

DEPARTMENT OF MINERAL RESOURCES
STATE OF ARIZONA
PHOENIX, ARIZONA

FRANK P. KNIGHT, DIRECTOR



HISTORY
OF
MINING IN ARIZONA

Compiled by Frank J. Tuck

Second Edition

Revised 1963

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SUMMARY OF PRODUCTION OF ARIZONA MINES 1860 - 1962

	Quantity	Value
Copper (tons)	18,427,000	\$7,473,161,000
Gold (ounces)	12,875,000	338,131,000
Silver (ounces)	369,987,000	288,231,000
Zinc (tons)	913,700	220,234,000
Lead (tons)	622,300	121,152,000
Sub-total — 5 Principal Metals		\$8,440,909,000
Manganese		\$ 21,600,000
Mercury (estimated)		1,200,000
Molybdenum (pounds)	47,100,000	48,400,000
Tungsten		6,000,000
Uranium (1956-1962)		38,736,000
Other years not available		
Vanadium (to 1950 Incl.) not published thereafter		460,000
Sub-total — Misc. Metals		\$116,396,000
Grand Total all Metals		\$8,557,305,000
Asbestos (estimated)		\$ 11,500,000
Barite		3,000,000
Cement (estimated)		70,000,000
Clays and Clay products		23,000,000
Feldspar		3,500,000
Fluorspar (estimated)		750,000
Gypsum (estimated)		4,400,000
Lime		33,900,000
Mica (1951-1962)		
Other years not available		550,000
Perlite		900,000
Pumice-Pumicite (1952-1962)		
Other years not available		9,120,000
Sand-Gravel (1917-1962)		136,200,000
Silica (1953-1954)		
Other years not available		662,000
Stone (Dimension and Crushed) 1889-1962		47,000,000
Sodium Sulfate, Coal, Rare Earths, Gems (estimated)		3,300,000
Grand Total All Nonmetallics		\$ 347,782,000
GRAND TOTAL ALL Metals and Nonmetallics		\$8,905,087,000

it was obtained largely from gold-mining operations in the Mammoth mine, near San Manuel, but more recently it was recovered from uranium ores in the northern part of the State.

Uranium has been discovered in several parts of the State, but the biggest developments so far have been in the northeastern part. In 1947 uranium minerals were found there and interest began to grow. The Department of Mineral Resources purchased its first Geiger counter that year and many samples were tested thereafter. In 1949, the first accredited Arizona discovery was made near Lee's Ferry in the Vermillion Cliffs district. The uranium boom in the Four Corners area really got started in 1950 and most of the Arizona production has come from there. However, the Cameron area and the Orphan mine at Grand Canyon have produced substantially. The latter now is the principal supplier to the 250-ton Tuba City processing plant, completed in 1956.

A Government buying station at Cutter, Gila County, purchased ore from the area during 1955-1957. Some shipments were made from the west border of Yavapai County at the Santa Maria River and from the Tyndall District, Santa Cruz County.

HISTORY OF MINING IN ARIZONA

Compiled by Arizona Department of Mineral Resources

Frank J. Tuck, Statistical Engineer

Frank J. Tuck, statistical engineer, compiled the first edition of History of Mining in Arizona for the Arizona Department of Mineral Resources from reports of the Arizona Bureau of Mines and the U.S. Bureau of Mines, and from the department's own records. The first printing has been distributed, therefore this second edition, an up-to-date revision of the first. It has been impossible to mention all of the mining districts but it is believed that the important ones are covered. Apology is made if any has been overlooked.

GENERAL CHRONOLOGICAL SUMMARY*

- 1530 Nuno de Guzman, president of the Governing Board of New Spain, hears of the Seven Cities of Cibola far to the north, whose streets were "paved with gold and silver." He founds San Miguel de Culiacan in Mexico.
- 1536 Alvar Nunez Cabeza de Vaca and the Negro, Estevan, reach Culiacan with fresh rumors of Cibola.
- 1539 Francisco Vasquez de Coronado sends Friar Marcos de Niza and Estevan to find the Seven Cities of Cibola. Niza was the first white European to enter Arizona. The expedition reaches the Zuni Pueblos. Estevan is slain by the Indians, and Niza returns with imaginative tales of gold and silver utensils.
- 1540 Coronado's expedition enters Arizona and discovers the Seven Cities of Cibola to be seven Indian villages with no metallic riches.
- 1557 Bartolome de Medina, of Pachuca, Mexico, invents the patio proceses of silver amalgamation.
- 1583 Antonio de Espejo discovers a deposit said to be silver ore, the first in Arizona, possibly the United Verde deposit, near the headwaters of the Verde River. He also discovers the Verde River salt deposits.
- 1604 Juan de Onate explores northern and western Arizona but discovers no mineral.
- 1691 Padre Eusebio Francisco Kino enters Arizona and for twenty-five years explores and develops the Papago country.
- 1705 Kino mentions the mining of rich silver ores. These were probably the Santa Rita Mountain deposits.

*Events up to 1950 inclusive are chiefly reported from Arizona Bureau of Mines Bulletins Nos. 145 and 159.

- 1736 Famous Bolas de Plata silver desposit at Arizonac in northern Sonora is discovered.
- 1750 Some copper is mined at Ajo.
- 1774 Placering for gold in Quijotoa district.
- 1776 Spanish Garrison is transferred from Tubac to Tucson, which up to this time was only an Indian village.
- 1777 Arivaca is mentioned as a mining community.
- 1790-1820 Period of prosperity for the Spanish Missions but mining is un-important.
- 1792 Legal ratio between gold and silver in United States is made 16 to 1.
- 1800 Copper is being mined in a primitive way at Santa Rita, New Mexico.
- 1823 Mexico obtains its independence. The Missions are abandoned.
- 1825 The first American Scouts begin to explore Arizona. Sylvester and John Pattee lease Chino deposit at Santa Rita, New Mexico.
- 1836 The Apaches are made unfriendly to the Americans by the murder of Chief Juan Jose.
- 1848 American troops under Kearney first enter Arizona. Marshall discovers gold in California.
- 1853 Gadsden Purchase from México acquires that part of Arizona and New Mexico south of the Gila River.
- 1854 Charles D. Poston begins search for gold and silver near Tubac.
- 1855 Mexican troops leave Tucson and Tubac and are replaced by Americans. Rich copper ore hauled from Ajo to San Diego for shipment to Swansea, Wales.
- 1856 Santa Rita silver mine near Tubac is opened. Exploration of Santa Rita and Cerro Colorado Mountains.
- 1857 Prospectors begin to enter Arizona in numbers. Gold ore found in Mohave County near Colorado River.
- 1858 Discovery of the Mowry lead-silver mine in the Patagonia Mountains. Discovery of the Gila City or Dome placers near Yuma.
- 1859 Rich silver ore is being mined at Heintzelman Mine in Cerro Colorado Mountains.
- 1861 Start of Civil War. Withdrawal of troops followed by Apache depredations.

Crushed stone, used for concrete, road material, railroad ballast, and smelter flux, has been the chief source of income for Arizona Stone producers.

The Arizona Bureau of Mines estimates the value of stone produced in Arizona from 1889-1948 to be \$14,234,000. From 1949 to the end of 1954, Arizona produced 2,776,251 tons of stone, worth \$3,585,749. Production then increased steadily and in 1962 was more than double that of 1954. The total value of stone produced from 1889 to the end of 1962 is estimated at \$46,768,000, exclusive of limestone used for cement.

TUNGSTEN

Tungsten mining in Arizona began around 1900 but except for the World War I period was of little importance until the price started to soar in 1933. In a 1941 circular the Arizona Bureau of Mines estimated the total value of tungsten ore mined at approximately \$2,500,000. The U. S. Bureau of Mines gives production for 1941 to 1950 at 741 tons of 60% WO₃ content. The value of this 741 tons is estimated at \$1,000,000. Production for 1951 to 1957, was 720 tons of 60% WO₃ with a value of \$2,536,000, making an overall total value to the end of 1957 of \$6,000,000.

The year of record production was 1941. The year of record value was 1955.

In 1951, the General Services Administration announced a domestic program for the purchase of 1,468,750 short ton units of tungsten over a period not to exceed five years. In 1956, further authorization was made, but money therefor was not appropriated.

The Dragoon and Huachuca mines, Cochise County, Campo Bonito, Pima County and the Aquarius and Yucca mines in Mohave County, were the principal producers before 1930. The Borianna in Mohave County, the Camp Wood, Black Pearl, and Tungstona, in Yavapai County, and the Las Guijas in Pima County were the chief producers in later years.

Production since 1957 has been very small.

URANIUM and VANADIUM

The U. S. Government did not permit the publication of Uranium and Vanadium statistics in some years prior to 1956. From 1956 to 1962 inclusive there have been produced in Arizona 1,711,297 tons of uranium ore valued at \$38,736,000. Vanadium figures are not available.

One of the important uses of vanadium is in the production of high-quality steels. The total value of vanadium that has been produced in Arizona is estimated at \$460,000 up to 1950. Prior to 1945,

duction from 1917 to 1948 inclusive to have been worth \$16,-668,000. Totals for the years 1949 to 1954 were 15,423,000 tons worth \$11,771,000.

Since 1954, sand and gravel production has climbed rapidly to a value of \$25,400,000 for 1962, nearly ten times the 1952 value. The main reasons for the climb were increased road and other construction including Glen Canyon Dam.

SILICA

Fine lump or crushed quartz and quartzite of high silica content have been employed in Arizona smelters for flux and for furnace lining. There is little available data as to the amount and value so used. Gold and other ores of high silica content are used also for silica flux. Therefore, the use of quartz or quartzite varies according to the use of siliceous ores.

In the late 30's and nearly 40's, Paul Lime Plant west of Douglas, produced finely ground quartzite for reverberatory furnace linings. In 1943-44 Arthur Enders mined a few thousand tons of silica from the Dixie claims, 40 miles northeast of Phoenix.

Relatively pure deposits of silica necessary for glass-making are not common, and some are not developed because of their location far from large centers of glass manufacture.

An outstanding deposit of silica sand of high quality occurs in Coconino County at Meteor Crater.

Rounded grain sand produced at Houck by Arizona Sand Co. is used for fracturing oil bearing strata.

STONE

Commercial stone is broadly classified as dimension stone, slate and crushed stone.

Commercial shipments of sandstone have been made from Coconino, Navajo, and Yavapai Counties. Coconino sandstone of various colors is quarried near Ash Fork, Seligman and Drake. Granite rock for buildings and monuments has been quarried in several Arizona localities, chiefly near Prescott, Phoenix, Casa Grande and Salome. Volcanic tuff quarried in Cochise, Gila, Maricopa, Mohave, Pima and Yavapai Counties, has been a popular building stone.

Marble was quarried many years ago in the Chiricahua Mountains of Cochise County. Onyx Marble has been produced in Coconino, Maricopa, Pima and Yavapai Counties. Crushed marble for roofing granules and other uses is produced in Cochise, Pima, and Yuma Counties.

No slate has been produced commercially in Arizona.

- 1862 Confederate troops occupy Tucson. They are driven out by California Column under General A. H. Carleton who established posts at Camp Verde, Ft. McDowell, and Ft. Whipple. La Paz gold placers discovered by Pauline Weaver.
- 1863 Castle Dome district near Yuma becomes known. Discovery of many placer and lode deposits in the Prescott region. The Moss Mine, Oatman district, Vulture Mine near Wickenburg, and Planet Mine near the Williams River are discovered. The Moss and Vulture are lode gold mines, the Planet is copper. Many lode deposits discovered in Mohave County. Arizona is made a Territory, chiefly because of gold discoveries, with Prescott as the Capitol.
- 1864 Henry Clifton rediscovers copper in eastern Arizona.
- 1865 Small-scale Mexican copper operations at Cananea, Sonora.
- 1866 Apaches on war path.
- 1867 Capital is moved from Prescott to Tucson.
- 1871 The Federal Government sends a large number of troops and determines to end the Apache problem which was finally settled with the surrender of Geronimo in 1886.
- 1872 Town of Clifton is founded by Metcalf and Stevens.
- 1873 U. S. Mint by act of Congress discontinues the coinage of silver dollars. Great financial and industrial panic.
- 1874 Globe becomes a booming silver camp. Railroad built from Clifton to Metcalf, the first in Arizona. McCracken silver-lead mine discovered in Mohave County. Richmond Basin Silver district northeast of Globe is opened.
- 1875 Silver King Mine in Superior district is discovered by Mason and Copeland. Silver Queen (Magma) also discovered. The Lesinsky brothers build a copper furnace of one ton daily capacity at Clifton. Detroit Copper Company founded and mining starts at Morenci.
- 1876 Southern Pacific Railway reaches Gila Bend from California. United Verde ore body is discovered at Jerome by M. A. Ruffner. Mineral Park district, Mohave County, active.
- 1877 John Dunn, Army Scout, makes first location in Warren district. Ed Schieffelin "goes to hunt for his tombstone".
- 1878 First shipment of matte from Copper Queen claim. First locations made at Tombstone recorded. Act of Congress again makes silver legal tender, Bland-Allison bill.
- 1879 Boom starts at Tombstone.

- 1880 Lesinky sells out to Arizona Copper Company at Clifton after making \$2,000,000. Phelps Dodge on advice of Dr. James Douglas buys half interest in Detroit Copper and builds small smelter at Morenci. Dr. Douglas pays first visit to Bisbee. Silver-copper ore is mined from Silver Queen at Superior (now the Magma).
- 1881 Railroad reaches Lordsburg. Old Dominion Copper and Smelting Company starts operations at Globe. Phelps Dodge acquires Atlanta claim at Bisbee. Mammoth district opened. A small copper furnace is in operation at the present site of Miami.
- 1882 United Verde Copper Company organized. Atlantic and Pacific Railroad crosses northern Arizona.
- 1883 Some copper mining is undertaken at Ray. A small smelter is built at Jerome.
- 1885 Copper Queen Consolidated Mining Company is formed. Territorial Legislature creates University of Arizona.
- 1886 Bonanza ores exhausted at Morenci and concentrator built by William Church to treat oxidized ore that averages 6.5 per cent copper. Six furnaces in operation at Globe.
- 1887 Dennis May discovers Congress gold mine.
- 1888 Dr. James Douglas turns down United Verde because of inaccessibility. Old Dominion Company reorganizes at Globe. First building to house the School of Mines of the University of Arizona is completed at Tucson. Harquahala gold deposit is discovered.
- 1889 Senator W. A. Clark obtains control of the United Verde mine, which resumes operations.
- 1890 Sherman silver purchase bill is enacted by Congress. Louis D. Ricketts becomes assistant to Dr. Douglas.
- 1891 The cyanide process after years of experimenting becomes a success in South Africa and revolutionizes gold mining.
- 1892 Phelps Dodge Corporation purchases United Globe Mines at Globe and also certain claims in the Miami district.
- 1893 Silver is demonitized. Disastrous panic. Prospectors turn from silver to gold. Copper Queen works first sulphides.
- 1894 Rail connection complete to Jerome. An unsuccessful attempt made to work the Ajo deposit. Raw copper on free list.
- 1895 Cyanide process is introduced at Congress Mine, one of the first installations of it in this country. Fortuna Mine south-

In 1946 the San Manuel mine reported the presence of an economical quantity of molybdenum in their immense copper ore-body.

In 1951 the Morenci Branch of Phelps Dodge Corporation began production of molybdenum concentrates as a by-product, at the rate of about 1,000 tons per year.

By-product molybdenum concentrates are now produced at the San Manuel, Esperanza, Morenci, Silver Bell, Inspiration, and Bagdad mines.

Total Molybdenum production in Arizona from 1916 to 1962 is 47,100,000 pounds with a value of \$48,400,000.

PERLITE

Perlite deposits near Superior first became of interest in 1944 and commercial production commenced in 1946. The production from 1946 to the end of 1948 was estimated by the Arizona Bureau of Mines to be worth \$65,000. There was a decline in production in the following three years, due to technical problems connected with its use, but in 1952 production nearly doubled that of 1951 and by 1957 it had climbed to 15,600 tons worth \$114,000. The value of production to the end of 1962 is estimated at \$900,000.

PUMICE AND PUMICITE

Scoria and cinders have for many years been used for railroad ballast and in road construction. About 1951 they began to be used as light weight aggregate in concrete for building blocks and such use has climbed since. There was only one property producing them in 1952, the Haigler property in Coconino County, where 14,500 tons were produced, worth \$87,000.

In 1960, the Pozzolan Division of Standard Gilsonite Co. acquired the Bonner pumicite deposit in Coconino County and put in fine grinding equipment to produce pozzolan for use in concrete for Glen Canyon Dam.

In 1961, Arizona was the largest producer of pumice and pumicite material in the Nation. The Santa Fe railroad was the largest producer of pumice. Cinders and scoria were quarried for light weight aggregate in Coconino, Cochise, Graham, and Yavapai counties.

The total value of Arizona production from 1952 to 1962 is \$9,120,000.

SAND AND GRAVEL

Sand and gravel are a product of all States in the Union, and Arizona is no exception. Records of production were first reported statistically in 1917. The Arizona Bureau of Mines reports the pro-

and Rattlesnake mines operated by Mercury Mines of America, had combined production reported to be 1078 flasks.

World War II created a demand for mercury, and production, which had been dormant in Arizona for many years, picked up a little. The principal producing mines during this period were the Ord Mine in Gila County, and Pine Mountain mine in Maricopa County. Production for the period 1941 through 1946 was 2761 flasks worth \$478,966.

The Arizona Bureau of Mines estimates the value of mercury produced up to the end of 1950 at \$880,000. In 1951 a few flasks produced from the Sunflower district were the first since 1946. None was reported for 1952-3 but in 1954-55, 640 flasks valued at \$181,593 came from that district. The leading producer was the Pine Mountain mine operated by the International Ore Corp.

Production dropped in 1957 to 1959 but Grimes and Brunson, and others in the Sunflower district increased in 1960 to 5 times 1959 production, and 1961 was higher.

The total Arizona production of mercury to the end of 1962 is estimated to be about 9000 flasks with a value of \$1,200,000.

MICA

Scrap mica has been produced in Arizona since about 1940. Four operations, in Maricopa, Mohave, Pima, Yuma and Cochise counties, have accounted for most of it.

Production figures were first reported by the U. S. Bureau of Mines in 1951 and have been given for most of the years since. Total production for the years 1951 to 1962 is estimated to be 26,500 tons worth \$550,000.

MOLYBDENUM

The first record of molybdenum production in Arizona, was in 1916, when war time demand for the metal brought about production of molybdic oxide at the Mammoth-Collins mine in Mammoth, Pinal County. From 1916 to 1919, this mine produced 447,876 pounds of MoO_3 . Production at the Mammoth mine was resumed in 1934 and continued through 1944. In 1938 the Miami Copper Company reported the recovery and shipment of a small quantity of molybdenite concentrates from the re-treatment of copper sulfide concentrates. In 1940 the Miami Company began roasting the molybdenite concentrates to make molybdic oxide.

In 1944 Bagdad Copper Corporation began shipments of molybdenum concentrates. Also the Squaw Peak Copper Mining Company, Camp Verde, Arizona, began shipments to the Metals Reserve Company.

east of Yuma is discovered.

- 1896 King of Arizona Mine northeast of Yuma is discovered by Chas. E. Eichelberger. The North Star mine near the King of Arizona, and the Commonwealth mine at Pearce are located. McKinley elected President, and gold standard assured. First disseminated copper ore is treated at Clifton by James Colquhoun, but this is relatively high-grade ore.
- 1898 War with Spain.
- 1899 McKinley is re-elected and free silver issue is dead. Daniel C. Jackling does the pioneer mill testing of a low-grade porphyry ore at Bingham, Utah. United Verde Extension Mining Company formed. An English company, Ray Copper Mines, Ltd., unsuccessfully attempts to work Ray deposit.
- 1900 A smelter is built at Douglas by Phelps Dodge Corporation. Rich gold ore is found in Oatman and Katherine districts. John R. Boddie, Captain Huie, and several others organize the Cornelia Copper Company to work the Ajo deposit.
- 1902 Calumet and Arizona Company is organized. First production at the Golconda mine in the Cerbat District.
- 1903 Phelps Dodge obtains control of the Old Dominion at Globe. Gold Road Mine is discovered in Oatman district.
- 1904 F. L. Ransome, of the U. S. Geological Survey, prepares report on the Bisbee district.
- 1905 Waldemar Lindgren writes report on Morenci for the U. S. Geological Survey.
- 1906 Philip Wiseman and Seeley Mudd obtain options at Ray. J. Parke Channing examines the copper deposits at Miami, and exploratory shafts are started. The famous McGahan vacuum smelter is built at Ajo, the most fantastic metallurgical scheme ever devised. First low-grade porphyry copper production at Morenci.
- 1907 Daniel C. Jackling undertakes extensive development work at Ray. John Lawler owns eight claims at Bagdad. Panic of 1907.
- 1907-1908 Arizona passes Montana in copper production and becomes the No. 1 copper producer in the U. S.
- 1908 Miami Copper Company and Inspiration Copper Company are organized. Tom Reed Gold Mines Company starts intensive operations on the Tom Reed vein in the Oatman district.
- 1909 Sacramento Hill at Bisbee is drilled. J. Parke Channing and

Seeley Mudd drill at Ajo and reject property. Cornelia Copper Company reorganizes as New Cornelia Copper Company. Louis S. Cates is placed in active charge at Ray. Arizona loses its No. 1 position in copper production.

- 1910 Hayden, Stone and Company finance Chino, and large-scale stripping operations commence at Santa Rita, New Mexico. Magma Copper Company at Superior is formed. Arizona regains the No. 1 position in copper production and retains it thereafter.
- 1911 Production starts at Miami Copper Company. American Smelting and Refining Company builds smelter at Hayden. Ray production starts on large scale. General John C. Greenway becomes interested in Ajo, and the New Cornelia property is drilled by the Calumet and Arizona Company. Production starts at Magma.
- 1912 Town of Oatman is started. Arizona is admitted to the Union as forty-eighth state. James S. Douglas becomes interested in United Verde Extension and development work there is begun. Consolidated Arizona Smelting Co. builds 400-ton concentrator, revamps Humboldt smelter and resumes the treating of copper ores from its Blue Bell and DeSoto mines southwest of Mayer.
- 1914 World War I starts.
- 1915 Large gold ore body is developed in United Eastern Mine at Oatman. Metal prices start to boom. International Smelting Company erects smelter at Miami. Flotation introduced at Inspiration, the first large-scale copper flotation plant in this country. Legislature creates Arizona Bureau of Mines.
- 1916 United Verde Extension mines bonanza ore body at Jerome.
- 1917 United Eastern purchases Big Jim at Oatman. Production starts at New Cornelia with leaching ore. War prices for metals. Extensive working of small high-cost copper, manganese, and tungsten deposits. New Cornelia buys property of Ajo Consolidated Company.
- 1918 Steam shovel operations start at Sacramento Hill at Bisbee. Paul Lime Plant at Paul Spur produces lime to neutralize acid in copper ores in flotation concentration.
- 1919 Experimental flotation plant is installed at Ajo.
- 1921 Postwar depression and shut down of copper properties. Entire Morenci district now controlled by Phelps Dodge.
- 1922 End of postwar depression.
- 1923 Copper Queen mill south of Bisbee is placed in operation.

to the end of 1962, the value of lime produced was \$21,850,000, making the total since the beginning of production \$33,900,000.

MANGANESE

The Arizona Bureau of Mines has reported that Arizona's production of manganese ore to the end of 1950 was approximately 83,800 tons valued at \$2,100,000, produced largely from the Bisbee and Tombstone districts.

In late 1952, the Government established a buying station at Wenden and from 1953 to 1955 it stockpiled manganese ores containing over 6 million units of recoverable manganese at a cost of \$10,743,000. This Wenden station was closed in April 1955.

Government purchases of manganese ores continued, under the carlot program initiated in 1952, until August 1959. The industry then came to a near standstill. The largest producer, Mohave Mining and Milling Co., operated its plants at Wickenburg into 1960 to complete a contract, then liquidated.

Numerous mines in Mohave, Yuma, Maricopa, Santa Cruz, Gila, Pinal, Cochise and Pima counties participated in the Government buying program.

The U. S. Bureau of Mines has reported manganese production in Arizona which, over the years 1915 to 1962 is estimated to have had a total value of \$21,600,000.

MERCURY

Arizona mercury deposits discovered to date have not been large and the principal production has occurred during war periods.

The quicksilver deposit in the Dome Rock Mountains near Quartzsite, was probably discovered as early as the year 1878. The quicksilver veins in Copper Basin, between Prescott and Skull Valley, were mined in the late eighties and early nineties, and the report is that the mercury was produced to supply the local demand of gold mines for quicksilver needed for amalgamation. Quicksilver was discovered in the Phoenix Mountains in 1916 by J. A. and Henry Porterie; and during the latter part of the same year cinnabar was found by Sam Hughes and associates. A few flasks of quicksilver were produced in a small retort built by Mr. Hughes. Cinnabar, a mercury mineral, was first discovered in the Mazatzal Mountains in 1911 by E. H. Bowman. Since then, occurrences of this metal have been found on Sycamore and Slate Creeks. There has been a small production of quicksilver from these ores, seldom over a few hundred flasks per year, and during some years, no production.

The period of record production was 1928-29 when the Ord

came from the Consolidated Feldspar Corporation property near Kingman, Mohave County.

The Arizona Bureau of Mines estimated the value of feldspar produced from 1923 to the end of 1948 to be \$2,200,000. To the end of 1962 this value is estimated to have increased to about \$3,500,000.

FLUORSPAR

Up to 1918 the only fluorspar production came as a by-product from lead mining in the Castle Dome district, Yuma County. Since 1918, the principal producers have been the Forbes mine, Greenlee County and the Lone Star in Cochise County, except for the peak year of production when treatment of old tailings in the Castle Dome district yielded much of the 1951 tons of spar produced in 1953. Some fluorspar was produced also from properties in Graham, Maricopa and Pima Counties. The closing of a custom mill at Deming, New Mexico, in 1955 forced Arizona mines to suspend work. In 1958 a small amount was shipped from the Snowball mine in Maricopa County and the National Fluorspar and Chemical Co. shipped some acid grade spar to the Government stockpile from its Bluebird mine in Gila County.

The value of Arizona's fluorspar production from 1902 to the end of 1962 is estimated to be about \$750,000.

GYPSUM

Arizona's gypsum production, which is used mostly in the manufacture of cement, but also in wallboard and soil conditioning, increased from 6686 tons in 1951 to 96,000 tons in 1956. The output comes from the Arizona Gypsum Corporation's properties near Feldman, Pinal County, and Camp Verde, Yavapai County, and the National Gypsum Company's property near Feldman. The latter company ships to its wallboard plant at Phoenix, built in 1955.

The value of gypsum production in Arizona to the end of 1962 is estimated to be \$4,400,000.

LIME

Lime, for building purposes has been produced in Arizona since 1894. Since 1915, the larger portion of the lime produced has been used in the flotation process at the copper concentrators. The principal plants are: the Paul Lime Plant, Cochise County; Hoopes & Company, Gila County; the Grand Canyon Lime-cement Company, Yavapai County; and captive plants of copper companies using limestone from their properties.

The Arizona Bureau of Mines has estimated the value of lime produced in Arizona from 1894-1948 to be \$12,046,000. From 1949

- 1924 Ray and Chino merge. Concentrator at Ajo put into operation, and treatment of sulphide ore commences. Smelter is completed at Magma.
- 1925 End of high-grade ore at Miami in sight. Company plans for working low-grade.
- 1926 Ray Consolidated is absorbed by Nevada Consolidated. Large-scale leaching operations started at Inspiration.
- 1928 Drilling program started on Clay ore body at Morenci. Extensive addition to concentrator at Ajo.
- 1929 Climax of boom and start of the great depression. Sacramento Hill open pit operations are discontinued. Miami Copper mining low-grade ore body successfully.
- 1930 Copper price collapses from 18 to under 10 cents a pound. Louis S. Cates becomes president of Phelps Dodge.
- 1931 Phelps Dodge absorbs Calumet and Arizona. Great Britain abandons gold standard.
- 1932 Curtailed copper operations. Extensive reworking of gold placer deposits. Four-cent tariff is placed on copper imports. Copper price declines to under 5 cents a pound.
- 1933 Price of gold is raised to \$25.56. Silver legislation.
- 1934 Price of gold is raised to \$34.95 per ounce with subsequent boom in small gold properties.
- 1935 Price for newly mined domestic silver is raised to 77.57 cents.
- 1936 Period of general recovery.
- 1937 Business pick up, high copper prices and subsequent collapse in summer and fall. Extensive development of Clay ore body (Morenci Open Pit Mine) is started.
- 1938 Partial or complete shutdown of copper properties and reopening in late summer. Price for newly mined domestic silver is reduced to 64.64 cents. War scares. United Verde Extension finishes ore body, and smelter is dismantled and sold. Arizona Small Mine Operators Association is formed.
- 1939 Arizona Department of Mineral Resources is created by Legislature. World War II begins. Mineral industries gear to high production. Copper, Lead, and Zinc prices begin long climb upward.
- 1940 U. S. copper imports exceed exports; government stockpiling stimulates entry of Latin American and African copper into United States. Zinc output largest in Arizona's history.

- 1941 Pearl Harbor. United States declares war on Axis nations. Copper price under voluntary control.
- 1942 Morenci begins large-scale, open-pit production. Record zinc output. Government premium prices inaugurated February, 1942. Most gold mines closed by government order L-208, October, 1942. Shattuck-Denn Mining Corp. purchases Iron King lead-zinc mine and mill from Iron King Mining Co.
- 1943 Open pit copper production at Castle Dome mine commences in April. Arizona's metal output greatest since 1929. Severe labor shortages. Zinc output establishes new record. U. S. Bureau of Mines starts exploratory drilling at San Manuel copper deposit after recommendation by B. S. Butler and N. P. Peterson, of University of Arizona and U. S. Geological Survey.
- 1944 Magma Copper Company becomes interested in San Manuel mine near Mammoth. Seven per cent decrease in Arizona metal production owing in part to labor shortage. Increase from 25,000 to 45,000 tons of ore per day at Morenci copper concentrator. Lead and zinc output highest in State's history.
- 1945 Cessation of hostilities with Axis. Zinc production makes new record, 38 per cent greater than 1944. Lead also sets new record, 37 per cent greater than 1944.
- 1946 San Manuel exploration continues: 211,500,000 tons of ore proved up. Lead and zinc production continues upward trend, exceeding 1945. Stimulation of interest in non-metallics owing to building boom.
- 1947 San Manuel Copper Company reports a total of 462,784,500 tons of copper ore proved. Government premium prices expire in June.
The A.E.C. organizes a Division of Raw Materials and establishes field office at Grand Junction, Colorado, for exploration procurement and processing of uranium ores.
- 1948 Copper excise tax is reduced from 4 cents to 2. (Tax had been suspended during the war, and suspension continued to March 31, 1949.)
High metal prices continue to stimulate mining industry. The output of copper ore and zinc-lead ore is the highest of any year in the history of the State. Open-pit development is completed at Inspiration and in progress at Ray. Underground exploration begins at San Manuel.
Arizona Portland Cement Co. starts first kiln at its new cement plant at Rillito.
- 1949 Copper import tax is again suspended in March to June 30,

Since 1945 accurate total production figures have been unavailable. In October, 1952, the General Services Administration opened an Asbestos purchase depot at Globe, and this resulted in the opening and re-opening of several asbestos properties. The largest of these were the Regal, Phillips Asbestos, Crown Asbestos, Chrysotile, and American Fiber.

The Arizona Bureau of Mines has estimated the value of asbestos produced from 1914-48 to be \$4,240,000. Production from 1953 to 1962, a period of government purchasing, is estimated to have been 27,000 tons with a value of \$8,500,000.

BARITE

The only period of important barite production in Arizona was from 1946 to 1955 when Arizona Barite-Macco Corp., operated a mine near Granite Reef Dam and a processing plant at Mesa. Its total production was valued at over \$3 million.

CEMENT

The first cement plant in Arizona was built by the Arizona Portland Cement Company at Rillito, Pima County. The plant was started up in December, 1949, with a capacity of 2,000 barrels per day. Capacity was increased to 4,000 barrels per day in 1951 and to 7,000 barrels per day in 1955. Present capacity is about 8,000.

The next of the two Arizona cement plants was built by the Phoenix Cement Co. at Clarkdale to meet its commitment to supply 3 million barrels of cement to the Glen Canyon Dam project. The plant was started in operation in the fall of 1959. Its initial capacity was 5,000 barrels per day. An additional kiln installation was completed in mid-1961 to bring plant capacity to about 2,600,000 barrels per year.

CLAYS

Clays have been produced in Arizona since 1894. Clay production in 1961 was 165,000 tons valued at \$240,000. Non-swelling type bentonites chiefly from the McCarrell properties near Sanders, Apache County, accounted for 16 percent of the tonnage and 41 percent of the value. The balance was mainly brick clay in Maricopa and Pima counties.

The value of Arizona clay products to the end of 1962 is estimated to be nearly \$23,000,000.

FELDSPAR

Feldspar production in 1962 (figures not published), was virtually the same as in 1961. As in past years, the entire production

from which leasers have mined copper, lead, zinc, gold and silver intermittently since 1899. Callahan Zinc Lead Co. completed a 140 ton mill in 1940 and milled in excess of 100,000 tons of ore before closing operations in mid-1944.

Three mines in the Harshaw district, the Flux, Hardshell and Trench produced from 1880-1925 a total of 5,500 tons lead and \$430,000 in silver. In 1937, American Smelting and Refining Co. purchased the Trench mine. In 1939, it completed a 200 ton flotation mill. The company later acquired the Flux mine. The Trench mill operated with few interruptions until A. S. & R. closed it in 1957. Nash & McFarland then purchased the mill, leased the Flux mine and have operated steadily since.

The Three R mine in the Palmetto district, 1909-1930, produced 5,000 tons of copper and \$65,000 in silver.

The Montana mine (Goldfield Cons. 1917-18) (Eagle Picher 1927-30) in the Oro Blanco district, produced 200 tons copper, 3,900 tons lead, \$100,000 in gold and \$293,000 in silver. The mine, operated by the Eagle-Picher Mining Co., ranked as the largest producer of lead and zinc in Arizona for 1935 to 1939 inclusive.

The production of the Oro Blanco District up to 1949 is given by the Arizona Bureau of Mines, as follows:

Silver	1909-1949	4,009,527 oz.	valued at	\$ 2,790,179
Gold	1873-1949	98,142 oz.	valued at	2,623,069
Lead	1909-1949	54,562,201 lbs.	valued at	2,688,818
Zinc	1917-1949	38,256,989 lbs.	valued at	2,061,017
Copper	1909-1949	3,152,630 lbs.	valued at	334,942
Total value through 1949				\$10,498,025

HISTORY OF MISCELLANEOUS METALS AND NON-METALLICS IN ARIZONA

Until 1953, when the United States Bureau of Mines began to report Arizona's non-metallic mineral production in more detail, there was no good source of information on Arizona's nonmetallic and miscellaneous metal mines.

ASBESTOS

Chrysotile asbestos mines in Arizona are in numerous localities over an area 60 miles long and 25 miles wide in the Salt River and Cherry Creek Basins, Gila County.

Early production in Arizona has been recorded as follows:

	Tons of Asbestos
1914-1939	11,938
1940-1944	7,668

1950. Owing to a drop in base-metal prices in March and April and subsequent reduction of the work-week to 40 hours, copper production is curtailed by 5 per cent under the output of 1948. Production of zinc and lead, however, reaches a new high.

1950 Production of copper, gold and silver increases while the output of zinc and lead decreases. Interest in tungsten, manganese, and other critical metals and minerals is stimulated by world conditions.

2-cent copper tax resumes July 1st.

Open-pit production commences at Ray.

Phelps Dodge begins development of Lavender Pit.

New Copper smelter blows in at Ajo.

Russia has atomic bomb and uranium exploration is intense.

1951 The 2-cent copper tax is suspended April 1st, with provision for resumption of the tax if copper drops to 24 cents.

1951-1953 Flood of imports of lead and zinc causes shut-down of many lead and zinc mines.

1952-1954 Banner Mining Company and Pima Copper Mining Company appear among notable producers of copper in the Pima Mining District south of Tucson.

1953 Castle Dome copper ore reserves are exhausted.

Operations cease at United Verde in March.

Development of Miami's low grade copper ore starts.

G.S.A. opens manganese ore purchasing depot at Wenden in January and Asbestos depot at Globe in June.

Copper price decontrolled May 1st.

Copper tax suspension is continued to June 30, 1954.

1954 Castle Dome's mill building is moved to Copper Cities, and production is begun at the latter mine in August.

Miami begins production from low-grade ore-body.

Inspiration takes option on Christmas mine.

A. S. & R. Company begins copper production from Silver Bell mine in Pima County, in March.

Phelps Dodge begins production at Lavender Pit (Bisbee), August 7th.

Copper tax suspension is extended to June 30, 1955.

1955 Kennecott ceases underground operations at Ray on January 28th; expands open pit mining.

Copper reaches its highest price in 90 years: 43 cents per pound in September.

Inspiration makes plans to expand its milling facilities and to develop the old Christmas mine near Winkelman.

Atomic Energy Commission opens uranium ore-buying station at Cutter, in June.

Manganese ore-buying station at Wenden closes in April.

Pima Mining Company announces plans in August for the development of its property as an open pit mine. Adjacent Banner mine in full production.

Strikes at most of the copper producing mines in July and August cause loss of production of 25,000 tons of copper.

Copper excise tax suspension is extended to June 30, 1958.

- 1956 The San Manuel Smelter begins operations on January 8th. The first stope undercut is completed January 23rd.

In June, agreements are negotiated between principal copper producers and Unions, providing for pay increases spaced over 3 years.

In February producers' copper price is raised to 46 cents while custom smelters quote up to 54½ cents. The price drops to 40 cents on July 10th and to 36 cents on October 25th. In November, Phelps Dodge cuts production about 8 percent. The Government purchase program for tungsten terminates in November when funds run out.

- 1957 Copper mines reduce operating schedules to equalize supply and demand.

Pima Mining Company places its mill south of Tucson in operation in January.

Kennecott places its new "leach-precipitate-float" plant in operation at Hayden, increasing recovery of oxidized copper. Inspiration converts to an acid leach-flotation (dual-metal-lurgical) process.

Cyprus Mines begins milling copper-zinc ore from its Old Dick mine on May 10th.

Duval begins construction of 12,000 tons per day concentrator at its Esperanza mine south of Tucson.

Zinc price drop to 10 year low of 10 cents and lead drop to 13 cents cause suspension of operations at Trench Unit, Johnson Camp, Big Dick, San Xavier, Head Center and other mines.

Uranium purchasing depot at Cutter is closed in June.

The Iron King mine with 1,000 tons of ore per day capacity is 6th largest zinc and 12th largest lead producer in the U. S.

- 1958 Copper mines continue curtailment of copper production. Arizona supplies one-half of the U. S. copper output.

Kennecott begins operations of its new copper smelter at Hayden in the middle of the year.

First commercial oil producer in State drilled by Humble Oil & Refinery Company in Apache County.

tons of lead, and 2,230 tons of copper.

- 1954 Iron King increases mill capacity to 900 tons daily.

- 1961 Since 1906, the Iron King mine in the Big Bug area has produced 4,400,000 tons of ore, 422,000 ounces gold, 14,100,000 ounces of silver, 250,000 tons of zinc, 86,000 tons of lead and 5,500 tons of copper.

BANNER DISTRICT

The principal mines of the Banner district are the Christmas (copper) and Seventy-Nine (lead) located in the Dripping Spring Mountains within southern Gila County.

The Seventy-Nine Mine deposit was first located in 1879 by Mike and Pat O'Brien. The Continental Commission Co. operated the property off and on from 1919 to 1926. The Seventy-Nine Lead-Copper Co. reopened the mine in 1928 and in 1929 it was the largest Arizona lead producer. In 1936 a 60 ton concentrator was started and it ran until decline in metal prices caused shutdown in early 1938. 1940 the Shattuck-Denn Mining Corp. reopened the mine and continued producing from it until 1949. The Callahan Zinc-Lead Co. acquired the property in 1950 and since then there has been some production by lessees.

The lead production of the Banner district has been largely from the Seventy-Nine mine, as has the zinc production.

Most of the copper from the district has been produced by the Christmas mine.

The Christmas mine, located in 1880 produced some 1,500,000 tons of ore averaging about 2.4 percent copper, up to 1954, when the property was optioned by Inspiration Consolidated Copper Co. The mine was under exploration and development from 1954 to 1962 when production was resumed with facilities designed for a rate of 4,500 ore tons per day.

DISTRICTS IN SANTA CRUZ COUNTY

Harshaw, Patagonia, Palmetto, Tyndall, Wrightson, Oro Blanco

The Arizona Bureau of Mines reports the production of the above districts from 1858 to 1933 to have been approximately 19,500 tons copper, 25,000 tons lead, \$1,315,000 in gold and \$4,637,000 in silver. Total value of production — \$16,592,000.

The oldest mine is the Mowry, which, from 1858-1930 produced 5,000 tons lead and \$500,000 in silver, and has produced some lead, silver and manganese since then. Another property in the Patagonia district is the Duquesne. The property includes several mines

Mammoth, Collins and Mohawk-New Years, which were consolidated in 1934 by the company.

The first claims were located in 1879. Mining continued intermittently, mostly on the Mammoth vein, until 1901 when the workings caved from the 750 level to the surface. This early mining was done entirely for gold; production from the Mammoth and Collins mines through 1901 was over 150,000 ounces of gold valued at more than \$3,000,000.

The camp was largely inactive from 1901 until 1915 when the wartime demand for molybdenum and vanadium resulted in re-opening the mines for a short period. In 1919 prices fell, and the mines closed again.

Increase in the price of gold in 1933 caused renewed activity and production of gold-vanadium-molybdenum ores began in 1934 from the oxidized part of the veins. Mining of this ore continued into 1943 when, stimulated by high prices and the need for base metals, the management developed sulfide ore bodies below the 650 level on the Collins vein. All lead and zinc production subsequent to 1944 has been from sulfide ores.

Operations were closed in 1952 and in early 1953 the property was acquired by Magma Copper Corp.

"In nearly 70 years of operation, the St. Anthony mine produced \$40 million worth of Ore." — Eng. & Mng. Jour. April, 1953.

MAGMA (SUPERIOR) DISTRICT

(See under Copper for the history of this District)

IRON KING MINE (BIG BUG MINING DISTRICT)

1906 First production from Iron King mine in Big Bug Mining District — gold and silver and a little copper.

1917-1918 Colvocoresses mines heavy sulphide at the Iron King mine for his Humboldt smelter.

1937 Iron King Mining Company purchases Iron King mine and begins development work on the lead-zinc veins.

1938 A 140-ton bulk flotation mill placed in operation.

1939 Shattuck-Denn Mining Corporation purchases the Iron King mine, and capacity is gradually increased to 500 tons daily. H. F. Mills in charge.

1947 Total production from 1906 through 1947 of the Iron King mine reported as: 926,802 tons ore yielding 119,465 ounces gold, 3,765,850 ounces of silver, 57,727 tons of zinc, 18,589

Excise tax of 1.7 cents per pound placed on copper imports July 1, 1958.

Import quotas set for lead and zinc by the President, and some mines resume production.

Government ceases purchase of asbestos at end of year.

1959 Cyprus Mines Corporation resumes operations in January at the Old Dick mine, after being inactive throughout 1958. Duval's Esperanza Mine begins producing copper in March. Molybdenum is an important by-product.

A long labor strike beginning in August stops copper production at Morenci, Ray, Superior and San Manuel mines for the remainder of the year. Other producers are forced to stockpile, curtail or stop production.

Asarco completes 5-years of exploration at its Mission project, and plans a \$43.5 million project to bring the property into production.

After three years of exploration by its subsidiary, Bear Creek Mining Company, Kennecott announces purchase of 120 mining claims near Safford.

Others are exploring in this area.

American Cement Corp's Phoenix Cement Co. Division completes its Clarkdale plant and starts operations on a reduced scale because of a strike at the Glen Canyon Dam project.

Underground mining at the Miami Mine comes to an end on June 26 after 48 years of continuous activity. The remaining recoverable copper in the mined-out area will be extracted by in-place leaching and precipitation.

Phelps Dodge Corporation starts work on an estimated \$5 million expansion program at Lavender open-pit mine at Bisbee.

Two exploratory wells in Apache County are listed as discoveries, one is an oil well, the other gas.

The government manganese carlot-purchase program ends and manganese production comes to a near end.

1960 Kennecott's \$40 million expansion program at Ray Mines Division enables production of 20,000 additional tons of copper annually.

Bagdad Copper Corporation starts leaching its immense stockpile of oxidized copper, and produces cement copper at its new \$2 million leaching plant.

Pima Mining Company is increasing its mill capacity from 3,000 to 3,800 tons per day in order to mine and mill some of Banner Mining Company's ore in addition to its own output.

Exploration is active in the Twin Butte's area.

Transarizona Resources, Inc. begins copper production south of Casa Grande using the salt-coke-segregation process. Arkota Steel Co. dedicates its new 75-ton Madaras process steel plant at Coolidge.

Primary copper production achieves a record year.

- 1961 Asarco's Mission Unit starts its new mill August 1, 1961, handling 15,000 tons copper ore per day, and modernizes its Hayden smelter to enable it to handle the Mission concentrates.

Miners at the Iron King lead-zinc mine are on strike from October to mid-December.

Phelps Dodge Corp. exercises options to buy 299 mining claims 10 miles north of Safford.

Pima Mining Company starts a \$4 million expansion program to double its capacity to 7,000 tons ore per day.

- 1962 Output of copper exceeds that of record year 1961 by 10 per cent.

Operations start at the Christmas mine equipped by Inspiration Consolidated Copper Co. for full production rate of 5,600 tons per day.

Production resumes at the Magma mine following 2-month shutdown due to a mine fire.

Duval Sulphur & Potash Co. announces a \$28 million project to place in production its copper-molybdenum property at Mineral Park, 15 miles north of Kingman.

The copper price holds at 31 cents through the year. The lead price holds at 10 cents, except for a dip in February and the zinc price drops from 12 to 11.5 cents in April. Production gets under way in the new helium field near Pinta.

HISTORY OF GOLD MINING IN ARIZONA

Source: J. B. Tenney, Arizona Bureau of Mines Bull. No. 137

Gold mining in Arizona did not start to any appreciable extent until after the acquisition of the territory by the United States from Mexico in 1848 and 1853. What little mining was done by the Spanish and Mexican miners was for silver. A little placer gold was brought in to the churches by Indian converts from the dry working of gravels in the desert, but no systematic mining was done.

After the final occupation of Arizona in 1853, the only accessible part of the Territory was that around the old Mexican settlements of Tucson and Tubac. Considerable prospecting was done in this part of the Territory by American prospectors, and several silver mines and one copper mine were opened, but little or no gold mining was done. On the outbreak of the Civil War, the withdrawal of troops opened the door to Apache raids, and all mining ceased.

1915-1919 Local people lease Grand Reef mine, build a small mill, and ship ore and concentrates.

1916 John Gleeson and T. C. Parker, lessees, reportedly ship \$90,000 worth of lead carbonate ore from No. 1 claim.

1919-1920 Aravaipa Leasing Company obtains Grand Reef property and makes some production.

1921-1924 Little activity in district. No production during 1921-22.

1925-1928 Grand Central Mining Company, headed by Lewis Douglas, acquires the Iron Cap and other claims near Aravaipa in 1925 and builds a mill with a flotation capacity of 90 tons per day. In 1927 this plant operated for five months. Production in 1926-28 is approximately 3,500,000 pounds of lead, 1,214,797 pounds of zinc, and \$20,000 worth of silver.

1929-1931 Production is mainly from the Grand Reef which in 1931 ranks second in Arizona lead production.

1932 Little activity and small production.

1937-1941 Base-metal production is resumed in the district. The Grand Reef Corp. in 1939 installs a mill of 100 tons daily capacity. During 1941, the Calistoga Mining and Development Co. treats Grand Reef tailings.

1942-1957 Athletic Mining Company buys the Aravaipa group of claims, develops the Iron Cap and Head Center mines, and becomes the district's largest shipper of lead and zinc ores. In 1948, it builds at Klondyke a flotation concentrator of 100 tons daily capacity. The Athletic Co.'s Aravaipa properties form one of the most important Arizona lead producers until their closing in 1957.

The production of the Aravaipa District is summarized as follows:

	Tons Lead	Tons Zinc	Tons Copper	Oz. Silver	Oz. Gold
1915-1948	8,365	2,550	394	229,289	777
1949-1951	4,062	3,108	147	50,492	2,562
1952-1957*	4,000	8,000	380	80,000	—
1958-1962	Not published, but production very small.				

*Estimated.

MAMMOTH (ST. ANTHONY) DISTRICT

The Mammoth-St. Anthony mine, operated by the St. Anthony Mining and Development Co., Ltd., has a long and varied history of development and production, which involves three mines — the

Early in 1912, Pioneer Smelting Company completed a custom smelter of 150 tons daily capacity at Sahuarita, but it operated for only about a year.

Empire Zinc Company purchased the San Xavier mine in 1912 and shipped lead-zinc-silver ore from it until 1918.

In 1943 Eagle-Picher Mining and Smelting Company constructed at Sahuarita a concentrator of some 175 tons daily capacity and reopened the San Xavier mine. The capacity was doubled in 1944 and later increased to 400 tons per day to take care of custom ores. From 1943 to 1952 the San Xavier mine was one of the most important producers of zinc and lead in Arizona. In 1954, McFarland and Hullinger leased the mine and operated on a reduced scale until 1959 at which time they owned both mine and Sahuarita mill. The property was optioned to Banner Mining Co. in 1960.

The lead-zinc production of the Pima District may be summarized as follows:

	Tons Zinc	Tons Lead	Ozs. Silver	Ozs. Gold
1876-1907	—	2,000	613,000	850
1908-1948	25,845	16,246	1,447,446	827
1949-1954	21,886	11,937	806,433	133
1955-1962	not available			

ARAVAIPA DISTRICT*

1870-1889 Mineral deposits were discovered in the Aravaipa district before 1880. A small smelter is reported to have been built here in the late seventies by Col. C. W. Birdwell, but little is known about production or operations prior to 1890.

1890-1895 Aravaipa Mining Corp., operating in the northern part of the district, sank its Arizona shaft to 580 feet and shipped two cars of ore.

1890-1900 J. W. Mackey opens Grand Reef mine to a depth of 300 feet. Other properties in the district are worked, and presumably lead-silver ores are shipped.

1900-1914 Small scale operations, mainly by lessees.

*Data for years prior to 1923 abstracted from C. P. Ross.

During the Civil War, prospectors entered the Territory with the California troops, and several exploring parties were organized to hunt for gold in the central part of the State, hitherto an unknown wilderness dominated by Apaches. Rich placers were found near the Colorado River at Gila City, La Paz, and Quartzsite, and soon after the Rich Hill, Lynx Creek, Hassayampa, and Big Bug placers in the Bradshaw Mountains of central Arizona were discovered. Base metal mines and even silver mines were not sought, as only gold could be mined at a profit from this inaccessible and hazardous corner of the world. After the richer parts of the placers were exhausted, gold ledges were located and worked in the crudest manner. Most of the free-milling ore proved superficial. Only one large deposit, the Vulture, was exploited on a large scale.

At the end of the Civil War, troops were again withdrawn, resulting in ten years of chaos and bloody warfare with the Apaches. Little mining was done except around Prescott and Wickenburg where some protection was given by troops guarding Prescott, then the capitol of the Territory.

Finally, in 1872, large reservations were set aside for the Indians and the first truce was declared. The country was then enjoying the post-Civil War period of high commodity prices. Gold was relatively low in price as compared with silver and copper. Prospecting for these two metals, on the establishment of peace with the Indians, took precedence over gold, resulting, in the succeeding ten years, in the discovery and exploitation of rich silver mines in the Bradshaws, and Silver King, Globe, and Tombstone areas. This silver boom was followed after the completion of the two transcontinental railroads in 1881 by the discovery and early exploitation of nearly every copper deposit in the Territory.

From 1884 to 1893 the country went through a severe deflation of commodity values. The copper and silver markets fell rapidly resulting in a relative rise in the price of gold. On the demonitization of silver in 1893, practically all silver mining ceased, and only the richest and largest copper mines continued to operate.

From 1893 to 1900, miners from all the old silver camps of the west again turned to the search for gold, which resulted in Arizona in the discovery of numerous new gold deposits, more notably the Congress and Octave in the Bradshaw Mountains, the Mammoth north of Tucson, and the rich Harqua Hala, La Fortuna, and King of Arizona mines in the desert of Yuma County. The development of the cyanide process and of better concentration methods encouraged the re-opening of numerous old mines near Prescott and the exploitation of the deeper base ore.

Towards the end of the nineteenth century, the long period of stagnation ended and commodity prices again turned upwards. Gold mining became less attractive, and the miners in Arizona turned their attention to copper. From 1900 until the business

collapse of 1929 and 1930, gold mining was subordinate to base-metal mining. The only exceptions were the discovery and exploitation of the rich vein deposits of the Gold Road, Tom Reed, United Eastern, and others, in the Oatman district. Gold mining also continued on a reduced scale in the older mines of the Bradshaw Mountains and in those of Yuma County. The North Star Mine in Yuma County was a fairly heavy producer of gold and silver from 1907-1911.

On the collapse of commodity prices in 1930, miners again turned their attention to gold. The first result was the search for new placers and the reworking of old fields, with indifferent results. The higher gold prices that were established by the United States in 1933 revived activity in most of the old gold camps and stimulated prospecting throughout the State. In 1933, production was about 12 percent greater than in 1932.

Arizona has produced more non-ferrous metallic wealth than any state or territory in the Union. While most of this production has been in copper, nearly every copper mining operation in the State has yielded important quantities of gold.

Before the advent of the big porphyry copper producers in 1912, the gold lode mines and placers were accounting for 75% of gold production in Arizona. From 1912 until 1942, when the gold mine closing order (L-208) was issued by the Government, the gold mines and placers still accounted for almost half of Arizona's gold production. Since the gold mine closing order, production of gold lode mines and placers has dropped to below 3% of the total; sometimes less than 1%.

HISTORY OF COPPER MINING IN ARIZONA, BY DISTRICTS NEW CORNELIA MINE IN AJO

- 1854 First mining of copper by Americans in Arizona said to have occurred in Ajo.
- 1855 Rich copper ore is hauled from Ajo to San Diego. Intermittent shipments of high-grade copper ore are continued off and on until 1900.
- 1900 John R. Boddie, Capt. Huie and others organize the Cornelia Copper Company, to work the Ajo deposit.
- 1906 The famous McGann vacuum smelter is built at Ajo, and comes to an inglorious end in an unsuccessful run.
- 1909 Cornelia Copper Company reorganize as New Cornelia Copper Company.
- 1909-1910 J. Parke Channing and Seeley W. Mudd drill at Ajo and reject the property.

JOHNSON CAMP AREA IN COCHISE COUNTY

Although this area has been a source of copper ores since 1881, it wasn't until 1942 that zinc concentrates were produced. At that time the Coronado Copper and Zinc Co. took over the Republic and Mammoth mines, and in 1945, they completed a 150-ton selective flotation concentrator and started shipping copper and zinc concentrates.

Coronado Copper and Zinc ceased operations in 1957. McFarland and Hullinger leased the property in 1959 and started shipping ores to their mill at Sahuarita while repairs were being made at the Republic Mill, which was ready in early 1960. McFarland and Hullinger ceased operations in January 1963.

Total production from Johnson Camp area to the end of 1955 was approximately 53,473,400 lbs. Copper and 60,205,500 lbs. Zinc.

PIMA DISTRICT*

Silver-lead deposits in the San Xavier and other districts of the Sierrita Mountains were known to the Jesuits and early Spaniards, who probably worked them in a small way. Some development was carried on there prior to 1875.

In 1880, Colonel C. P. Sykes purchased the San Xavier mine and organized San Xavier Mining and Smelting Co., but was unsuccessful.

From 1882 until the demonitization of silver in 1893, silver-lead ore was shipped intermittently from the Sierrita Mountains to various reduction works. The principal mines worked were the San Xavier, Olive, Matchless, Silver Blende, Fortuna, Arizona Queen, Veta, Democrat, Banner, Santa Cruz, Patterson, Annie, Minor, Chloride and Celia.

During 1897, L. H. Manning shipped ore from the San Xavier mine.

During 1906-7, Calumet and Arizona Mining Company carried on development of the Red Carbonate group southwest of Twin Buttes. During World War I, low-grade fluxing ore was shipped from this property by Alfred Paul.

During 1908-13 Chesterfield Mining Company shipped lead-silver ore from the Esperanza and Annie Mines.

*For years prior to 1931, largely abstracted from unpublished notes of J. B. Tenney.

HISTORY OF LEAD-ZINC MINING IN ARIZONA, BY DISTRICTS BISBEE OR WARREN DISTRICT

Prior to 1880, lead carbonate ore was mined from the Hendricks claim, about a quarter of a mile south of Bisbee, and smelted in a primitive furnace at a spring near the present main street of the town. Some oxidized lead ore from the Hendricks claim was used for flux at Charleston during the early eighties, but there is no available record of the quantity of lead produced prior to 1908.

The Copper Queen company granted leases on lead areas in the Uncle Sam mine during 1908, and in the Gardner and Southwest mines during 1910. Subsequently the company carried on successful development of lead ore in the Gardner and Southwest mines.

During 1911-17 notable bodies of oxidized siliceous lead ore were discovered and worked in upper levels of the Shattuck mine.

The first zinc production of the district was in 1917-18; during those years Calumet and Arizona Mining Company shipped lead-zinc sulfide ore to paint manufacturers in Kansas. Shipment of zinc ore to smelters began in 1922.

In 1925 the Shattuck mill, built in 1918, was converted to flotation. In 1927 Phelps Dodge Corp. built a flotation plant of 150 tons daily capacity for treatment of low-grade lead ore, and installed at Douglas a lead smelter of 200 tons daily capacity. The concentrator operated for only five months, and the lead smelter closed in April, 1930.

In 1939 the district produced zinc for the first time since 1927. Subsequently zinc-lead ore bodies were mined in the eastern part of the district. Part of the ore was sent to the Shattuck-Denn custom mill at Bisbee, and some to the Eagle-Picher mill at Sahuarita, until November 1945, when Phelps Dodge Corporation completed its present zinc-lead concentrator.

Mining of lead-zinc ores in this district discontinued in June, 1953, due to low lead and zinc prices.

The output of zinc and lead by periods was as follows:

	<i>Tons Zinc</i>	<i>Tons Lead</i>
1908-16	—	26,854
1917-1921	305	11,482
1922-27	7,118	31,862
1928-38	—	7,336
1939-48	115,119	51,768
1949-53	66,584	25,567
1954	—	—

- 1911 Gen. John C. Greenway becomes interested in Ajo, and New Cornelia property is drilled by the Calumet and Arizona Company.
- 1912 Leaching tests begin at Ajo by the New Cornelia Co.
- 1917 A five thousand ton leaching plant is built at Ajo and becomes completely successful.
The New Cornelia Company acquires the property of its neighbor, the Ajo Consolidated Company.
- 1918 New Cornelia pays its first dividend—November.
- 1924 A 5,000 ton flotation plant, designed by H. Kenyon Burch, is started at Ajo. Expanded to 29,000 tons in subsequent years.
- 1929 New Cornelia merges with Calumet and Arizona.
- 1930 Leaching plant at Ajo is abandoned after producing 345,000,000 pounds of copper.
- 1931 New Cornelia becomes a Branch of Phelps Dodge Corp.
- 1932 Operations at Ajo are suspended in April and the property remains idle until July, 1934.
- 1950 New copper smelter is blown in at Ajo in July, and New Cornelia begins to treat concentrates instead of shipping them to Douglas.
- 1962 Total production to end of 1962 — 254,566,000 tons of ore and approximately 3,948,716,000 pounds of copper.

CLIFTON-MORENCI MINING DISTRICT

- 1864 Henry Clifton and a group of prospectors from Silver City, New Mexico, re-discover rich copper carbonate ore, formerly mined by Mexican explorers in eastern Arizona.
- 1872 A prospector named Isaac Stevens, together with Bob Metcalf and six others, locates the first mining claims and founds the town of Clifton.
- 1873 Leszinsky Brothers build a one-ton copper furnace at Clifton, and organize the Longfellow Copper Company.
- 1874 Wm. Church, of Joy's Camp (Now Morenci), obtains an option on four patented claims, including the Copper Mountain, and organizes the Detroit Copper Mining Company, with Capt. E. B. Ward and others from Detroit.
- 1880 Detroit Copper Mining Co. builds smelter on the San Francisco River, three miles below Clifton, and later a 20-in.

- gauge railroad is built, using the first locomotive (1881) ever operated in the territory of Arizona.
- 1882 Phelps Dodge, on recommendation of Dr. James Douglas, contributes toward the building of a new smelter by the Detroit Copper Company, and acquires a half-interest in the property.
- 1883 A railroad is built from Clifton to Lordsburg, N. M. The Longfellow Group is acquired by a syndicate of capitalists who organize the Arizona Copper Company, Ltd. The Humboldt and Morenci mines are included in the Company's holdings.
- 1886 Church builds and operates the first copper concentrator in Arizona. A few months later, James Colquhoun builds another and larger concentrator for Arizona Copper Co.
- 1893 Colquhoun leaches the rich mill tailings from the old concentrators, and produces copper at a profit.
- 1895 The Arizona Copper Company pays its first dividend. Phelps Dodge Company purchases Capt. Ward's Detroit Copper Company and Clifton becomes for many years the greatest copper district in the southwest.
- 1897 Dr. Douglas becomes president of the Detroit Company, and with Charles E. Mills and James Colquhoun, develops and expands both the Detroit and Arizona Copper Company properties.
- 1906 Colquhoun constructs the No. 6 concentrator to handle the leaner sulphide ores.
- 1917 The Detroit Copper Company becomes known as the Morenci Branch of the Phelps Dodge Corporation.
- 1919 Shannon Copper Company, at Metcalf is acquired by Arizona Copper Company. This property had produced 172 million pounds of copper from 1903 to 1918.
- 1921 Arizona Copper Company has a record of producing 870 million pounds of copper from 1873-1921. Detroit Copper Company — a record of 460 million pounds of copper from 1882-1921.
The Arizona Copper Company is absorbed by Phelps Dodge Corp.
- 1930 Louis S. Cates becomes president of Phelps Dodge Corporation, and directs a thorough program of development and testing of the Morenci property.
- 1942 Open pit production at Morenci commences in January, with

- 1945 E. R. Dickie converts Bagdad underground mine to open pit with truck haulage.
- 1950 Mill expansion is completed, bringing capacity up to 4,500 tons per day.
- 1954 Bagdad makes plans to double production.
- 1960 Bagdad starts leaching oxide ores with its new \$2 million leaching facilities and sulfuric acid plant.
- 1962 A sixth ball mill is added and plant capacity is increased 20 percent.

SILVER BELL MINING DISTRICT

- 1865 Copper ore is mined from the Boot mine and treated in crude adobe furnaces.
- 1873 The Mammoth (Boot) mine ships selective copper ore out by wagon.
- 1881 Main line of the Southern Pacific Co. is completed through Red Rock and activity in the district increases.
- 1891 Silver Bell Mining Co. builds smelter at Tucson.
- 1902-1903 Imperial Copper Co., acquires Silver Bell, builds railway to mine and a smelter at Sasco nearby.
- 1909-1912 Imperial drills El Tiro Copper Co. property and finds El Tiro low-grade orebody.
Oxide Copper Co. drills disseminated copper deposit.
- 1915-1921 A. S. & R. Co. acquires Imperial property, and operates through World War I into 1921.
- 1928 A.S. & R. Co. has acquired El Tiro Copper Co. property and abandons Sasco smelter and railroad line.
- 1930 Total production of Silver Bell district to date is estimated to be \$15,746,000, mostly in copper.
- 1940 A. S. & R. Co. acquires the property of Oxide Copper Co.
- 1946 A. S. & R. Co. begins extensive exploration at Silver Bell.
- 1951 Development of the Oxide and El Tiro open pits starts in December after a purchase agreement with Government.
- 1954 Construction of 7,500 ton concentrator started in early 1952, is completed and the mill started April 1st.
- 1951-1962 Production of Asarco's Silver Bell Mine totals 23,896,600 tons of ore, yielding 183,966 tons of copper, to the end of 1962.

The Pima mine discovery stimulated prospecting in the district and in 1954, Dr. Harrison A. Schmitt, consulting geologist, advised Duval Sulphur & Potash Co. to acquire the Esperanza property in the Sierrita Mountains. Drilling started in 1955. Stripping was started in 1957 and a contract was let for the construction of a mill of 12,000 tons-per-day capacity. Production began in early 1959 and has been maintained steadily since then. In 1962, Duval announced plans for a 12,000 tons-per-day project at its copper-molybdenum property 15 miles northwest of Kingman.

Among the prospectors in the district following the Pima discovery was American Smelting & Refining Co., which optioned its first property, obtained state mineral leases, and staked claims, in 1953. It started drilling in 1954. In 1958, the project was named "Mission" and underground development started. In 1959, Asarco appropriated \$43,500,000 for a 15,000 tons-per-day operation and stripping of overburden and surface construction were started. The first ore was milled in July 1961. Full production soon followed and has been maintained since.

Copper production of the Pima district to the end of 1962 has exceeded 200,000,000 pounds.

BAGDAD (EUREKA) MINING DISTRICT

- 1886 The Bagdad claims in Eureka district, Yavapai County, are discovered.
- 1906 Giroux Syndicate works Bagdad property with small success.
- 1908 Giroux Syndicate is followed by Bagdad Copper Company.
- 1919 Arizona-Bagdad Copper Company takes over Bagdad claim, and churn drills the property, proves a section of the ore-body and produces some ore.
- 1925-1926 Arizona Bagdad tries leaching Bagdad orebody in place but without success.
- 1927 Bagdad Copper Corporation succeeds Arizona-Bagdad, and drills 130 churn-drill holes.
- 1930 The Corporation completes a 200-ton mill.
- 1935 It mines high-grade molybdenite.
- 1936 Bagdad starts block caving project.
- 1941 A 2,500 ton flotation mill is erected.
- 1944 J. C. Lincoln of Lincoln Electric Company acquires stock control of Bagdad Copper Corporation, and appoints E. R. Dickie as general manager.

daily production of 25,000 tons ore. Mill and Smelter begin operations.

- 1943 Morenci concentrator capacity is increased to 45,000 tons daily.
- 1951 Morenci begins production of molybdenum concentrates as a by-product at the rate of about 1,000 tons per year.
- 1961 Morenci smelter uses reformed natural gas instead of wood poles for fire refining of anode copper.
- 1962 To the end of 1962, the Morenci mine produces 293,372,000 tons of ore and 4,820,869,000 pounds of copper.

UNITED VERDE, JEROME MINING DISTRICT

- 1876 United Verde ore-body is discovered in Jerome by M. A. Ruffner. The first claim in the United Verde group is the Venture No. 1, located on Feb. 17th by John O'Dougherty, John Kelly and Josiah Riley.
- 1880 Phelps Dodge Company sends Dr. Douglas to Jerome to examine the district. The long 175-mile wagon haul to the Santa Fe Railroad discourages him from recommending exploitation.
- 1882 United Verde Copper Company is organized by Fred Thomas, George Treadwell, and Eugene Jerome.
- 1883 Small smelter is built at Jerome, and turns out nearly \$800,000 worth of copper in the first year.
- 1887 Dr. Douglas visits the United Verde a second time, when the railroad is only 45 miles away. He negotiates for an option, but his terms are opposed by Charles Lennig, the principal creditor of the United Verde.
- 1888 W. A. Clark, with his smelter man, Joe Giroux, takes a lease on the United Verde and buys it the following year.
- 1894 Clark builds a 27-mile narrow-gauge railway to connect with the Santa Fe running south from Ash Fork to Prescott. Clark also builds a smelter and roast heaps like those at Rio Tinto.
- 1899 George Hull, assisted by Louis Wicher, forms the United Verde Extension Mining Company.
- 1912 New smelter is started at Clarkdale. James S. Douglas becomes interested in United Verde Extension Mining Company, and development work is begun.
- 1915 New Smelter is completed, and Santa Fe builds a branch railway of standard gauge to this point.

- 1916 United Verde Extension electrifies the mining world by cutting 300 feet of 15 percent ore.
- 1919 Beginning of open-pit operations at Jerome.
- 1927 United Verde begins operations in a 1000-ton concentrator. Capacity later increased to 1600 tons.
- 1931 United Verde purchases the Verde Central.
- 1935 Phelps Dodge Corporation purchases the United Verde.
- 1938 United Verde Extension ore-body is finally exhausted after paying over 42 million dollars in dividends. It had produced over three-quarters of a billion pounds of copper, which with gold and silver values, was worth over 125 million dollars.
- 1940 Open pit mining at United Verde is completed, and underground mining continues to be employed chiefly in removing the pillars left in the mine.
- 1953 Mining operations at United Verde terminate on March 23rd, after producing over 2½ billion pounds of copper, which, with gold, silver and zinc values, was worth almost one-half billion dollars.

BISBEE (WARREN) MINING DISTRICT

- 1877 Discovery of ore in the Bisbee district is made in August by American Army Scout, Jack Dunn, who called his claim the Rucker, after an army officer of that name. Hugh Jones discovers Copper Queen deposit and a claim named the Mercey is located by George Warren on December 27.
- 1878 Warren's claim is relocated as the Copper Queen by George Eddleman and M. A. Herring on December 15th. A little copper furnace is erected by Warner Buck on the Robb claim and some matte is produced unprofitably.
- 1879 Copper Queen prospect is purchased by John Ballard and Wm. Martin with the advice of Ben and Lewis Williams. The San Francisco brokerage firm of Bisbee, Williams & Company sponsored the new company, and the town is named after Bisbee.
- 1880 Geo. Center builds a smelting furnace under the direction of the Williams brothers, and does well for a time.
- 1881 James Douglas comes to Bisbee and obtains an option on the Atlanta claim, next to the Copper Queen.

PIMA DISTRICT* — COPPER

Emperor Copper Mining Company developed Mineral Hill copper deposits from 1882 until the slump in the copper market of 1884.

In 1898, Azurite Copper and Gold Co. built a furnace of 30 tons daily capacity at the Mineral Hill mines and produced copper for about a year. Six years later the property was acquired by the Mineral Hill Consolidated Copper Company which developed it until the 1907 panic. In 1916, the old smelter was enlarged, and production was resumed for three years, after which the mine was closed again.

The Twin Buttes copper deposits were worked some during the nineties by Baxter, Ellis, and Irish. In 1903, Twin Buttes Mining and Smelting Co. began extensive development in the district, and by 1906 had built a railway from Tucson through Sahuarita to the mines. Operating the Senator Morgan, Copper Glance, Copper Queen, and Copper King mines, this company shipped ore to smelters at Sasco and elsewhere until 1914.

In 1913, Bush Baxter Co., which had been working the Minnie mine, leased the Senator Morgan and worked it for nine months. American Smelting and Refining Co. operated the Minnie for a while prior to 1916. As Glance Mining Co., Bush and associates developed the Glance. As Midland Copper Co. they acquired the Queen and shipped ore up to the end of 1926. In 1929, Buttes Mining Co. shipped ore from the Minnie.

In 1950, Banner Mining Co. lease-optioned the Mineral Hill property 16 miles south of Tucson, and in 1951 started rehabilitation with the help of a D.M.E.A. loan. A D.M.P.A. purchase contract aided the construction of a 400-ton flotation plant which went into operation in June, 1954. Meanwhile, the company located another orebody nearby and sank the Daisy shaft into it. Banner has continued to explore and acquire properties. Its mill has expanded to 1000 tons per day capacity. A new Palo Verde shaft and workings have opened a new nearby orebody of promise.

Also in 1950, the United Geophysical Corporation located an anomaly east of the Mineral Hill mine in an area devoid of surface indications. It was the first copper orebody of magnitude to be discovered by geophysical methods. Results of exploration and development work by Pima Mining Co. induced Cyprus Mines Corporation, together with Union Oil and Utah Construction Companies to prepare in 1955-56 for open pit mining with skip hoisting, and to build a mill of 3,000 tons-per-day capacity. The property has been in operation steadily since 1956.

*For years prior to 1931, largely abstracted from unpublished notes of J. B. Tenney.

in gold and silver credits from 41,442,617 tons of .725% copper ore.

Development of Miami's low-grade ore body is started.

- 1954 Castle Dome's mill building is moved to Copper Cities where production begins in August and is at full capacity in November.
Production from Miami's low grade orebody is started.
Inspiration makes plans for use of a dual process of leaching and concentration, involving three million dollars for rehabilitation of its concentrator.
Underground mining at Inspiration suspended in August. Inspiration takes an option on the Christmas mine at Christmas. This property has produced some 1,500,000 tons of ore averaging 2.4% copper. Inspiration plans an intensive development program at this mine.
- 1955 Inspiration begins \$5.66 million "dual process" metallurgical project late in the year at Inspiration property.
- 1956 Inspiration completes conversion to dual process.
- 1957 Miami Copper Co. completes new L-P-F circuit in Miami mill. Inspiration's new 15,000 tons-per-day flotation concentrator starts operating in January.
- 1959 Underground mining at Miami mine stops after 48 years of nearly continuous activity. In place leaching and precipitation to be used for further copper extraction.
- 1960 Inspiration purchases International smelter at Miami and expands its refinery.
Tennessee Corp. acquires Miami Copper properties.
- 1961 Inspiration completes McDonald shaft and starts concentrator construction at Christmas mine.
- 1962 The Christmas mine starts shipping concentrates to the Inspiration smelter.
Up to the end of 1962, production of the major mines is as follows:

<i>Mine</i>	<i>Tons of ore</i>	<i>Pounds of copper</i>
Miami	152,688,440	2,430,235,960
Inspiration	180,926,750	3,426,711,211
Castle Dome	41,442,617	552,035,536
Copper Cities	27,825,383	339,156,393

- 1883 After one failure, Atlanta workings penetrate a great ore-body.
- 1885 Apparent exhaustion of the ore in the Copper Queen leads to merger of Atlanta and Copper Queen under the name of Copper Queen consolidated Mining Company. Douglas, acting for the firm of Phelps Dodge Company is the moving spirit of the merger.
- 1888 A railway is built by the Copper Queen Company from Bisbee to Fairbanks, the site of its smelter, to which the ore had been packed on mules and burros for several years.
- 1893 Converters are added to the Copper Queen Smelting plant, improving the quality of the copper product.
- 1898-1901 Lake Superior and Western Development Company, which later became the Calumet & Arizona Mining Company, purchases the Irish Mag claim from Martin Costello.
Douglas arranges an amicable agreement over apex rights between the Copper Queen and the Irish Mag owners.
- 1900 Plans are made for new reduction works at Douglas, and the necessary railroad is constructed thereto.
- 1904 New Smelter at Douglas blows in. Organization of Shattuck Arizona and Denn Arizona Companies.
- 1908 First lead ore is produced at Bisbee.
- 1916 Production of first zinc ore at Bisbee.
- 1917 The name of Copper Queen Consolidated Mining Company is changed to Phelps Dodge Corporation.
- 1918 Shattuck builds concentrator. Steam shovel extraction of Sacramento Hill copper orebody is started. The Paul lime plant at Paul Spur is built about this time.
- 1923 The first unit of the 4,000-ton Warren plant is put in operation in April, to handle the Sacramento Hill ore, which had been developed off and on since 1916.
- 1925 Shattuck and Denn mines are merged.
- 1931 Phelps Dodge absorbs Calumet and Arizona, thereby acquiring large orebodies of direct smelting grade.
- 1932 Sacramento Hill ore-body is exhausted and the Warren mill is shut down. Open-pit glory hole and block caving had been used in exploitation of this ore-body.
Also heap-leaching as well as gravity and flotation concentration had been employed.

- 1939 Bisbee district produces zinc ore for the first time since 1927.
- 1947 Shattuck Denn Mining Company sells Denn Mine to Phelps Dodge and terminates its lease on Shattuck mine.
- 1950 Development of the Lavender Pit at Bisbee for open-pit copper mining is commenced.
- 1951 Copper Queen discontinues production of lead-zinc ore.
- 1954 Lavender Pit begins production in August. A 12,000 ton flotation concentrator is started, and concentrates are shipped to Douglas smelter.
- 1955 A copper precipitation plant is completed at the Copper Queen Branch.
- 1959 Phelps Dodge Corp. announces a \$5 million expansion program at its Lavender pit mine.
- 1961 From its start in 1954 to the end of 1961, the Lavender pit mine has produced 32,000,000 tons of ore which has yielded 500,000,000 pounds of copper.
- 1962 The value of the mineral production of the Bisbee district through 1962 is estimated to be in excess of \$1,300,000,000.

RAY MINING DISTRICT

- 1873 Silver prospectors organize Mineral Creek Mining District (Ray).
- 1880 A five-stamp mill is built by Mineral Creek Mining Co.
- 1883 Ray Copper Co. is organized. 17 claims. Copper furnace.
- 1898 Globe Exploration Co. (Ltd.), London, acquires option on Ray, Taylor and Innes groups of claims. Builds 75-ton concentrator at mine.
- 1899 250-ton mill, shops, offices and staff houses are built at Kelvin, 7 mile narrow gauge railroad is built between Kelvin and Ray. Freight is hauled in wagon trains drawn by steam traction engines from Red Rock, 43 miles south.
- 1900 Smelter built at Kelvin is never used.
- 1905 Railroad is completed between Kelvin and Phoenix.
- 1906 Calumet Copper Company shipping ore. D. C. Jackling and associates, Philip Wiseman and Seeley Mudd obtain option at Ray.
- 1907 Ray Copper Company and Gila Copper Company organize to acquire English Company's holdings.

- 1911 Miami produces first concentrates.
- 1912 The Live Oak and Inspiration merge in January, as the Inspiration Consolidated Copper Company. Iron Cap Mine in Gila County produced 60 million pounds of copper from 1912 to 1927.
- 1915 Inspiration begins the production of copper in 1915 after six years of development and the expenditure of about fifteen million dollars. The International Smelting Company erect a three million dollar smelter at Miami. Flotation introduced at Inspiration, the first large scale copper flotation plant in this country.
- 1921 Postwar depression and shut-down of copper properties.
- 1922 First systematic exploration work is initiated at the Castle Dome Mine in Gila County by Pinto Valley Mining Co.
- 1924 Old Dominion shuts down its smelter permanently, and ships its concentrates to the International Smelter at Miami.
- 1926 Inspiration begins ferric-sulphate leaching of its ores, producing electrolytic copper.
- 1932-1935 Complete shut-down of Inspiration and Miami mines begins in 1932. Miami resumes in 1934 and Inspiration in late 1935.
- 1941 Miami Copper exercises its option on the Pinto Valley holding (Castle Dome Mine) and organizes the Castle Dome Copper Company to take over the property.
- 1942 Bechtel Company commences preliminary work early in January on the Castle Dome mine. In April, 1943, concentrates start moving from the Castle Dome mill to the International Smelter.
- 1946 Miami Copper Co. resumes churn drilling of the Copper Cities ore-body.
- 1948 Copper Cities drilling is completed.
- 1946 Inspiration begins plans for open-pit mining and pit development.
- 1948 Inspiration starts producing a portion of its ore by open-pit mining in March.
- 1949 Inspiration completes preparations for underground leaching of copper left in caved areas.
- 1953 Castle Dome ore reserves are exhausted in December after production of 514 million pounds of copper and \$777,024.00

- 1957 San Manuel ranks 4th among Arizona copper mines.
- 1961 San Manuel is the second largest copper producer in the State.
- 1962 Magma Copper Co. absorbs San Manuel Copper Corporation. The mine becomes the San Manuel Division of the Magma Company. Production of the San Manuel mine to the end of 1962 is 70,802,886 tons of ore and 468,390 tons of copper.

GLOBE-MIAMI-INSPIRATION MINING DISTRICT

- 1874 Globe becomes a booming silver camp.
- 1881 Old Dominion Copper & Smelting Company starts operations at Globe. A small copper furnace is in operation at the present site of Miami. Old Dominion produces over 800 million pounds of copper from 1882 to 1930.
- 1886 Six furnaces in operation at Globe.
- 1888 Old Dominion Company reorganizes at Globe.
- 1892 Phelps Dodge purchases United Globe Mines at Globe and also certain claims in the Miami district.
- 1901 Chrysocolla a blue green silicate is mined at the Keystone Mine; also at the Live Oak.
- 1903 Phelps Dodge obtains control of the Old Dominion at Globe.
- 1904 The Warrior Mine in Gila County produces over 30 million pounds of copper from 1904 to 1919.
- 1906 The Gibson Mine produces 12 million pounds copper 1906 to 1918. J. Parke Channing examines the deposits at Miami, and exploratory shafts are started.
The General Development Company sinks a shaft on the Captain claim and another on the Red Rock, in the Miami district.
- 1907 The Miami Copper Company is organized in November and development work is actively undertaken. Arizona Commercial Mine in Gila County produces 92 million pounds of copper from 1906 to 1930. Superior and Boston mine in Gila County produces 19 million pounds of copper from 1907 to 1926.
- 1908 Inspiration Copper Company is organized.
- 1909 Railroad extended to Miami from Globe. Inspiration begins active development work.

Jackling starts churn drill exploration work.
Arizona Hercules Copper Mining Company and Kelvin Calumet Mining Company active in district. Both are later absorbed by Ray Consolidated Copper Company.

- 1909 Louis S. Cates is placed in charge of Ray Consolidated Copper Company. Ray Central Copper Mining Company succeeds Kelvin Calumet Mining Company.
- 1910 Ray Consolidated Copper Co. acquires Gila Copper Co.
- 1911 8,000-10,000 ton mill begins operations at Hayden.
- 1912 A. S. & R. Co. builds smelter at Hayden to handle Ray concentrate. Ray Central Copper Mining Company absorbed by Ray Consolidated Copper Company.
- 1914-1915 Ray Consolidated develops flotation concentration at Hayden, to supplement gravity concentration.
- 1921 Ray Consolidated shuts down its operations in March, and remains down one year.
- 1922 Ray Consolidated and Chino merge.
- 1926 Nevada Consolidated Copper Company absorbs Ray Consolidated and Chino.
- 1927 Nevada Consolidated Copper Company purchases property of Arizona Hercules Copper Company.
- 1933 All mining operations shut down in March. Kennecott Copper Corporation acquires Nevada Consolidated.
- 1937 Mining operations are resumed at Ray.
- 1938 First two units of a modern scrap-iron precipitation plant are completed to recover copper from water-soluble ores.
- 1943 Kennecott assumes direct operation of properties.
- 1948 Kennecott decides to prepare part of Ray ore body for open pit operation.
- 1950 Open-pit production is commenced at Ray. Mill at Hayden is enlarged to handle 15,000 tons of ore daily.
- 1954 Kennecott makes pilot-plant tests to increase recovery of oxidized copper in its milling ores at Hayden. Plans to spend five million dollars on the new process. Conversion from underground to pit operation is completed.
- 1955 Underground mining is stopped permanently and leaching of caved areas is started.

- 1956 \$40 million expansion program starts at Ray-Hayden.
- 1960 The expansion program enables production of 20,000 additional tons of copper annually.
- 1962 Kennecott's Ray Mine accounts for the production of 140,-325,000 tons of ore and the recovery of 3,103,557,000 pounds of copper from 1911 through the end of 1962.

MAGMA (SUPERIOR) DISTRICT

- 1873 Silver King outcrop at foot of Stoneman Grade is discovered by a soldier named Sullivan.
- 1874 G. G. Mason discovers Silver Queen (Magma) vein.
- 1875-1889 Main production activity of Silver King mine, a famous silver producer.
- 1880-1893 Lake Superior and Arizona Mining Co. actively develops Gold Eagle mine.
- 1910 Magma Copper Co. is organized by Wm. Boyce Thompson and associates, to work the Silver Queen property.
- 1914 Magma concentrator with about 200 tons per day initial capacity is constructed.
- 1915 Magma Arizona railway is completed.
- 1916 Magma increases concentrator capacity to 300 tons daily by addition of 50 ton section designed for zinc-lead ores. After 3 months' successful use, it is converted to treat copper ores.
- 1917-1920 Renewed activity at Silver King Mine.
- 1922 Capacity of Magma concentrator is increased to 600 tons daily, and construction of a copper smelter starts.
- 1924 Magma completes 500 ton smelter.
- 1923-1928 Principal development of Belmont mine.
- 1933 Lake Superior and Arizona mine (Gold Eagle) becomes important copper-gold producer.
- 1937 Magma installs refrigeration plant for cooling mine. A new unit of 250 tons daily capacity for treatment of complex zinc-copper ore is added to the concentrator.
- 1943 Magma mine is the largest producer of zinc in Arizona.
- 1944 Magma Copper Company becomes interested in development of San Manuel ore-body near Mammoth.

- 1945 San Manuel Copper Corporation is organized in August. Magma production of zinc ore ceases in July, owing to wartime labor shortage.
- 1946-1948 New Magma concentrator built. Capacity, 1500 tons per day.
- 1950 Magma resumes mining zinc ores along with regular copper production.
- 1952 Magma shuts down the copper-zinc section of its mill, and devotes entire plant to production of copper.
- 1961 The company acquires the adjoining property of Belmont Mining Co. An underground fire stops Magma mine production in December.
- 1962 The fire is blocked off and production is resumed in February. Newmont Mining Co. acquires 81 percent of Magma stock. The Superior area to the end of 1962 has been credited with the metal production of 714,913 tons of copper, 37,252 tons of zinc, 1,965 tons of lead, 39,810,811 ounces of silver and 455,388 ounces of gold.

SAN MANUEL (OLD HAT) MINING DISTRICT

- 1906 Part of the San Manuel group of claims is located.
- 1917 At least two holes are drilled. Results indicate too low copper content for continuing drilling.
- 1925 Five of the principal claims are located.
- 1936-1942 James M. Douglas and four others acquire these and other claims.
- 1943 The U. S. Geological Survey and Bureau of Mines recommend exploration. The Bureau starts churn drilling.
- 1944 Wesley P. Goss, general manager of Magma Copper Co. becomes interested. Magma buys the property (21 claims) and continues drilling.
- 1945 San Manuel Copper corporation is formed by Magma.
- 1948 Drilling is completed and No. 1 shaft is started.
- 1952 Reconstruction Finance Corp. authorizes loan of \$94,000,000 for mine development and mine, mill (35,000 TPD) and smelter construction.
- 1953 W. P. Goss becomes president. Remains general manager.
- 1956 Production starts in January. Six underground caving blocks in production at year end.