.
- II. Mineral Production of Large and Small Producers in Arizona in 1966.
- III. Arizona's Mine Production of the Five Principal Metals, 1957 to 1966.
- IV. Relative 1966 Production in the United States for the Five Principal Metals.
- V. Value of Mineral Production in Arizona, by Counties, 1965 - 1966.
- VI. Copper, Gold, Silver and Molybdenum Recovered from Metal Mines in Arizona in 1964, 1965 and 1966.

## ACTIVE MINES

No major copper mine came into production during the fiscal year, but expansion projects at several existing mines increased the total productive capacity. The number of active mines of all kinds decreased, as is shown in Table VII on page VIII of the Appendix. In April, 1967, a department survey showed 40 active copper mines, 3 of them with ores containing also lead or zinc; 5 lead and/or zinc mines; 9 gold or silver, 8 uranium, and 35 other producers of metallic or non-metallic minerals, making a total of 97, compared to 111 in April, 1966. Sand, gravel, stone, clay, and the solid and liquid fuel producers are omitted from these lists.



## EMPLOYMENT

The Arizona Employment security commission reported for 1966 that there were employed in Arizona mining, quarrying and smelting an average of 18,542 covered employees with total covered wages of \$147,439,443, or an average of \$7,952 per year per employee. The "total covered wages" reported by the Commission represent only the amount paid by the employer directly to the employees, including pay for time not worked such as vacation pay, paid holidays, and other off-time pay. It also includes premium wages for hours worked in excess of 40 hours in a week, or for shift differentials.

It does not include additional labor costs incurred by the employer that are not included in the employee's pay envelope - such as social security and unemployment taxes, group life insurance premiums, pension accruals, supplemental unemployment benefits, and hospitalization insurance. This group of "fringe benefits" alone is estimated to cost well in excess of \$20,000,000 per annum. In addition some \$4,500,000 is spent as the cost of operating hospitals and recreation facilities for the benefit of employees of the company and their families and other residents of the mining community.

## COPPER

Arizona's copper production in 1966, 739,569 tons, was an all-time record for the seventh consecutive year. It was 51.7 percent of the Nation's total mine production of 1,429,152 tons, and Arizona again was first among the United States, as it has been since 1910. Over one-half of the State's total came from Pima and Pinal Counties, with Pima first in rank and Pinal a close second. Greenlee, Gila, Cochise, Yavapai and Mohave, are the other important copper producing counties in the order named. Arizona's production of recoverable copper for the first half of 1967 has been 392,513 tons, 4.2 percent above that of the first half of 1966, according to reports of the U. S. Bureau of Mines.

Domestic demand for copper continued strong throughout the fiscal year. Record production, stockpile releases totalling 350,000 tons authorized in March and December 1966, export quotas, suspension of import duty, more than doubling of net imports in the first half of 1967 compared to the first half of 1966, renewed government participation in copper exploration and announced participation in stimulation of production, were insufficient to overcome buyer's fears of shortages because of labor and political uncertainties in Africa, Chile and the United States, particularly a threatened industry-wide strike in the United States in mid-1967, and the possible Vietnam war expansion.

However the excessively high prices abroad in early 1966 did not hold. By July 1, 1966 the London Metal Exchange price for copper had fallen from a high of 98-3/4 cents on April 5, 1966 to 74-1/4; by the end of June, 1967 it was around 44 cents. Foreign demand, particularly European, had fallen off.

Domestic producers' copper price held at 36 cents per pound until early in January 1967, excepting that Copper Range and Inspiration raised to 38 cents in September 1966. All were at 38 cents early in January although Inspiration was at a price averaged for its Inspiration Mine copper at 38 and Christmas Mine at 47 cents.

The end of the fiscal year found foreign demand eased, production high, the U. S. government's set-asides of 26 percent not being fully used, a major U. S. strike

threatening, and reports of increasing inventory build-ups more frequent.

19,325,000 tons of ore mined in 1966 at the Morenci mine of Phelps Dodge Corp. yielded 141,178 tons of copper, 9 percent above its previous all-time record of 129,406 tons in 1964. The Morenci pit rapidly advanced to the southwest, the sites of offices, main mine shaft and the upper town, being removed or covered with waste. Construction of new administration and town buildings proceeded throughout the year. At its New Cornelia Branch at Ajo in 1966, Phelps Dodge produced 68,296 tons of copper from 10,487,000 tons of ore, or 3.8 percent less copper than in 1965. The Copper Queen Branch at Bisbee produced 61,293 tons of copper, 26,964 from the Copper Queen mine and 34,729 from the Lavender pit. The total was off 8.7 percent from that in 1965. The total copper production of Phelps Dodge's Arizona properties in 1966 was 271,167 tons, up 2.3 percent from 1965 and 37 percent of the State's total.

The San Manuel Division of Magma Copper Co. produced 101,390 tons of copper in 1966, up 8.1 percent from 1965. Magma's Superior Division produced 19,631 tons, or 0.9 percent above that in 1965.

The American Smelting and Refining Co.'s Arizona properties produced 70,387 tons of copper in 1966 - 46,584 from its Mission mine south of Tucson and 23,803 from its Silver Bell mine at Silver Bell. Production at the Mission mine was lower because of more refractory ore from the mine. However, mill expansion to increase capacity about 50 percent was completed in the first half of 1967 and a new 9-yard shovel and eleven 85-ton trucks were added at the mine late in 1966. Silver Bell production was up a little and a sixth ball mill was added in 1966 to increase capacity to 10,500 t.p.d. The company also proceeded with increases of smelting and refining capacities in order to handle increased output of the mines. Development of a low-grade open pit mine at the company's North San Xavier Unit in the Papago Indian reservation was started early in the fiscal year.

The Ray Mines Division of Kennecott Copper Corporation produced 71,790 tons of copper in 1966, down 0.5 percent from 1965. In October 1966 the company announced its decision to increase production by 24,000 tons of copper annually, from a copper silicate orebody at Ray, using open pit mining and a vat leaching system followed by electrolysis; the entire project to cost approximately \$35 million.

Inspiration Consolidated Copper Company produced in 1966 a total of 57,112 tons of copper - 48,917 from its open pit mine at Inspiration and 8,195 from its property at Christmas. Total production was off 8.7 percent due principally to a three weeks strike in late 1966 and to the collapse in March 1966 of a new leaching plant ore excavator. From October 1966 to the end of the fiscal year, the Christmas mine production was entirely from its new open pit. Early in 1967, stripping and other work preparatory to open pit mining operations with production of cement copper by heap leaching and precipitation on iron, was started at its new Ox Hide mine on the Schultz property just west of Miami.

Duval Corporation's two Arizona properties produced a total of 48,930 tons of copper in 1966, up 20 percent from 1965 production. Its Mineral Park property north of Kingman yielded 25,565 tons and its Esperanza mine south of Tucson 23,365. Major repairs to the ball mills in the concentrator at Mineral Park were completed and operation at full capacity was resumed early in 1967. An expansion project to increase the capacity of the Esperanza concentrator by 25 percent was completed around the end of the fiscal year.

The Miami Copper Company Division of Tennessee Copper Corporation produced a total of 34,873 tons of copper from its three Arizona properties, an increase of 14 percent above 1965. Its Copper Cities, Miami, and Castle Dome mines produced 24,228; 8,584; and 2,061 tons respectively.

Bagdad Copper Corporation produced 20,140 tons of copper in 1966 of which 6,512 tons derived from heap leaching of oxide ores. The total was only 136 tons below the 1965 figure. Its refinery continued at considerably below capacity. About the end of the fiscal year the company started to strip waste to permit open pit mining of 17 million tons of new ore around the present orebody estimated to average 0.71 percent copper.

Pima Mining Company produced 39,315 tons of copper in 1966 from its Pima mine south of Tucson, up 118 percent above 1965. Expansion of the mine's productive capacity from 16,000 to 30,000 ore tons was 98 percent complete at the end of June 1967.

Ranchers Exploration and Development Corporation produced 4,139 tons of copper in fiscal 1966-67, an increase of 30 percent above the previous year, from its Bluebird mine near Miami. In June 1967 it decided to build a plant to upgrade the copper leach solutions by a solvent extraction process, the resulting solutions going to an electrowinning circuit. The plant is designed to produce 30,000 pounds per day of cathode copper.

The Anaconda Company increased the stripping rate at its Twin Buttes property south of Tucson to approximately 300,000 tons of alluvium per day and it was expected that ore would be reached in the northwest corner of the pit in the fall of 1967. A branch railroad to the property was completed in the fiscal year.

McAlester Fuel Company at its Zonia mine east of Kirkland Junction were forced to drilling and blasting in the fall of 1966 because ripping of the open pit ore became too difficult. In the spring of 1967 they started another, smaller leach pit when some percolation difficulty appeared in the leach piles of the first pit.

After stripping several hundred thousand tons of waste from its Mineral Hill orebodies east of Parker and completing facilities for vat leaching followed by precipitation of copper on scrap iron, Arizona Ranch and Metals Company began operation of the 800 ore tons per day layout in the fall of 1966. Well before mid-1967, the "bugs" were eliminated and results were good.

Banner Mining Company continued pilot plant and laboratory research on its patented process to recover copper from oxidized ores of relatively high lime content. Results were encouraging.

White Mesa Company operated its White Mesa (Mardun) copper mine south of Page for a few months of the fiscal year, but slimes and other troubles in their open pit - vat leaching operations were difficult.

Late in 1966, El Paso Natural Gas Company started stripping oxide copper ore and constructing facilities at its Emerald Isle property south and near to Chloride, for conveyor transportation of ore and extraction of copper by the leach-precipitation-flotation method at the rate of 1000 tons per day. The work was well along at the end of fiscal 1967.

In November 1966 Tombstone Mines, Inc., subsidiary of Calix Mines, Ltd. of Canada, took over the Mame Mine near Courtland from Inter-State Accounting & Office Service.

After overcoming operating troubles in the process of leaching old stope fill and dumps, production straightened out in mid-February, although shortage of sulphuric acid was troublesome.

The Scruggs Mining Company started a copper leaching project at the old San Juan property north of Safford.

Big Hole Mining Company started small scale leach-precipitation of copper at the United Verde property at Jerome in the first quarter of fiscal 1967.

In November 1966, General Cable Corporation of New York announced plans for a multi-million dollar plant at or near Kingman for the manufacturing of copper rod and wire.

In the latter part of 1966, Powdered Metals Corporation leased the Standard Group of claims in the Silver Reef district of Pinal County. The company completed a pilot plant in Phoenix to test a copper processing method patented by George E. Harlan. At the end of fiscal 1967 Clevite Corporation had joined Powdered Metals in a venture called Harlan Metals Corporation which proceeded with drilling to prove copper ore reserves and with pilot plant testing.

A group, including Freeman and Bale Lomelino of Blythe, California, tried breaking and leaching in place about 10,000 tons of copper ore but were unable to recover more than a small part of the leach solutions. They then started in June 1967 to drill to establish ore reserves prior to going ahead with vat leaching.

#### Copper - Zinc

Cyprus Mines Corporation completed nearly 1500 feet of its new shaft to serve its Old Dick and Copper Queen mines in the Bagdad district of Yavapai County, and did some other development work in the fiscal year.

Standard Metals Corporation of Denver completed drilling, geophysical work and feasibility studies at the Antler mine east of Yucca then in early 1967 contracted with Centennial Development Company for the sinking of a 500 foot shaft at 70 degrees. It was down about 150 feet at the end of the fiscal year. A 250 tons per day mill and an auxilliary ferro-fertilizer plant are planned.

Standard Copper Corporation of New York started mining and milling operations at the Copper World mine about 16 miles easterly from Yucca early in July 1966 but were unable to run at capacity because of water shortage and other troubles. At the end of June 1966, additions and changes in the mill expected to increase capacity, were completed.

Western Minerals Corporation applied in 1966 to the Office of Minerals Exploration for a loan for 7,350 feet of core drilling. At the end of May 1967 the application had not been acted upon. Meanwhile, a little underground drifting and mining was done, at the Indiana-Arizona mine near Silver Bell.

Continental Materials Company started mine and mill operations at its CWT mine near Twin Buttes, south of Tucson, in May 1967. At the middle of June, it was producing about 400 tons of ore per day from development headings. Mill capacity is 500 t.p.d.

G. H. Stoffers continued to ship ore from the Moore Shaft at Johnson Camp to the Deming, New Mexico, mill of American Zinc Company until February 1967. A month or two later he leased from American Zinc the old flotation mill at Klondyke and resumed mining, the ore being trucked 82 miles to Klondyke. It is possible that he may take custom ores and thus stimulate production in the Aravaipa-Klondyke area.

#### LEAD - ZINC

The domestic price of pig lead f.o.b. New York started the fiscal year at 15 cents per pound then dropped to 14 cents in October 1966 because of low foreign prices. United States consumption in 1966 set a new record, the increase being met largely by increased imports plus 73,000 tons from the national stockpile.

The domestic price for prime western zinc f.o.b. East St. Louis was 14.5 cents through the fiscal year until May 1967. It then dropped to 13.5 cents. United States consumption of zinc also set a new record in 1966. The increase was met mostly by large increases in imports plus stockpile sales of 42,000 tons. However, domestic consumption in the first half of 1967 was off ten percent from the first half of 1966.

Arizona's lead production in 1966 was 5,211 tons, 14 percent below 1965. Zinc production was 15,985 tons, 36 percent below 1965. It ranked 6th in lead and 12th in zinc production among the United States in 1966.

The Iron King mine at Humboldt produced more than 95 percent of Arizona's lead and more than 90 percent of her zinc output in 1966. In 1965 it ranked 10th in lead, 13th in zinc, 15th in gold and 15th in silver among the United States producers of these metals. At the end of 1966 it changed to a system of shrinkage stoping to within 40 feet of the level above and breaking down the crown pillar by longholing, in an attempt to cut costs to offset the drops in lead-zinc prices.

Some lead-silver concentrates were shipped to El Paso by Lyman Wall from his mill in the Castle Dome district which treated ores from old dumps at the New Chance and Linda mines. Some lead-silver ores also were shipped from the Glove mine east of Amado, Santa Cruz County and some were stockpiled at the Jamison mine in the Cerbat district, Mohave County near the end of the fiscal year. At the Jamison, a 50-ton pilot mill is in plan by the Chico Mining Company. Early in the fiscal year some lead-zinc ores were shipped from the Indiana mine at Duquesne, east of Nogales, and from the U. S. mine in Copper Basin, near Skull Valley, Yavapai County, ores from the latter going to the Iron King mill.

#### GOLD - SILVER - MOLYBDENUM

Practically all of Arizona's production of these metals comes as by-products from copper, lead-zinc and complex ores.

##### Gold

Gold Stocks of the United States at the end of June 1967 were \$13,169 billion, down from \$13,529 billion at the end of June 1966. The "reserve ratio" of gold to Federal Reserve notes dropped to 31.6 percent at the close of the fiscal year, down from 34 percent in mid-1966. Preliminary figures indicate short-term foreign



liabilities of \$26,801 billion at the end of May - up \$200 million in the month. Arizona's gold production for the first half of 1967 was 70,904 ozs., off 5.2 percent from the first half of 1966, according to the United States Bureau of Mines.

In 1966, Arizona produced 142,528 Troy ounces of gold worth \$4,988,000 or 5 percent less than in 1965. The U. S. Bureau of Mines reported one placer gold mine. Its production was not divulged but it must have been but a few ounces because the total for 2 dry gold lode mines plus the one placer was but 32 ounces.

Seven of Arizona's larger mines were in the top 25 gold producers in the Nation in 1965. They, with their ranks in parentheses, were Bisbee (7), New Cornelia (9), San Manuel (12), Iron King (15), Magma (17), Morenci (18), Christmas (25). All except Iron King were copper producers.

Ray Shaw et al started building a 25 t.p.d. mill at the Vivian gold-silver mine in the San Francisco district, Mohave County, early in 1967. C. J. Creese of Arivaca continued his small tonnage milling of gold-silver-lead-copper ore in Fraquita Canyon until spring of 1967 and then sold out.

### Silver

On May 18, 1967 the Treasury announced that it would restrict disposition of its silver to domestic consumers and that melting and exporting of silver coins was prohibited. Prices advanced sharply. In June 1967 a bill was enacted to limit the period of redemption of silver certificates to one year and to permit the Treasury to write off certificates it considers will not be turned in. The Treasury's stock of silver bullion at the end of June was 440.2 million ounces of which 135.1 million was "free silver". On January 1, 1967 it had been 591.9 million and 154.3 million respectively. Spot silver at the end of June was \$1.68 per ounce.

production  
Arizona's for the first half of 1967 was 3,354,000 ounces, up 3.8 percent from the first 6 months of 1966. The major Arizona silver producing mines, with their national ranking in parentheses, were Mission (9), Bisbee (10), Iron King (15), Mineral Park (17), Morenci (18), New Cornelia (19), and Magma (23).

The Office of Minerals Exploration, U. S. Geological Survey, in November 1966 engaged with Big Treasure Mining and Development Company to explore for silver in the Saddle Mountain district in Pinal County.

### Molybdenum

Molybdenum has become the most important by-product of a number of the copper producers of Arizona. Its total value in 1966 was \$17,812,000, 12 percent above 1965 and 35 percent above the combined value of the gold and silver produced in 1966. It ranked third behind copper and sand and gravel in value. Kennecott completed a new unit for molybdenum recovery in the first half of 1967. Pima Mining Company authorized a new unit in March of 1967, to be ready about October.

## URANIUM - VANADIUM

### Uranium

Arizona's production of uranium ore in 1966 was 64,195 tons valued at \$1,978,000, down 44 percent in quantity and 50 percent in value from 1965. The drop was largely due to the closing of the Orphan mine in Mid-1966 and of the Tuba City mill at the end of 1966. The mill was then dismantled by El Paso Natural Gas Company, but in the spring of 1967 Westec Corporation decided to reactivate the mine. At the last of the fiscal year it was seeking to sell the mine and later did so.

However, the ore will have to be treated out of the state. The Tuba City mill was the only one in Arizona.

#### Vanadium

Processing plants outside of Arizona extracted, from Arizona Uranium ores from the Four Corners area, vanadium valued at \$453,000 in 1966. This was an increase of 19 percent above the 1965 production value, and probably indicates an increase in uranium production in that area and period.

#### I R O N

The U. S. Bureau of Mines did not disclose the amount or value of iron ore produced in Arizona in 1966. In 1965 Arizona produced 8,000 long tons of usable iron ore valued at \$51,000.

The principal tonnage of iron ore mined in the fiscal year was that taken by the CF&I Steel Corporation from the Apache Iron deposit leased by it from the Fort Apache Indian Tribe and shipped to its plant at Pueblo, Colorado, for testing. More was taken in the first half of 1967 than in 1966.

Some magnetite concentrates were shipped from the Omega mine southeast of Florence to the Arkota Steel mill at Coolidge for grinding for use in farm equipment tires. Coarser magnetite was sold for sand blasting. Operations were intermittent.

Archean Exploration Corporation in the first half of 1967 completed a small iron reduction plant 18 miles west of Snowflake to treat ore from the Frog Pond iron deposit northeast of Young near the Fort Apache Indian Reservation.

#### MERCURY

In mid-1966, the price of mercury reversed its downward trend and rose from \$340 per flask on June 6th to about \$750 in late October then turned downward. In June 1967 it was \$480.

Harpoon, Inc., subsidiary of United Nuclear Company, moved away from the Pine Mt. mine in the Sunflower district, Maricopa County, after doing considerable rehabilitation and development work, and producing some mercury. Small production came from the National and Mercuria mines in the same district. H. C. Smith left the Ord mine early in 1967.

#### ALUMINUM

General Aluminum and Chemical Company with a plant at Goodyear melts and refines aluminum salvaged from airplanes or purchased drosses. Supreme Perlite Co., Inc. has a similar plant next to that of General Aluminum, Royal Aluminum and Refining Company and Thomas Enterprises each operated plants at Humboldt in which aluminum was separated from drosses and formed into ingots.

#### EXPLORATION

Exploration, especially for copper, continued to be very active in 1966-67.

Search for new uranium deposits increased markedly. The Department of the Interior



Heavy Metals Program opened the OME participation in exploration loans to 75 percent for antimony, bismuth, gold, mercury, platinum group metals; rutile, silver, tantalum and tin, in September 1967.

Among the many Arizona areas in which exploration work was reported are:

Apache County:	Four Corners, Pinta-St. Johns
Cochise:	Johnson Camp, Hartford, California and Dos Cabezas districts.
Coconino:	Francis and Warm Springs districts;
Gila:	Miami, and Midway districts;
Graham:	Lone Star district;
Greenlee:	Metcalf and Copper Mountain districts;
Maricopa:	Magazine, Webb, White Tank, Sunflower, Cave Creek and Wickenburg districts;
Mohave:	Mineral Park, Cerbat, Wallapai, White Hills, Gold Basin, Owens, Cedar Valley and Cleopatra districts and an area north of Wikieup.
Navajo:	Black Mesa, Monument Valley, Chediski and Apache Iron districts and the Pink Cliffs area southwest of Holbrook;
Pima:	Growler, Quijotoa, Copper Mt., Gunsight, Ajo, Helvetia, Greaterville, Coyote, Silver Bell, Fresnal, Pima, Twin Buttes and Arivaca districts;
Pinal:	Ray, Superior, Copper Creek, Mineral Creek, Vekol, Silver Reef, Owl Head, Saddle Mt., Ripsey, Tiger, Pioneer, Mammoth, Goldfields, and Bunker Hill districts;
Santa Cruz:	Oro Blanco, Duquesne, Patagonia, Plametto and Harshaw districts;
Yavapai:	Walnut Grove, Peck, Pine Grove, Black Hills, White Picacho, Black Canyon, Bagdad, Agua Fria, Tiger, Verde, Copper Basin, Bradshaw, Eureka, Crown King and Humbug districts;
Yuma:	Ellsworth, Plomosa and Planet districts.

#### FLUXING ORES

Siliceous ores, with or without metal content were produced for flux or slurry for copper smelters from the Nancy #2 and Burro mines in the Turquoise and Johnson districts in Cochise County; the Copper Hill mine, Globe district, Gila County; the Harmony mine, Metcalf district, Greenlee County; the Sheridan Pit, Anderson Pit and San Antonio mines, in the Cimarron Mts., Gunsight Hills and Ajo districts, Pima County; the Copper Butte, Orizaba, Pico 1-3, Tiger, Gold Hill, and Silver Bell mines in the Pioneer, Silver Reef (2), Mammoth, Canyon del Oro, and Martinez Canyon districts, Pinal County; and the Commercial mine in Yavapai County; and others.

#### NON-METALLIC MINERALS

Arizona's production of non-metallic minerals exclusive of mineral fuels in 1966 was valued at \$42,710, up 15 percent from 1965. Production and values of individual items are given in Table II page IV of the Appendix.

Percent changes in 1966 production value from 1965 for some individual items were: sand and gravel, up 23; stone, off 2; gypsum, down 27; lime, up 5; pumice, up 10; diatomite, up 350.

Paul Lime Plant, Inc., in the fiscal year installed a new rotary kiln at Paul Spur as the major part of a \$700,000 project to double its plant capacity there.

The Arizona Helium Corporation early in 1967 announced plans to build a \$350,000 helium plant at Navajo. Helium production for the first half of 1967 was 457,838 MCF, all from existing wells.

Developments of great importance occurred in the mineral fuels industry in Arizona. The Peabody Coal Company signed a contract for delivery of upwards of 117 million tons of coal to the planned Mohave Power Project, in the southern tip of Nevada, of a group of power companies headed by Southern California Edison Company. The coal is to be mined from the Black Mesa field of northern Navajo County and moved as slurry by pipeline to the site of the project. The project plans call for the first of two 750 megawatt generators to be ready by 1970-71.

A discovery of great importance to the Navajo Indians and to Arizona was the Dineh bi Keyeh oil field in the Lukachukai Mountains in the northeast corner of the State. Found in February 1967, it produced to the end of June 786,916 barrels, equal to more than half (53 percent) of the total all-time Arizona oil production up to that time. In the same short period the new field also produced 74,703 MCF of natural gas, or 10 percent of the State's all-time production up to the end of June.

#### DEPARTMENT ACTIVITIES

Laws, regulations and administrative procedures relating to mineral rights in Arizona and in the public lands of all of the western states, continued to be subjects of numerous inquiries as well as matters of concern to the department, whose primary objective is assisting in the development of the State's mineral resources. Many papers relating to these land matters and also to mine taxation, import controls, mine safety, gold, silver and monetary policies, air and water pollution, land classification, and mining economics, were received from government agencies, the American Mining Congress and others. Many of the papers invited comment and required study. Hearings of the Public Land Law Review Commission at Albuquerque, were attended by the assistant to director and hearings of the Bureau of Land Management at Kingman, Phoenix and Safford were attended by our field engineers and administrative assistant. The director attended on invitation the annual meeting of the National Advisory Board of the Bureau of Land Management in April at Phoenix.

The director was one of several who accompanied representatives of the Department of the Interior in their two-day study of surface mines of copper companies in the Tucson and Globe-Miami areas pursuant to Public Law 89-4 requiring such studies in all states. He attended, as a delegate and chairman of its committee on mining taxation, meetings of the Western Governors' Mining Advisory Council in Salt Lake City in September 1966, Denver in February and West Yellowstone, Montana in June 1967. He was appointed chairman of the Nominating committee at the June meeting of the WGMAC. These meetings were during a meeting of the American Mining Congress and just prior to meetings of the Colorado Mining Association and the Western Governors' Conference all of which he also attended. He attended two days of sessions of the Council of Economics, American Institute of Mining, Metallurgical and Petroleum Engineers at the annual meeting of the Institute at Los Angeles in February; and Arizona meetings of the AIME and the ASMOA in the fiscal year. He talked on mining subjects to meetings of the Phoenix and Tucson Councils of the ASMOA, the Ajo Subsection, AIME, the Phoenix Engineers Club, and to a conservation class at A.S.U. He collaborated in the revision of the department booklet, Mining in Arizona, which was printed near the end of fiscal 1967; and wrote several articles which were published in Pay Dirt magazine.

The assistant to director's office was vacated June 30, 1966; temporarily filled from August 3 to January 16; and the incumbent started on February 1, 1967.

News releases were written by the assistants for statistical reports and for publications. Aid was given to the Tucson Trade Bureau and others in the work preparatory to Tucson Copper Days, including an article on functions of the department, and assistance with video-sonic presentations. The present assistant wrote a detailed discussion of an article on Copper Smelting and Refining: What Will the Nation Need, by George F. Leaming, Research Specialist, Division of Economic and Business Research, University of Arizona, which was published in Pay Dirt magazine. Because of inability to obtain a statistical consultant following the resignation of F. J. Tuck at the end of April, the assistant director did much to fill the void. He continued as secretary of the Maricopa Subsection, AIME after joining the Department.

Department assistance was given to state agencies on mining questions relating to property tax studies, mineral rights, industry development, legislation and mining matters; to Federal agencies concerned with legislation, public lands, mining statistics, mine and exploration loans, pollution, mining costs; and to the many companies, private agencies including research, and individuals in and out of the state who sought information about Arizona mining properties and mining. Among them were most if not all of the more than 50 exploration teams of substantial companies which were seeking new mineral deposits during the year. The department has file information on approximately 3000 mining properties.

#### Publications

The following statistical reports were mimeographed and distributed to a mailing list of over 200 parties (over 20 percent out-of-state) including legislators, mining companies, government agencies, banks, newspapers, libraries and individuals, and upon request:

Inventory of Arizona Lands as of June 30, 1965                      8 pages.

Copper Industry, Statistics for 1965 Compared with Other Years;  
Arizona, United States, and World.    37 pages.

Lead and Zinc Industry, Statistics for 1965 Compared with Other Years;  
Arizona, United States and World    33 pages.

The Gold and Silver Industries in the World, United States and Arizona;  
Salient Statistics Year 1965                      19 pages.

Also mimeographed and distributed were:

Active Mine List, October 1966

Active Mine List, April 1967

Directory of State and Federal Agencies in Arizona of Interest to Mining.

Bibliography - Lost Mines in Arizona

Revised list of Arizona Registered Engineers Available for Consulting Work.

The department's booklet, Mining in Arizona was revised, almost completely in the base metal sections, brought up to date (May 1967) in all sections, and printed with illustrated cover.

A brochure, The Penny in Your Pocket, written by Edward H. Peplow, Jr. while assistant to director and illustrated, was printed early in the fiscal year.

The department booklet, Laws and Regulations Governing Mineral Rights in Arizona continued to be much in demand.

### Information and Other Services

The department's files, maps and library on approximately 3000 Arizona mining properties and on mining subjects, were in constant use, and information is perhaps the department's most important service. At least one field engineer is scheduled to be present at the Phoenix office and the engineer for the southern district is at the Tucson office every Monday and other work days when not in the field. The engineers were at announced places at announced times available for consultation. The administrative assistant was available at the Phoenix office for consultation on public land matters.

During the fiscal year, the field engineers travelled 30,754 miles, attended 126 meetings of the Arizona Small Mine Operators Association, visited 579 mines, and discussed mining problems with individuals on 2,017 other occasions - 537 in the field, 683 in the offices and 797 by telephone. Reports of activities and findings were written and filed. They also answered 107 mail inquiries. Their miscellaneous services included: Chairman and program committee chairmen of Phoenix Council, ASMOA; program chairman and member of Law Review Committee, Tucson Council, ASMOA; attendance at various meetings of AIME subsections; talks on silicosis by G. W. Irvin to University of Arizona Class in Mining Ventilation, to Phoenix ASMOA and Tucson AIME Subsection; talks and movies by Irvin to 5 schools, 5 service clubs and the University of Arizona Student Chapter AIME; movies and talks at ASMOA meetings by all field engineers.

There were 2345 visitors and 5956 telephone calls to the department during the fiscal year. Respective figures for 1965-1966 were 2132 and 5578.

### Mineral Museum

There were approximately 14,876 visitors to the Mineral Museum exclusive of 69,995 visitors during the 10-day State Fair, according to the report of Museum Curator Lee Hammons. Special visits for 3,637 school children and special meetings with total attendance of 1,710 were held in the museum quarters. The museum continued to be supported by four copper companies; the support including employment of the curator. The department continued to furnish utilities and janitor. Museum attendance has increased greatly in recent years.

### APPROPRIATION

\$ 88,502.00

### EXPENDITURES:

Personal Services	\$ 60,270.71	
Professional Services	6,690.00	
Travel - State	5,707.45	
Travel - Out of State	794.75	
Current Expenditures:		
Postage	945.00	
Tel & Tel	1,359.17	
Utilities	1,399.72	
Maintenance & Repairs	645.31	
Office Supplies	1,631.29	
Printing	1,157.80	
Maintenance Supplies	26.26	
Other Contractual	415.51	
Other Supplies	314.47	
Subscription & Dues	189.75	
Fixed Charges	49.50	
Building & Equipment Insurance	199.00	
Capital Outlay	1,117.22	
TOTAL EXPENDITURES		\$ 82,912.91
Balance - returned to General Fund		5,589.09
		<u>\$ 88,502.00</u>

Unused appropriation for personal and professional services (\$2,386) and for in and out-of-state travel (\$2,048) were the principal items in the \$5,589 returned to the General Fund.

DEPARTMENT OF MINERAL RESOURCES

STATE OF ARIZONA

BOARD OF GOVERNORS

Charles F. Willis, Phoenix - Chairman  
(term expires January 31, 1971)

Jack W. Still, Prescott  
(term expires January 31, 1969)

Matt Danenhauer, Clifton  
(term expires January 31, 1972)

Willie J. Roper, Kingman  
(term expires January 31, 1968)

Stephen H. Congdon, Tucson  
(term expires January 31, 1970)

PERSONNEL

Frank P. Knight	Director
B. H. Gerwin	Assistant to Director
Lewis A. Smith	Field Engineer - Central District
Gerald W. Irvin	Field Engineer - Southern District
Fremont T. Johnson	Field Engineer - Northern District
Mrs. Glenn W. Pare	Administrative Assistant
Mrs. Pauline Halloren	Secretary
Mrs. Ray E. Sparkes	Secretary
Leonard Klein	Consultant

OFFICES

Phoenix Office, Mineral Building, State Fairgrounds  
Tucson Office, Room 164, State Office Building.

MINERAL MUSEUM, Mineral Building

Lee Hammons, Curator.

## STATUTORY POWERS AND DUTIES

"Aid in the promotion and development of the Mineral Resources of the State.

Conduct studies of the economic problems of prospectors and operators of small mines for the purpose of assisting in their solution.

Assist in discovering sources of supply for persons desiring to buy minerals.

List and describe available mining properties.

Make mineral resource surveys and conduct other investigations which may interest capital in the development of the state's mineral resources.

Serve as a bureau of mining information in conjunction with the Arizona Bureau of Mines.

Publish and disseminate information and data necessary or advisable to attain its objectives.

Cooperate with the state land department to encourage mining activity on state lands.

Cooperate with the corporation commission in its investigations and administration of laws relating to the sale of mining securities.

Cooperate with the Arizona Bureau of Mines, and deliver to the Bureau problems which the field work of the division shows to be within the scope of the activities of the bureau.

Cooperate with federal and other agencies designed to develop mines and minerals.

Oppose congressional acts favoring reciprocal or duty free imports of foreign minerals.

Use its authority in other ways to assist in more extensive exploration and development of the mineral resources of the state."

TABLE I

Arizona production and value of the five principal metals in 1966, as reported by the United States Bureau of Mines were as follows:

739,569 tons copper	@	36.170¢/lb	\$ 535,004,000
5,211 tons lead	@	15.115¢/lb	1,575,000
15,985 tons zinc	@	14.500¢/lb	4,636,000
142,528 ozs. gold	@	\$35.00/oz	4,988,000
6,339,000 ozs. silver	@	\$1.293/oz	8,196,000
			<hr/>
			\$ 554,399,000

This compares with the following final figures for 1965:

703,377 tons copper	@	35.4¢/lb	\$ 497,991,000
5,913 tons lead	@	15.6¢/lb	1,845,000
21,757 tons zinc	@	14.6¢/lb	6,353,000
150,566 ozs. gold	@	\$35.00/oz	5,269,000
6,095,000 ozs. silver	@	\$1.293/oz	7,881,000
			<hr/>
			\$ 519,339,000



TABLE II

MINERAL PRODUCTION OF LARGE & SMALL PRODUCERS IN ARIZONA IN 1966 1/LARGE COPPER PRODUCERS:\*

		<u>PRODUCTION</u>	<u>VALUE</u>
Copper . . . . .	tons	734,735	\$531,507,000
Gold . . . . .	ozs	127,431	4,460,000
Silver . . . . .	ozs	5,595,644	7,235,000
Molybdenum (Content of Concentrates) . .	lbs	10,161,000	17,812,000
			<u>\$561,014,000</u>

SMALL MINERAL PRODUCERS:

Asbestos . . . . .	short tons	W	W
Clays 2/ . . . . .	short tons	89,000	\$ 121,000
Copper (recoverable content of ore) short tons		4,834	3,497,000
Diatomite . . . . .	short tons	1,353	36,000
Gem Stones . . . . .		NA	120,000
Gold (recoverable content of ores) troy ounces		15,097	528,000
Gypsum . . . . .	short tons	75,000	394,000
Iron ore (usable) . long tons . . gross weight		W	W
Lead (recoverable content of ores) short tons		5,211	1,575,000
Lime . . . . .	short tons	218,000	3,721,000
Mercury . . . . .	76-pound flasks	363	160,000
Natural gas (marketed) . . . million cubic feet		r/ 3,400	r/ 436,000
Petroleum (crude) . . . . .	42-gallon barrels	132,000	370,000
Pumice . . . . .	short tons	1,103,000	1,674,000
Sand and Gravel . . . . .	short tons	18,730,000	20,448,000
Silver (recoverable content of ore) troy ounces		743,356	961,000
Stone . . . . .	short tons	2,271,000	4,091,000
Tungsten concentrate (60% WO <sub>3</sub> ) . . short tons		2	5,000
Uranium ore . . . . .	short tons	64,195	1,978,000
Vanadium . . . . .	short tons	W	453,000
Zinc (recoverable content of ores) short tons		15,985	4,636,000

Value of items that cannot be disclosed:

Cement, clay (bentonite), feldspar, helium,

mica (scrap), perlite, pyrites, and values

indicated by symbol W . . . . .

Small Mine sub-total

3/ 14,347,000

r/\$ 59,551,000

TOTAL

\$620,565,000

Percentage due to small mines

9.6

\* Phelps Dodge (Morenci, New Cornelia, Bisbee), Kennecott, Inspiration and Christmas, Miami, Copper Cities, Castle Dome, Magma, and San Manuel, Asarco's Silver Bell and Mission, Pima, Bagdad, Duval's Esperanza and Mineral Park.

r/ Revised. NA Not available. W Withheld to avoid disclosing individual company confidential data; included with "Value of items that cannot be disclosed".

1/ Production as measured by mine shipments, sales, or marketable production.

2/ Excludes bentonite; included with "Value of items that cannot be disclosed."

3/ Value of metals and mineral fuels, \$2,242,000; value of nonmetals, \$12,105,000.

Source: USBM reports of 1966 statistics.

TABLE III

## ARIZONA'S MINE PRODUCTION OF

	GOLD ozs.	SILVER ozs.	COPPER lbs.	LEAD lbs.	ZINC lbs.	TOTAL VALUE
1957	152,449	5,279,323	1,031,708,000	24,882,000	67,810,000	\$332,082,000
1958	142,979	4,684,580	971,678,000	23,780,000	57,064,000	273,398,000
1959	124,627	3,898,336	860,594,000	19,998,000	74,650,000	282,977,000
1960	143,064	4,774,992	1,077,210,000	16,990,000	71,622,000	366,340,000
1961	145,959	5,120,007	1,174,106,000	11,874,000	59,170,000	370,101,000
1962	137,207	5,453,585	1,288,484,000	13,932,000	65,776,000	416,418,000
1963	140,030	5,373,058	1,321,954,000	11,630,000	50,838,000	426,038,000
1964	153,676	5,810,510	1,381,976,000	12,294,000	49,380,000	471,743,000
1965	150,431	6,095,285	1,406,754,000	11,826,000	43,514,000	519,335,000
1966	142,528	6,338,696	1,479,138,000	10,422,000	31,970,000	554,399,000

TABLE IV

## RELATIVE 1966 PRODUCTION

	U. S.	ARIZONA			LEADING STATE
			% of U.S.	Rank in U.S.	
Gold	1,803,420	142,528	7.9	4th	South Dakota 606,467
Silver - ozs	43,669,000	6,338,696	14.5	3rd	Idaho 19,776,785
Copper - tons	1,429,152	739,569	51.7	1st	Arizona 739,569
Lead - tons	327,368	5,211	1.6	6th	Missouri 132,255
Zinc - tons	572,558	15,985	2.8	12th	Tennessee 103,117

Source: U. S. Bureau of Mines

TABLE V

## VALUE OF MINERAL PRODUCTION IN ARIZONA, BY COUNTIES

County	1965	1966	Minerals Produced in 1966 in order of value
Apache . . . . .	r/\$4,307,906	\$ 5,208,819	Helium, sand and gravel, uranium ore, vanadium, petroleum, natural gas, pumice, clays, stone.
Cochise . . . . .	W	51,094,213	Copper, sand and gravel, gold, silver, lime, stone, zinc, lead.
Coconino . . . . .	W	4,153,689	Pumice, uranium ore, sand and gravel, stone, copper, silver, gold.
Gila . . . . .	70,389,453	72,186,623	Copper, lime, molybdenum, asbestos, stone, silver, sand and gravel, gold, mercury, iron ore, clays.
Graham . . . . .	W	148,568	Sand and gravel, pumice, copper,
Greenlee . . . . .	93,809,251	105,583,016	Copper, lime, silver, stone, gold, molybdenum, sand and gravel.
Maricopa . . . . .	6,004,733	7,739,805	Sand and gravel, mercury, clays, mica (scrap), stone, copper, silver, gold.
Mohave . . . . .	19,586,739	24,412,574	Copper, molybdenum, sand and gravel, silver, stone, feldspar, zinc, gold, lead.
Navajo . . . . .	1,468,466	1,231,436	Sand and gravel, uranium ore, stone, iron ore, vanadium.
Pima . . . . .	149,153,395	162,020,777	Copper, cement, molybdenum, silver, sand and gravel, gold, stone, zinc, clays, lead, tungsten concentrate.
Pinal . . . . .	141,730,125	151,631,186	Copper, molybdenum, silver, gold, sand and gravel, gypsum, lime perlite, stone, pyrites, diatomite iron ore, lead.
Santa Cruz . . . . .	377,323	808,662	Sand and gravel, zinc, lead, silver, copper, stone, gold.
Yavapai . . . . .	33,054,812	31,860,510	Copper, cement, zinc, sand and gravel, lead, molybdenum, silver, stone, gold, lime, pumice, gypsum, clays, uranium ore.
Yuma . . . . .	1,290,738	2,364,802	Sand and gravel, stone, copper, lead, gypsum, silver, gold, zinc.
Undistributed . . . . .	r, 1/ 58,919,163	120,000	Gem stones.
Total . . . . .	r/ \$580,092,000	\$620,565,000	

r/ Revised. W Withheld to avoid disclosing individual company confidential data: included with "Undistributed."

1/ Includes gem stones that cannot be assigned to specific counties and values indicated by symbol W.

Source: U. S. Bureau of Mines

TABLE VI

COPPER, GOLD, SILVER AND MOLYBDENUM RECOVERED  
FROM METAL MINES IN ARIZONA IN 1964, 1965 and 1966

	<u>1964</u>	<u>1965</u>	<u>1966</u>
Ozs. gold recovered from all copper ores mined	133,983	133,830	127,431
Ozs. silver recovered from all copper ores mined	4,915,362	5,352,850	5,395,644
Lbs. molybdenum recovered from all copper concentrates	6,296,000	9,400,000	10,161,000
Lbs. copper recovered from all copper ores mined including all clean-up	1,280,272,100	1,308,986,600	1,359,481,200
Lbs. copper recovered from mine waters	90,800,800	89,282,500	114,965,800
TOTAL LBS. COPPER RECOVERED FROM ALL COPPER MINES	<u>1,371,072,900</u>	<u>1,398,269,100</u>	<u>1,474,447,000</u>
TOTAL LBS. COPPER RECOVERED FROM ALL OTHER MINES	<u>10,903,100</u>	<u>8,484,900</u>	<u>4,691,000</u>
GRAND TOTAL LBS. COPPER RECOVERED FROM ALL MINES	1,381,976,000	1,406,754,000	1,479,138,000
TOTAL TONS COPPER ORES MINED	86,132,000	92,860,000	101,558,298
TOTAL TONS ALL ORES MINED	86,808,000	93,285,430	102,151,704

Source: U. S. Bureau of Mines Area Reports

TABLE VII

PRODUCING MINES IN ARIZONA IN 1966 AND 1967

<u>MINES</u>	<u>During</u> <u>1966*</u>	<u>April</u> <u>1966**</u>	<u>April</u> <u>1967**</u>
Copper	45	32	37
Copper, with lead or zinc	4	5	3
Lead and/or zinc	13	12	5
Sub-total	62	49	45
Dry gold lode	2	5	2
Dry gold-silver lode	4		
Dry silver lode (Ag-Pb)	15	3	7
Sub-total	21	8	9
Gold Placer . . . . .		1	1
Uranium . . . . .		11	8
Mercury . . . . .		6	2
Silica (with or without metal content)		12	9
Asbestos . . . . .		5	4
Gypsum . . . . .		4	4
Lime, limestone, cement, , . . . .		5	5
Marble . . . . .		3	3
Perlite . . . . .		2	2
Bentonite . . . . .		1	1
Mica . . . . .		2	2
Feldspar . . . . .		1	1
Iron ore or concentrate. . . . .		1	1
Totals		111	97

\* Source: U. S. Bureau of Mines

\*\* Source: Arizona Department of Mineral Resources.