Vol. XXII, No. 5 November, 1951

University of Arizona Bulletin

ARIZONA BUREAU OF MINES

THE MINERAL RESOURCES OF ARIZONA

PREPARED BY
THE ARIZONA BUREAU OF MINES STAFF
PRIMARILY FOR HIGH SCHOOL STUDENTS

ARIZONA BUREAU OF MINES
MINERAL TECHNOLOGY SERIES No. 44
BULLETIN No. 159

TEN CENTS
(Free to Residents of Arizona)

PUBLISHED BY
University of Arizona
TUCSON, ARIZONA

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Prepared by the Arizona Bureau of Mines Staff,
primarily for high school students
1951

PRODUCTION SUMMARY

For the past forty years Arizona has led the United States in copper production, and during the past several years has exceeded all other states in the total combined value of copper, zinc, lead, silver, and gold produced.

The total value of all mine output in Arizona during 1858-1950 has amounted to approximately $4,749,426,000, distributed as follows:

Commodity	Value	Per cent of total value
Copper	$3,933,915,000	82.83
Gold	286,978,000	6.04
Silver	233,669,000	4.92
Zinc	115,788,000	2.44
Lead	85,027,000	1.79
Minor metals	16,049,000	0.34
Nonmetallics	78,000,000	1.64

The first important mining in Arizona was for gold and silver. During the early days, base metals were of little interest in this region, remote from centers of population and lacking in transportation facilities. Development of and continued search for precious metals led to discoveries of copper, lead, and zinc deposits which acquired primary commercial importance during later years. Thus, from the standpoint of value of production, Arizona's leading metal was gold during 1858-1877, silver during 1878-1887, and copper for all the years after 1887. Zinc supplanted gold as the State's second most valuable metal product during 1944-50, and lead took third place over silver during 1945-50.

DISTRIBUTION OF DEPOSITS

Referring to the accompanying map, Arizona's principal mining districts occur within a belt of intense faulting, folding, and igneous intrusion which lies south-southwest of a line projected through Morenci and Jerome. Bordering this belt on the northeast is the Plateau, of relatively flat-lying strata, where nonmetallics, uranium-vanadium ore, and comparatively small amounts of base metals have been mined.

COPPER

COPPER MINERALS

In nature, copper most commonly occurs combined chemically with other elements, notably sulfur and iron. The most important copper minerals resulting from these combinations

MAP SHOWING DISTRIBUTION OF LARGE COPPER MINING DISTRICTS OF THE SOUTHWEST

of elements are chalcocite (copper and sulfur) and chalcopyrite (copper, iron, and sulfur). Bornite is another important copper-iron sulfide. These minerals are referred to as copper sulfides.

Chalcocite is a blackish gray mineral containing approximately 80 per cent copper and 20 per cent sulfur. It is soft and can be easily cut with a knife. Chalcopyrite, the other most important copper mineral, contains about 35 per cent copper, 30 per cent iron, and 35 per cent sulfur. It is brass-yellow and sufficiently soft to scratch readily with a knife blade. Bornite is generally iridescent red-brown in color and contains about 63 per cent copper, 11 per cent iron and 26 per cent sulfur. It is slightly softer than chalcopyrite.

Many of the large open pit mines have produced significant quantities of copper from so-called oxidized copper minerals of which the most important are malachite, chrysocolla, and cuprite. These minerals do not have the metallic appearance which characterize the copper sulfides. Malachite and chryso-

colla are green. The former is a copper carbonate, the latter a copper silicate. Cuprite, a copper oxide, is red of various hues. The oxidized copper minerals ocur most commonly in the upper levels of copper deposits; there, the circulating water together with oxygen acted on the sulfide minerals and leached out part or all of the copper, which may have been redeposited below.

ARIZONA COPPER MINING

Although Bingham Canyon, Utah, currently has a higher production of copper than any single district of Arizona, this latter State has the seven large producing districts, Bisbee, Miami-Inspiration-Castle Dome, Jerome, Morenci, Ajo, Ray, and Superior. The accompanying map illustrates how these and other important districts lie within a circle 160 miles in radius.

Arizona has produced more than 25 billion pounds of copper, valued at $3,933,915,000, during the past seventy-seven years. This amount of copper would be sufficient to form a solid cube with an edge 357.4 feet long—almost the distance between goal posts on a football field.

The yield for various significant periods has been as follows:

Years	Pounds of copper
1874-1899	855,417,177
1900-1913	3,432,653,000
1914-1918	3,051,845,629
1919-1929	6,659,862,024
1930-1938	3,151,280,624
1939-1945	4,623,344,000
1946-1950	3,585,746,000
1874-1950	25,360,148,454

More than half of this total production has been made during the last twenty-three years.

The output for 1950 was 806,602,000 pounds, according to figures released by the U. S. Bureau of Mines. Morenci, with about 311,066,000 pounds, was the State's largest producer, and it was followed in order of yield by Ajo, Inspiration, Ray, Miami, Castle Dome, Superior, Bisbee, Jerome and Bagdad.

How long this impressive record of production may continue into the future depends primarily upon the discovery and successful development of new ore bodies. As examples of known reserves, the published figures cite approximately 5 billion pounds of copper in the ground at Morenci and more than 7 billion pounds for the remarkable new discovery, San Manuel; combined, these two districts alone have gross reserves amounting to more than 50 per cent of the total copper produced in Arizona prior to 1949.

The bulk of Arizona's current copper production is obtained from low-grade ores averaging less than one per cent copper. Technological advances since 1905 permit such ores to be mined on a large scale by open-pit and underground methods and con-

centrated by the flotation process. The concentrate so obtained is further treated by smelting and refining methods resulting in production of essentially pure copper and the recovery of the silver and gold found in such ores. Leaching methods are also used, but to a lesser extent, for the extraction of copper from its ores.

ZINC AND LEAD

ZINC AND LEAD MINERALS

Sphalerite, the important zinc ore mineral, is composed of 67 per cent zinc and 33 per cent sulfur. Unlike galena and copper sulfides, sphalerite does not have a metallic luster. It is resinous, like pitch, and commonly yellow to brown in color. Sphalerite is soft and powders when scratched.

The most important lead mineral is galena, a chemical commination of lead and sulfur. Galena contains about 87 per cent lead and 13 per cent sulfur. It is lead gray in color and has a metallic luster. It is very soft and commonly occurs in tiny cubes.

ARIZONA ZINC AND LEAD MINING

Arizona ranked fifth in zinc and fourth in lead production within the United States for 1946, and second in zinc for 1949.

Arizona during 1905-50 produced 1,035,490,497 pounds of zinc, valued at $115,788,000. The output of lead in the State during 1894-1950 amounted to approximately 988,467,000 pounds, valued at $85,027,000. Approximately 85 per cent of the total zinc and 57 per cent of the total lead were mined during 1934-49.

During 1949, some thirty-five Arizona districts produced zinc, and sixty-three produced lead. The Bisbee district yielded more than half of the zinc and more than a third of the lead output of Arizona for 1949; other important producers of these metals were the Old Hat, Pima, Big Bug, Harshaw, Jerome, Johnson Camp, and Aravaipa districts.

Arizona's zinc and lead production since 1939 has come largely from ore bodies previously unknown or undeveloped. The ores are mined by underground methods and for the most part concentrated by the flotation process. The lead concentrates are shipped outside the State for smelting, and the zinc concentrates for retorting.

GOLD

Gold ranks second to copper in total value of metal production in Arizona, although it was surpassed by zinc for 1944-50 and by lead for 1945-50.

During 1858-1950, Arizona produced approximately 11,492,000 ounces of gold, valued at $286,978,000. The largest output for any one year was 332,694 ounces, recovered in 1937. In contrast, the 1949 yield was 108,993 ounces.

Prior to 1896, the annual production averaged less than 100,000 ounces; probably more than half of it was obtained from placer

deposits until about 1880, after which the placers decreased in importance. For the period 1858-1923, approximately 64 per cent of Arizona's gold output came from siliceous ores, 29 per cent as a by-product from ores of copper, lead, and zinc, and 7 per cent from placers; the largest production from siliceous ores was in 1923 when it amounted to 184,459 ounces. After 1923 and particularly during 1943-50, the major portion of the gold production has been a by-product from base-metal ores, mainly copper ores, rather than from gold-quartz mines.

During recent years, the New Cornelia open-pit copper mine at Ajo has been the State's leading gold producer. In 1948 it yielded 35 per cent of the total gold or six times as much as all the siliceous ores of Arizona.

SILVER

Since 1858 Arizona has produced approximately 311,146,000 ounces of silver, valued at $233,669,000.

Silver was second only to gold in its influence on the early history of Arizona. During the period of 1878-87, production from silver bonanzas such as Tombstone and Silver King brought the value of its output in the State above that of gold.

After 1903, the silver production of Arizona came predominantly as a by-product from ores of copper, lead, and zinc, rather than from siliceous ores. During recent years, the Bisbee district has been the State's leading silver producer.

The 1950 yield of silver in Arizona amounted to 5,325,441 ounces, valued at $4,819,793, which was considerably below the maximum output of 9,422,552 ounces attained in 1937.

MINOR METALS

Molybdenum, tungsten, manganese, quicksilver, vanadium, and uranium ores have been mined in Arizona, but their combined value compared with that of the five major metals—copper, gold, silver, zinc, and lead—has been small. They are of critical importance during periods of national emergency.

Avaliable records of production for the minor metals are incomplete, and the totals cited are based to a considerable extent upon estimates.

Molybdenum: Molybdenum is a metal chiefly used for the toughening and hardening of steels. The total production of this metal in Arizona is estimated as approximately 10,800,000 pounds, valued at $8,000,000. It was obtained in part from gold-mining operations in the Mammoth mines, near San Manuel, but most of it since 1938 has been recovered from copper ores, particularly at Miami.

Tungsten: This metal is used chiefly to produce superior cutting tools. Arizona prior to 1949 produced tungsten ore with an approximate total value of $4,609,000. Most of it has come from lode deposits in Mohave County, in the northwestern

portion of the State, and from Pima, Pinal, and Cochise counties, in the southeastern portion.

Manganese: Manganese is a metal added to purify steels or to produce superior wearing surfaces of steel. Arizona's production of manganese ore has amounted to approximately 83,800 tons, valued at $2,100,000. This output was largely from the Bisbee and Tombstone districts, and to a less extent from numerous other districts.

The manganese deposits of the Artillery Peak area, in west-central Arizona, have been rated as the second largest in the United States. Although below present commercial grade, they may be regarded as a potential reserve for the future.

Quicksilver: Arizona's total production of quicksilver is valued at approximately $880,000. The principal known deposits are in the Mazatzal, Phoenix, and Dome Rock mountains and in Copper Basin.

Vanadium: 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. Prior to 1945 it was obtained largely from gold-mining operations in the Mammoth mines, near San Manuel, but more recently it has been recovered from uranium ores of the northeastern part of the State.

Uranium: During recent years, uranium ore has been mined in northeastern Arizona, but no data as to its quantity and value have been released.

NONMETALLICS

Although most of the nonmetallics mined in Arizona have been used locally, some of them, such as asbestos, bentonite, feldspar, fluorspar, sodium sulfate, and barite, have found their chief markets outside the State. Hence, as population and industries have expanded during recent years, particularly in the Pacific Coast Region and in the Southwest, the mining of nonmetallic minerals in Arizona has shown marked increase.

The value of nonmetallics produced in the State is small compared with that of copper but is approaching that of lead. By commodities it has been approximately as follows:

Sand and gravel, 1917-48	$15,668,000
Stone, 1889-1948	14,234,000
Lime, 1894-1948	12,046,000
Clay products, 1894-1948	10,269,000
Asbestos, 1914-48	4,240,000
Clay (raw), 1918-48	4,018,000
Feldspar, 1923-48	2,200,000
Gypsum	1,357,000
Sodium sulfate	865,000
Coal	857,000
Cement	505,000

Semiprecious stones	500,000
Fluorspar, 1902-48	295,000
Barite, 1929-48	255,000
Perlite, 1946-48	65,000
Total through 1948	$67,374,000
Estimate for 1949-50	$10,626,000
Total through 1950, approximately	$78,000,000

COLLEGE OF MINES, UNIVERSITY OF ARIZONA

In Arizona, the training of young men for the Mineral Industry is carried on by the College of Mines of the University of Arizona. Engineering degrees are offered in Mining, Metallurgy, and Geology. In addition to the work on the Campus, field work and visits to mines and metallurgical plants are emphasized due to the favorable location of Tucson for such work.

SUMMARY OF MINING HISTORY IN ARIZONA

1530 Nuño 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 Nuñez 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 process 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 Oñate 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.

1736 Famous Bolas de Plata silver deposit at Arizonac in northern Sonora was discovered.

1750 Some copper mined at Ajo.

1774 Placering for gold in Quijota district.

1776 Spanish garrison transferred from Tubac to Tucson, which up to this time was only an Indian village.

1777 Arivaca mentioned as a mining community.

1790-1820 Period of prosperity for the Spanish missions but mining was unimportant.

1792 Legal ratio between gold and silver in United States made 16 to 1.

1800 Copper 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 Mexico of that part of Arizona and New Mexico south of the Gila River.

1854 Charles D. Poston begins search for gold and silver near Tubac.

1885 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 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-sliver mine in the Patagonia Mountains. Discovery of the Gila City or Dome placers near Yuma.

1859 Rich silver ore being mined at Heintzelman Mine in Cerro Colorado Mountains.

1861 Start of Civil War. Withdrawal of troops followed by Apache depredations.

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 were discovered. The Moss and Vulture were lode gold mines, the Planet was copper. Many lode deposits discovered in Mohave County. Arizona was made a Territory, chiefly because of gold discoveries, with Prescott as the captial.

1864 Henry Clifton rediscovers copper in eastern Arizona.

1865 Small-scale Mexican copper operations at Cananea, Sonora.

1866 Apaches on war path.

1867 Capital 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 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 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 started at Morenci.

1876 Southern Pacific railway reaches Gila Bend from California. United Verde ore body 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 Lesinksy 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 undertaken at Ray. A small smelter built at Jerome.

1885 Copper Queen Consolidated Mining Company formed and builds concentrator and smelter. Territorial Legislature creates University of Arizona.

1886 Bonanza ores exhausted at Morenci and concentrator built by William Church to treat oxidized ore that averaged 6.5 per cent copper. Six furnaces in operation at Globe.

1887 Congress gold mine discovered by Dennis May.

1888 Dr. James Douglas turns down United Verde because of inaccessibility. Old Dominion Company reorganized at Globe. First building to house the School of Mines of the University of Arizona completed at Tucson. Harquahala gold deposit discovered.

1889 Senator W. A. Clark obtains control of the United Verde mine, which resumes operations.

1890 Sherman silver purchase bill 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 demonitized. Disastrous panic. Prospectors turn from silver to gold. Copper Queen works first sulphides.

1894 Rail connection completed to Jerome. An unsuccessful attempt made to work the Ajo deposit.

1895 Cyanide process introduced at Congress Mine, one of first installations of it in this country. Fortuna Mine southeast of Yuma discovered.

1896 King of Arizona Mine northeast of Yuma discovered by Chas. E. Eichelberger. McKinley elected President, and gold standard assured. First disseminated copper ore treated at Clifton by James Colquhon, but this was relatively high-grade ore.

1898 War with Spain.

1899 McKinley 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 district. 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.

1903 Phelps Dodge obtains control of the Old Dominion at Globe. Gold Road Mine 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.

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 reorganized as New Cornelia Copper Company. Louis S. Cates is placed in active charge at Ray.

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.

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 Corneila property is drilled by the Calumet and Arizona company. Production starts at Magma.

1912 Town of Oatman started. Arizona admitted to the Union as forty-eighth state. James S. Douglas becomes interested in United Verde Extension, and development work there is begun.

1914 World War I starts.

1915 Large gold ore body 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. Arizona Bureau of Mines created by State Legislature.

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.

1919 Experimental flotation plant installed at Ajo.

1921 Postwar depression and shut down of copper properties.

1922 Entire Morenci district now controlled by Phelps Dodge. End of postwar depression.

1923 Copper Queen mill south of Bisbee is placed in operation.

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 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 discontinued. Louis S. Cates becomes president of Phelps Dodge. Miami Copper mining low-grade ore body successfully.

1930 Copper price collapses from 18 to under 10 cents a pound.

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 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 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 shut down of copper properties and reopening in late summer. Price for newly mined domestic silver reduced to 64.64 cents. War scares. United Verde Extension finishes ore body, and smelter is dismantled and sold.

1939 World War II begins. Mineral industries geared to high production. Copper, lead, and zinc prices begin long climb upward.

1940 U. S. copper imports exceed exports; government stock piling 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.

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.

1943 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 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 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.

1948 High metal prices continue to stimulate mining industry. The output of copper ore and zinc-lead ore was the highest of any year in the history of the State. Open-pit development was completed at Inspiration and in progress at Ray. Underground exploration begins at San Manuel.

1949 Owing to a drop in base-metal prices in March and April and subsequent reduction of the work-week to 40 hours, copper production was 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 increased while the output of zinc and lead decreased. Interest in tungsten, manganese, and other critical metals and minerals was stimulated by world conditions.