INDEX OF MINING PROPERTIES IN YUMA COUNTY, ARIZONA

by Stanton B. Keith · Geologist

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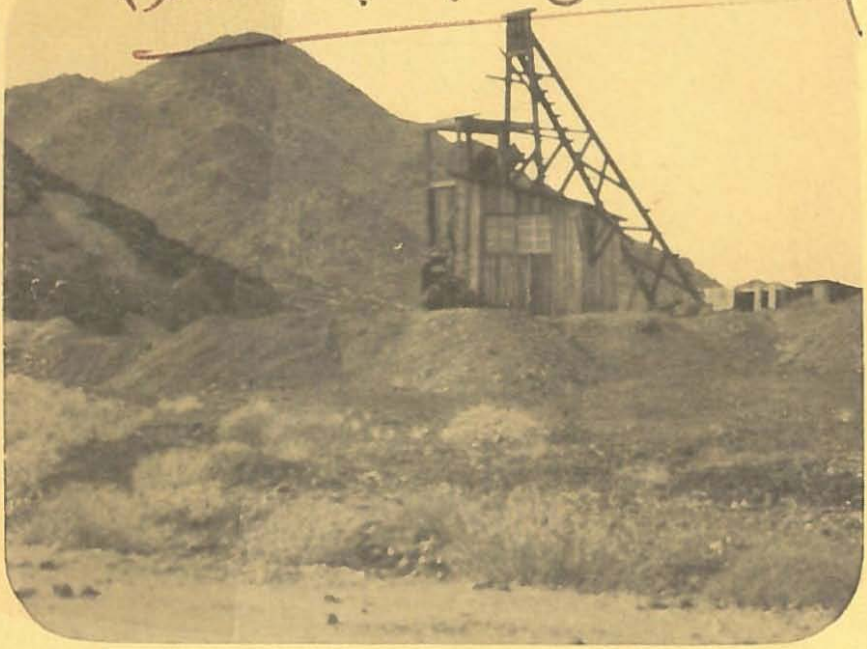

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State of Arizona
Bureau of Geology and Mineral Technology
Geological Survey Branch

The University of Arizona
Tucson

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INTRODUCTION

"Index of Mining Properties in Yuma County, Arizona" is the fourth of the series covering the counties of the State. The first three of the series, covering Cochise, Pima, and Santa Cruz, were published as Arizona Bureau of Mines Bulletins 187 (1973), 189 (1974), and 191 (1975).

Yuma County was one of the earliest important mineral-producing areas in Arizona. Numerous large and small mining and placer operations were active, and almost all the more important mineral deposits of precious and base metals in the county were first found and prospected during the second half of the 19th century. The records of most of those early mining activities are scanty and scattered in old documents and records, publications by individuals or Federal and State agencies, articles in technical journals, public and private reports, and newspaper clippings. Even since 1900, the mining records are far from complete and are not readily available to persons needing or seeking such information. Thus this index is designed to provide, in a concise form, a summary of the available information on most of the mining properties in the county and the more important sources of information that may be found concerning those properties.

It would be impossible to name and describe every mining property or prospect that may have been located or worked in Yuma County. This is particularly true in this case, where detail records of location and features are often scarce. Although some 225 mining properties, or groups of properties, have been described herein, there may be an equal number that have been located and worked to a limited extent for which little or no information is available. The selection for this index has been made on the basis of estimated and/or recorded production of notable amounts of ore or mineral, special geologic or mineralogic character, or the importance of the deposit to overall mineral resources that might become available and economic in the future. The index also provides a basis for land-use planning by indicating areas of mineral potential. Comments, suggestions, and corrections regarding this index will be useful and are welcome.

The author is indebted to the personnel of the Bureau for the help in the preparation of the format and maps, especially Joe R. LaVoie and Richard R. DuPont.

HISTORY

Yuma County, in southwestern Arizona, was one of the original four counties created by the Territorial Legislature in 1864, and is the only county of Arizona that has retained its original boundaries. It was named after the Yuma Indians, the major tribe in the area. The origin of the name "Yuma" has never been clear. It may have come from the Old Spanish word "umo," meaning smoke, since the Indians built large smoky fires in the hope of inducing rain for their crops.

Yuma County encompasses some 9,991 square miles in land area of which about 85 percent is owned and/or controlled by agencies of the Federal government. Most of the northern and east-central sections are under the jurisdiction of the Bureau of Land Management. The Colorado Indian Reservation covers about three percent of the land along the Colorado River in the northeastern part, and most of the southern and west-central areas are covered by military withdrawals, including the Cabeza-Prieta Game Range. The Kofa Game Range covers a large area in the center of the County and restricted areas along the Colorado River are held for reclamation and wildlife refuges. State-owned land accounts for only four percent of the county area and the remaining eight percent is privately owned. At the present time only about one-half of Yuma County is readily open to mineral exploration and mineral claim location.

Yuma County has a population of some 72,600 (1976 estimate), of which over 75 percent live in the general Yuma area and the balance are located mainly in small farming settlements along the Colorado and Gila Rivers. The population density would be slightly over seven persons per square mile but due to the arid and inhospitable character of most of the County, large sections have no permanent residents.

Mining, especially in the second half of the 19th century, played a very important role in the history of Yuma County. There is no evidence that the local Indians took an interest in using or developing mineral products outside of common stone for implements. Many Spanish religious, military, and exploration groups or individuals entered or crossed the southern part of the County along the Camino del Diablo (Devil's Highway) or followed the Gila or Colorado Rivers in the period from about 1540 through the early 1780s. Hernando de Alarcón ascended the Colorado River and Melchior Diaz crossed the County westward to the Colorado River in 1540. Juan de Oñate followed the Santa Maria and Bill Williams Rivers to the Colorado, and down to the Gulf of California, in 1604 and early 1605, noting the Gila River on the way. Father Kino made the first map of southern Yuma County from his numerous journeys through that area from 1699 through 1702. It was twenty years later when Father Sedelmair next passed down the Gila River and up the Colorado River to the Bill Williams River. In 1768 to 1781, Fray Garcés,

Order of St. Francis, traveled the Gila and Colorado Rivers and established a settlement near the present city of Yuma. In 1781 the settlement was destroyed by an Indian revolt during which Garcés was killed. The Spanish made no further attempts to settle in the region although some Spanish or Mexican prospectors may have been present. The first Americans known to have entered the area were beaver trappers, such as Sylvester Pattie and his son James who operated on the Gila River in 1825–1826. In 1832, Pauline Weaver was reported to be trapping in the area. With the start of the Mexican War in 1846, several U.S. military groups crossed Yuma County and provided some geographic information on the region. The Treaty of Guadalupe–Hidalgo in 1848 gave the United States all of the County north of the Gila River and the Gadsden Purchase in 1853 gave the balance of the present County to the United States. Through the Boundary Commission surveys of 1849 and 1854–1855 and the railroad surveys of 1854 and 1856, with their accompanying scientists, generalized knowledge of the geography and geology along the border and the major rivers became known. The California gold rush in 1849 brought hundreds of people through southern Yuma County, passing down the Gila River or over the Camino del Diablo from Mexico. Many of them perished in Indian raids or from lack of water. A ferry across the Colorado River was established at Yuma in 1850 and a military post was stationed there in 1851. The first steamboat reached Yuma in late 1852 and the semi-weekly Butterfield stage line through southern Yuma County was started in 1857. Surprisingly, through all this period of Spanish, Mexican, and early American travels through the County, there is no record of any mineral exploration or prospecting. Reportedly, the fur trappers on the Gila River did note the gold placer deposits at the north end of the Gila Mountains as early as the 1840s but the discovery was not publicized until 1858. The outbreak of the Civil War in 1861 had little impact on the activities in Yuma County. In 1862, Pauline Weaver discovered the gold placers at La Paz, on the west side of the Dome Rock Mountains, and the rush was on to find additional rich placers and mines in western Arizona.

The earliest indications of actual mining and smelting activity in the County may have been in the Castle Dome district. Raymond (1872) and Blake (1899) reported that the first known prospectors in that district, in 1863, found ancient surface workings overgrown by mature mesquite and palo verde trees, and old, well-worn trails leading south to the ruins of crude smelting furnaces on the bank of the Gila River. Who those early miners were is still a mystery.

In the Santa Maria district, south of the Bill Williams River and a few miles east of its junction with the Colorado River, copper deposits were discovered as early as 1858 but were not developed or mined until the early 1860s when picked, high-grade copper ore was shipped out by river boats from the Planet mine, destined for Swansea in Wales, England. The rich silver-lead deposits

in the Eureka and Silver districts were found in the early 1860s and the Castle Dome mining district was organized in 1863. The rich gold placer deposits at Gila City and at the Laguna Dam site near Yuma; in the La Paz, Middle Camp, Oro Fino, and La Cholla districts in the Dome Rock Mountains; in the Plomosa district on the west side of the Plomosa Mountains; and the rich near-surface gold and silver-lead ores, except at Castle Dome, were rapidly worked out. Local concentration and smelting operations generally were unsuccessful and only very high-grade ores could be profitably mined and shipped to reduction works in Europe or to the Selby Smelting Works in San Francisco. Haulage was by wagon to the Colorado River, by boat down the river to the Gulf of California, and then by ocean vessels. The route required several transfers of cargo and the shipments entailed high transportation costs.

The copper-gold deposits in the Cienega district near Parker and those near Bouse, at the north end of the Plomosa Mountains, were prospected in the early 1860s but not worked extensively until later. Gold and lead-silver ores were found in the central Plomosa Mountains and the gold, lead, silver, and copper deposits in the Granite Wash Mountains at about the same time. The copper-gold veins in Cunningham Pass were known by 1863 and various small deposits in the Harquahala Mountains were prospected by the late 1860s. The isolation of many of these deposits, with the resulting high transportation costs for supplies and mineral products, delayed any extensive mining operations until nearby railroad transport became available. The Southern Pacific Railroad reached the Colorado River from California, at Yuma, in 1877 and was continued up the Gila River across southern Yuma County in 1878. This line quickly replaced the more costly ocean transport. Riverboats continued to operate on the Colorado River until the last such boat was retired from service in 1883, at the time when the second trans-Arizona railroad line, the Atlantic & Pacific (Santa Fe) was completed across the Colorado River farther to the north. The major mining operations in Yuma County in the 1880s were on the lead-silver ores at Castle Dome, the short-lived but rich gold deposits at the Bonanza or Harquahala and Golden Eagle mines in the Little Harquahala Mountains, and on the silver-lead ores in the Silver district in the Trigo Mountains.

The demonetization of silver in 1893 diverted prospecting interests from silver deposits to new gold finds. The bonanza deposit at the Fortuna mine in the Gila Mountains was found in 1895, that at the King of Arizona mine in the Kofa Mountains in 1896, and at the nearby North Star mine in the Kofas in 1906. These three mines reportedly produced over seven million dollars in bullion during a fifteen-year period. In the early 1900s, the Arizona & California Railroad constructed a branch line from the Atlantic & Pacific Railroad in California to Parker, Arizona and in 1905–1907, the Parker cut-off line, to a connecting railroad at Wickenburg, was completed. This railroad provided needed transportation facilities to the Cienega, Santa Maria,

Plomosa, Ellsworth, Cunningham Pass, and Harquahala district mines, and spurred increased mining activities in those areas. The Arizona & Swansea Railroad, from Bouse to Swansea, was built in 1910, making possible much larger-scale mining of copper ore in the Santa Maria district. Numerous other districts in Yuma County have produced, intermittently, small amounts of gold, silver, copper, and lead since the 1860s but the tonnage generally was small and their periods of activity short. The over-all production of base and precious metals has declined markedly during the 1900s, as shown in Figure 1, although there have been short periods when gold, copper, and lead production have produced peak years.

Other mineral products, such as manganese, tungsten, fluorite, barite, mercury, iron, and bentonitic clay, have been produced in the County over relatively short periods of time, due to local demand, high war-time prices, or government buying programs.

Table I is a summary of the reported and estimated production of base and precious metals by mining districts in Yuma County through 1974. A total of some 2,831,000 tons of ore mined contained about 25,447 tons of copper, 12,696 tons of lead, 126 tons of zinc, 544,895 ounces of gold, and 2,533,300 ounces of silver. Some 185,470 ounces of gold and 54,490 ounces of silver is estimated as reported as produced from placer deposits, giving a total value of base and precious metals of over $33 million. The early official records of production from Yuma County prior to 1848 are very scanty and up to 1901 are based on fragmentary data collected by Special Commissioners to the Secretary of the Treasury (1867 through 1875), Director of the Mint (1880 to 1903), and the Annual Report of the Director of the U.S. Geological Survey (1880–1882). In 1883, the U.S. Geological Survey began publishing the annual volumes "Mineral Resources of the United States," but the more detailed production information on base and precious metals by states, counties, and districts was not provided until the 1905 edition. The summary results on those metals continued to be published by the U.S.G.S. through 1931, and by the U.S. Bureau of Mines in the "Minerals Yearbook" from 1932. Thus for base and precious metals prior to the early 1900s, production figures are in large part estimates from fragmentary official and unofficial data but are believed to be close approximations. For other mineral products, few detail production statistics by properties, or even districts and counties, have been made public. For these, the estimated and reported figures may be more questionable. It is believed, however, that Yuma County has produced some 170,000 or more long tons of manganese ore and concentrates of which the major share was low grade (15–25% Mn) and only a small proportion averaged above 40% Mn. Almost all of this amount was sold to stockpiles operated under the Government Purchase program in the middle and late 1950s. The value paid for this production may have been around $7 million. The estimate of tungsten production from the County would be some 3,500

short ton units (70,000 pounds) of tungsten trioxide (WO_3) produced mainly during the Government Purchase program of the early and middle 1950s. Some intermittent production, on a small scale, has continued through 1974. The total dollar value of the tungsten production would be some $205,000. Fluorspar production, almost all from the Castle Dome district, would amount to an estimated 3,300 tons of byproduct lump and gravel which was sold mostly as flux to a California cement plant in the early 1900s and from 1916 through 1918 for potash recovery. The value of this mineral product is estimated at $50,750. Barite ore (70–80% $BaSo_4$) has been produced in the Plomosa, Ellsworth, and Mohawk districts at various times and would amount to about 3,000 tons with a value of some $27,000. In the early 1900s, some 116 to 156 flasks of mercury (at 75 pounds per flask) were produced from one mine in the Dome Rock Mountains (La Cholla district) for a value of around $6,000. Other metallic and nonmetallic mineral products, excluding sand, gravel, and common stone, that have been produced in Yuma County, would include a few hundred tons of iron ore and bentonitic clay from the Plomosa district, crushed marble and quartzite from the Harquahala district, and some gem material. The total value of all mineral products produced in Yuma County, excluding sand, gravel, and common stone, would appear to exceed some $40.4 million.

GEOLOGY

The geology of Yuma County is complex and, as a whole, still lacks satisfactory interpretation. Except for a few local areas where detail geologic mapping and investigations have been made, the geology of the County has only been defined by general reconnaissance mapping. The earliest geologic reconnaissance survey reports were by the geologists, Dr. Thomas Antisell (1857), who accompanied Lieutenant Parke in an expedition up the Gila River in 1855, and Jules Marcou (1856), who traveled along the Bill Williams River in connection with a railroad survey. J. S. Newberry (1861), described the geology along the Colorado River in Lieutenant Ives' report. Blake (1865) gave brief descriptions of the geology of the iron and copper deposits just south of the Bill Williams River. Other early reports, providing information on the geology and initial mining operations in Yuma County, were made by J. Ross Browne (1868), R. W. Raymond (1869, 1870–1877), H. C. Hodge (1877), Patrick Hamilton (1881), J. F. Blandy (1893), W. P. Blake (1899, 1903), T. B. Comstock (1901), J. H. Pratt (1902), H. L. McCarn (1904), F. C. Smith (1907), George Hatley (1907), *The Copper Handbook* 1902–1910, and Edwin Higgins (1910). The first general geological reconnaissance report and map of northern Yuma County was made by W. T. Lee (1903) of the U. S. Geological Survey. In the area covered, he broadly defined the gneissic, schistose, and intrusive rocks, as well as the

highly metamorphosed, faulted, and tilted blocks of quartzite, argillite, and limestone. He considered all these formations as Precambrian. The overlying volcanics and unmetamorphosed sediments he placed in the Tertiary to Quaternary. In 1909, Howland Bancroft (1911) of the U.S.G.S. made a rapid reconnaissance of the ore deposits in northern Yuma County, briefly mapping and describing the geology and mineralization in parts of the Santa Maria or Bill Williams, La Paz or Weaver, Plomosa, and Ellsworth or Harcuvar mining districts, as they were then known. He considered the basal formations as a Precambrian granite-gneiss-schist complex, containing dioritic phases and pegmatite and aplite dikes. He also included as Precambrian the overlying metamorphosed quartzites, limestones, dolomites, schists—formed from argillites and shale—and some basic lavas and intrusives. However, in the Harcuvar and Granite Wash Mountains, he noted large, granitic, intrusive masses, with associated dikes, which intruded the Precambrian complex and thus were probably Mesozoic in age. Large areas of volcanics and sediments in the Plomosa Mountains and at the western edge of the Buckskin Mountains he considered as Tertiary and Quaternary. R. C. Blanchard (1913) mapped and described the geology of the western Buckskin Mountains in a Columbia University thesis. He classed the basal granite–gneiss complex and the sedimentary blocks in the complex as Precambrian, although reporting fossils in the limestone blocks.

In 1914, Jones (1916 a, b) of the U.S. Geological Survey made a geological reconnaissance of the gold deposits near Quartzsite and in the Kofa Mountains. In the former, he considered the schist, containing interbedded marble beds and lenses, as Precambrian, and the granitic intrusives as probably Mesozoic in age. In the Kofa Mountains, he noted that Tertiary volcanics rested on an eroded surface of highly metamorphosed sediments which he considered to be Precambrian. These sedimentary formations were intruded by granite and associated dikes which he believed to be Mesozoic. In the late 1910s, the U.S. Geological Survey started reconnaissance surveys of the watering places and ground water conditions on arid public lands of southwestern Arizona, marking routes and providing information to travelers as to available water supplies. Generalized geographic, topographic, and geologic features were shown on maps and described in the accompanying or supplemental reports. C. P. Ross (1922, 1923) covered the central and part of the northwestern sections of Yuma County, north of the Gila River, while Kirk Bryan (1922, 1925) covered the part south of the Gila River. In general, Ross concurred with the geologic mapping of Bancroft, but suggested that the metamorphosed sediments were of two or more ages and that there were at least two separate periods of granitic intrusions. The basal complex of granitoid gneiss and schist, with associated, highly metamorphosed sedimentary rocks, was placed in the Precambrian but some of the less intensely metamorphosed sediments, including limestones in the Buckskin and Har-

quahala Mountains, he considered to be Paleozoic in age. Bryan, in the first geologic reconnaissance of southern Yuma County, was more concerned with physiography than the geologic formations, classifying the basal complex as pre-Tertiary and some granitic intrusions as possibly Mesozoic.

In 1919, and continuing into 1922, N. H. Darton of the U.S. Geological Survey, through a cooperative agreement with the Arizona Bureau of Mines, carried out reconnaissance mapping and study of the geology of Arizona, incorporating the work of previous investigators but adding to, or correcting some earlier interpretations. The results were published in the 1924 Geologic Map of Arizona and his "Resumé of Arizona Geology" (1925). In Yuma County, he definitely recognized Carboniferous fossils in limestone in the western part of the Buckskin Mountains and in the Harquahala Mountains. He also suggested that other areas of schist associated with limestone and quartzite in central Yuma County, occurring as fault blocks within the Precambrian basal complex, might be of Paleozoic age. He believed that some Paleozoic sediments originally may have covered a large part of southwestern Arizona but had been mostly removed by erosion. Darton also recognized that some of the partly metamorphosed sediments in the southwestern Plomosa Mountains could be Lower Cretaceous and that the granitic intrusions seen in many of the ranges were Mesozoic in age.

Starting in 1929 and continuing at intervals through 1932, Eldred D. Wilson of the Arizona Bureau of Mines pursued field work covering southern Yuma County which resulted in "Geology and Mineral Deposits of Southern Yuma County, Arizona,"Arizona Bureau of Mines Bulletin 134, 1933. This monumental work is still the best source of geologic information on that large desert area. The general lack of fossils in the formations in that area made age correlations uncertain, but by indirect evidence Wilson classified the basement schist, gneiss, and granite as Precambrian to Mesozoic, although favoring the later age in most cases. He did not find any Paleozoic formations but did note large areas of sedimentary rocks in the Castle Dome, Middle, Kofa, and Tank Mountains which he classed as Mesozoic in age. He also mapped areas of tilted and faulted red conglomerates, sandstones, and shales, older than the Tertiary volcanics but which he considered to be early Tertiary. Wilson found marine beds near Cibola, along the Colorado River, which he correlated to similar beds in Osborne Wash, east of Parker, and placed them in Tertiary time. He believed that the mountain ranges resulted from faulting and uplift after the Tertiary volcanic activity, but that there was a general lack of any folding. He recognized that detail studies were needed to better define the ages of the geologic formations and the structural patterns of the area.

No additional regional geologic studies of Yuma County were made until Wilson's review and supplemental reconnaissance mapping for the 1960 Geologic Map of Yuma County, which later was incorporated, almost unchanged, into the 1969 Geologic Map of Arizona, a cooperative project of the Arizona Bureau of Mines and the U. S. Geological Survey. Some of the

geologic features of Yuma County also were described by Wilson in his "A Resumé of the Geology of Arizona," Arizona Bureau of Mines Bulletin 171, 1962. Wilson's reconnaissance mapping of this later period considerably revised the earlier interpretations, particularly in the northern half of the County where more detail is shown by him in both geologic formations and structure. Laskey and Webber (1949) had shown strong thrust faulting in the Artillery Mountains in southeastern Mohave County, and by comparing the Paleozoic rocks of the thrust plate to those found in the Buckskin Mountains, suggested that the thrust may have come from the southwest. Wilson also delineated large-scale thrusting in the Buckskin, Granite Wash, and Harquahala Mountains, usually resulting in scattered detached fault blocks of Paleozoic and Paleozoic–Mesozoic sediments resting on the Precambrian complex, but in some cases Precambrian on Laramide sediments or Paleozoic–Mesozoic formations on Mesozoic. Wilson also mapped areas of Paleozoic and Mesozoic sediments in the southern Plomosa Mountains, the Little Harquahala Mountains, and outcrops of that age at the north ends of the Dome Rock and Granite Wash Mountains. He identified large areas of partly metamorphosed Mesozoic sediments, gneiss, and schist, numerous Mesozoic granitic intrusives, and scattered large and small Laramide intrusive bodies and sediments in the various mountain ranges in the County. He did move back most of the previously considered Tertiary andestic and rhyolitic volcanics to Cretaceous in age, and added large areas of partly consolidated Quaternary–Tertiary sediments. The marine sediments, lake beds, and some andesites remained as Tertiary, and he recognized Quaternary basalts, rhyolite, intrusive dikes and plugs, and valley alluvium.

In recent years, more detail geologic studies have been made of local areas in the County. Professional papers, water-supply papers and open-file reports by personnel of the U. S. Geological Survey, bulletins by the Arizona State Water Commission and Arizona Land Department in cooperation with the U. S. Geological Survey, and articles in technical magazines, have covered geohydrologic investigations along the Colorado and Gila Rivers and in other valley areas in the County. These reports have dealt primarily with Tertiary and later formations and have had little specific connection to the mineral deposits. They have furnished some radiometric ages for local formations, such as the intrusive quartz monzonite in the Yuma area, which suggests an original Precambrian age but with the radiometric age reset during the Laramide orogeny. Other dikes, sills, and small irregular intrusive bodies in the Yuma area are probably early Tertiary in age. In the Yuma area, the reports suggest that the mountain ranges are due to elevation and tilting along strong northwest-striking faults in no later than middle Tertiary time, with some later minor structural adjustments. Notable geologic studies of local areas have been carried out by graduate students in recent years: Miller (1966) and Jemmett (1966) in the Plomosa Mountains, Ciancanelli (1965) in the Granite Wash Mountains, Parker (1966) in the Trigo Mountains, Varga

(1976) in the west end of the Harquahala Mountains, and some others referred to in the discussion of specific districts. Miller's work was reproduced as "Geologic Map of the Quartzsite Quadrangle, Yuma County, Arizona," USGS Map GQ–841, 1970. Miller and McKee (1971) discussed the thrust and strike-slip faulting in the Plomosa Mountains. Damon and others have made radiometric age determinations of scattered formations in Yuma County which have often revised their ages. Such determinations of many of the andesitic and rhyolitic flows and tuffs show middle to late Tertiary ages rather than Cretaceous; the granitic intrusive in Granite Wash Pass appears to be Laramide rather than Mesozoic; and the redating of at least some of the probable Precambrian complex took place in Jurassic time. Shackleford (1975, 1976), in the Rawhide Mountains of southeastern Mohave County, and Varga (1976), in the western Harquahala Mountains, have proposed that the apparent thrust faulting is actually gravity sliding from doming. However, the wide extent of the apparent thrust faulting throughout the Buckskin Mountains and southwestward into California, in the southern Plomosa Mountains, in the western part of the Granite Wash Mountains and possibly in traces in the Harcuvar Mountains, and in the Harquahala Mountains makes the origin of this structural deformation solely by gravity sliding hard to comprehend. In most cases the movement involved the displacement of Paleozoic or later formations along a relatively flat but undulating plane at or near the top of the Precambrian complex with the plane of the fault often marked by brecciation, mylonitization, and gouge. The structural picture also has been complicated by later northwest-striking faulting, often with right-lateral movement. Major faulting of this latter type may have produced the northeast-striking anticlinal wrinkle in the eastern Buckskin Mountain and possibly the similar northeast alignment of the Harcuvar and Harquahala Mountains, probably aided by massive intrusions in and under those ranges. Some gravity sliding on a local scale may have occurred during this structural deformation but until more detail mapping and study of the complex structural pattern on a regional scale proves otherwise, large scale overthrusting, probably from the southwest, followed by northwest-striking faulting and igneous intrusions in mid-Tertiary time remains as the most logical explanation of the present geologic picture of this northwestern Yuma County area.

As indicated in the above review and discussion of the geology of Yuma County, much more detail geologic mapping and investigation is needed before an adequate understanding of the geologic picture of the County can be acquired and the relationship of the geology to the many mineral deposits and occurrences can be fully and more accurately correlated.

MINERAL DEPOSITS

Yuma County contains numerous and varied occurrences and deposits of metalliferous and nonmetalliferous minerals but there have been few major

posits found to date from which over 100,000 tons of ore or mineral have en produced. Those major ore-producing districts of base and precious etals that have yielded over one million dollars in total value of base and ecious metals would be Santa Maria (more than $12 million in copper, lver, and gold), Kofa (some $4.8 million in gold and silver), Harquahala ver $2.8 million in gold, silver, lead, and copper), Fortuna (about $2.3 illion in gold and silver), La Paz (over $2.1 in gold and silver), Castle ome (some $2 million in lead, silver, gold, zinc, and copper), Silver (over 1.8 million in silver, lead, gold, and zinc), and Plomosa (almost $1.2 illion in silver, gold, copper, lead, and zinc).

The location of the scattered occurrences and deposits of these metals are own on the Arizona Bureau of Mines "Map of Known Nonferrous Base nd Precious Metal Mineral Occurrences in Arizona, 1969." The Bureau's Map of Known Metallic Mineral Occurrences (Excluding Base and Preious Metals) in Arizona, 1969" indicates the location of other metals, and 'Map of Nonmetallic Mineral Occurrences of Arizona, 1965," the location f nonmetallic occurrences. The Arizona Bureau of Mines Bulletin 180, 'Mineral and Water Resources of Arizona, 1969," also provides information n the minerals found in Yuma County and will be referred to in the following liscussion under the notation "ABM 180" with page number or numbers.

Copper occurrences have been found in almost all mountain ranges in Yuma County but in most districts it is a minor metal constituent of the nineral deposits, occurring sparingly as copper staining or in secondary oxidized form due to deposition or concentration by weathering and leaching of sparse copper-bearing minerals along faults and fractures. However, notable deposits of copper mineralization with good silver and gold values have been found and mined in a broad northwest to southeast band extending from the Buckskin Mountains through the Harcuvar and Harquahala Mountains. Copper mineralization also is prominent in the northern part of the Plomosa Mountains and in the Granite Wash Mountains along the southwestern border of the above apparent copper zone. No porphyry-type deposits have been recognized and the known deposits are of the replacement or vein types. In the Cienega, Santa Maria and Midway districts, the copper deposits occur mainly as irregular, usually massive, bedded replacements of carbonate rocks by iron oxides and copper minerals. In the Ellsworth, Cunningham Pass, Harquahala, and northern Plomosa districts, the copper mineralization usually occurs in veins or dike-like bodies associated with iron oxides, siderite, quartz, and calcite. Spotty barite and fluorite may occur with both types and dioritic dikes or dike swarms and Laramide or Tertiary granitic intrusives often are present nearby, usually along strong, inferred, northwest-striking fault zones. Especially noteworthy are the high gold and low silver values accompanying the copper mineralization in the Cienega, Midway, and Cunningham Pass districts.

Lead and zinc occurrences in Yuma County are more localized, and except

for the major deposits in the Castle Dome and Silver districts, these minera are relatively scarce and spotty. The major occurrences in Yuma County ai summarized in ABM 180, p. 182–205. Some small deposits have been mine in the Alamo, southern Plomosa, Middle Camp-Oro Fino, and Harquahal districts and a few occurrences have been found elsewhere. Zinc usuall occurs with lead but, more often than not, was not recovered or reported in th early mining operations. The lead deposits also contain high silver values an were originally mined as much for silver as for lead. The major lead-zinc silver deposits occur mainly in vein-type deposits in fault or fracture zones i Mesozoic sediments or Tertiary volcanics in the Castle Dome and Silve districts, but some lens-like replacements in carbonate rocks have been foun in the southern Plomosa Mountains. The lead and zinc mineralization appear to have a peripheral relationship to the major copper zone of northeastern Yuma County but no clear zonal relationship can be established. Barite an fluorite are common gangue minerals in the Castle Dome and Silver districts A dike swarm of diorite and rhyolite is present at the former and Laramid intrusive at the latter. The reason for the east-west zone of strong lead-zinc-silver mineralization from Castle Dome through Middle Mountains to th Silver district is not explained.

Gold occurrences in Yuma County are widely scattered through almost all districts but the major economic concentrations in placer and lode deposits are limited to a relatively few locations. Wilson reviewed the lode gold mines (1934, revised 1967), and the gold placers (1961). ABM 180, p. 156–167, summarizes gold placers and lodes in Arizona, and Johnson (1972) summarized the placer gold deposits.

The rich placers in the La Paz, Middle Camp-Oro Fino, La Cholla, Plomosa, Dome, Laguna, Muggins, and Silver districts were derived from the weathering and erosion of numerous small and irregular gold-quartz veins and stringers in Mesozoic intrusive and metamorphic rocks. The gold was concentrated in adjacent washes or on bordering terraces close to the source. More than one sequence of erosion and deposition may have concentrated some of the placer deposits. The gold in the placers ranged in size from nuggets to fine grains and carried variable, small amounts of silver. All the major placers occur in the western half of the County and none of them are directly associated with the major, bonanza, gold and gold-silver lode deposits in the Kofa, Fortuna, and Harquahala districts. These latter deposits occurred as isolated, lensing and irregular, fissure vein deposits in Mesozoic metamorphic rocks and Cretaceous or Tertiary volcanics. Other smaller but notable gold-silver veins have been mined in the Castle Dome, Sheep Tank, and Ellsworth districts, occurring in Mesozoic or Tertiary formations and usually closely associated with small, possibly Laramide, intrusives. All the lode deposits were relatively limited in extent and none have been studied in any detail to determine the possibilities of other similar occurrences in their

general areas. The other many, small, and generally insignificant gold occurrences in the County resulted from the superficial concentration of spotty and weak gold mineralization that was present along veins in fractures or faults. In general, the ratio of gold to silver is higher in Yuma County than in the more eastern areas of southern Arizona. Excluding the high silver districts of Castle Dome and Silver, the ratio in total production would be about one and one-half ounces of gold for each ounce of silver. The gold placers and bonanza lode deposits account for much of this high ratio but in several districts, such as Cienega and Cunningham Pass, gold exceeds silver as a constituent of the lode copper ores.

Silver occurs with gold in the lode and placer deposits and is an important byproduct in the lead and copper ores in all districts.The main silver-bearing deposits are summarized in ABM 180, p. 251–270. There are not any purely silver deposits in the County although those in the Castle Dome and Silver districts, on a value basis, might be so considered. Some silver enrichment in the form of silver halides has been found, usually as superficial minerals produced by weathering, but the amounts have been small.

Manganese deposits have been found in many districts in Yuma County but, as a whole, they are low grade and superficial as described by Farnham and Stewart (1958), and in ABM 180, p. 211–225. A syngenetic type, similar to the Artillery Peak deposits in southeastern Mohave County, occurs as manganiferous material mixed with clastic sediments in playa-like deposits in the Alamo district at the east end of the Buckskin Mountains. Although having considerable tonnage, the material is very low grade and requires maximum concentration to be acceptable even under government buying programs and bonus prices. The more common epigenetic deposits occur in many districts as vein-like and replacement types in small, lensing fillings, mixed with wall rock, calcite, quartz, and iron oxides, in fissure or breccia zones, mostly in andesitic flows and tuffs. The average grade of the material mined is seldom more than 10% Mn although careful hand picking and concentration processes may produce ore up to or better than 40% Mn. The deposits have only been economic to mine during periods of high or subsidized prices such as under the government buying program of the 1950s.

Tungsten, in the form of the mineral scheelite, has been found in scattered deposits as reported by Dale (1959) and in ABM 180, p. 276–281. The scheelite occurs as disseminations or in small grains in pockets and lenses in wall rock, or in quartz veins in gneiss, schist, or limestone. It is best developed in calcareous schist or limestone near granitic intrusives. The most productive deposits have been found in the Ellsworth district, on the western side of the Granite Wash Mountains. Here the deposits have been worked intermittently from the 1950s to recent time but most other deposits in the County could only be worked economically in periods of subsidized prices under a government buying program.

Fluorspar is a common gangue mineral in many mineral deposits, particularly those of base and precious metals, in Yuma County. It is found associated with barite, calcite, and quartz in lensing veins in andesite, rhyolite, and schist, and in minor amounts with some epigenetic manganese, tungsten, and uranium mineralization. It is most plentiful in the lead-silver-barite veins in the Castle Dome and Silver districts. Wilson (1951), ABM 180, p. 348–357, and Elevatorski (1971) have furnished notes and references on fluorspar occurrences in the county. The mineral may make up some fifty percent of the vein material in a few deposits and is often varicolored. By far, the major production of fluorspar from Yuma County came many years ago as a by-product from the lead-silver operations in the Castle Dome district.

Barite, like fluorspar, with which it is commonly and intimately associated, is found as a gangue mineral in veins in several districts of Yuma County as described by Stewart and Pfister (1960) and in ABM 180, p. 311–315. It is prominent in the lead-silver veins in the Castle Dome and Silver districts and lensing barite veins have been mined near Bouse in the Plomosa districts, in the Harcuvar Mountains, and in the Mohawk district, at the north end of Mohawk Mountains. Most occurrences are in volcanic or metamorphic rocks in fault, breccia, or fracture zones associated with calcite, silica, and metallic ore minerals, as well as fluorspar, and except at Castle Dome, have limited width, length, and depth. Only a relatively small amount of barite has been mined commercially in Yuma County due to high transportation costs to markets elsewhere.

Bentonite deposits have been recognized in the Gila River valley near Dome and Wellton and near Bouse, where a small amount was mined for local use in drilling mud. The mineral material is formed by the alteration of volcanic ash or tuff and usually occurs in lake-bed type sediments. ABM 180, p. 324–336, reviewed the bentonite resources of Arizona and suggested that there are good possibilities of finding additional deposits in Yuma County.

Iron oxides, mainly in the form of hematite, is common in Yuma County but seldom in sufficient quantities or purity to be considered a possible economic resource. Harrer (1964) has furnished an excellent review of the iron resources of the County which has been summarized in ABM 180, p. 168–182. Most prominent are the massive replacement deposits of hematite with associated copper mineralization in limestone in the Santa Maria district of the Buckskin Mountains. Low-grade manganiferous iron oxides, usually mixed with other minerals, occur in the northern part of the Plomosa district but some higher grade ore was reportedly shipped from one deposit in that area. The large possible resources in the Santa Maria district, such as in the Mineral Hill mine area, have been prospected and tested but have not been exploited commercially. Titaniferous magnetite in alluvium occurs south of Hope near Granite Wash Pass as reported by Harrer (1964, p. 137) and in ABM 180, p. 275.

Mercury was found in the La Cholla district of the Dome Rock Mountains n the late 1800s, as described by Lausen and Gardner (1927), Wilson (1941) ınd in ABM 180, p. 226–230. Cinnabar with minor gold, wulfenite, and :opper minerals occurred in a restricted ore shoot in a brecciated quartz vein n schist. A small production was made in the early 1900s but the operations vere short-lived.

Some gypsum has been found and mined for local agricultural use from small deposits on the south side of the Harquahala Mountains and in the Plomosa district, as noted in ABM 180, p. 371–382. The deposits are be-lieved to occur in Permian limestone beds and appear to be of limited size and extent. Larger deposits of gypsum and anhydrite may underline the valley alluvium in some of the intermountain basins in Yuma County but have not been noted.

The white and colored, massive and fractured, marble deposits in the Harquahala Mountains, with some quartzite, have been exploited for many years, mainly from broken and crushed stone for a variety of markets. The marble and quartzite are considered to be Paleozoic in age. The coarsely crystalline marble, of probable Paleozoic age, in the Buckskin Mountains has not been exploited commercially. ABM 180, p. 385–398, notes these deposits. The only other reported nonmetallic mineral product produced in Yuma County was mica scrap from schistose rocks near Quartzsite, in 1955–1960 (ABM 180, p. 403).

The intense search for uranium occurrences came in the 1950s and numerous reports of indicated radioactivity due possibly to uranium in Yuma County were made and investigated (U. S. AEC Preliminary Reconnaissance Reports). Some were found to be lacking in any significant radioactivity and others showed relatively weak radioactivity mostly from unidentifiable mineral sources. No substantial uranium sources were found in vein-type structures but a promising area of significant uranium occurrence was noted in the tuffaceous ash beds and opalized mudstones in a large area of Tertiary lake-bed-type sediments in the Muggins Mountains (Keith, 1970). Unfortunately, this area lies within the Yuma Test Station and thus has not been open to additional prospecting.

Very minor and trace amounts of other metals have been noted in Yuma County but they are mainly of mineralogic interest. Meeves (1966) found weak traces of beryllium associated with copper, lead and zinc, tungsten, manganese, and barite-fluorite deposits. Antimony, bismuth, and/or selenium have been reported in association with manganese and lead-silver deposits (ABM 180, p. 94). Rare earths and thorium have been noted in a few localities (ABM 180, p. 247–250). Vanadium, in the form of lead vanadates, occurs in the Case Dome and Silver districts (ABM 180, p. 294). In the field of nonmetallics, alunite occurs in the Dome Rock Mountains (ABM 180, p. 302); kyanite and related minerals in boulders derived from and in quartz-

mica schist in the Dome Rock Mountains (Wilson, 1929, 1933; ABM 180, p 384); perlite occurrences have been reported in the southern part of the Trigo Mountains (ABM 180, p. 406); and some zeolite (clinoptilolite) was iden tified in the bentonite deposit near Dome (ABM 180, p. 465). Finely crystal line quartz in the form of agate and chalcedony has been collected as gem material in the gravels near the Colorado River north of Cebola and some clear quartz crystal has been collected at Crystal Hill in the Plomosa Mountains (ABM 18, p. 361–362). A small amount of so-called "chrysoprase" was reported as sold from a deposit in the Plomosa district.

Yuma County was well prospected for mineral deposits, particularly for gold and silver, by the means then available, in the late 1880s and early 1900s but has received less attention in respect to possible mineral occurrences since that time, except for brief periods when subsidized prices or government buying programs for strategic materials were in effect. No new major economic mineral discoveries have been made in the County since the early period. The relative inaccessibility of much of the area, the inhospitable character of the desert region due to lack of water and intense summer heat, the military withdrawal of large areas from prospecting amd mining, and the restrictions on access and operations in other areas have all discouraged intensive geologic and mineralogic investigations. As shown by the detail geologic work done in a few local areas and by the few scattered radiometric age dates presently available, the reconnaissance mapping for the Geologic Map of Yuma County (1960), used for the Geologic Map of Arizona (1969), needs considerable revision. Additional regional and district geologic mapping, structural studies, and thorough mineral investigations, using the latest available techniques, are almost certain to produce favorable loci for mineral prospecting. The most promising and reasonably accessible area for geologic research for large, economic mineral deposits would be in the broad, northwest to southeast zone in northern Yuma County, including the Cienega, Santa Maria, Ellsworth, Cunningham Pass, and Harquahala districts. Some of the other districts appear to have less potential possibilities but can not be ruled out until examined or tested more thoroughly, particularly in pediment areas out from known mineral occurrences, such as in the Castle Dome district. These possibilities are suggested in the discussions of the specific districts. Overall, Yuma County appears to have the mineral resource potential of again becoming an important producer of metal and mineral products.

EXPLANATION OF TABLES AND MAPS

Four tables, a production graph, a set of mining district maps, and a reference bibliography are included in this index. Table I is a production summary, partly estimated, of base and precious metal ore from the mining districts of Yuma County through 1974. The production graph, Figure 1, depicts the tonnage and value of the output of these metals from 1900 through

974. Table II lists the more commonly used property names, alphabetically, ith the mining districts in which they are located. Table III lists alphabetically the names of some of the known mining property owners and/or perators connected with the properties and respective districts. The lists in able II and III can not be considered all-inclusive or specifically up to date ince names of mines, owners, or operators have changed frequently, which omplicates the task of proper identification.

Table IV is the main index, giving briefly detailed information, as available, on the mining properties, listed alphabetically by mining districts. The ocations are given by surveyed or protracted township, range, and section, nd as closely as possible to the position in the section. Mineral products are isted by chemical symbols or by name, generally in the order of their production importance. Minor or trace elements are shown in parentheses. The general geology is very briefly summarized, based largely on the reports or data listed in the references. The general type of operation is noted and the production figures are based on reported and/or estimated data. The references cited are listed in the bibliography and are not all-inclusive. They are believed to provide the most informative information available.

The small-scale maps show the location of the mining districts in Yuma County and the location of the mining properties within the districts. The numbered locations are keyed to the respective numbers shown in Table IV. Major geographic features, surveyed or protracted township, range, and section lines and the generalized geology from the 1960 Geologic Map of Yuma County also are shown. The bibliography at the back of the bulletin includes all references cited in the text or in Table IV.

NOTES ON INDIVIDUAL MINING DISTRICTS

Alamo Mining District

The Alamo Mining district, as defined in this bulletin, covers the eastern part of the Buckskin Mountains and the alluvial plains in the northeastern corner of Yuma County (Figure 3). It joins the Santa Maria district to the west and in earlier reports was included as a part of that mining district. The name, from the Spanish word for cottonwood, comes from the former, small settlement of Alamo at Alamo Crossing on the Bill Williams River. The crossing, in the past, was on an important route between Yuma and Mohave Counties.

The eastern Buckskin Mountains are rugged and rough with narrow, steep-walled canyons and alluvial washes produced by dendritic drainage. Ives Peak, 3927 feet in elevation, is the highest point in this area of the range. The north-bordering Bill Williams River cuts through a series of rock canyons separated by some wider, flat, sandy basins. At the eastern end of the district, a broad alluvial plain, with some few remnant rock outcrops, has been formed along Bullard Wash, Date Creek, and the Santa Maria River.

The geology of the district has not been studied in detail by federal or state

geologists. Bancroft (1911) did not report on the mineral deposits of thi district and his reconnaissance map only showed, in the area, an undiffer entiated Precambrian granite-gneiss-schist complex. The Geologic Map o Arizona (1924), showed Precambrian schist and granite gneiss in the district A part of the eastern limits of the district was mapped in some detail by Laskey and Webber (1949), in connection with their investigation of man ganese occurrences in the Artillery Mountains of southeastern Mohave County. Eldred Wilson's reconnaissance mapping of the area furnished the geologic data for the Geologic Map of Yuma County, Arizona (1960), which was shown also on the Geologic Map of Arizona (1969). Gassaway (1972) studied the Tertiary sedimentary formations in the Lincoln Ranch basin area along the Williams River in the western part of the district. More recently, Shackelford (1975) carried out investigations in the Rawhide Mountains on the north side of the Bill Williams River, in Mohave County. The earliest geologic description of this general region was made by Jules Marcou (1856) in connection with a railroad survey. Lee (1908) made a brief geological reconnaissance report on the Bill Williams River valley and the Buckskin Mountains. The first description of mineral deposits in the district was by Jones (1920), in which he briefly described one of the manganese occurrences. Wilson and Butler (1930) quote Jones' description of that deposit.

The basal formation of the district appears to be a Precambrian complex of deformed granitic gneiss, impure marble lenses, and schist of sedimentary and volcanic origin. Small patches of apparent Paleozoic and/or Mesozoic quartzites, carbonates, and phyllites rest unconformably on the Precambrian, often along apparent, relatively-flat fault contacts. Again, unconformably, late Tertiary fanglomerates, arkose, limestone, basalt, latite, and rhyolite locally cover the older rocks. Some small and local intrusions of monzonite of uncertain Mesozoic or Laramide age also are found. Erosional remnants of Quaternary basalt are present and Tertiary to Quaternary alluvium covers large basin areas. Strong structural deformation and erosion is evident throughout the district but the geologic history is not yet well defined. The apparent Precambrian complex appears to be domed or folded along a broad northeast-trending anticline. Right-lateral faulting along ancient lines of crustal weakness may bound the eastern end of the mountains and apparently similarly aligned faulting occurs within the range. Wilson's mapping and Laskey and Webber suggest that the blocks of Paleozoic and Mesozoic sediments resulted from large-scale thrust faulting while Shackelford suggests that in the Rawhide Mountains, they resulted from gravity sliding in Late Tertiary time. It appears probable that Paleozoic and Mesozoic sediments covered larger areas in the past. Regardless of the method, some kind of faulting took place at or near the contact between the Precambrian complex and the later formations as indicated by local gouge and mylonization. Locally, the carbonate rocks are contact metamorphosed and marmorized, probably due to the nearby monzonitic intrusions.

The major economic mineralization found in the district has been the relatively low grade manganese deposits, of apparent syngenetic origin, in late tertiary beds. The small, irregular, largely oxidized vein deposits of copper and lead with variable gold and silver values occur in the Precambrian complex but are usually closely associated with or above the apparent fault plane between the Precambrian and later formations. They probably are related to the later monzonite intrusions. The fault plane may have acted as a channelway for the mineralizing solutions. However, the exact charater and origin of these deposits is unclear.

The manganese deposits of the district were known as early as 1916 and worked to some extent in 1918. The major period of production occurred in the 1950s when over 160,000 long tons of low-grade, crude manganese ore was mined. Some, averaging better than 15% Mn, was shipped direct to the Government buying station at Wenden, while lower grade material was concentrated to meet the required grade specifications. Only a few thousand tons of picked or concentrated manganese ore averaged better than 40% Mn. No figures are available on the value of the manganese production, but it could have amounted to several million dollars.

The small base and precious metal deposits were discovered early and have been worked intermittently since the late 1800s. Reportedly, the first, sorted, high-grade ore from the deposits was mined and packed out on burros by Graves, who died in a cave-in in 1900. Later, Rogers mined and shipped out wagon loads of ore running as high as 50 ounces silver and 0.26 ounces gold per ton and containing 26 percent lead and minor copper. Later owners and operators had their ore concentrated in a small mill in Reid Valley (Lincoln Ranch basin) along the Bill Williams River. The total estimated and recorded production of base and precious metals from the Alamo district would be some 824 tons of ore containing about 27 tons of lead, 22 tons of copper, 984 ounces of silver, and 66 ounces of gold for a total value of some $13,790.

Future economic mining possibilities in the Alamo district appear limited. Some 200,000 tons or more of manganese-bearing material, averaging 3–10 percent Mn, may remain around the previously operated mines, but at present the feasibility and economics of mining and concentrating the manganese to a marketable product is not favorable. The occurrence of the small, scattered base and precious metal mineralization has not been investigated or studied in detail. The mineralization does occur within an apparent broad, favorable mineral-bearing zone. Careful examination of the deposits as well as their relationship to the regional geology and structure might suggest loci of possible economic mineralization.

Alamo Springs Mining District

The Alamo Springs mining district, as defined in this bulletin, covers the northern part of the Kofa or S. H. Mountains of central Yuma County (Figure 4). It has been referred to as the Alamo District in some earlier reports but has

been renamed here to distinguish it from the Alamo district of northeaste Yuma County. The district takes its name from Alamo Springs, a series weak water seeps near the head of Alamo Wash. Cottonwood trees, calle "alamo" in Spanish, may have grown near the seeps or along the wasl Alluvial plains with some scattered rock outcrops, to the north and eas separate the district from the Livingston Hills of the Plomosa district, th New Water Mountains of the New Water district, and the Little Horn Mour tains of the Sheep Tank district. To the west, a narrow pass separates the Kof Mountains from the north end of the Castle Dome Mountains. The arbitrar southern border would be an east-west line just south of Hoodoo Wash an Squaw Peak.

The topography of the district, particularly the western section, is ex tremely rugged with irregular mountain peaks up to 4,877 feet in elevation steep-walled ridges, and deep narrow canyons, some of which contain nativ palm trees. To the east, the terrain becomes more subdued with scattered lower, large and small flat-topped mesas and ridges, separated by irregula sandy washes.

The geology of the district has not been studied in detail. Jones (1916) mad a brief reconnaissance of a part of the district and Wilson (1933, 1934, revised 1967) made brief trips into the area. The geology shown on the 1924 edition of the Geologic Map of Arizona was revised by Wilson for the Geologic Map of Yuma County, Arizona (1960) and used in the revised Geologic Map of Arizona (1969). The major exposed rock formations of the northern Kofa Mountains are made up of an extensive and thick series of volcanic flows, tuffs, and breccias, of at least 2000 feet in thickness. The Cretaceous or Tertiary andesitic to rhyolitic volcanics are overlain by Quaternary basaltic flows to the east. Underlying the volcanics at the north end of the mountains, partly metamorphosed, tilted, faulted, and fractured Mesozoic shale, sandstone, conglomerate, and minor limestone are exposed. Also mapped in the northeastern section are Mesozoic and/or Laramide or Tertiary intrusives. The latter appears, in part, to intrude some of the volcanics and thus makes the respective ages uncertain.

The district appears to have been strongly deformed by structural movements in pre-Quaternary time although only some of the apparent northwest-striking faults with right lateral movement have been mapped. The lineation of the intrusives suggests that they were emplaced along a major deep-seated fault zone.

The mineralization found to date in the district has been relatively minor, mostly associated with fault or shear zones or with Laramide or Tertiary granitic intrusives. Oxidized copper mineralization has been prospected in numerous places in or near the granitic intrusive in the northeastern section, such as at the Alamo and Alonak mine groups where small veins and seams of chrysocolla, malachite, and copper oxides occur with sericite, epidote, chlo-

ite alteration, and magnetite. Considerable shallow prospecting has been done and some 65 tons of ore averaging about 1.4% copper and minor silver was shipped in 1957 and 1964. At the Cemitosa prospect, some very fine free gold occurred in a breccia zone containing calcite stringers in andesite porphyry overlying Mesozoic granite along the edge of the basalt-capped mesa. In the central part of the district, around the small camp of Ocotillo, prospecting and development was carried out in the early 1900s along a northwest-striking shear zone in the andesitic volcanics. Rand, Geyser or Silent King, IXL, Regal and the C.O.D. group were the principal workings along that zone. The Big Horn also appears to be along the same one and is similar geologically. These prospects and small mines show spotty, fine, free gold with gouge, brecciated wall rock cemented by silica or calcite, and iron and manganese oxides. Except for the 300-foot shaft and levels at the Geyser mine, the workings are shallow. There has not been any recorded production but small amounts of ore reportedly ran as high as 7 ounces of gold per ton and panning of crushed rock from the shear veins and the alluvium in adjacent washes showed gold values. Undoubtedly a small amount of gold from these workings and placers was sold or traded to buyers and credited as from an unknown source or to the Kofa district.

On the western side of the district, exploration was carried out in the early 1900s along strong fault zones cutting volcanic andesite porphyry. Northwest-striking fractures and breccia zones with cementing calcite contained iron oxides and spotty gold values. The Kofa Queen mine of the Kofa Queen Mining and Milling Co., produced, in 1921, some 100 tons of ore averaging about 0.8 ounces of gold per ton with minor silver. The Tunnel Spring (Ramshorn) workings showed a few dollars per ton of gold in panning but has had no recorded production.

The mineral deposits of the Alamo Springs district have not received a detailed study or examination. The area is isolated and largely difficult to explore. It lies within the Kofa Game Range where mining activities may be restricted and is in an area under consideration for wilderness classification which would effectively prohibit future exploration and mining. Most of the area is covered by the thick Cretaceous or Tertiary and Quaternary volcanics but there are interesting geologic features that suggest possibilities for exploitable mineral deposits such as the strong faulting in connection with the Laramide intrusions where copper mineralization has been found. The district deserves further careful investigation before classifying it as devoid of economic mineral deposits.

Castle Dome Mining District

The Castle Dome mining district lies in the southern portion of the Castle Dome Mountains and also covers the Middle Mountains to the west, in southwestern Yuma County (Figure 5). The origin of the name "Castle

Dome'' is said to have come from a corruption of ''Capital Dome,'' the nam given by American soldiers at Fort Yuma in the 1880s to the high dome-lik peak in the range. The early Spanish explorers called the peak ''Cabeza d Gigante'' (Giant's Head). The Middle Mountains were named by the earl miners due to their position midway between the Castle Dome mines and th shipping port at Castle Dome Landing on the Colorado River.

The Castle Dome Mountain mass is an elongated, northwest-trendin range, narrowing and curving northeastward in the northern part where it i separated from the Kofa Mountains by a narrow alluvial pass. The range i rugged and blocky with steeply sloped rocky spires and dome-like tower which are separated by box-like canyons. Rock pediments, with thin alluvia cover, extend outward into broad alluvial plains on all sides from the ver ragged borders of the mountain mass. The Middle Mountains are a relatively low, narrow range exhibiting irregular ridges and sharp peaks and are flanked by wide, poorly developed pediments.

The best available geologic description of the Castle Dome and Middle Mountains was given by Wilson (1933). His reconnaissance mapping (1933, 1960) revised that shown on the 1924 Geologic Map of Arizona and has been used for the 1969 Geologic Map of Arizona. The northern half of the Castle Dome range is covered by a thick series of volcanic rocks, including rhyolite, andesite, tuff, and obsidian, more than 2,000 feet thick, ranging in probable age from Cretaceous to Quaternary. The older volcanics have been cut by quartz porphyry dikes. Locally at the north end, remnants of a Quaternary basaltic flow, up to several hundred feet thick, cap the older volcanics. In the southern half of the range, the geology is more complex with large areas of partly to strongly metamorphosed sedimentary and intrusive rocks. The mostly strongly metamorphosed formations, consisting of schist and gneiss, were originally mapped as Precambrian and later considered as Mesozoic by Wilson. They appear to be in fault contact with the less metamorphosed sedimentaries consisting of shales, cherty limestones, and local arkosic sandstones, quartzite, slate, and conglomerate. This formation has been dated tentatively by Wilson as Cretaceous. The most striking geologic feature of this southern area is the extensive dike swarm of dioritic and rhyolitic intrusives which have a general northwest trend and cut the Cretaceous sedimentary series throughout most of its exposure. The rhyolitic dikes, referred to as quartz porphyry, appear to be somewhat younger than the dioritic dikes and the volcanic rocks, while the dioritic dikes may be older than the volcanics. The thick volcanic cover of andesite and rhyolite flows and tuffs, resting on the eroded Mesozoic and Cretaceous sedimentaries, were dated by Wilson as Cretaceous but may be Tertiary. Along the southern and eastern border of the mountains, remnant outcrops of Quaternary basalt cap the Cretaceous or Tertiary volcanics and form isolated hills in the alluvial plains. Outside of the dike swarms, the only intrusive masses that have been mapped occur to the

north and northeast of Thumb Peak and at the extreme southern end of the range. They may be of Mesozoic or Laramide age and are granitic to syenitic in composition. Strong, northwest-striking, normal faulting is evident or can be assumed throughout the range and along the borders, resulting in variable amounts of tilting of the Mesozoic formations and the volcanics.

The Middle Mountains have a geologic setting similar to the southern part of the Castle Dome Mountains. Mesozoic schists and sedimentaries, in apparent fault contact, are cut by diorite-porphyry and rhyolite-porphyry dikes and are covered by a thick series of Cretaceous or Tertiary lavas and tuffs, and also a few small remnant outcrops of Quaternary rhyolitic and basaltic lavas and tuffs. The older metamorphic, sedimentary, and volcanic formations have been faulted and tilted.

The most prominent and important mineral deposits in the Castle Dome district are the argentiferous galena-fluorite-barite fissure veins in the Mesozoic sedimentaries, closely associated with the dike swarm. They occur on a southwest-sloping pediment on the west side of the Castle Dome range. The veins are in a wide, steep-dipping, compound fault zone which cuts the sediments and diorite-porphyry dikes. The veins appear to be most productive where the diorite porphyry forms one or both walls of the veins and also where they are closely associated with quartz porphyry intrusions, although values are generally poor where veins are in the latter rock. The veins have the same general northwest strike as the dikes and fault zone and have a steep dip. They may be continuous for considerable distances but lense from a few feet to over ten feet in width. Economic mineralization was limited to local ore shoots and in depth to 200 to 300 feet below the surface. The character of the veins in greater depth has not been described. On the surface, the veins are marked by weathered, crystalline fluorspar, calcite, and barite with local gypsum and minor quartz. Locally this gangue contained tabular to irregular masses of galena superficially oxidized to cerrusite, anglesite, and lead oxide. Partly oxidized galena nodules often were encountered in the alluvium over buried vein outcrops. In depth the unoxidized galena occurs as sheet-like masses or irregular, vein-like bodies scattered through a gangue of often banded, coarsely crystalline, varicolored fluorite, crystalline calcite, bladed to massive barite, and minor quartz. Local oxidized channelways and vugs may contain hydrozinete, smithsonite, wulfenite, vanadinite, mimetite, quartz, calcite, and aragonite. Little or no copper mineralization and only oxidized zinc mineralization have been found in the deposits due to the deep oxidation. Wall rocks show pronounced silicification, carbonatization, and sericitization with some small, partly oxidized pyrite crystals and weak chloritization. The one ore deposit found in the Middle Mountains has similar characteristics to the Castle Dome deposits but is smaller and less oxidized.

To the southwest of Thumb Butte, in an area locally called the Thumb Butte or Old Montezuma district, scattered, irregular calcite-quartz veins,

containing spotty chalcocite, copper carbonates, and minor oxidized lead and zinc mineralization, occur in the Mesozoic sediments. Only one mine, the Copper Glance, Thumb Butte No. 1, or Montezuma, had any significant production although several other prospects contributed a few tons of copper ore.

About three miles east of the Castle Dome mines, in a deep rugged canyon area at the head of Big Eye Wash, Cretaceous or Tertiary andesitic volcanics, intruded by rhyolite porphyry dikes, are in apparent fault contact with badly shattered Mesozoic quartzites. A small intrusive stock invaded the fault zone and, in a brecciated zone, several small, irregular, short veins and veinlets of brecciated quartz, cut by veinlets of calcite and manganiferous calcite, contain narrow and lenticular ore shoots of good gold values and minor, oxidized, copper and lead mineralization. The ore shoots are limited in all dimensions. Spotty gold placer deposits occur in the washes below the vein occurrences.

In the southern and southeastern sections of the Castle Dome Mountains, small, irregular, gold-bearing veins have been prospected in the strongly metamorphosed Mesozoic sediments and in the intrusive and Cretaceous or Tertiary volcanics. In the Sheep Claim area (T.6S., R.17W., secs. 10 and 15, protracted), narrow, lensing quartz veins with adularia and rock inclusions contain gold values and minor lead oxides. The Keystone mine, formerly called the Goat (T.4S., R.17W., N. cen. sec. 33, protracted), contained small rich pockets of silver ore in irregular veins of quartz, manganiferous calcite, rock breccia, manganese oxides, and some minor smithsonite, in Mesozoic schist cut by quartz-porphyry dikes. Also in the southeastern part of the range, lenticular pockets and stringers of manganese oxides mixed with calcite, quartz, and rock breccia occur along shears and fracture zones in the Cretaceous or Tertiary andesitic volcanics.

The Castle Dome district was one of the earliest and most continuously operated mining areas in Arizona. In December, 1862, a meeting was held by all persons claiming interest in the mineral deposits and the district was organized under the chairmanship of Col. Snively. H. Ehrenberg was elected as Secretary and Recorder. Snively and Connors were the principal owners. The district has been productive to some extent almost yearly up to the present time. The earliest American prospectors in the area found old workings with well-established, slow-developing, desert vegetation growing out of old pits and dumps, well-worn trails to the Gila River, and the ruins of adobe smelting furnaces along the river. Who carried out the considerable work done has never been determined. The discovery of the deposits in 1862 caused initial excitement due to the mistaken belief that the heavy, silvery galena was pure silver rather than lead containing only some 30 ounces of silver to the ton. Some mining did continue for the next twenty years and hand-sorted and sacked ore was shipped which ran 58–69 percent lead and $23–$190 in silver. The ore was carried by wagon to Castle Dome Landing, above Yuma, on the

Colorado River; transferred to river boats; and finally to clipper ships in the Gulf of California for transport to the Selby smelter in San Francisco. In 1868, the ores shipped reportedly averaged 60 percent lead and $40 per ton in silver, giving a total value of $90 per ton. Mining and sacking costs amounted to $12 per ton; hauling to Castle Dome Landing, $15; and transport by boat to San Francisco, $18. In 1870, several owners and captains of the Colorado River steamboats organized companies to exploit the deposits. The Castle Dome mine was acquired and worked by Miller and Nagle and the Flora Temple by Polhamus and Company. Brush (1873) studied the anglesite found in the mines and noted that it was banded like wood tin, often around a nucleus of unoxidized galena. The outside layer contained only 16.87 oz. Ag/T while the galena contained 27.3 oz. Ag/T. A small smelter was built at Yuma in 1875, but with the completion of the Southern Pacific Railroad to Yuma from the California coast in 1876, local smelting could not compete economically with the Selby smelter. The ores continued to be barged to Yuma from Castle Dome Landing until the extension of the rail line along the Gila River in 1878 made riverboat transport unprofitable. The ore was then shipped by rail from Dome siding some 20 miles to the southwest of the mines.

During the early 1870s, a considerable amount of ore was shipped because premium prices were being paid for lead free from arsenic and antimony and thus ideal for the manufacture of white lead for paint. In the late 1870s, the Castle Dome Mining and Smelting Company, with Prof. William P. Blake as President, was organized to acquire all the important mines in the district and to start shipping the ore to their own smelter at Melrose, California. Production by that company was increased and was continued until 1883. Thereafter, the mines were leased to others and production declined. In 1890 Gondolfo and Sanguinetti took over the mines and until late 1896 shipped considerable amounts of ore to the Selby Smelter. Since then a few hundred to a few thousand tons of ore per year have been shipped almost continuously. The output came from the mines and from the reworking of old fills and dumps by numerous small companies and individuals. Accurate production records for some of the early years are missing, but the Castle Dome lead-silver mines are estimated to have produced, through 1974, at least some 119,000 tons of ore containing more than 10,500 tons of lead, about 478 thousand ounces of silver, and 38 tons of zinc. Small amounts of copper and gold were recovered as byproducts. During 1902–1904, 1908–1909, and in 1913, hand-sorted fluorspar crystal fragments and clean screenings from mine production and dumps were shipped to the Riverside Portland Cement Plant in California to be used for flux, and in 1916 through 1918, for potash recovery. Some additional shipments of lump and gravel spar also may have been made but no accurate totals of all fluorspar shipped is available. The best estimate is some 3,300 tons.

The gold-silver veins of the district were known and prospected by the 1870s but little mining took place until 1912 when the deposits in the Big Eye area were opened up. Intermittent production since that time has accounted for some 2380 tons of ore containing about 2150 ounces of gold and 19,000 ounces of silver. The small gold placers, mainly in the Big Eye area, were discovered in 1884 and were worked by Mexican dry-washers in the early years and sporadically since that time by various individuals. The total recovery, mostly prior to 1900, is estimated as 7,000 ounces of gold with considerable silver.

Copper mineralization was found in the Thumb Butte area in the 1870s and small-scale operations, principally at the Copper Glance mine, have produced some 150 tons of ore containing about 9 tons of copper, 1,465 ounces of silver, and minor gold and lead.

The U. S. government buying program of low-grade manganese ores in the middle 1950s led to the exploration for such material in the andesite volcanics of the Castle Dome range, and some 400 tons of 26–30 percent manganese was shipped from small surface workings in the southeastern part of the district. The total value of the mineral production from the Castle Dome district would exceed $2 million.

Except for the examination by Wilson (1933), the geology and mineralization of the Castle Dome district has not received the careful study that it deserves. The strong lead-zinc-fluorspar-barite mineralization, the extensive dike swarms, and the possible mineral zoning all suggest the possibility of deep igneous intrusions and additional hidden economic deposits. The westward-extending pediment area under the Castle Dome Plain and onto the Middle Mountains and the copper occurrences to the south deserve careful investigation. Mineralization also may extend under the thick volcanic capping but would be difficult to prospect. The district does lie within the Kofa Game Range, which may restrict mining operations, and is under consideration for withdrawal as a wilderness area, which would prohibit future mining activities. It would be hoped that a thorough examination would be made before any withdrawal is made of this important mineralized area.

Cienega Mining District

The Cienega mining district covers the western end of the Buckskin Mountains in the northwest corner of Yuma County (Figure 6). The district name came from the Spanish word for marsh or swamp, and a wet grassy meadow (due to springs) occurs at Cienega Springs some 4.5 miles northeast of the settlement of Parker, which is located along the Colorado River and at the north end of the Colorado Indian Reservation. The Cienega district joins the Santa Maria district along an arbitrary boundary to the east and has been included in the later district in the past.

The topography of the district varies from rugged ridges to large and small, relatively flat, steep-walled mesas dissected by irregular canyon-like washes.

An extensive volcanic plateau rises from about 1,000 feet in elevation in the western part to over 1,600 feet eastward. Osborne Wash separates the mountain area from the extensive, sandy Cactus Plain to the south, and ragged steep slopes border the Bill Williams River to the north and the Colorado River to the west.

The geology of the Cienega district is complex and although mapped in some detail in the past, still has many unexplained features. Jules Marcou (1856) gave a general description of the area along the Bill Williams River in connection with a railroad survey, and Lee (1908) made a brief geological reconnaissance report on the Bill Williams and Colorado River valleys and the Buckskin Mountains, including a sketch map. Bancroft (1911) reported on some of the mining operations of the district with notes on the general geology and a reconnaissance map. Blanchard (1913) wrote a Columbia University thesis on the area. The geology of the district, as shown on the 1924 edition of the Geologic Map of Arizona, resulted largely from the work of Bancroft but was modified by Darton as outlined in his "A Resumé of Arizona Geology" (1925). Wilson further revised the geology of the district by reconnaissance mapping for the Geologic Map of Yuma County, Arizona (1960), which is also shown on the 1969 Geologic Map of Arizona. In 1965, three Master of Science theses on the geology of the district were submitted to the University of Missouri at Rolla by Fernandez, Al-Hashimi, and Zamorano. More recently, Shackelford (1975, 1976) carried out geologic structural studies in the Rawhide Mountains to the north of the Bill Williams River to the east, but his conclusions may have a bearing on the structures in the Cienega district.

All investigators of the district have considered that the basal metamorphic gneiss and schist were probably Precambrian. The younger geologic history is not as certain. Bancroft and Blanchard included the limestones and other less metamorphosed sediments that appeared to be intimately associated with the Precambrian, as of Precambrian age. Darton (1925) and Ross (1922, 1923) recognized Carboniferous fossils in some of the limestone. Wilson's reconnaissance mapping for the Geologic Map of Yuma County further defined numerous areas of undivided Paleozoic and Mesozoic shale, quartzite, and limestone in the district. More recent investigators also recognized Paleozoic and Mesozoic formations but opinions on their structural relationship to the Precambrian complex differ. Lee (1908) recognized a conglomerate formation which he considered to be Quaternary, unconformably overlying the older formations along the rivers, but Wilson included the formation with other sandstone and shale beds which he dated as Laramide but which could be Tertiary in age, as recognized by later investigators. The youngest formation of the district is the thick capping of basaltic flows, tuffs, and agglomerates, with some rhyolite tuff near the base, which is probably late Tertiary to early Quaternary in age. Remnants of Quaternary basalt occur along the southern border of the district. Scattered, generally small, rhyolitic to andesi-

tic dikes and plugs, possibly of Tertiary age, intrude the older formations; and similar dikes and plugs occur in the younger plateau-forming basalt and may have been the source of the volcanics. The ages assumed for the intrusives and most of the formations are far from certain at the present time.

The geologic structure of the district is complex and subject to differing views as to its origin. Faulting, folding, and tilting of the pre-Quaternary formations have long been recognized but the spatial relationship of the Paleozoic, Mesozoic, and Tertiary beds to the Precambrian complex is not firmly established. The structural pattern is a regional one, extending from at least the Riverside and Big Maria Mountains in eastern California to the Artillery Mountains of southeastern Mohave County, and southeastward to at least the Harquahala Mountains. Laskey and Webber (1949), from their detail mapping and study of the manganese deposits in the Artillery Mountain region, suggested that massive thrust-faulting from the southwest brought Precambrian and Paleozoic rocks over Cenozoic formations along a low-angle but gently rolling fault plane that was later folded and faulted. The thrust fault plane was complex, including slices of brecciated, pulverized and altered granite, gneiss, and sedimentary formations. California geologists also have suggested similar thrusting and later folding and faulting in the mountains to the southwest of the Cienega district. Wilson's reconnaissance mapping of Yuma County likewise shows thrusting of Precambrian and Paleozoic-Mesozoic formations. Later northwest-striking, normal faulting and related folding greatly modified the thrust plane and the attitude of the formations affected. Recently, Shackelford (1974, 1976) has challenged the thrust hypothesis in respect to the Rawhide Mountain area, believing instead that the structural pattern resulted from complex late Tertiary low-angle normal faulting and gravity sliding of Precambrian to Late Tertiary formations over a Mesozoic (?) mylonitic gneiss complex. It would appear that additional study and interpretations will be required before the true nature of this extensive structural deformation pattern is resolved. In any case, the movement of the formations above the apparent fault plane appears to have been to the northeast and that the structural relationships are chaotic.

The mineralization in the Cienega district consists mainly of copper silicates, carbonates, and oxides with spotty high grade gold and minor silver. Most orebodies found are relatively small, irregular, and spotty, occurring as replacements in metamorphosed limestone, in breccia and in fissure zones in limestone, quartzite, and Precambrian metamorphic rocks, and apparently almost always closely associated with the apparent regional thrust plane or the somewhat later or accompanying normal faulting, either or both of which may have acted as channels for mineralizing solutions from a deep source. Some minor quartz veins with gold and minor lead have been prospected and traces of mercury and tungsten have been reported.

The Cienega district mineral deposits were discovered as early as 1860 and ıave been worked intermittently since then. Prior to 1900, the production ecords are scanty but early records show production in 1870 and 1884 from uch mines as the Billy Mack, Sue, and Quartz King. Ore was carted to the Colorado River for shipment by boat to Yuma. The withdrawal of the river-ɔoats in 1884 and the low prices for copper in the late 1890s practically closed lown mining operations in the district. With the completion of the cut-off ailroad line from Parker through Bouse to Wickenburg in 1907, by the Arizona & California Railroad, and the later line to the smelter at Swansea in 1910, many of the old mines were reopened and new ones were put into ɔperation. Production has been intermittent and variable in yearly amounts of ɔre shipped, ranging from a relatively few tons to over 1,000 tons in 1943–1944, 1949, and 1957. There has been no recorded production since 1969. An important economic factor in the operations of these spotty and small nines was the high gold content, averaging about 0.6 ounces per ton as ıgainst 0.2 ounces of silver per ton. The total estimated and recorded production from the Cienega district would be some 19,000 tons of ore containing ıbout 917 tons of copper, 11,707 ounces of gold, 3,364 ounces of silver, and a few hundred pounds of lead for a total value of about $656,000.

The economic mineral potential of the Cienega district has not been studied in detail but deserves a careful and thorough examination. The district lies along a broad belt of copper-gold mineralization, adjacent to similar mineralization in California to the west and in Yuma County to the east and southeast. It is an area of structural complexity and the source of the mineralization is unknown. Further, the thick Quaternary-Tertiary volcanic cover masks a large part of the district but one may assume that additional deposits could lie hidden beneath the volcanics. Geologically and mineralogically, the district would appear to be a favorable possible target for the discovery of additional economic mineralization.

Cunningham Pass Mining District

The Cunningham Pass mining district lies in the Cunningham Pass area of the central Harcuvar Mountains of northeastern Yuma County (Figure 7). In the past it has been included in the Ellsworth mining district which, in this bulletin, is limited to the western end of the range and the adjoining Granite Wash Mountains. The pass and district are named after James or Charles Cunningham, who, in the middle 1880s, built a stone house in the Pass and staked the original mining claims on what was later the Critic mine. Harcuvar is a Mohave Indian word for "very little sweet water."

The Harcuvar Mountains are a long, narrow, northeast-trending rugged range with a serrated crest and steep slopes descending to the broad Butler Valley alluvial plain to the north and the McMullen Valley plain to the south.

Cunningham Pass is the main divide through the range and has served as the main route from Wenden to areas to the north. Harcuvar Peak, 4,630 feet in elevation, is the high point in the district.

The geology of the Harcuvar Mountains is as yet poorly defined or described. It has not been studied geologically in any detail. Lee (1908) mentioned the range, in conjunction with the Harquahala Mountains, noting that they consisted "of a crystalline complex underlying and to some extent including masses of quartzite, argillite, and metamorphic limestone." Bancroft (1911) described briefly the geology of the Cunningham Pass area and the Harcuvar Mountains and showed on his reconnaissance map the Precambrian complex and a large Mesozoic granitic intrusive around Harcuvar Peak. He noted that the intrusive was often strongly metamorphosed and that stringers of the granite branched out from the main mass. Locally he found contact metamorphic minerals and found that contacts between granite, gneiss, and schist were difficult to distinguish. In Cunningham Pass he saw that the Precambrian complex was generally gneissic but included schistose phases of former basic intrusive. Numerous dikes of pegmatite and aplite and some prominent diabase intrusives were seen as well as many ledges of impure siliceous hematite, some being of considerable width. Ross (1922, 1923) briefly reviewed the geology of the Harcuvar Mountains but based most of his information on Bancroft's work. However, he did not show on his geologic map the large granitic mass at Harcuvar Peak. Darton (1925) accepted the conclusions of Bancroft and Ross but the 1924 Geologic Map of Arizona, based largely on his reconnaissance mapping, changed the outline of the granitic intrusive and the gneiss-schist complex but did not separate Mesozoic or later granite from Precambrian granite. It also failed to show the Harcuvar Peak intrusive. Wilson, from his reconnaissance mapping for the Geologic Map of Yuma County, Arizona (1960), did not show Mesozoic granite around Harcuvar Peak but outlined Laramide granitic outcrops along the borders of the range in the Cunningham Pass area as is also shown on the 1969 Geologic Map of Arizona. Various miscellaneous reports on the mines in the district mention encountering carbonaceous and shaly formations in the workings but do not specify their relationship to the Precambrian complex or Mesozoic granite. They do mention the presence of numerous dikes and diorite intrusives, as well as many strong (and often wide) erosion-resistant ledges of impure hematite. The most complete geologic report on the Cunningham Pass district is given by Tovote (1918). He noted that erosion has worn down the rocks to the old Precambrian complex of gneiss and schist, the latter apparently derived mostly from igneous rocks. He found that the schist generally strikes NE and dips moderately NW but is folded and contorted and the complex has been invaded by a quartz-monzonite-type intrusive with numerous affiliated pegmatite dikes and sills that are irregular in outline and strike, forming a network, and by more basic dikes ranging from

ornblende-diorite to dense porphyritic diabase that have a northwest strike. 'he age of these intrusions is not clear but the strong metamorphism of the 'recambrian rocks and the presence of the intrusives in the Precambrian omplex suggest that the range is largely underlain by a large intrusive body. Evidence also indicates that there is a large intrusive mass around Harcuvar 'eak but the age of such an intrusion is uncertain. Reportedly, a potassium-rgon dating of biotite in the gneiss in the range showed a mid-Tertiary age vhich might represent a resetting of the radiometric age at that time due to structural deformation or intrusions. Biotite from granodiorite in Granite Wash Pass, formerly considered Mesozoic in age, has been radiometrically dated as Laramide which also suggests that the intrusions may all be post-Mesozoic. Detail geologic mapping and radiometric age determinations will be required to determine the true geologic relationships.

Structurally, the predominant feature of the district is the evidence of a strong, wide fault zone striking northwesterly through the Cunningham Pass area. Although not readily evident on the surface, the mine workings have disclosed strong northwest-striking shearing both before and after mineralization as well as subordinate north and northeast-striking fracturing, producing a complicated network of intersecting and offsetting breaks in the rocks. The intrusive masses and dikes are cut and sometimes displaced by the mineralized faults and fractures. The northeast trend of the range, similar to that of the Buckskin and Harcuvar Mountains but contrary to the usual northwest trend of other Basin and Range mountains in this part of Arizona, suggest "wrinkle" folding between strong, right-lateral, northwest-striking fault zones, but much more detail geologic mapping and structural study is needed to determine the origin and resulting pattern of the structure in the district.

The mineralization in the Cunningham Pass district consists mainly of copper and iron, with high gold values and less silver, in veins along shear zones and fractures and sometimes in or along intrusive dikes. The mineralization tends to be spotty, occurring in lenses, pockets, and stringers, and at times is disseminated in the gangue or in the bordering wall rocks. In the oxidized zone, the copper ore minerals are chrysocolla, copper carbonates, and copper oxides with some relict copper sulfides, usually in association with massive or disseminated specular hematite. The hematite often forms massive, impure iron ledges over the veins. Some spectacular high grade pockets and stringers of gold flakes and disseminations have been found in the hematite ledges. Tovote indicated that the veins, often as composite stringers and lenses up to four feet wide, tend to branch out northward in "en echalon" fashion from almost due west to due north with the strongest vein zone striking about N45° W. He found the dips to vary from relatively flat to steep and that subordinate cross veins intersect and displace the main veins with local enrichment of the mineralization. He recognized two periods of ore

formation, one with a quartz gangue apparently related to the earlier pegma tite dikes and the other with hematite gangue related to the more basic dikes which cut and may replace the earlier mineralization. In depth, the ore minei als are chalcopyrite, bornite, chalcocite, and subordinate pyrite in a gangue c siderite, dolomite, and ankerite. Post-mineral barite and minor calcite also ar found. The silver content of the ore mined seldom exceeded 2 ounces per to while gold varied from about 0.1 to 2.4 ounces per ton. The deepest mining at the Critic and some other workings, reached 500 feet below the surface, bu no information is available on the character and continuation of the ore i depth. Tovote believed the best ore to occur in strongly folded areas, alon pegmatite contacts, and near the more basic intrusives. Relatively weal uranium values were found in a fracture zone cutting Precambrian schist an Laramide (?) granitic intrusive (USAEC Prelim. Reconn. Rpt., ASL-4).

The copper-gold mineralization of the district was found as early as th 1860s by prospecting parties who accompanied or closely followed th Weaver-Peeples' expedition from La Paz to Prescott and Wickenburg along the McMullen and Butler Valleys. Hermen Ehrenburg, the noted Germar mining engineer, visited Cunningham Pass in 1865 and found about 51,20 feet of development work had been done on eighteen lode deposits, mainly or the Cunningham (Critic) deposit. However, the high iron content of the ore made gold amalgamation difficult and the deposits were too inaccessible fo profitable mining of copper ore.

When the Parker cut-off line of the Arizona and California Railroad was completed in 1908, the Cunningham mine, relocated as the Critic, was reopened and small, hand-picked, high-grade shipments began to be made sporadically from the Critic and other properties of the district. With the high copper prices of the first World War, larger-scale, profitable production was possible and such mines as the Wenden, Wenden King, Desert, Bullard, Cuprite, and Little Giant were opened by various companies. They were only moderately successful. After initial development, most operations changed to leasing, the outstanding example being that of Joseph Nolcheck who successfully worked (and later acquired in 1921) the Critic property, built a small flotation plant, and shipped concentrates almost continually until the middle 1940s. Unfortunately, in World War II the Harcuvar Mountains became a training ground for the military with the result that mining activities ceased and the facilities and installations were largely destroyed. The district has never fully recovered although some small shipments have been made from 1947 through 1960.

The total estimated and recorded production of base and precious metals from the Cunningham Pass district through 1974 would be some 9,000 or more tons of ore containing about 773 tons of copper, 4,436 ounces of gold, 2,344 ounces of silver, and very minor lead. The high gold content may be largely due to gold enrichment in the oxidized part of the deposits.

The Cunningham Pass district has many intriguing and favorable geologic and mineralogic characteristics. It lies within an apparent wide, northwest-trending, mineralized belt of strong copper-gold-silver mineralization. There is strong structured deformation and the district probably overlies a large granitic intrusive of Laramide or later age which produced numerous dikes in the Precambrian metamorphics. The district has not been studied geologically in the detail it deserves and offers excellent opportunities for the discovery of possible economic ore deposits.

Dome (Gila City) Mining District

The Dome or Gila City mining district lies at the north end of the Gila Mountains about 14 miles east of Yuma and south of the Gila River (Figure 3). The district was named after the railroad station and siding at Dome (originally called Castle Dome) of the Southern Pacific Railroad, established in the early 1880s. The Castle Dome Mountains to the northeast are clearly seen from this location. Gila City, taking its name from the river and located a short distance west of Dome, was established as a stage station in the late 1850s at about the same time that the placer gold deposits were found. It had a very short life as a settlement.

The north end of the Gila Mountains is rugged, with steep slopes and deep canyon-like washes draining into the Gila River and producing alluvial benches and terraces on a narrow pediment out along the mountain front. The topography and geology of this section of the Gila Mountains was briefly described by Bryan (1925) and in greater detail by Wilson (1933). According to Wilson, the north end of the Gila Mountains consists largely of a large Mesozoic granitic intrusion that apparently invaded the older metamorphosed sedimentary rocks that Wilson classed as Mesozoic schist, although containing some gneiss. Marble occurs in an east-to-west belt in the schist across the northern part of the mountains, and irregular dikes of granite, pegmatite, and aplite have invaded the earlier rocks in numerous places. The north end of the schist is marked by a fault which separates the schist from faulted and tilted early to middle Tertiary clastic sedimentary rocks consisting of well-stratified, weakly-consolidated sandstone, arkose, silts, and clays which form a pediment mantled by Quaternary gravels. The gold placer deposits, the main mineral resource of the district, occurred in the gravels at or close to the beveled surface of the Tertiary formation and in residual benches and terraces along the gulches. The gravels, up to fifteen feet thick, mantle the fault zone and extend as narrowing terraces into the canyons in the schist. The source of the gold is not clear, as no high-grade veins are known in the north end of the Gila Mountains. The gold must have come from the weathering of many small and pockety low-grade gold-bearing quartz veins in the Mesozoic formations, and was carried down over the Tertiary sediments by rejuvenated streams after the faulting and uplift of the mountain mass. A few irregular and

lensing quartz veins, containing weak and spotty oxidized copper mineralization and gold, have been prospected in the Mesozoic schist. The marble member of the Mesozoic schist has not been exploited to any major extent although some parts are of high calcium-low magnesium content. It is faulted, of irregular thickness, and interbedded in part with schist and quartzite. Some contact metamorphic minerals occur locally in the marble.

Although reportedly first noticed by early fur trappers on the Gila River, the finding of the Dome (Gila City) placers was first publicized by Col. Jacob Snively in 1858. Within a short time, over a thousand men were reported as prospecting and working the gulches and canyons along the north end of the Gila Mountains. The best placer deposits were depleted by 1865 but some gold has continued to be recovered intermittently up to the present time by repeated reworking of the gravels. No successful large-scale placer operation has been carried out although several schemes were tried. The total estimated and recorded placer gold production would amount to at least 26,000 ounces of gold, containing also some 1,180 ounces of silver, for a total value of almost $345,000, mostly prior to 1865. Little or no production resulted from the workings on the small prospects or from the marble occurrences.

The Dome district may continue to produce a few ounces of gold from placer operations, but there are no geologic indications of any major economic deposits.

Eagle Tail Mining District

The Eagle Tail mining district covers the Eagle Tail Mountains and Cemetery Ridge in east-central Yuma County, along the border with Maricopa County (Figure 2). The Eagle Tail Mountains were named after Eagle Tail Peak, at the southeastern end of the range in Maricopa County. There, three rock spires resemble the tail feathers of an eagle. Cemetery Ridge reportedly received its name from the graves of prospectors killed in the 1870s.

The Eagle Tail Mountains are a relatively low, elongated, narrow, broken, and rugged northwest-trending range with sharp scarps along both sides. Court House Rock, sometimes called Cathedral Rock, is a residual outlying butte on the northeast side of the range. Ross (1923) first described the mountains as highly colorful and conspicuous, consisting of a thick mass of nearly horizontal lavas with interbedded tuffs, resting on an irregular erosional surface of Precambrian metamorphic and igneous rocks.These formations, he found, were cut by pipes, dikes, and sills of light-colored intrusive. He suggested that the range was a fault block broken by cross faulting. Darton (1925) noted that the narrow but prominent ridge presented a fine succession of Tertiary volcanics. The 1924 Geologic Map of Arizona, based on his reconnaissance, shows Cretaceous-Tertiary volcanics resting on Precambrian

granitic rocks. These were covered locally by remnants of Quaternary volcanics. The most detail geologic mapping of the Eagle Tail range was done by Wilson in his reconnaissance mapping for the 1960 Geologic Map of Yuma County, which was used for the 1969 Geologic Map of Arizona. He showed Cretaceous andesite and rhyolite volcanics covered in part by Quaternary basaltic flows and intruded by a general northwest line of Cretaceous intrusive plugs, dikes, and sills of rhyolite to andesite. He showed outcrops of Precambrian granitic rocks occurring along the northeast side of the range. The strong lineation of the intrusives suggested to him a major, northwest-trending fault zone. Some recent radiometric dating suggest a middle Tertiary age for the volcanics and intrusives.

Cemetery Ridge is a low, northwest-trending range of interrupted and broken hills with gentle slopes except for Nottbusch Butte in the southern part and the sharper-crested ridges and rugged canyons in the northern portion. Wilson (1933) made a brief visit to the ridge and noted schist along the western margin, granite intruding the schist, and numerous dikes of rhyolite and granite porphyry and some hornblendite. Thick rhyolitic to basaltic flows and tuffs covered various parts of the older formations. Ross (1923) previously had noted that the hills appeared to be composed of Tertiary lava, tuff, and sedimentary rocks and Darton (1925) observed schist in the center of the hills, probably covering a basement of Precambrian granite and schist and irregularly overlain by Tertiary volcanics. The 1924 Geologic Map of Arizona, based largely on Darton's work, shows Precambrian granitic and associated rocks in the center of the ridge, with a covering of Cretaceous to Tertiary volcanics to the north and Quaternary volcanics to the south. Wilson's later reconnaissance mapping for the 1960 Geologic Map of Yuma County, also used for the 1969 Geologic Map of Arizona, shows the main middle section of the ridge to be Mesozoic gneiss with some Cretaceous and Quaternary volcanics at the north and south ends and along the southwest side. He mapped a small Cretaceous intrusive in the gneiss. Since the only geologic mapping done in this district has been by reconnaissance, the geology and structure could be subject to considerable modification by more detail investigations. As in the Eagle Tail Mountains, the volcanics and intrusives would now appear to be middle to late Tertiary.

According to Wilson, the mineralization found along the northwest side of the Eagle Tail Mountains consisted of spotty occurrences of base and precious metals, mostly oxidized and enriched near the surface, with a gangue of quartz, calcite, and barite in fissure and fracture zones cutting Cretaceous or Tertiary volcanics and Precambrian rocks. Weak copper mineralization, with minor gold and silver and a gangue of iron and manganese oxides, quartz, gouge, and brecciated wall rock along fractures and faults, has been prospected in several localities on Cemetery Ridge. Some irregular manganese-

bearing breccia zones occur in the Cretaceous or Tertiary andesite in Cemetery Ridge where Wilson also noted some non-commercial asbestiform actinolite.

The prospecting in the Eagle Tail district dates back to the mid-1860s and the mineralization has attracted attention sporadically since then. Except for the small production of some 40 tons of handpicked 22% manganese ore there has been no reported mineral output in the district.

Due to the relative inaccessibility of the district, there has been little or no detail study made of the geology and mineralization of the Eagle Tail district but both the Eagle Tail Mountains and Cemetery Ridge probably have been thoroughly prospected in the past without finding indications of any major mineral deposits. The Eagle Tail Mountains apparently lie along a strong major fault zone that may have been active during several periods in the past and thus the possible loci of hydrothermal mineralization. Although the district can not be assigned a high priority for mineral exploration, the geology and mineralization should be carefully examined since it lies along the border of the southeast extension of the favorable mineralized zone found to the north.

Ellsworth Mining District

The Ellsworth mining district, as defined in this bulletin, is confined to that part of the Harcuvar Mountains west from about Harcuvar Peak, and includes the Granite Wash Mountains, in north-central Yuma County (Figure 7). The district in the past has been called Harcuvar, and also included the Cunningham Pass district to the west and the Harquahala district to the south. The origin of the name "Ellsworth" is unknown.

The western part of the Harcuvar Mountains presents a very rugged, serrated terrain, reaching 4,618 feet in elevation at Harcuvar Peak, with steep slopes and deep canyons. The ragged mountain borders are formed by the indentations of numerous, irregular stream washes. The northeasterly-aligned, relatively narrow range is cut by several saddles or passes such as Cottonwood-Sycamore and Tank Passes, the latter separating the Harcuvar Mountains from the Granite Wash Mountains. The latter range is a north-to-northwest-trending mountain mass, equally rugged but somewhat lower in elevation with Salome Peak at 3,991 feet the highest point. To the south, the Granite Wash Mountains are separated from the Little Harquahala Mountains by Granite Wash Pass through which the highway and railroad line run.

The geology of the district, as a whole, has only been mapped and studied by reconnaissance and as yet is not well defined or understood. Lee (1908) gave a very brief description, considering the rocks to be Precambrian granite, gneiss, and metamorphic sediments. Bancroft (1911) likewise considered the mountains to be made up of Precambrian gneiss and schist with included metamorphosed sediments into which masses and dikes of probable

Mesozoic granitic rocks and some basic rocks were intruded. Bancroft's interpretation of the geology was used by Ross (1922, 1923), except for the Harcuvar Peak intrusive. Darton (1925), however, noted that the limestone within the metamorphic sediments in various places in the Granite Wash Mountains might be Paleozoic and that great thicknesses of shale, schist, and phyllite occurred in those mountains. The 1924 Geologic Map of Arizona, based largely on Darton's reconnaissance mapping, shows several outcrops of Carboniferous sediments in the Precambrian complex in the northern part of the Granite Wash Mountains but did not show the Harcuvar Peak granitic intrusive. Wilson's reconnaissance mapping for the Geologic Map of Yuma County, Arizona (1960), also used in the 1969 Geologic Map of Arizona, made several revisions in the regional geology of the district. He restricted the Precambrian granitic-gneissic-schist complex to the Harcuvar Mountains and the low northwest-trending prong of the Granite Wash Mountains. The shale, schist, and phyllites noted by Darton in the southern part of the Granite Wash Mountains were placed by Wilson as Mesozoic in age, and a thrust block of undifferentiated Paleozoic-Mesozoic shale, quartzite, and limestone was mapped on the northwestern edge of the range. The intrusive mass between the Harcuvar and Granite Wash mountains and some smaller outcrops to the south were considered by Wilson as Laramide while others along the east side and in the Granite Wash Pass area were classed as Mesozoic. Bancroft's probable Mesozoic intrusive at Harcuvar Peak was not differentiated from the Precambrian gneissic complex. Metzger (1951) believed that the intrusive at the junction of the two mountain ranges had the form of a laccolith, dipping under the formations to the east. Kam (1964), in noting the general geology of the ranges bordering McMullen Valley, included the metamorphosed sedimentary rocks of the Granite Wash Mountains in the Precambrian complex as well as the gneiss and most of the granite of the Harcuvar Mountains. He follows Metzger's belief that the Mesozoic granitic intrusives in the western part of the Harcuvar Mountains and the Granite Wash Pass area may be extensions of a laccolithic intrusion. Kam noted that the granite at Salome Peak was concordant with the Precambrian metamorphic complex and west of Harcuvar Peak the granite is in contact with the Precambrian complex which dips into the base of the peak. He found numerous stringers of granite intruding the granitic gneiss in varying directions in the foothills. Kam also noted numerous dikes of varying composition, roughly aligned wih northwesterly strikes in the Granite Wash Mountains. He considered the dikes to be contemporaneous with major Mesozoic intrusions. Ciancanelli (1965) studied a small area in the northwestern corner of the Granite Wash Mountains where metamorphosed sediments are intruded and deformed by what he considered to be a Cretaceous intrusion of granodiorite altered to a quartz monzonite. He believed the metamorphosed sediments glided to the north and northeast from a former high area to the southwest. He found later basalt and diabase dikes

that were intruded along north-to-northwest-striking faults which later also were the loci for rhyolite dikes. He noted that a northeast-trending fault system, primarily of a reverse or thrust type, was offset by a northwest-trending normal fault system containing the dikes. He considered the quartz monzonite to be a discordant intrusive. More recent radiometric dating of the granitic intrusive at Granite Wash Pass gave an age of 65.0± 5.5 m.y. (Damon, 1968), which places it as Laramide and thus suggests that the other intrusives of the area need to be checked as to their age. The reported radiometric dating of biotite in the gneiss of the Harcuvar Mountains as 24 m.y. suggests a resetting of the radiometric clock in mid-Tertiary time, probably related to a major structural readjustment or intrusion. The above brief summary of the geologic investigations of the district points out the uncertainties of the present knowledge of the geology of the area.

A variety of mineral deposits has been found in the Ellsworth district, although few have been of major economic significance. Along the northwest-trending structural breaks in Sycamore-Cottonwood and Tank Passes, spotty copper-gold mineralization occurs, associated with a quartz, siderite, calcite, and barite gangue in fault and breccia zones in the Precambrian metamorphic complex intruded by Laramide granitic bodies and numerous acid to basic dikes. The outcrops are usually strongly marked by massive iron oxides that may contain oxidized copper mineralization and free gold. These vein-like deposits generally are discontinuous, often faulted, and may be cut by later acidic dikes. Barite lenses may be associated with the iron and some manganese oxides, and minor amounts of fluorite have been found to occur along the major structural breaks, in subsidiary branches, or at intersections of fissure veins. The mineralization is in the form of discontinuous lenses, pods, and veinlets, with some disseminations in the wall rock or breccia. The primary copper mineralization found has been chalcopyrite, some bornite and minor pyrite which oxidized near the surface to malachite, azurite, cuprite, chalcocite, and minor chrysocolla. Siderite appears to be the major gangue mineral. The mineralization found in these areas is similar to but appears to be not as strongly developed as in the Cunningham Pass district.

Mineralization in the main part of the Granite Wash Mountains is more varied. Irregular fissure veins in the Mesozoic or Laramide intrusive and the Mesozoic metamorphosed sediments contain spotty and irregular copper, gold, silver, lead, and zinc mineralization with quartz and calcite. This mineralization, mostly oxidized, is commonly associated with dikes. The major copper deposit of the district, at the Yuma mine, occurs in contact metamorphosed marble. Tungsten mineralization has been found as scheelite, mainly in contact metamorphic deposits but also in quartz veins associated with the metamorphosed limestone in the northwestern part of the district, and in quartz veins associated with diabase dikes in a granitic intrusive in the southeastern part of the district. Numerous small spotty gold deposits have

been found in narrow, discontinuous quartz veinlets and lenses in the metamorphosed Mesozoic sediments, usually close to dikes and granitic intrusions. Erosion of these occurrences gave rise to gold placer deposits in small gulches close to the source of the gold. Relatively weak uranium values were found in a fault zone cutting Precambrian schist and Laramide granite (USAEC Prelim. Reconn. Rpt. A-P-301).

The mineral occurrences in the Ellsworth district were discovered in the 1860s, but outside of prospecting and small placer operations, little mining was done until the completion of the Parker cut-off of the Arizona & California Railroad in 1905–1907. Some spectacular free gold strikes were made in the early 1900s, such as the Salome strike at the Glory Hole mine in 1909. At about the same time, the prospecting for copper was carried out around Harcuvar Peak, in Cottonwood Pass, and in Tank Pass, by shallow shafts, tunnels, and drilling. Some small, high-grade pockets and streaks of oxidized copper ore with gold and silver values were found, but the average grade and size of the deposits was not sufficient to produce economic shipping ore. Intermittently, some mining by fifteen to twenty operators has produced small, handpicked shipments of copper and gold ore and some lead and zinc, particularly during war years with high prices, but the total tonnage has been low.

The total estimated and recorded production of base and precious metals from mines in the Ellsworth district would be some 14,000 tons of ore containing about 386 tons of copper, 14,700 ounces of silver, 2,395 ounces of gold, 12 tons of lead, and 4.5 tons of zinc. Only about 300 ounces of gold with minor silver was produced from placer operations.

The tungsten mineralization was recognized but not mined until the 1950s when premium prices were paid under the government buying program. Some production has continued intermittently, with some 1,000 short ton units of WO_3 produced through 1974. Likewise a few carloads of barite ore produced from hand picking operations have been shipped from the district.

Most of the mineral exploration and mining in the Ellsworth district has been shallow and no detail geologic study has been made of the relationship of the numerous deposits to the complex geological and structural setting. Until careful geologic mapping and investigations should prove otherwise, the Ellsworth district continues to be a favorable area for the location of economic mineral deposits.

Fortuna Mining District

The Fortuna mining district covers the central part of the Gila Mountains in southwestern Yuma County (Figure 2). The name of the district came from the Fortuna mine, meaning fortune or fate in Spanish. It lies south of an arbitrary boundary with the Dome district at the northern end of the Gila Mountain range. The district now lies within the Luke Air Force Range.

The Gila Mountains are an extremely rugged, angular, and sharply serrated northwesterly-elongated range with deeply furrowed canyons on both sides. The jagged crest ranges from 1,300 to 3,150 feet in elevation without any outstanding peaks. An elevated dissected pediment is evident along the mountain slopes and another break in slope occurs at the base of the mountains. The Yuma Desert, one of the driest, hottest, and most inhospitable areas in the United States, lies to the west and the Lechugilla Desert lies to the east.

The earliest notes on the geology of the district were furnished by Blake (1897), who visited the Fortuna mine and gave a general description of the rocks he saw on the trip. He noted the granite at the north end of the range and the stratified and laminated mica and hornblendic slates with interbedded quartzites farther south. Bryan (1925) noted the schist and gneiss intruded by granite but did not place an age on those formations. Darton (1925) used the description of Bryan except noting that feldspathic dikes cut the schist. The 1924 Geologic Map of Arizona shows the range to consist mainly of Precambrian schist with granite intrusions. The most detailed geologic investigation of the district was made by Wilson (1933). He mapped schist and gneissés that he believed could be Precambrian or possibly younger and granite intrusions that he tentatively regarded as Precambrian but might be as late as Mesozoic or Tertiary. He found the schist and gneiss to have been intruded by amphibolites, pegmatites, and granite. The only younger formation is the Quaternary gravel that laps up against the steep mountain slopes, covering rock pediments.

The Gila Mountains apparently are bounded by block mountain-forming faults. The schists strike across the range, parallel to the original bedding with only minor folding. Wilson believed the faulting throughout the range to have occurred at several periods in the past, some prior to or accompanying the periods of igneous intrusion but much probably in late Tertiary or early Quaternary time.

The district contained only one major economic mineral deposit, that at the Fortuna gold-quartz vein deposit, although other small gold-bearing veins and the pegmatites have been prospected. At the Fortuna deposit, fine-grain, free gold with minor copper minerals and pyrite occur in a gangue of brecciated quartz with calcite and iron and manganese oxides, along irregular, lensing, faulted, intersecting veins in fault and fracture zones in metamorphosed Mesozoic schist. Blake (1897) and Wilson (1933) have given descriptions of the geology and mineralization of the Fortuna mine. The vein or veins occurred in a network of faults, some preceding the mineralization and the loci of the mineralization and others cutting the veins. The ore body appeared to be localized in a relatively small chimney along the upward-branching vein system. The wall rocks are altered by carbonatization and silicification and the mineralization was lost by faulting in depth. Many other quartz veins occur in the vicinity and elsewhere in the district but very little gold was found

n them. Also, there are prospects for copper and mica in the district as lescribed by Wilson (1933).

Some hundreds of prospectors passed the Fortuna gold deposit in the 1850s on their way to California along the western branch of the Camino del Diablo (Devil's Highway), but the insignificant quartz outcrop failed to attract their attention. The vein was discovered between 1892 and 1895 by four prospectors and the property was acquired by Lane who organized the La Fortuna Gold Mining and Milling Company in 1896. Blake (1897) gives an interesting account of the camp and early operations. The mine was very successful until closed down in 1904 after unsuccessful attempts to find a faulted segment of the vein below the 800 level. In 1913, the Fortuna Mines Corporation acquired the property but abandoned the project at the end of 1914, after mining a few pillars and exploring for new ore. In 1924, the Elan Mining Company purchased the property and made a small production but were unsuccessful in finding the lost vein and closed down in 1926. Since then several individuals have reworked the tailings and prospected other veins in the area. The total estimated and recorded production from the Fortuna district would be some 213,500 tons of ore containing about 134,489 ounces of gold, 10,655 ounces of silver, and 98 pounds of copper, having a total value of some $2,801,000.

There may be other gold-bearing quartz lodes in the Fortuna district, but past intense prospecting would indicate that they would be hard to find and in general the area would have a low priority rating for the location of economic deposits. The district is within a military withdrawal area and thus not open to prospecting and exploration at this time.

Gila Bend Mountains Mining District

The Gila Bend Mountains mining district, at the east-central border of Yuma County, covers the western end of the Gila Bend Mountains (Figure 2). This part of the range also has been called the Nottbusch Mountains after an early settler and prospector in the region. Some ridges and mesas to the south are now called Picacho Hills, and Black Mountain is an isolated low peak farther to the south. The name of the main range and district comes from the big bend in the Gila River to the east in Maricopa County.

The Gila Bend Mountains in Yuma County are a somewhat subdued collection of scattered, eroded, low peaks and hills, aligned in a general east-west direction, with steeper slopes to the south and a more gently sloping, eroded and irregular pediment to the north. The most detail description of the geology and mineral deposits of the district in Yuma County was given by Wilson (1933, p. 144–147). Ross (1923) had noted the Tertiary volcanics near Clanton's Well at the western end and the granite and similar rocks in the range. Darton (1925) also states that the western end contained granite and possibly gneiss and schist. Wilson (1933) mapped strongly-laminated Pre-

cambrian schist with some local chert-banded limestone in a band along the north side of the range. The schist has been sheared, faulted, and intruded by numerous andesitic to granitic dikes as well as some more massive granitic bodies. In one area, cherty limestone with minor sandstone overlies the schist and shows minor faulting and tilting as well as some andesite dikes. Capping these formations to the south is a thick series of andesitic to basaltic lavas and tuffs. In his reconnaissance mapping for the Geologic Map of Yuma County (1960), also used for the 1969 Geologic Map of Arizona, Wilson considered the sediments to be Laramide and the volcanics as Cretaceous. More recent radiometric age dating of the volcanics near Clanton's Well show them to be middle Tertiary.

The mineralization of the district occurs in gold-bearing quartz, in fissure veins or silicified zones in the schist or granite, and as spotty, partly oxidized lead-fluorite-quartz veins in a fault zone in calcareous and cherty schist. Oxidization apparently has been strong and deep, concentrating the gold values near the surface and developing strong showings of iron oxide in the veins. Minor copper oxides, carbonates, and silicates often occur in the iron oxides. Although some very minor amounts of gold may have been recovered from the district, none has been reported or estimated.

Although the known mineralization in the Gila Bend Mountains in Yuma County does not suggest the occurrence of economic deposits, the district does lie along the edge of a strong northwest structural trend containing mineral occurrences of base and precious metals. Careful geologic investigations might reveal possible loci of hidden deposits in this area.

Harquahala Mining District

The Harquahala mining district covers the Harquahala and Little Harquahala Mountains of northeastern Yuma County (Figure 9). The district extends into Maricopa County, but only that part within Yuma County is covered in this bulletin. In the past, the Harquahala district was included in the Ellsworth district. The names of the two ranges come from a Mohave Indian word, "Ah-ha-quahala" which means "running water," but the larger range was originally called "Penhatchaipet" from a spring of that name on the south slope. Various spellings of Harquahala have been used in the past and for a long time the name was divided into two words rather than combined into one.

The Harquahala Mountains are a prominent, compact, and massive northeast-trending range with a steep, relatively even northern slope and a less steep and more deeply canyon-incised and irregular southern side. The crest is somewhat rounded with the highest point, Harquahala Mountain, 5,681 feet in elevation, near the center of the range near the boundary between Yuma and Maricopa Counties. The Little Harquahala Mountains are more subdued and consist of a broken collection of roughly northwest-aligned irregular

peaks and hills at the junction of the Granite Wash Mountains to the north and the Harquahala Mountains to the east. The Little Harquahala Mountains are separated from the other two ranges by Granite Wash Pass and Harrisburg Valley respectively. Extensive pediments extend outward from both the Harquahala and Little Harquahala Mountains.

The geology of the two ranges is very complex and as yet not well defined. Except for local areas, the presently available geologic maps result from reconnaissance mapping which may be modified considerably by more detail studies. Lee (1908) noted that the rocks near Harrisburg, between the two ranges, consisted "of a crystalline complex underlying and to some extent including masses of quartzite, argillite, and metamorphic limestone. A few miles south of Harrisburg, where these sediments were examined most closely, the strata stand nearly vertical." However, he evidently considered the formations as Precambrian. Bancroft (1911) noted that sedimentary strata made up a large portion of the Little Harquahala Mountains. These included quartzite, limestone, shale, and dolomite on top of a basal granite. He apparently considered the metamorphosed sediments as Precambrian and the granite as possibly Mesozoic. Similarly, in his brief examination of mines at the western end of the Harquahala Mountains, he noted basal gneiss and granitic rocks overlain by schists, quartzites, limestone, and intercalated argillites and schists which he considered as undifferentiated Precambrian on his reconnaissance map. Ross (1923), however, distinguished three different series of metamorphic rocks of which he believed the granitic gneiss and overlying calcareous quartz-mica schists and quartzite as Precambrian while the limestone and other metamorphosed sedimentary beds could be Paleozoic. He followed Bancroft's classification of the formations in the Little Harquahala Mountains. Darton (1925) found Carboniferous fossils in the limestone in both ranges and thus proved the presence of metamorphosed Paleozoic rocks mixed in with largely crystalline rocks of probable Precambrian age. His reconnaissance mapping of the ranges was shown on the 1924 Geologic Map of Arizona. Wilson further defined the geology of the ranges in his reconnaissance mapping for the Geologic Map of Yuma County (1960), as also shown on the 1969 Geologic Map of Arizona. He noted a large area of Mesozoic schist in the central part of the Little Harquahala Mountains with Mesozoic sediments to the west and a northeast-striking, folded and tilted band of Paleozoic sediments and intrusive Mesozoic granite to the southeast. However, as more recent investigators have found, the formations have been complexly folded, faulted, and intruded. The granitic rocks of the Granite Wash area have been radiometrically dated as Laramide and the other intrusives may also be of that age. In the Harquahala Mountains, Wilson showed complex thrust-faulting of undifferentiated Paleozoic-Mesozoic metamorphosed sediments and Precambrian schist and gneiss. Recent detail geologic investigation and mapping by Varga (1976) in the western end of the range

added additional information on the geologic formations and structure. Varga presents a very complicated structural picture of folding, faulting, and intrusion. He concluded that the granite intrusion postdated the formation of the gneiss, that the granitic intrusion occurred in a sill-like body along the Precambrian-Paleozoic boundary, and that this interface also was the plane along which gravity gliding, rather than thrusting, occurred prior to the granitic intrusion. Lack of radiometric dating of the intrusive makes uncertain a definite time sequence. Varga favors a mid-Tertiary deformation period. He found strong right-lateral faulting and high-and low-angle normal and reverse faults which complicated the geologic setting and made formational correlations difficult. A clear determination of the geology and structural events in this district will await more detail local and regional investigations.

The mineralization in the Harquahala district is varied and complex. Gold, silver, copper, lead, and zinc occur in pockety deposits, large and small, usually associated with iron oxides and gypsum where oxidized, and with auriferous pyrite in depth. Often the deposits occur in brecciated, lenticular quartz and jasper veins along shear zones and faults. The host rocks may be any of the Precambrian, Paleozoic, or Mesozoic rocks. Closely associated are diabase and aplite or quartz dikes and the source of the mineralization is believed to be the granitic intrusive. Spotty tungsten mineralization is associated with some discontinuous quartz veins and lenses in gneiss and limestone in scattered localities. Seams and irregular replacement bodies of mixed manganese and iron oxides occur locally in the metamorphosed sediments. The most prominent ore deposits, at the Bonanaza (Harquahala) and Gold Eagle mines, occur in strongly deformed and faulted metamorphosed Paleozoic sediments intruded by an elongated body of quartz monzonite. The rich, high-grade, but pockety shoots of gold ore in the oxidized zone give way to auriferous pyrite with some base metal sulfides in fracture zones in depth. The weathering and erosion of these deposits created gold placers in the gulches of the Little Harquahala Mountains close to the deposits. Titaniferous magnetite sands have been explored on the western peneplain of the Little Harquahala Mountains (T.4 N., R. 14 W.) but have not been exploited (Harrer, 1964), and marble and quartzite have been quarried intermittently for many years from the Paleozoic metamorphosed beds in the Harquahala Mountains.

Both ranges in the Harquahala district have been prospected since at least the 1880s, producing numerous small workings and a few moderate- to large-scale mines. The Bonanza or Harquahala and the Golden Eagle mines in the Little Harquahala Mountains, discovered in November, 1883, have accounted for some 94 percent of the total tonnage output of the district. The Bonanza Mining Company rapidly developed and mined the spectacular rich gold ore found near the surface and reportedly produced some $1.6 million in bullion between 1891 and early 1893 when the property was sold to a British

syndicate for $1.25 million. However, the new company, the Harqua Hala Gold Mining Company, only recouped about one-tenth of the purchase price as the ore values were mined out by 1895 and subsequent lessees and operators failed to find any substantial additional amounts of economic mine ore. Since that time the metal production from those properties has resulted mainly from the reworking of the stope fill, dump, and tailings of the earlier operations. Only a few of the other scattered mining operations intermittently produced over one hundred tons of ore containing precious and base metals. The tungsten and manganese production was related to government stockpile buying in the 1950s.

The estimated and recorded production of base and precious metal ore from the lode mines of the Harquahala district through 1974 would be some 160,000 tons containing about 129,915 ounces of gold, 89,401 ounces of silver, 60 tons of lead, and 45 tons of copper. Placer production is estimated at 1,148 ounces of gold with some 100 ounces of silver, mostly prior to 1900. The total value of base and precious metal production would be about $2,846,000. About 1,100 short ton units of tungsten oxide and a few lots of sorted 20% manganese oxide were produced during the time of premium prices in the 1950s. The total production of marble, mostly crushed, is not recorded but would be substantial.

Superficially at least, the Harquahala district appears to be well mineralized but except locally, the geology and mineralization have not been studied in detail. The district lies within a wide, northwest-southeast favorable zone of copper-gold mineralization with strong northwest-striking faulting, and probable Laramide to mid-Tertiary granitic intrusions into the Paleozoic and Mesozoic formations. Possible hidden ore bodies could occur. The district should receive detail examination for economic mineral deposits.

Kofa Mining District

The Kofa mining district lies in the southern part of the Kofa Mountains of central Yuma County (Figure 4). The name was derived from the contraction of "King of Arizona," the name of the most prominent and famous gold mine in the district. The mountains were earlier, and locally still are, called the S. H. Mountains, the initials reportedly being derived from various names such as Short Horn (Blake, 1893), Stone House (Darton, 1925) and another more vulgar name attributed to early soldiers or prospectors to whom the small peaks behind the larger spires resembled outhouses (Barnes, 1935). All government maps now use Kofa as the official name of the range.

The southern Kofa Mountains consist of a deeply and irregularly grooved, slightly sloping, mesa-like block with small flat-topped mesas, jagged spires, and other odd erosional forms. The western and southern edges present sharp, steep slopes while to the east, the topography is more subdued but still rugged. Numerous canyons and washes radiate out of the mountains on long,

gently-sloping alluvial plains. Peaks and buttes rise to over three thousand feet in elevation in the range. A narrow, poorly-defined gap in the rocks separates the Kofa Mountains from the Tank Mountains to the south.

The earliest geologic description of the range was given by Jones (1916) who noted the thick layers of what he considered Tertiary and Quaternary rhyolite and andesite volcanic flows, accompanied by tuffs, breccias, coarse sandstone, and basalt, apparently resting on an eroded surface of Precambrian metamorphosed sediments exposed in foothills along the southern edge of the range. The volcanics and sediments were intruded by pegmatite and monzonite porphyry dikes. Ross (1923) and Darton (1925) did not make a reconnaissance of the range but cited Jones' description. The 1924 Geologic Map of Arizona shows Tertiary-Cretaceous volcanics resting on Precambrian schist with Cretaceous and Precambrian granite intrusives. Wilson (1933) made a more detail study of the geology of the range. He noted an irregular belt of slightly metamorphosed, tilted, faulted, and fractured Mesozoic sandstone, shale, conglomerate and limestone along the southwest margin of the range beneath the thick volcanic capping. At the north end of the belt, he mapped a small area of schist that might be Precambrian to Mesozoic. He noted also Mesozoic or Tertiary dikes of diorite, pegmatite and monzonite porphyry which intruded the schist and sediments and Mesozoic granitic intrusive stocks at the extreme south end of the range. His later reconnaissance mapping for the Geologic Map of Yuma County (1960) included the schist with the Mesozoic sediments but did not modify his previous mapping to any major extent. The 1969 Geologic Map of Arizona is based on the county geologic map.

The mineralization in the Kofa district consists mainly of fine-grained gold and silver in quartz and brecciated wall rock with some local and minor copper and lead mineralization, and scheelite, in irregular fissure veins in the Mesozoic sediments. Considerable manganese oxides and minor fluorite also occur as gangue minerals. Some erratic and irregular manganese oxides have been prospected and mined in fracture zones in andesitic volcanics. Local, small, gold placers occur in the washes near the major gold mines.

The King of Arizona mine, the main producer of the district, was discovered in 1896 and was known as the Gleason before renamed, developed, and mined by the King of Arizona Mining and Milling Company. Blake (1898) gave a brief description of the early operations, noting the high grade values, up to some 40 ounces of gold per ton, in the upper workings. The mine continued operations to the middle of 1910 when economic ore played out in depth. Jones (1916) reported that the production of gold-silver bullion from the mine netted some $3.5 million dollars. The North Star Mine, a short distance to the north of the King of Arizona, was discovered in 1906 and worked by the Golden Star Mining Company from 1907 to mid-1911 when the profitable ore was exhausted. The recorded production of gold and silver

from this mine was valued at about $1.1 million. Numerous other deposits of gold and silver with minor base metal sulfides have been worked through the years but produced, at best, only a few hundred tons of ore. Several ventures to reopen and work the King of Arizona mine have been unsuccessful. The tungsten and manganese operations resulted from the Government buying and premium price programs of the 1950s.

The total estimated and recorded production of precious and base metals from the Kofa district, through 1974, would be some 779,000 tons of ore containing about 226,654 ounces of gold, 103,257 ounces of silver, 3.5 tons of lead and one ton of copper. Placer operations produced about 2,500 ounces of gold with 500 ounces of silver. The total value of the base and precious metals produced would be some $4.8 million. Production of manganese oxides and tungsten amounted to some 230 long tons of picked low-grade ore and 94 short ton units of WO_3 respectively.

The precious metal production from the Kofa district has come from a relatively small exposure of Mesozoic sediments and the latter probably extends underneath much, if not all, of the volcanic capping. It is interesting to speculate whether other bonanza deposits may lie hidden by the capping although the thickness of the latter may make discovery difficult or impossible. Likewise, one can speculate whether the present high price of gold would make renewed activity on the gold-bearing veins economically feasible. Unfortunately the district lies within the Kofa National Wildlife Refuge and is being considered for withdrawal as a National Wilderness Area which limits or would prohibit mining activities.

La Cholla Mining District

The La Cholla mining district covers an arbitrarily defined area along the eastern slope of the central Dome Rock Mountains, extending from about 4 to 14 miles southwest from the old settlement of Quartzsite on Interstate Highway 10 (Figure 10). It is named after La Cholla Mountain and Wash, two prominent physiographic features of the area. Cholla is a Spanish term for a large varied type of desert cactus having cylindrical, spiny points growing from low stout trunks and a bad reputation for its barbed spines. The southern part of the district lies within a military withdrawal area, the Yuma Test Station.

In the La Cholla district, the mountain slopes are rough and ragged, carved by numerous stream valleys and canyons which debouch onto a low, sloping pediment along the edge of La Posa Plain. The underlying rock of the pediment was incised along channels and was subsequently covered by a variable thickness of gravel and finer alluvium which extends back into the irregular mountain front along the valleys and canyons. In depth the gravel and alluvium was cemented by lime carbonate and silica.

The Dome Rock Mountains in this district have not been mapped or

studied geologically in any detail. Bancroft (1911) visited some of the mines and noted Precambrian arenaceous shales metamorphosed into quartz-mica schists. Ross (1923) described the mountains as composed chiefly of Precambrian gneiss and schist but also containing granite of probable Mesozoic age. Darton (1925) also noted the schists containing many scattered crystals of magnetite. The 1924 Geologic Map of Arizona, based largely on Darton's reconnaissance, shows Precambrian schist and gneiss with some granite of indefinite age in the district. Wilson's reconnaissance mapping for the Geologic Map of Yuma County (1960), and shown on the 1969 Geologic Map of Arizona, more closely defined the geology of the district. He showed large fault blocks of partly metamorphosed, Mesozoic arenaceous, argillaceous, and limy sediments and Mesozoic schist and gneiss, intruded and possibly underlain by Mesozoic granite. However, until the formations are dated radiometrically or carefully correlated with similar well-dated rocks in nearby areas, the ages and sequence of formation is only tentative. Wilson mapped several strong fault zones in the Mesozoic sediments and metamorphics. Strong shearing and fracturing, generally aligned with a northwest strike, are common structural features.

The principal mineral product of the district has been placer gold, found along the eastern pediment of the mountains, and occurring in an area of four or five miles in length and having an irregular width. The main placer area was within a broad, irregular re-entrant to the south of La Cholla Mountain. Irregularly-eroded, tilted slates and schist form the bedrock of the pediment above which are unsorted subangular to slightly rounded gravels of fine and coarse fragments of schist, slate, and quartzite, more or less firmly cemented with lime carbonate or silica. Most of the gold was found at or near bedrock and occurred in fine to moderately large, angular, or crystallized grains, indicating relatively short transport from its source. Such a source was probably the numerous small gold-bearing quartz veins and stringers in the Mesozoic schist. Many of these veins were prospected but few produced more than token amounts of economic ore. Also in the Mesozoic schist and sediments in the mountains, irregular copper mineralization in the form of chalcocite, bornite, and tetrahedrite with traces of molybdenum, tellurium, and bismuth have been prospected and mined. Most of this mineralization appears to have a close association with major fault or shear zones. One occurrence of mercury ore also was found and mined in a shear zone in Mesozoic sediments. Dumortierite, kyanite, andalusite, and sillimanite have been found locally in the schist outcrop south of Granite Mountain near Quartzsite.

The La Cholla placer deposits probably were discovered in the 1860s, at about the same time as those in the La Paz, Middle Camp, and Oro Fino districts. However, their cemented character and the lack of water discouraged interest in the exploitation of the La Cholla placers until the early 1900s

vhen several attempts were tried with variable success at large-scale mining ınd dry and wet recovery. The La Posa Development Company carried out arge-scale operations at the Arizona Drift mine, from the 1930s through 941, by sinking shafts and running drifts, extracting the gold ore from old tream channels. The copper and gold mines of the district have been worked ntermittently with indifferent success since the early 1900s and the Cinnabar nine operated for a short period in the early 1900s.

The total estimated and recorded gold placer production from the La Cholla listrict through 1974 would be about 9,464 ounces of gold with some 900 ounces of silver. Mine production of precious and base metals for the same period would amount to some 294 tons of ore containing about 332 ounces of gold, 2,917 ounces of silver, and 20.3 tons of copper. The total value of all base and precious metal production would be about $252,734. From 1908 hrough 1914, some 116 to 156 flasks of mercury were produced.

The La Cholla district has not been studied in detail as to the geology and nineralization. The possibilities for economic ore deposits can not be ruled out without a careful examination but it would appear, on the basis of current knowledge, the district has a low priority rating for large-scale profitable nineral deposits. The southern part of the district lies within the military Yuma Test Station and thus is off-limits for mineral exploration.

Laguna (Las Flores) Mining District

The Laguna or Las Flores mining district covers the Laguna Mountains, sometimes called the San Pedro Mountains, in southwestern Yuma County (Figure 8). The mountains are bordered on the west by the Colorado River, on the south by the Gila River, and on the east by Castle Dome Wash. Low hills and ridges extend northward along the Colorado River to major washes draining into the Colorado River. The Spanish name "Laguna" (meaning "lake") came from a lake or swamp that was formed in the past along the Colorado River near Laguna Dam. Las Flores (meaning "the flowers" in Spanish) was the name given by early Mexican miners to the mining area and settlement on the eastern flank of the main mass of the range.

The Laguna Mountains are a relatively low, rugged, irregularly dissected range bordered by elevated pediments. Elevations range up to some 1,080 feet. Ross (1923) described the mountains as consisting of Precambrian metamorphic rock with some more recent lavas. Darton (1925) did not mention this range but the 1924 Geologic Map of Arizona showed Precambrian metamorphic schist with some Tertiary-Cretaceous volcanics. Wilson (1933) examined the mountains in more detail, noting schist and gneiss of Precambrian to Mesozoic age, cut by pegmatite dikes and quartz veins approximately along the major laminations, and Tertiary, well-stratified sandstone, sills, and gypsiferous clays around the margin of the mountains, at places in fault contact with the older rocks. He found these sediments to be faulted and tilted

and to form the base of the pediment around the mountains. Volcanic rocks were seen on the western side of the range resting on the older metamorphics and possibly the Tertiary sediments. Quaternary, poorly stratified, weakly-consolidated gravels with minor sand, clay, and silt were found to occur on the beveled Tertiary beds and metamorphics. Wilson believed they were deposited by the Colorado and Gila Rivers when the rivers were at higher elevations than at present. Wilson's mapping for the 1960 Geologic Map of Yuma County modified his earlier mapping by showing the metamorphic rocks as Mesozoic, some of the sediments as Laramide, and the volcanics as Cretaceous. This later mapping also is shown on the 1969 Geologic Map of Arizona. Olmsted (1973) made geologic studies of the Yuma area as part of a geohydrologic investigation. He noted that all the basement gneiss and schist appear to predate the Late Cretaceous to early Tertiary Laramide orogeny, suggesting that the original rock may have been Precambrian but metamorphosed in Late Cretaceous. The dikes and veins may be early Tertiary. Some 5,000 feet of nonmarine Tertiary sedimentary rocks with locally interbedded volcanics overlie the metamorphic complex, and from radiometric dating are of middle Tertiary age.

Gold placer deposits and the gold-quartz veins are the only economic mineral occurrences that have been found in the Laguna district. In the McPhaul Bridge area, gold placer ground was found in gravels covering the bedrock of tilted, beveled, Tertiary sediments, mostly in the inter-arroyo benches. In the Las Flores area, placer gold was found in the gulches below the gold mines in the metamorphic rocks. At the eastern end of the Laguna Dam, gold-bearing quartz veins in the schist and gneiss produced coarse-gold placer deposits that extended into the Colorado River, some gold being recovered from potholes up to 100 feet above the present river. Most of the gold mining was done in the Las Flores area where gold-bearing quartz veins are along zones of shearing and brecciation in metamorphic schist and are usually short, irregular, and lenticular. The quartz is shattered with iron oxides, carbonates, sericite, manganese oxides and gypsum filling the fractures and voids. The gold occurs in ragged fragments in the quartz and iron oxides. Weak, oxidized copper minerals suggested to Wilson that sulfides may have been present. The wall rocks show strong sericitization and minor silicification and carbonatization.

The placer and vein deposits probably were found and prospected prior to 1865 and a small stamp mill was reported in operation at Las Flores in 1870. Dredging on the Colorado River in the Laguna Dam location was carried out around 1884 or 1885 but ended in the destruction of the dredge in a flood. When the Laguna Dam was constructed in 1907, workers found gold nuggets in the potholes, and a small gold-quartz vein in the bedrock along the bank of the river. Some small-scale intermittent mining and placer operations have continued up to recent times but the most productive period was prior to 1900.

The total estimated and recorded gold and silver production through 1974 from placer deposits probably has amounted to some 5,700 ounces of gold with about 1,100 ounces of silver. Total estimated and recorded lode production through 1974 would amount to some 556 tons of ore containing about 324 ounces of gold, 661 ounces of silver, and 98 pounds of copper. The total value of the mineral production would be about $187,670.

Some placer gold may continue to be found, but in general, the lode deposits appear weak and spotty. A large part of the district is covered by the Yuma Proving Ground and thus is not open to mining activities.

La Paz (Weaver) Mining District

The La Paz or Weaver mining district, as arbitrarily outlined in this bulletin, includes most of the Dome Rock Mountains of west central Yuma County, excluding the La Cholla and Oro Fino-Middle Camp districts in the eastern central and southeastern sections of the range (Figure 10). The name "La Paz," meaning "peace" in Spanish, came from the early placer mining settlement of La Paz near the mouth of the La Paz Wash close to the former course of the Colorado River. This settlement had as many as several thousand inhabitants during the local gold rush of the 1860s and was the county seat of Yuma County until 1870. At present only relic adobe ruins mark its location. The settlement may have been named after the settlement of La Paz at the south end of Lower California or from the reported date of the discovery of the gold placers by Pauline Weaver, being on January 12, 1862, the day of the Feast of our Lady of Peace. Weaver's name often has been used for the district in the past.

The Dome Rock Mountains are a highly irregular, north-trending range some ten miles wide in the southern part and extending northward into several narrow and broken, rugged ridges, declining in height, and separated by alluvial washes and plains. The mountain areas rise sharply from the bordering, wide and relatively flat, dissected rock benches and pediments which in turn are coated by variable thicknesses of outwashed, alluvial gravel, sand, and clay, some of marine origin, and the rest from the washes, fanglomerates, and Colorado River deposition.

The geology of the Dome Rock Mountains has not been studied in detail. Bancroft (1911) briefly described the geology at the mining locations he visited in his reconnaissance. He noted and mapped the ranges consisting of a Precambrian granite-gneiss-schist complex with metamorphosed sediments and sedimentary schists. Jones (1916) studied the formations in the northern half of the range and noted that quartz-epidote, porphyritic schist made up a large part of the mountains but that there were large areas of later granite, probably Mesozoic. Ross (1923) considered the mountains as composed chiefly of Precambrian gneiss and schist but also containing probable Mesozoic granite and several intrusive, acidic rocks of probable Tertiary age. Darton (1925) summed up the observations of Bancroft and Jones, noting the

schistose porphyritic rock, a metamorphosed quartz monzonite, a quartz diorite porphyry, and amphibolite and biotite schist derived from diabase and diorite. He noted that the granitic rock intruded the schists. At the north end of the range, he found schists, intercalated with thin lensing marble beds, that are cut by granite gneiss, amphibolite schist, quartz-epidote schist, and granite. Some schists are metamorphosed sediments with dikes of quartz porphyry or aplite. Later dikes are pegmatites, diabase, and minette. Darton believed that some of the marble and quartzite in the northern area might be Paleozoic or younger. The 1924 Geologic Map of Arizona shows local areas containing Carboniferous formations but most of the range is classified as Precambrian schist and does not show the probable Mesozoic and later intrusives. Wilson in the reconnaissance mapping for the Geologic Map of Yuma County, 1960, used also for the 1969 Geologic Map of Arizona, places the schist, gneiss, and metamorphosed sediments as Mesozoic and the intrusives as mainly Mesozoic with some small areas of Laramide granitic rocks. The lack of radiometric dating of the formations and the evidence from the more recent Miller (1970) study and mapping of similar formations in the Plomosa Mountains to the east, suggest that more detail study is needed to determine the ages and relationship of the formations in the La Paz district. The Cenozoic geologic history of the Colorado River area of this district has been well described in several government reports and those of individual investigators, but outside of the location of the placer gold deposits, the Cenozoic sediments have no importance relative to the mineral potential of the district.

Strong northwest, east-west, and some northeast-trending faults have been noted and the strong sheeting, development of schistosity, and metamorphism suggest strong deformation throughout the district. These features may be related to late Mesozoic or Cenozoic structural or intrusive events as numerous pegmatite and basic dikes and quartz lenses, veins and stringers may occur along or may cut across the structural grain of the pre-Cenozoic formations.

The gold placer deposits have been the most important economic mineral resource of the district. The gold was derived from numerous, mostly small and narrow, lensing quartz veins and stringers in the Mesozoic intrusive and metamorphic rocks of the range. Strong erosion liberated the gold and it was washed down and concentrated along gulches and washes as well as on benches and on the eroded pediment between drainage lines over a large area. The upper reaches of La Paz, Goodman, and Gonzales Washes and their tributaries, and Ferrar Gulch, contained the richest placer deposits. These deposits consisted of sand, gravel, and clay with angular rock fragments and boulders. Near the surface, the alluvium is unsorted and unconsolidated but 15 to 20 feet below, the material became more consolidated. When deeper, the alluvium was firmly cemented by calcium carbonate. The best values and nuggets were found on or close to igneous or metamorphic bedrock. The gold

articles were rough and angular, showing limited transport. Considerable ıagnetite is associated with the gold in the placers. To the west the gold-earing material has been buried progressively deeper under more recent out-/ash gravels and boulders and the Colorado River sediments.

Some gold-bearing, quartz veins have been prospected and mined but usu-lly the limited size at the deposits and the spotty characteristic of the gold estricted economic operations. Relict sulfides and their oxidation products are ıften associated with the gold in the veins. Also scattered throughout the listrict, vein-like deposits of oxidized copper mineralization with relic sul-ides have been found and mined on a small scale. These deposits usually ›ccur in quartz-fissure zones along faults or in skarn zones developed in thin ›eds or lenses of metamorphosed quartzite and limestone in schist, and some-imes in the granitic intrusive. Some lead mineralization also is found in some /ein deposits. Spotty tungsten mineralization occurs locally in the metamorphosed bands or lenses of limestone in the schist, and manganese ›xides have been mined from shallow deposits in fracture zones and replace-ment bodies in the limestone. Local zones of kyanite with quartz and rutile may be found in pegmatitic bands in the granitic intrusive.

Indians guided the trapper Pauline Weaver and his party to the gold placer deposits in January, 1862. News of the discovery spread rapidly, leading to an influx of miners and the establishment of the settlement of La Paz. Intense dry placer operations continued for about two years but the rapid depletion of the richer deposits and the discovery of other rich placer areas elsewhere led to a decline in placer operations in the La Paz area and the gradual desertion of the settlement. The county seat was moved from La Paz to Yuma in 1870, and from 1873 to 1876, much of the placer ground was included in the new Colorado River Indian Reservation, which restricted mining operations to a small portion of the productive area. In 1910, the south boundary of the Reservation was moved northward, opening up the old placer ground, and plans were made for hydraulic mining on a large scale, bringing water from wells along the Colorado River. Before operations were started, however, much of the area again was included in the reservation and the plan of operation was abandoned. In more recent times other large-scale placer opera-tions have been considered but not carried out. Only minor, small-scale, and intermittent placering has taken place in the district in recent years. The discovery of the gold placers led to prospecting and small-scale mining of the gold-bearing, quartz veins and stringers. Few mining operations have been productive but intermittent work through the years on scattered occurrences have produced ore containing gold, silver, copper and lead. The tungsten and manganese ores were produced in the 1950s when premium prices were being paid by the Government for the products.

The total estimated and recorded production of placer gold from the La Paz district from 1862 through 1974 would be around 100,000 ounces of gold

with some 25,000 ounces of alloyed silver. Less than 2% of this amount h: been recovered since 1900. The total mine production of precious and bas metals for the same period would amount to some 11,200 tons of ore contair ing about 2,400 ounces of gold, 1,000 ounces of silver, 8 tons of copper and tons of lead. The total value of the base and precious metal productior through 1974, would be about $2.1 million. About 5,000 tons of 0.4% WO ore and some 400 long tons of 41–51% Mn ore have been produced from th district. The total value of the mineral production from the district would b about $2.2 million.

The La Paz district has not been sufficiently studied in detail, geologicall or mineralogically, to rule out the possibility of hidden economic minera deposits. The numerous prospects, a strong structural deformation, and th probable Laramide or Tertiary granitic intrusions all suggest favorable condi tions in the district. Unfortunately, however, except for the central part of th mountains, the district is covered by the Colorado Indian Reservation to th north and the Yuma Test Station to the south, limiting the opportunities fo mining activities.

La Posa (Wellton) Mining District

The La Posa or Wellton mining district covers an arbitrary area including the Wellton Hills and the Copper Mountains in south-central Yuma County (Figure 11). It might be extended southeastward to include the Cabeza Prieta Mountains where one small copper prospect occurs at the north end of that range. "La Posa" probably is a corruption of the Spanish word "pozo" meaning well, and the name "Wellton" came from the small settlement on the railroad where several wells were sunk for water. The Copper Mountains derived their name from the widespread copper staining found in the range. The Baker Peaks at the north end of the Copper Mountains were named after a stage driver. The district is presently included in the Luke-Williams Air Force Range and thus withdrawn from public access.

The Wellton Hills are an isolated group of irregular, scattered, steep-walled, and rugged hills and buttes covering a six square-mile area. They are surrounded and divided by flat, alluvium-covered pediments. Elevations range up to about 1,119 feet or some 500 feet above the desert plain. The Copper Mountains, to the east and southeast of the Wellton Hills, are a rugged, lenticular, sierra-type range, strongly dissected, three to four miles wide in the center, and having elevations up to 2,808 feet. They extend from the Baker Peaks at the north end, a cluster of angular, pyramid-shaped buttes, to a low divide to the south, which separates them from the Cabeza Prieta Mountains. Well-defined, alluvial-covered pediments occur on both flanks and the mountain mass has been deeply eroded into numerous buttes and ridges, often separated by alluvial-filled washes and canyons.

The first description of the geology of this district was by Bryan (1925) who noted that the Wellton Hills appeared to be remnants of a complexly faulted, elevated area of crystalline rocks including granite, granite gneiss and schist. He also mentioned Tertiary lavas not subsequently noted in the area. His description of Baker Peaks included sheeted granitoid rocks of the crystalline complex and arkosic sandstone and conglomerate to the south near Baker Tanks. The Copper Mountains he found to be composed of granite and granitoid rocks of a crystalline complex. He considered the complex as pre-Tertiary and probably Precambrian. Darton (1925) makes brief reference to the Baker Peaks, noting Bryan's work. The 1924 Geologic Map of Arizona shows the Wellton Hills and Baker Peaks as composed mainly of Precambrian schist with some Tertiary sediments to the south of Baker Peaks. The Copper Mountains are shown as mostly Precambrian granite. Wilson (1933), in his more detailed sudy and mapping of southern Yuma County, shows and describes the Wellton Hills as composed of gneiss and minor amounts of schist, cut by scattered dikes of granite porphyry and pegmatite. He noted pronounced banding, jointing, and probable strong faulting. He found the Baker Peaks to be made up of well-stratified arkosic sandstone and conglomerates of probable Tertiary age that were derived from a granitic source. The beds were considerably affected by faulting. He found the northern part of Copper Mountains to include Precambrian to Mesozoic gneiss and pegmatites, and indurated Tertiary conglomerate. Large irregular bodies of aplite and pegmatite intrude the gneiss and many stringers and veins of copper-stained quartz were found. The southern half of the range was granite. In his reconnaissance mapping for the Geologic Map of Yuma County (1960), Wilson classified the gneiss and granite of the district as Mesozoic and the sedimentary beds as Laramide. Radiometric dating is required to help determine the ages of the formation and their relationship. The structural pattern also is not clear at this time but it appears that strong northwest-striking faulting played a large role in the deformation and elevation of the Wellton Hills and the Copper Mountains.

Wilson (1933) noted the many gold bearing quartz veins occurring within northwest to west-striking breccia fault zones in the Wellton Hills. The quartz is coarsely crystalline, weakly banded, and locally vuggy with visible specks of free gold and stained by iron oxides and oxidized copper mineralization, probably from primary sulfides. Besides quartz, ferruginous calcite occurs as a gangue mineral. The wall rocks are intensely sericitized and less silicified. Wulfenite is found locally. Similar mineralization also occurs in the Copper Mountains along with gypsum and jarosite. Chalcocite, with irregular bunches of chrysocolla and malachite, has been mined. The McMillan prospect at the north end of the Cabeza Prieta Mountains (T12S, R16W, NE¼ Sec. 16 protracted) has similar mineralization associated with dikes of

aplite and pegmatite. A small amount of placer gold has been recovered from the district, in the alluvium close to the gold-bearing quartz veins in the Wellton Hills.

Prospectors undoubtedly combed the Wellton Hills and the Copper Mountains in the late 1800s and numerous claims were staked on promising outcrops that showed free gold. There was some small, intermittent production from some of the properties through 1941, and in particular prior to 1900 and in the 1930s. The workings were mostly shallow and the ore pockety.

The total estimated and recorded production from the lode mines in the La Posa district through 1974 would be some 415 tons of ore containing 153 ounces of gold, 300 ounces of silver, and 8 tons of copper. About 28 ounces of gold with 8 ounces of silver were produced from placers in 1910 and 1914. The total value of the mineral production would be some $8,000.

The La Posa district has not been closely examined for possible indications of economic mineral deposits but the district appears to have interesting gological and mineralogical features that should be studied. However, the restrictions due to the presence of the military reservation prevents such a study at the present time.

Middle Camp and Oro Fino Mining Districts

The Middle Camp and Oro Fino mining districts cover two relatively small, adjoining areas along La Cholla Wash and its tributaries in the east-central Dome Rock Mountains of west-central Yuma County (Figure 10). In the past they have been considered parts of the Plomosa district. The name "Middle Camp" came from Middle Camp Mountain, a prominent peak located in the center of the placer mining area in the Dome Rock Mountains. "Oro Fino," a Spanish term, referred to the general fine-grained character of the placer gold found in that area.

La Cholla Wash is a broad, gently eastward-sloping, alluvial-filled, eroded basin with numerous tributaries cutting back into the mountains to the north and south. The head of the wash nearly joins the head of Gonzales Wash, on the west side of the range, in a narrow, low pass through which Interstate Highway 10 passes.

The earliest description of the gold placers in these districts was written by John A. Church in a private report cited by Heikes and Yale (1913). Bancroft (1911) made brief note of the placer deposits in the Middle Camp and Oro Fino districts but visited the Mariquita prospect in the Precambrian schist intruded by younger granites or quartz monzonite. Jones (1916) made notes only on the Oro Fino placers in the district. Wilson (1960, 1961) summarized the geologic information on the two placer areas as also shown on the 1969 Geologic Map of Arizona. The bedrock of the area, according to Wilson, consists of Mesozoic granite, schist, shale, and slate and a small Laramide quartz monzonite intrusive on the north side of the wash. He found mostly

Mesozoic metamorphic rocks with some Mesozoic granite as the basal rocks and some small and local intrusive dacitic plugs on the southern side of the wash. Numerous gold-earing quartz veins and stringers occur in the intrusives and metamorphic rocks. Most of the veins also contain oxidized products and remnant sulfides of copper, lead, and zinc. Nodules of galena and some scheelite occur locally in the placer deposits. Alunite occurs in Sugarloaf Butte or Peak. It is natroalunite and is found in a complex network of irregular, branching veins cutting schistose and porphyritic dacite and adjoining schist (Heineman, 1935; Thoenen, 1941; ABM 180, p. 302).

The Middle Camp gold placers consisted of rich seams of gold-bearing granitic gravel at or near bedrock, and nuggets in crevices in the bedrock near the mountains. Lesser values were found in the thicker gravels and cemented gravels farther out in the valley area. In the Oro Fino area, to the east, the gold was finer grained, occurring in unconsolidated rock debris down to some twelve feet below the surface and in an underlying cemented gravel up to at least eighteen feet thick. The rock debris was mostly slaty and the bedrock was tilted and beveled shale and slate.

The placer deposits and numerous small prospects and mines were discovered at about the same time as those of the La Paz district to the west. Worked primarily prior to 1900 by numerous small dry washing operations, they have since been operated intermittently on a small scale up to the present time. Several attempts were made at large-scale placer operations, bringing water from wells near Quartzsite. None of those operations were successful.

The total estimated and recorded production of placer gold from the Middle Camp and Oro Fino districts through 1974 would amount to some 12,000 ounces of gold with 1,500 ounces of silver, mostly prior to 1900. Mine production, estimated and reported, for the same period, would be some 900 tons of ore containing 320 ounces of gold, 250 pounds of silver, 61 tons of lead, 9 tons of zinc, and about 500 pounds of copper. The total value of the metal products from the districts would be about $239,000.

The best values in the placer deposits in the Middle Camp and Oro Fino districts probably have been depleted although some values may remain in the deeper consolidated alluvium. The scattered occurrences of base metal sulfides and the presence of Laramide granitic intrusives suggests that careful geologic examination should be made in the districts for possible loci of hidden economic deposits.

Midway Mining District

The Midway mining district covers an arbitrary area on the south-central edge of the Buckskin Mountains of northern Yuma County (Figure 12), extending east and west from the site of the former railroad stop at Midway on the abandoned Arizona and Swansea Railroad. A supply of water for the trains was kept at this site, which was about midway between Bouse and

Swansea. The location also was used as a camp ground for prospectors in this area.

Rugged southwest-trending prongs of the Buckskin Mountains extend into the district with one such prong nearly joining the northeast extension of the Bouse Hills. A narrow divide at this point separates Butler Valley to the east from the Cactus Plains to the west. Irregular, small foothills occur along the rugged southern edge of the mountains, cropping out above an alluvial-covered, shallow, dissected rock pediment.

Lee (1908) briefly noted the Precambrian granitic gneiss and schist and metamorphic sediments in the Buckskin Mountains; Bancroft (1911) visited the district in his reconnaissance of the ore deposits, citing probable Precambrian gneiss and schist of granitic origin, intrusions of pegmatite, aplite and amphibolite, and some Tertiary conglomerate. Ross (1923) and Darton (1925) made only brief note of the Precambrian igneous and metamorphosed sediments of the area and the 1924 Geologic Map of Arizona shows only Precambrian schist in the district. Wilson's reconnaissance mapping for the Geologic Map of Yuma County (1960), used for the 1969 Geologic Map of Arizona, outlined the formations in greater detail, showing a large mass of Mesozoic sediments, partly metamorphosed, in the central part of the district, apparently lying unconformably above the Precambrian gneissic complex at the southwest end of an apparent, major, anticlinal fold. No detail geologic mapping is presently available for the district but various notes on the prospects and mines suggest that numerous dikes of pegmatite, aplite, and more basic types, and lenses of limestone and marble occur in the Precambrian complex. The Mesozoic sediments include limestone, shale, sandstone, and conglomerate. It is probable that considerable faulting is present as well as folding, fracturing, and jointing.

The mineralization in the district consists mainly of spotty oxidized copper mineralization, with relict sulfides, in sheer veins or replacement beds cutting Precambrian metamorphics or Mesozoic sediments. The gangue minerals are quartz with local barite and fluorite. Iron oxides are prominently associated with the deposits. Some varicolored marble lenses have been prospected for stone products.

The Midway district was prospected in the late 1800s and early 1900s but most of the work has been superficial. Some carefully handpicked copper ore has been shipped but the total production from the district through 1974 would only amount to some 250 tons of ore containing about 4 tons of copper, 45 ounces of gold, and 34 ounces of silver with a total value of some $4,000.

No promising mineral deposits have been found or developed in the Midway district, but the area needs to be studied geologically and mineralogically in greater detail in connection with the main mass of the Buckskin Mountains. The district lies within the apparent northwest-southeast favorable structural and well-mineralized zone of northern Yuma County.

Mohawk Mining District

The Mohawk mining district covers the Mohawk Mountains of southeastern Yuma County (Figure 13). The origin of the name "Mohawk" is not known but dates back to at least the 1860s when the Butterfield Stage had a station of that name at the north end of the range, at or near the present railroad station of Mohawk. The range was at one time called the Big Horn Mountains. Except for the part north of the railroad and Interstate Highway 8, the range lies within the Luke-Williams Air Force Range.

The Mohawk Mountains are a long, narrow, tapering range, extending southeastward from the Gila River for some twenty-nine miles between the broad, sandy Mohawk Valley to the west and San Cristobal Valley to the east. It is marked by a sharp, jagged and broken crest, up to over 2,000 feet in elevation, deep, rugged canyons, and steep, rough slopes. Narrow dissected pediments with detached remnant-like hills fringe the mountain flanks and wind-blown sand mantles the pediments.

The geology of the range was first described by Bryan (1925) as largely Precambrian to Mesozoic granite and similar coarse-grained crystalline rocks with massive jointing. The 1924 Geologic Map of Arizona showed Precambrian schist in the north-central portion with granite at the north and south ends of the range. Wilson (1933), with more detailed examination, noted the Precambrian to Mesozoic schist, gneiss, and granite intruded by dikes of granite porphyry, aplite, and pegmatite. He found that the north end was capped by steeply-dipping, Tertiary, unmetamorphosed conglomerate, sandstone, and shale. In his reconnaissance mapping for the Geologic Map of Yuma County, used also in the 1969 Geologic Map of Arizona, Wilson considered the schist, gneiss, and granitic intrusions as Mesozoic and the sediments at the north end as Laramide. He noted that considerable faulting, fissuring, and jointing had taken place.

Spotty mineralization of lead, silver, barite, copper, gold, and molybdenum have been prospected in the Mohawk district. Locally some rich lead-silver and some barite has been produced. The mineralization occurs in pensing fissure veins containing quartz, calcite, local barite and fluorite, iron oxides, breccia, and gouge, and the host rocks are the Mesozoic schist and granitic gneiss.

The mineralization in the district was prospected at least as early as the late 1800s but little work was done until the early 1900s. Mining has been sporadic and only a total of some 60 or more tons of ore containing about 21,346 ounces of silver, 11 tons of lead, 1 ton of copper, and 7 ounces of gold have been reported as produced through 1974. About 18 cars of picked barite ore were reported as shipped in 1929–1930. It is said that a small lime quarry was operated at the northern end of the range prior to 1911, using a small bed of marble within the gneiss.

The sparse and spotty mineralization in the Mohawk district is not en-

couraging in respect to possible hidden ore deposits and its present inclusion, to a large extent, within a military reservation precludes any mining activity.

Muggins Mining District

The Muggins mining district covers the Muggins Mountains in southwestern Yuma County (Figure 8). The name "Muggins" is said to have come from the name of an early-day prospector's burro. At the present time the district lies within the U.S. Defense Department's Yuma Test Station.

The Muggins Mountains are a roughly oval range with intricately and sharply dissected ridges, spires, and steep-walled canyons in the western and northeastern sections and more subdued but rugged and irregularly dissected central and southeastern sections. The range is surrounded by gently sloping plains with the Gila River bending around its southern margin.

Ross (1923) briefly noted that the rocks of the Muggins Mountains appeared to be Precambrian granitic gneiss with small amounts of capping Tertiary lavas. The 1924 Geologic Map of Arizona showed Precambrian gneiss and schist in the northwestern sector with Tertiary–Cretaceous volcanics in the southwest and northeastern parts. Wilson (1923) mapped and described the Precambrian to Mesozoic gneiss and schist; a small outcrop area of Mesozoic indurated arkoses, sandstones, shales, and impure limestones in the northeastern part of the range, capped by a considerable thickness of Tertiary andesitic lavas and a thick series of breccias, agglomerates, and tuffs; and mainly rhyolitic flows in the southwestern sector. Covering the central and southeastern parts of the range he noted thick gravels of Quaternary to Tertiary age which apparently covered a thick series of silts and clays of probable Tertiary age which outcrop around the margin of the mountains, particularly the southern edge. For the Geologic Map of Yuma County (1960), Wilson further defined the formations as Mesozoic gneiss, Laramide sediments, Cretaceous andesite flows, tuffs, and agglomerates, Cretaceous andesite and rhyolite flows, and Quaternary-Tertiary sediments. The 1969 Geologic Map of Arizona follows Wilson's reconnaissance mapping except the Quaternary–Tertiary sediments are classified as middle Tertiary. It has been noted that the Mesozoic gneiss and schist have been cut by numerous pegmatite dikes, and quartz veins and stringers; that the rhyolite lava flows have interbedded conglomerates and tuffs; and that the Tertiary silts and clays, probably of lacustrine origin, have interbedded, somewhat decomposed, volcanic tuffs and ash beds, opalized mudstone, and chalcedonic layers. Strong faulting is evident in the older rocks.

The main economic mineralization found in the past in the Muggins Mountains has been the gold placer deposits in two areas: along the southwestern margin and in the upper reaches of Vinagaroon Wash. In the former, in washes and canyons draining southward from Muggins Peak, Klothos Temple or Coronation Peak, and Long Mountain, gold-bearing gravels occur as ancient bars on terraces above and in the stream channels, where the bedrock

is conglomerates intercalated with the lavas. The conglomerate consists of gneiss and granite pebbles cemented in a sandy to clayey matrix. Wilson believed the gold to have been derived originally from gold-bearing quartz veins in the gneiss, schist, and granite. Erosion of the veins produced low-grade placers in the conglomerate which in turn was later eroded to form the payable gold-bearing bars. The placer deposits near the head of Vinagaroon Wash, in the west-central area of the mountains, were derived directly from the disintegration of the quartz veins in the Precambrian metamorphics. The quartz veins themselves, carrying sparse free gold and locally minor copper, along with some copper staining in the pegmatite dikes, have been prospected but with little economic success.

Wilson (1933) noted radioactive hot springs near the southeastern margin of the mountains (T.8S., R. 18W., Sec. 12). Later, U.S. Atomic Energy Commission investigators found several scattered occurrences of secondary uranium in the Tertiary sediments in the southeastern part of the mountains (AEC Preliminary Reconnaissance Reports; ABM Bull. 182, p. 256–257). These occurrences reportedly occurred mainly in association with Tertiary tuffaceous beds and lacustrine sediments. The relationship suggests the probable extraction of minute quantities of uranium from the decomposition of the rhyolitic tuffs and redisposition by reduction in a carbonaceous environment as might exist in a lacustrine sediment.

The Muggins Mountains were first prospected in the 1860s and the placer deposits produced considerable gold and silver prior to 1900. The total production of placer gold and silver through 1942, about the time mining activity in the district ceased due to the withdrawal for military purposes, was some 2,748 ounces of gold with about 500 ounces of contained silver. Scattered mining and prospecting of the lode deposits have produced some 410 tons of ore containing 251 ounces of gold, 116 ounces of silver, and 567 pounds of copper. The total value of the precious and base metals from the district would be some $69,139.

Small amounts of placer gold may still be extracted from the deposits but the possibilities of large economic lode deposits of precious or base metals are not favorable. The uranium occurrences need to be examined carefully for possible low-grade deposits under the gravel cover. Unfortunately the present military reservation covering the district prevents mining activity.

Neversweat (Palomas Mountains) Mining District

The Neversweat or Palomas Mountains mining district covers Neversweat Ridge and the Palomas Mountains of east-central Yuma County (Figure 2). The origin of the name "Neversweat" is unknown but may have been jokingly given to this small topographic feature, in a very dry and hot area, by Nottbusch, a settler at Palomas and prospector and discoverer of the old Nottbusch or Silver Prince mine, in the ridge, in the early 1900s. Palomas is a Spanish word for "doves" and was the name of a now vanished settlement on

the Gila River to the southeast of the range. The area was noted for large flocks of white wing doves each summer. Neversweat Ridge and the western half of the Palomas Mountains are now included in the Yuma Test Station of the Defense Department.

Neversweat Ridge is a relatively small and low ridge with steep and angular slopes rising from the surrounding plains, with several low, flat-topped hills at the north end where separated by a narrow gap from the Tank Mountains. The Palomas Mountains to the east are a crescent-shaped range with sharp, pinnacled, northwest-trending ridges rising steeply to over 1,900 feet in elevation in the southwestern portion and deeply dissected and gently dipping mesas on the northern and eastern sides. A wide hilly pediment borders the southern edge.

The most detailed reconnaissance geologic mapping and description of the district was provided by Wilson for his bulletin on southern Yuma County (1933), and for the Geologic Map of Yuma County (1960), as also shown on the 1969 Geologic Map of Arizona. According to Wilson, Neversweat Ridge and the hills to the north are composed mainly of Mesozoic schists intruded by irregular Tertiary rhyolite and andesite dikes and cut by brecciated fault zones. The Palomas Mountains showed a small mass of Mesozoic schist in the southeastern part and a large Mesozoic granitic intrusive along the southern edge. Long, thin, andesite dikes cut the schist and granite. Faulting is evident in both of these rocks. Wilson mapped a small outcrop of Cretaceous rhyolitic to andesitic lavas to the northwest of the granite and showed the entire northern, western, and eastern sections to be covered by Quaternary tuffs and basalt.

In Neversweat Ridge, several narrow, lensing veins of barite, fluorite, and gypsum contain irregular bunches of argentiferous galena and oxidized lead and silver mineralization. The mineralization is along brecciated fault zones. In the south-central section of the Palomas Mountains a few, narrow, silicified, brecciated fault zones in the granite contain iron oxides with minor oxidized copper mineralization, such as at the Engles and Adams prospects (T5S, R13W, W. cen. section 16).

The Neversweat district has been prospected since the early 1900s but only one mine, the Silver Prince, has produced any significant amount of ore. The total production of the district has been some 187 tons of ore containing about 1,438 ounces of silver, 21.5 tons of lead, 111 ounces of gold, and 4.5 tons of copper for a total value of about $11,000.

The generally weak and spotty base and precious metal occurrences in the Neversweat district are not encouraging for the possible existence of large, economical ore deposits and at present the military withdrawal prevents any mining activity in a large part of the district.

New Water Mining District

The New Water mining district covers the New Water Mountains, a poorly

lefined group of ridges and clustered mesas and hills extending southeastward rom Black Mesa in the southern part of the Plomosa Mountains of central Yuma County (Figure 14). The name "New Water" probably came from a well in Alamo Wash at the south end of the mountain group. The New Water Mountains are a southeasterly-extending prong of the Plomosa Mountains and their location often is designated in various locations on different maps. The southern part is included in the Kofa Game Range.

The southeasterly-striking range, on the eastern side of the mountains, is a narrow, steep-walled, and sharp-crested ridge dissected by numerous washes on both flanks. The northeastern side is marked by a moderately-sloping pediment. Numerous outlying, detached but clustered, rounded hills, mesas and short ridges, separated by dendrictic washes, occur in the western part of the range. There is no definite break between the Plomosa Mountains and the New Water Mountains.

The geology of the New Water Mountains is known only through reconnaissance mapping. The 1924 Geologic Map of Arizona showed Quaternary volcanics and a small area of Tertiary-Cretaceous volcanics. Wilson, for the Geologic Map of Yuma County (1960), provided the most detail geologic information available on the formations. His reconnaissance mapping was used for the 1969 Geologic Map of Arizona. However, his map only provides a generalized geologic picture. The major exposed rocks appeared to him to be a thick series of Cretaceous volcanic flows, welded tuffs, and breccia of andesitic and rhyolitic composition, capped to the south by Quaternary basaltic flows. He found relatively small outcrops of Mesozoic sediments in two areas and a small Tertiary intrusive plug was mapped in the middle. Small Mesozoic and Laramide intrusions are shown along the south edge of the range. Various miscellaneous reports and the alignment of the topography suggest that northwest-trending faulting and fracturing are prevalent throughout the range.

Known mineralization in the New Water Mountains is restricted to spotty scattered, oxidized, copper mineralization associated with limonite, and to some local, small, high-grade chimneys of copper ore, in fracture veins and pipes in the andesitic volcanics. No continuous bodies of economic ore have been found. This mineralization was known to occur for many years before being worked in the early 1940s. The total production would be some 480 tons of ore containing about 18 tons of copper and 480 ounces of silver for a total value of some $5,000.

A careful geologic study is required to determine the significance of the copper-bearing area and the possibility of hidden primary ore in depth.

Plomosa Mining District

The Plomosa mining district, as defined in this bulletin, covers the Plomosa Mountains from the Bouse area southward to include the Livingston Hills. It also includes the Bouse Hills to the east of Bouse, and the Bear Hills,

a southeastward extension (Figures 14 and 15). The border with the New Water district to the southeast is an arbitrary line to the southeast of Black Mesa. In the past this large district was considered to include the east side of the Dome Mountains and all the area southward to the Castle Dome and Kofa districts. Plomosa is a Spanish word for "lead colored" and for the district may have referred to the dark, dull coloring of the heavily iron- and manganese-stained rocks found, or possibly also alluded to the early discovery of argentiferous lead in the district. The placer mining settlement on the west-central flank of the mountains has long since been abandoned although it was a thriving community in the early days. The southern end of the mountains lies within the Kofa Game Range.

The Plomosa Mountains are a raggedly-outlined, north-south range, relatively low in elevation except for Black Mesa (3,639 feet in elevation) in the southern part. In general the range is rugged and broken into ridges, knobs, isolated peaks, and mesas. The northern part is a relatively narrow, ragged ridge declining northward until disappearing beneath the sandy Cactus Plain. Along the borders, steep, irregular slopes break off sharply into flatter, alluvium-covered pediments with scattered residual hills. La Posa Plain lies to the west and the Renegras Plain to the east. To the south the range becomes wider and consists of more massive but broken and often detached southeastward-trending ridges with scattered, irregular, steep-walled hills, peaks, and mesas. Black Mesa, in this southern area, is made up of two high, relatively flat mesas and is a dominant topographic feature. The Bouse Hills are a low, scattered collection of irregular hills with a northeasterly trend from the north end of the Plomosa Mountains. The Bear Hills are a detached series of narrow ridges extending southeastward from the central part of the range. The Livingston Hills consist of steep-walled, ragged hills with a general southeastward alignment. Erosion has strongly dissected the Plomosa range with numerous large and small washes and canyons cutting the rocks and separating various topographic features.

The geology of the Plomosa district is complex with formations apparently ranging in age from Precambrian to Quaternary, including various sedimentary, metamorphic, volcanic, and intrusive types and strong local structural deformation. Bancroft (1911) visited various locations of reported ore deposits in the district and noted what he believed to be a Precambrian gneiss-schist complex and metamorphosed sediments, volcanics, and possibly intrusives, capped locally by Quaternary-Tertiary lava flows. Ross (1923) considered the complex range to be composed mainly of Precambrian metamorphic rock but noted probable Paleozoic limestone, lava flows, intrusive rocks, and local Tertiary sediments in the northern part and thick flows of late Quaternary olivine basalt in the southern part. He also noted red conglomerate of probable Tertiary age along the eastern side south of Bouse, probable Paleozoic sediments in the southern areas, and numerous dikes of rhyolite and trachyte. He recorded that the Tertiary volcanics included lavas,

uffs, and agglomerates with some interbedded sediments. Darton (1925) oncurred in general with Bancroft and Ross in that the range was largely ranite and other crystalline rocks overlain by a thick series of Tertiary olcanic rocks and a heavy cap of basalt on Black Mesa. He did note that nasses of fine-grain, partly schistose rocks of probable volcanic origin, uartz biotite schist, and coarse gneiss occurred in the southwestern section nd that apparent Carboniferous limestone occurred at various places. He also oted that the schists and gneisses were cut by granites, aplite, and diabase. The 1924 Geologic Map of Arizona, based on the early geologic reconnaissance mapping, showed Precambrian granite and related rocks, with scattered ocal Carboniferous beds, in the northern part; Precambrian schist and lower retaceous sediments along the southwestern section; and Laramide and Quaternary volcanics in the southeastern areas. Wilson's reconnaissance napping, used for the Geologic Map of Yuma County (1960) and the 1969 Geologic Map of Arizona, revealed in greater detail the complex assemblage of the geologic formations. In the Bouse Hills he showed Mesozoic granite capped by Cretaceous andesite and in the north end of the Plomosa Mountains, outcrops of Precambrian gneiss, Mesozoic and Laramide sediments, one small outcrop of undivided Paleozoic-Mesozoic sediments, local Cretaceous andesitic volcanics, and a Laramide intrusive plug. In his mapping, the southern part of the northern section was covered by Cretaceous andesitic avas and locally a capping Quaternary basalt. In the southern half, Wilson mapped areas of undivided Paleozoic-Mesozoic sediments, Mesozoic schist and sediments, local, scattered Mesozoic and Laramide granitic intrusives, Cretaceous andesitic and rhyolitic volcanics, and a capping Quaternary basalt. Jemmett (1966) studied and mapped the geology and mineralization of the northern part of the Plomosa Mountains. He suggested that the gneissoid and schistose basement complex consisted of old Precambrian units and a Paleozoic unit and in contrast to Wilson, considered that there was no deposition during the Mesozoic. He related the later Cenozoic-Tertiary sediments in the area—conglomerates, agglomerates, shale, limestone, and tuffs—to the Artillery Peak Formation of Lasky and Webber, being similar to the beds in the manganese-bearing area of southeastern Mohave County. He did map strong faulting in the area but no igneous intrusions. Miller (1966, 1970) studied and mapped the Quartzsite quadrangle in the southern half of the Plomosa Mountains and Miller and McKee (1971) discussed the faulting in that area. Miller recognized Precambrian quartz monzonite (1730–1750 m.y.) in the center of the quadrangle, which was the northern part of the outcrop shown by Wilson, and Mesozoic schist and Laramide granite. The balance of the schist Miller classed as Precambrian or Mesozoic metavolcanic rocks. To the north of the Precambrian intrusive he found the Paleozoic section to be highly deformed and faulted. Wilson's large Paleozoic-Mesozoic undifferentiated block to the south was found by Miller to consist of thrust- and block-faulted Mesozoic to Cenozoic intrusives and Mesozoic to

Tertiary clastic sedimentary units similar to those found to the south in the Livingston Hills area and to the northeast of Black Mesa. The Paleozoic outcrops to the north of Black Mesa he considered to be relatively undeformed fossiliferous beds of Cambrian through Permian sediments. To the west of Black Mesa, he mapped deformed Paleozoic rocks occurring in various scattered faulted blocks. In the central part of this southern section of the range, a strong zone of imbricate thrust faults was mapped by Miller with movement to east or west over a considerable distance. In the southern part also, Miller mapped several right-lateral northwest-striking faults of considerable length and separation. From radiometric age dating of the rhyodacite (19–20 m.y.) that overlies the thrust-faults but is cut by the strike-slip faulting, Miller and McKee considered the thrusting to be pre-middle Miocene and the strike-slip faulting as post-middle Miocene. Much remains to be done in determining the geologic picture of the Plomosa Mountains and its relationship with the geology of the surrounding areas.

The mineralization in the district is as varied as the geology. Deposits of copper-gold, lead-zinc-silver, gold-silver, manganese and/or iron oxides, barite-fluorite, tungsten, bentonite, chrysophase, and gold placers have been found and worked. In the northern Plomosa Mountains, numerous deposits of copper-gold and gold-silver occur in fissure and fault veins, mainly in metamorphosed Cretaceous or early Tertiary sediments cut by dioritic to granitic dikes and plugs. Prophylitization, biotitiation, and feldspathization of the metamorphosed sediments are widespread. The ore occurs in irregular shoots and bunches, is oxidized and enriched down to some 350 feet or more below the surface, and is associated with strongly developed iron and manganese oxides. Lead and zinc mineralization is rare and gold often predominates over silver in the ores. Barite and fluorite are common gangue minerals in the copper-gold fissure veins and occur in other deposits, without base metals, in fissure veins in isolated outcrops of metamorphosed sediments to the north of Bouse, in the andesitic volcanics to the east of Bouse, and along the eastern side of the range in metamorphosed sediments, volcanics, and Precambrian gneiss. Small bodies of manganese oxides, usually associated with variable amounts of iron oxides, occur in irregular, lensing fracture zones in the andesitic volcanics and the underlying metamorphosed sediments and intrusives along the eastern side of the northern part of the range, and in the Bouse Hills.

To the south, lead-zinc and silver mineralization, with only minor copper, have been found in fracture zones cutting metamorphosed sediments and andesitic volcanics and as replacement bodies in Paleozoic limestone. The main productive mineralization of the district has been the gold placers on the western side which resulted from the erosion of numerous small, irregular gold-quartz veins, with some lead, zinc, silver, and copper, in the Mesozoic or Precambrian schist. In the Bear Hills, some copper-silver-gold and manganese oxides occur in fault fracture zones in the andesitic volcanics. In the

Livingston Hills some base and precious metals and tungsten mineralization have been found.

The discovery of the Plomosa gold placers in the 1860s led to prospecting in the mountains for the source of the gold and the finding of numerous small mineral deposits. The Apache Chief mine group reportedly was worked by Frenchmen in the early 1860s and it and other small mines and prospects for base and precious metals in the southern area have been worked sporadically since that time. The copper-gold deposits near Bouse were found in the late 1800s but not worked extensively until the completion of the Arizona & California Railroad through Bouse in the early 1900s. The barite deposits have been worked intermittently and the bentonite was mined for local drilling usage. Manganese and tungsten ores have been produced only during periods of government buying at premium prices. A small amount of chrysophase was reportedly mined for gem use. There has been some mineral production from the Plomosa district for almost every year from the 1860s through 1970 but except for the gold placer operations, mainly prior to 1900s, the production has been relatively small, mined ore seldom exceeding 1000 tons yearly and only sporadically from any single deposit or group of deposits except in the 1930s.

The total estimated and recorded production of base and precious metals from mines through 1974 would be some 25,514 tons of ore containing about 5,984 ounces of gold, 127,405 ounces of silver, 529 tons of copper, 343 tons of lead, and 65 tons of zinc. The gold placers probably produced some 18,000 ounces of gold with 1,800 ounces of silver. The total value of the base and precious metal production would be some $1,172,000. About 9,000 long tons of low-grade manganese ore, 500 tons of iron ore, 2,700 tons of barite ore, one ton of bentonite, and one ton of tungsten concentrates have also been produced, bringing the total value of the mineral production to over $1.5 million.

The geology of the Plomosa district is better known than most districts in Yuma County but the relationship of the mineralization to the geology has not been studied in sufficient detail to provide clues as to future economic mineral possibilities. The various mineral values are widely scattered and no distinct mineral zoning is apparent but the type of mineralization does seem to have an association with certain formations. It would appear that a careful examination of some of the well-mineralized areas, such as west of Bouse, east of the old placer deposits, and around Black Mesa, should be made. The southern part of the Livingston Hills is covered by the Kofa Game Range which would restrict mining activities in that area.

Santa Maria Mining District

The Santa Maria mining district (also called in the past, in whole or in part, the Planet, Swansea, Bill Williams, or Mineral Hill Wash districts) covers the central Buckskin Mountains in northern Yuma County (Figure 12).

Santa Maria is a Spanish name applied by early Spanish explorers tc the entire river system originating in Yavapai County and joining the Big Sandy to form what was later called the Bill Williams River; thus the Santa Maria district, as considered here, is some distance west of the presently named Santa Maria River. Bill Williams, for whom the river was named, was apparently an early trapper in Arizona in the late 1830s and the 1840s. Planet, Swansea and Mineral Hill Wash have been important mining areas in the district. Arbitrary borders separate the Santa Maria district from the Cienega district to the west, the Alamo district to the east, and the Midway district tc the south.

The Buckskin Mountains, also called the Williams Mountains, in the Santa Maria district, consist of a broken or jumbled group of irregular individual mountains, ridges, and scattered peaks, locally ranging up to over 3,100 feet in elevation as at Planet Peak. Numerous major and minor washes and some alluvial flats are scattered through the range. The slopes are rugged and often steep. The overall trend of the major topographic features of the range is toward the northeast, but this general trend is obscured by the extensive erosion which makes the mountains less compact than other large ranges in Yuma County.

Jules Marcou (1856) furnished the earliest geologic description of the Bill Williams River area in connection with an early railroad survey. He noted the exposures of gneiss bordering the river. Blake (1865) and in the reports of the Governor of Arizona to the Secretary of the Interior in the late 1800s and early 1900s, Browne and Raymond in mining statistics west of the Rocky Mountains (1868–1877), Hodge (1877), Blandy (1893), and McCarn (1904) furnished brief notes on the geology and ore deposits of the district. Lee (1908), in his reconnaissance, noted biotite granite, granitic gneiss and schist overlain by quartzites, slates, and black metamorphic limestones which were faulted and intersected by intrusive rocks. He also mentions the deposits of copper and iron ore. Bancroft (1911) classed the granites, gneisses, schists, quartzites, limestones, dolomites, and argillites as Precambrian. These he found to be intruded by diabase and other basic rocks in dikes and sills that for the most part had been metamorphosed to amphibolites. He also noted the occurrence of breccia resting on the old Precambrian rocks but gave no structural interpretation. Blanchard (1913) covered some of the district in his thesis study but likewise classed the gneiss-schist and metamorphosed sediments as Precambrian. Ross (1923) only visited the southern border of the Buckskin Mountains. He believed that the range was composed mostly of Precambrian igneous and sedimentary rocks. Darton (1925) first noted that some of the limestone in the Buckskin Mountains was Carboniferous in age and on the 1924 Geologic Map of Arizona, small outcrops of Carboniferous sediments are shown within the Precambrian complex. Wilson's reconnaissance mapping for the Geologic Map of Yuma County (1960), used also for

the 1969 Geologic Map of Arizona, shows in greater detail the outline of the areas of Precambrian gneiss and schist, the fault blocks of undivided Paleozoic-Mesozoic shale, quartzite and limestone, and Laramide sandstone, shale, and conglomerate, a small Laramide granitic intrusive, some Cretaceous intrusive, and Quaternary-Tertiary sediments. Except for the latter, he shows these formations have been affected by thrust faulting and tilting with the relatively flat thrusting movement mainly at or near the top of the Precambrian complex. Shackelford (1975, 1976), in a study of the Rawhide Mountains in Mohave County, to the northeast of the Santa Maria district, but having similar geology and structural features, suggests a thrust-like movement to the northeast of a chaotic assemblage of brecciated and inversely imbricated Precambrian (?) to late Tertiary igneous, metamorphic, and sedimentary rocks along an extremely sharp basal dislocation surface on a Mesozoic schist-gneiss complex. However, he credits the dislocation to gravity sliding on shingling, concave-upward, northwest-striking faults rather than to large-scale thrust faulting. He considered the maximum age of the deformation to be Miocene (15.9 m.y.).

The oldest rocks in the Santa Maria district appear to be a gneiss and schist complex, originally of Precambrian age but metamorphosed at a later date. Above the undulating erosional top of this unit there appears to be a relatively flat but rolling fault zone in which occurs a variable thickness of breccia or conglomerate containing gneiss, quartzite, limestone, pulverized rock, and some local gouge. Above this zone numerous large and small fault blocks of gneiss and schist; partly metamorphosed, Paleozoic quartzite and limestone, with argillite beds altered to amphibolites near the bottom; possibly Mesozoic, partly metamorphosed shale and limestone; and Laramide or Tertiary shale, sandstone, and conglomerates have been found. All these formations are folded, tilted, and locally faulted. The units of the Precambrian complex have a northeast orientation and are cut by numerous aplite, diabase, and quartz dikes. A small Laramide granitic stock to the southeast of Swansea and a long, narrow, Cretaceous schistose, intrusive dike to the south of Planet were mapped by Wilson. Late Tertiary and Quaternary alluvial deposits fill the major washes and intermountain valleys and plains, and a thick capping of late Tertiary to Quaternary basaltic volcanics lies to the west of Mineral Wash. Considerable more detail geologic and structural studies will be required to determine the true relationship of the formations and the structural pattern, taking into consideration the regional character of the deformation over a much larger area than only in the Santa Maria district.

The main mineralization of the Santa Maria district consists of cupriferous hematite deposits occurring mainly as irregular, lensing, and locally massive replacements of dolomite and marblized Paleozoic limestone. Both specular hematite and soft hematite often contain dissemination, coatings, veinlets, and some more massive bodies of malachite, azurite, and chrysocolla in the

oxidized zone and in depth, chalcopyrite, bornite, and pyrite. Silver and gold occur with the copper mineralization and the accessory gangue minerals include chlorite, epidote, sericite, biotite, muscovite, hornblende, and calcite. Locally the gangue may include barite and fluorite. Ore lenses may occur at several horizons in the metamorphosed Paleozoic sediments with the wall rock heavily impregnated and stained by hematite which also fills joints, fractures, and forms replacement bodies. Chemical analysis of the ore bodies average up to 68% Fe and 8% Cu and spectrographic analyses indicate the presence of various small amounts of manganese, titanium, nickel, vanadium, chromium, cobalt, zinc, lead, gallium, zirconium, and strontium. Although numerous deposits of hematite and cupriferous hematite have been found in the district, only a few of the larger deposits have been mined successfully. Some gold ore has been produced from a breccia zone in Paleozoic quartzite near the Planet mine and some placer gold has been recovered from the neighboring washes. Locally, manganese oxides, mixed with hematite, occur in replacement lenses in the metamorphosed Paleozoic limestone.

The Santa Maria district ore deposits were found as early as the 1850s. Samples of copper ore were sent to Dr. Jackson, a Boston mineralogist, in 1858. In 1862, 100 tons of selected high-grade copper ore were shipped by Ryland from the Planet mine to San Francisco by boat down the Colorado River to the mouth for transfer to clipper ships. The ore was sold for $100 per ton. In 1865, some 1500 tons of ore and crudely smelted matte were produced and shipped by three companies operating in the district. In 1868, due to a drop in the price of copper and the withdrawal of the river boats, mining ceased, but was revived in 1872 with the reopening of the Planet mine Production was intermittent up to 1883 when operations again ceased but by then some two million pounds of copper, in ore and impure smelting products, may have been shipped out. Some operations at the Planet mine were renewed in 1899 and in 1902 the Planet Copper Mining Company started large-scale development work to open up the Planet deposits. This company was reorganized as the New Planet Copper Mining Company in 1909 and development continued. However, ore shipments did not start until 1914 after the construction of the Arizona & California Railroad's Parker cutoff or as sometimes later called, the Santa Fe short-line, between Parker and Wickenburg in 1907. The Arizona & Swansea Railroad, Bouse to Swansea, was completed in 1910. Most of the subsequent production was by lessees up to 1923 and there has been little copper ore produced from the Planet property since that time.

The Signal or Copper Prince copper deposit group near Swansea was discovered early but not much development work was done until about 190 when this group, along with the Clara and Moro deposits, was opened up by various companies. With the completion of the Bouse to Swansea line, and the construction of the smelter at Swansea by the Clara Consolidated Co

and Copper Mining Company, production of copper began in 1910. However, the financial drain of the railroad and smelter led to the bankruptcy of the company in 1912. The company was reorganized as the Swansea Consolidated Gold and Copper Mining Company but after attempted operations this latter company also went bankrupt in 1914. The property was leased in 1915 and produced some ore in 1916. In 1917, the property was leased to W. A. Clark of Jerome and was called the Swansea Lease Incorporated. With a flotation plant, the new operators shipped ore and concentrates to the Humboldt Smelter from late 1919 through 1920, and from 1922 to early 1924. Then the lease was surrendered. After legal suits in 1925 and 1926, the Clara-Swansea Mining Company took over the property and started shipment of ore to the United Verde Extension smelter. In August 1929, a fifteen-year lease was granted to the American Smelting and Refining Company which erected a new flotation concentrator. This company produced copper concentrate through 1930 and in 1937 before surrendering the lease. Since then there has been only sporadic production. In the early 1940s and in more recent years, exploration for additional ore has been carried out by various mining companies but there has been no commercial production from the deposit. The Clara and Moro deposits have been worked intermittently, mostly in a small way in conjunction with the Signal mine, from 1911 through 1956.

The Mineral Hill mine group in Mineral Wash was prospected in the early 1900s but little development work or mining was done until the 1950s when some copper ore was produced. From 1964 through 1970 considerable amounts of copper ore and tailings, with byproduct iron, were shipped. The manganese deposits were mined in the 1950s when the government was buying low-grade ore. There are numerous other small prospects and mines in the district on scattered deposits of copper, gold, silver, iron, and manganese that have produced limited amounts of ore since the early 1900s. The gold placers, mainly near the site of Planet, have been worked sporadically during the 1900s.

The total estimated and recorded production of base and precious metals from mining operations in the Santa Maria district through 1974 would be some 1,405,000 tons of ore containing about 22,675 tons of copper, 24,606 ounces of silver, and 1,128 ounces of gold for a total value of some $12,041,000. About 400 long tons of manganese ore and concentrates (20–30% Mn) and some 200 ounces of placer gold with 20 ounces of silver also have been produced.

The Santa Maria district has not been examined in detail for mineral deposits although containing several major productive deposits and very interesting geologic features favorable for economic mineralization. The structural pattern of the formations in this area is not well understood and should be studied carefully in order to determine the origin and probable controls of the mineralization. The district lies in the northern end of an apparent wide,

northwest-trending, strongly mineralized, structurally complex zone that could contain important, large, economic mineral deposits.

Sheep Tanks Mining District

The Sheep Tanks mining district is located in the northwestern part of the Little Horn Mountains in central Yuma County (Figure 16). In the past it has been considered as a part of the Alamo Springs district of the northern Kofa Mountains which lie to the west. The Little Horn Mountains were so named because the desert big horn sheep were found there but the range was not as high as the Big Horn Mountains to the northeast in northwestern Maricopa County. The name Sheep Tanks came from natural water tanks reportedly used by the wild sheep.

The Little Horn Mountains consist mainly of clustered mesas and ridges separated by steep-sided narrow and open canyons and washes. Elevations range up to some 3200 feet above sea level. They are separated from the Kofa Mountains by a low broad saddle and extend east-southeast towards the Clanton Hills. The borders are extremely ragged with numerous outlying hills resting on eroded but thinly alluvium-covered rock pediments.

The geology of the range was first described briefly by Ross (1923) as steep and somber bluffs of Tertiary lava, tuff, and sedimentary rocks resting on a basal crystalline complex which cropped out in some washes. The 1924 Geologic Map of Arizona showed Tertiary-Cretaceous volcanics capped by Quaternary volcanics. Wilson (1933) mapped and described the geology and mineral deposits in greater detail and in his reconnaissance mapping for the Geologic Map of Yuma County (1960), used for the 1969 Geologic Map of Arizona, he provided an even more detail interpretation of the geology. He considered the oldest rocks exposed to be a thick series of Cretaceous rhyolite, dacite, and andesite flows with small intrusive masses of Laramide diorite-porphyry. He found the Cretaceous volcanics to be capped unconformably by several hundred feet of Quaternary tuff and basalt over much of the range. Structurally, the older volcanics are block-faulted and tilted, with strong fault line scarps. The structural trend is mainly northwest but some east-striking faults or fracture zones have been noted. In the Sheep Tanks mine area, Wilson noted rhyolite flows unconformably underlying thick dacite flows and irregular, crosscutting masses, sills, and dikes of diorite porphyry which intrude both rhyolite and dacite. He found intensely silicified and iron- and manganese-stained breccia, unconformably overlying the rhyolite and diorite porphyry and in apparent fault contact with the dacite. Late Tertiary volcanic agglomerate covers all the older volcanic formations. Strong faulting and fracturing occurs throughout the district. More recent radiometric age dating suggests that the older volcanics are mid-Tertiary. Cousins (1973) studied the manganiferous calcite occurrences in the Sheep Tank district. It is unfortunate that although evidently aware of Wilson's

1933; 1934, revised 1967) earlier detail geologic mapping and description of ıe district and ore deposits, he did not acknowledge Wilson's work nor xplain the considerable differences between his mapping and interpretation nd that of Wilson.

The main mineralization in the district, at the Sheep Tanks mine, occurs in wide brecciated fault zone locally cemented and filled by quartz-carbonate eins. In the veins, irregular masses and streaks of limonite, pyrolusite, uartz, and calcite, cut by barite veins, contained shoots of gold and silver nineralization and locally some chrysocolla and lead minerals. Flaky gold vas visible in some of the limonite. The wall rocks are the older volcanic ›reccia which locally is intensely silicified, chloritized, and sericitized. The nineralization appears to be shallow. The other precious metal prospects in he district have been of only minor importance. A few ounces of placer gold, eportedly, was recovered from areas close to the Sheep Tank mine. The ıanganese oxides at the Sheep Tank mine were prospected for manganese ore ›ut were not productive. To the south, however, irregular deposits of man-;anese oxides, mixed with calcite and brecciated wall rock, occurs in tringers, pods, and overlapping lenses in a shear zone in the Tertiary andesite lows.

The precious metal mineralization in the Sheep Tanks district was located n 1909 but little development work was done until about 1926 when the most ›romising prospects at the Sheep Tanks mine were acquired by the Sheep Tanks Mines Company. Production was intermittent from 1929 to 1942 by ⁄arious owners and leases. Subsequently, in the 1950s, some manganese enses at the Sheep Tank mine were selectively mined but no ore was shipped. At the same time at properties to the south, manganese ore was mined and hipped under the government purchasing program.

The total mine production of precious and base metals from the district hrough 1974 would be some 17,400 tons of ore containing about 20,904 ›unces of gold, 39,731 ounces of silver, and one ton of copper for a total ⁄alue of some $735,000. A few ounces of gold came from placer workings nd about 250 long tons of low-grade manganese ore has been shipped.

The spotty and shallow character of the mineralization in the Sheep Tanks listrict is not encouraging as to the possibilities for the occurrence of conomic ore deposits. However, a more detail examination should be made ›efore ruling out the possibilities of other economic deposits in the area.

›ilver and Eureka Mining Districts

The Silver and Eureka mining districts lie in the southern part of the Trigo Mountains in western Yuma County, bordering the Colorado River (Figure 7). The Silver district, with arbitrary boundaries, occurs to the north of the mall Eureka district at the extreme southern end of the range, along an astward bend of the Colorado River. It has often been included in the Silver

district. Eureka, from the Greek word for "I have found it," was probabl given to the district because of the discovery of the old Selby Bonanz (River-view) mine. The name Silver was applied to the more northern distric because of the rich silver ores found there. Trigo, a Spanish word for wheat was applied to the mountains since it was reported that the local Indians used type of wild, grass-type wheat growing in the area. The Trigo Mountain have been called the Chocolate Mountains by local settlers but the latter nam is now restricted to a more eastern range separated from the Trigo Mountain by Yuma Wash. The eastern part of the two districts is within the militar Yuma Test Station.

The topography in the Silver district consists of numerous, relatively rug ged, ragged, north-trending ridges, rising to about 1,200 feet in elevation, an separated by canyons and flat-trending ridges, rising to about 1,200 feet i elevation, and separated by canyons and flat-bottomed alluvial valleys alon irregular stream drainages. In the Eureka district, the surface is even mor rugged with irregular, steep-walled, separated ridges and deep canyons

Ross (1923) mentions the probable Tertiary volcanics with an underlyin basal crystalline complex occurring in the Trigo Mountains but he did no visit them. Darton (1925) indicated that the range consisted largely of Ter tiary volcanic rocks with underlying granites and schist in the southern an southeastern parts as shown on the 1924 Geologic Map of Arizona. Wilso (1933) mapped and studied the geology and ore deposits of the Silver an Eureka districts and later revised the geology in reconnaissance mapping fo the Geologic Map of Yuma County (1960), as also shown on the 196 Geologic Map of Arizona. The most detailed geologic mapping and study o the Silver district was done by Parker (1966).

The oldest exposed rocks in the district, mapped and described by Parke are a complex of schist, gneiss, phyllite, and amphibolite, resulting from th metamorphism of sediments and intrusives, and Mesozoic granite. Abundar dikes of aplite or pegmatite occur locally near small, stock-like masses c Laramide granodiorite. These formations, according to Parker, are overlai by middle Tertiary volcanic flows, flow breccias, and pyroclastics of andesit to rhyolite composition and in turn are overlain, unconformably, by Quate nary basalt and locally by rhyolitic ash or pumice. The predominant structure are northwest- to north-striking normal faults displaced by transverse eas west faults. Parker suggests that these form an apparent horst-graben typ structure in the mineralized zone.

The mineralization in the Silver district occurs mainly in the north t northwest fault fissures in association with the Laramide granodiorite intru sive. Ore shoots on the lensing fault veins were formed primarily at th intersections of faults and breccia zones and have limited length, width, an depth. The mineralization itself consists of iron oxides, vuggy quartz, barite fluorite, celestite, and manganiferous and ferruginous calcite, with spott residual argentiferous galena, lead oxides, argentite, silver halides, lead ca

›onate and sulphate, and zinc carbonate. Pyrite and sphalerite probably were ›resent in the primary ore. Notable amounts of vanadinite and wulfenite have ›een found in vugs and cavities and have furnished spectacular specimens to nuseums and mineral collectors. In brecciated zones, the wall rocks are :hloritized, sericitized, silicified, and carbonatized. There has been strong ›xidation down to 500 to 700 feet or more and the present water table is below ;00 feet. The mineralization exhibits mesothermal to epithermal characteris-ics and appears to be related to but later than the granodiorite intrusion.

In the Eureka district, the mineralization at the Riverview (Eureka) mine as much the same character as the deposits in the Silver district. Also, everal small prospects and mines have been worked for oxidized copper ıineralization. The deposits have silver and gold values and a gangue of ıanganese- and iron-stained calcite, breccia, gouge, and quartz in fissure 'eins in Mesozoic schist. They occur near the mouth of Arrastra Creek (T45, ℞23W, sec. 36). There has been no recorded production from these copper ›ccurrences. One small occurrence of tungsten also has been reported in the :ureka district.

Along the Colorado River, in the Paradise Valley area, gold placers occur n bench gravels, arroyo bottoms, and in ancient bars and channels. No detail ıformation is available on these placer deposits although they have produced onsiderable gold. Wilson (1933) noted that dumoriterite with minor kyanite ›ccurred in quartzose schist boulders in the Colorado River terrace gravels lownstream from Clip.

The mineralization near the Colorado River in the Eureka district was ɔund by prospectors in the early 1860s and the district was organized in 862. Prior to 1860, much argentiferous lead ore was shipped from veins near he river. George Silby, founder and original owner of the Selby Smeltering Vorks in San Francisco, worked the Riverview (Eureka) mine in the 1860s, hipping the high grade lead-silver ore to his smelter by boat. The discovery ›f the bonanza lead-silver deposits in the Silver district was made by Col. ;nively at about the same time but their inaccessibility and the lack of water lelayed their development until about 1879 when Messrs. Sills, Johnson, Norton, and Crawford relocated the abandoned claims and organized the ;ilver district. Mining started at the Red Cloud, Black Rock, Pacific, 'apago, Silver Glance, Hamburg, and Princess claims. The townsite of ;ilent, probably named after Judge Silent, a prominent mining man and Associate Justice of the Territorial Supreme Court, was established near the Red Cloud mine. The high-grade ore was freighted by teams down Red Cloud Wash to Norton Landing on the Colorado River, for shipment by boat o the Selby Smeltering Works. A small smelter was built at Silent in 1880 but vas operated only intermittently for some three years. The Blaine or Silver Clip deposit to the north was found in the early 1880s. A road was built to the Colorado River at the mouth of Clip Wash where a stamp mill and the ;ettlement of Clip were established around 1883. Numerous other small

mines and prospects were opened up in the early 1880s and by 1884, the Silver district was the most productive in Yuma County. A high rate of production, mainly from the Red Cloud and Clip mines, continued through 1889 and then decreased and finally ceased in 1893 when silver prices dropped. Local smelting and milling attempts during that period were generally unsuccessful. In 1917, the Red Cloud mine was reopened and a dry concentator was built. Only a small production was achieved before the mill burned down the following year. A cyanide plant was built at the Clip mine in 1927 and water was pumped from a well near the Colorado River. The plant was rebuilt in 1928 and treated some ore but was never very successful technically or economically. Since then, intermittently, companies and lessees have extracted some ore from pillars left in the old mines, reworked the old dumps and mined available ore in numerous prospects which up to 1950 totaled a few thousand tons of ore containing lead, silver, zinc and minor copper. The tungsten prospect in the Eureka district was found in the 1950s but was not worked extensively. The gold placers in the Paradise Valley area may have been known at an early date but were worked mainly in the 1950s and 1960s.

The total mine production of base and precious metals from the Silver and Eureka districts must be largely estimated since the major output occurred in the 1880s, before accurate records were available. Various estimates and early reports of production for that period range as high as $5 million in value but a more reasonable figure, as compiled by Tenny and reported by Wilson (1933), would be about $1.7 million. When added and compared to the reported mine production since 1900, the estimated and recorded production from the mines in the two districts would be the equivalent of some 52,34[illegible] tons of ore containing about 1.6 million ounces of silver, 1,457 tons of lead 940 ounces of gold, 15 tons of zinc, and three-quarters of a ton of copper Some 1,160 ounces of placer gold with about 87 ounces of silver have been produced from the districts. The total value of the production would be some $1,847,000. Only a very minor amount of tungsten ore, if any, has been produced.

The Silver and Eureka districts offer interesting and speculative possibilities for hidden ore deposits. Known mineralization is shallow and spotty but apparently related to the Laramide granodiorite intrusion which was capped by later volcanics. Careful geologic investigations and evaluation might disclose larger deposits of economic mineralization in depth under the volcanic capping. Unfortunately, the eastern part of the districts is within the military Yuma Test Station and thus closed to exploration and mining activities.

Tank Mountains Mining District

The Tank Mountains mining district covers the Tank Mountains, a range extending southeastward from the Kofa Mountains in central Yuma County

Figure 2). The name comes from the occurrence of natural rock tanks which, fter rains, furnished a source of water for desert wildlife and prospectors. The northwestern portion of the range has been called the Frenchman Mountains, probably from some early French prospectors, and the southern portion s the Puzzles Mountains after the name of a local prospect in that area. The borders of the district are somewhat arbitrary and, except for the eastern portion of the range, the district is covered by the Kofa Game Range and the Department of Defense Yuma Test Station.

The Tank Mountains are separated from the Kofa range by Engesser Pass, a low saddle formed by sinuous drainage channels to the valleys and plains to west and east. The northern section of the mountains consists of scattered, broken, irregular, steep-sided ridges and mountain peaks, rising to 2,500 feet n elevation and deeply carved by canyons and wide washes. To the southeast, the topography becomes less rugged or high, with scattered flat-top mesas, buttes, and rounded hills.

The 1924 Geologic Map of Arizona showed the range to consist mainly of Tertiary-Cretaceous volcanics with some scattered outcrops of a Precambrian granitic complex. A covering of Quaternary lavas was shown at the eastern end. Wilson (1933) mapped and examined the Tank Mountains, showing and describing the formations, structure and mineral occurrences. His later reconnaissance mapping for the Geologic Map of Yuma County (1960) was used for the 1969 Geologic Map of Arizona. Wilson's reconnaissance mapping and description is the most detail geologic work done on the range. He showed the oldest rocks of the district to be Mesozoic or older metamorphic schists that crop out in large to moderate size bodies at the southwestern and southeastern sections of the range. He extended the Mesozoic sedimentary series of the southern Kofa Mountains into the northern Tank Mountains where it is intruded by an elongated, north-south body of Mesozoic granitic rock and a small volcanic plug of Cretaceous rhyolite. He found the schist and sediments to have been cut by dikes and irregular masses of diorite and granite. Unconformably overlying these formations he mapped a thick series of Cretaceous and Quaternary volcanics, the former consisting of rhyolitic to andesitic tuffs, flows, and breccias covering a major portion of the northern and western sections of the range, and the latter, of basaltic character, coating most of the eastern and southern parts. From more recent radiometric age dating it would appear that the rhyolitic and andesitic lavas are probably middle Tertiary in age.

Known mineral deposits in the district are scanty, consisting of a few minor occurrences of gold-bearing, quartz-carbonate veins in the Mesozoic granite and schist; weak, oxidized copper mineralization in fracture veins in the Tertiary volcanic andesites; and low-grade manganese oxides in a fracture zone in andesite. Gold placers have been found near the occurrences of the gold-bearing veins in the northern and southern parts of the district.

The gold-bearing veins and placers were prospected as early as the 1860s but the isolation of the area and lack of water hampered operations. Only sporadic attempts have been made to prospect and develop the mineral occurrences. The total estimated mine production of precious metals probably has not exceeded some 50 tons of ore containing about 50 ounces of gold and up to 10 ounces of silver. Dry placer operations may have produced as much as 200 ounces of gold with minor silver. Only about 50 long tons of low-grade manganese oxides have been mined and shipped under the government buying program in the 1950s although the small deposit was found and prospected during the time of World War I.

The Tank Mountains district does not appear to be favorable for large economic mineral deposits although the volcanic capping may hide possible mineralization. At present the location of most of the district within the Kofa Game Range and the military Yuma Test Station limits or prohibits mining activities.

Trigo Mountains (Cibola) Mining District

The Trigo Mountains or Cibola mining district lies in the central part of the Trigo Mountains of west-central Yuma County (Figure 17). The southern part of the range is covered by the Silver and Eureka districts. The mountains were named for the Spanish word for wheat since a small, succulent, grass-like wheat, used by the Indians, grows in the area. Cibola was a Spanish name given to the Hopi villages far to the northeast and it is unknown why the name was applied to the farming settlement, river landing, and the local, broad and flat valley area along the Colorado River. The eastern part of the district lies within the Department of Defense Yuma Test Station.

The Trigo range in this district is rugged with broken, irregular, steep-sloped ridges, separated by deep canyons or flat valley washes. Elevations rise to some 2,500 feet. Numerous intermittent stream beds trend irregularly across a broad and dissected bench westward to Cibola Valley and the Colorado River.

The geology of the district has not been studied in detail. The 1924 Geologic Map of Arizona shows predominant Tertiary-Cretaceous volcanics in the district and Wilson (1933) first observed an area of Precambrian to Mesozoic schist in the northern part, underlying Tertiary volcanics. The additional reconnaissance mapping by Wilson for the Geologic Map of Yuma County (1960) redefined the Mesozoic schist and gneiss and classed the volcanics as Cretaceous. His mapping was used for the 1969 Geologic Map of Arizona. The more recent work of Parker (1966) in the Silver district to the south would apply to the formations in the Trigo district. His work suggests that the older schist, gneiss, phyllite, hornfels, and amphibolites are Mesozoic or older and the volcanic flows, breccias, agglomerates, and pyroclastics of andesitic to rhyolitic composition are of middle Tertiary age rather

han Cretaceous. The basal, metamorphic complex is intruded by diikes and rregular masses of granitic rock and small diorite porphyry dikes. Tertiary to)uaternary alluvial sediments lap up onto older formations along the western lank of the range and also occur in interior valleys. Numerous faults and 'racture zones, mostly aligned in a northwest direction, cut the rock 'ormations.

In the Mesozoic schist, several, scattered, narrow, branching, gold-bearing ıuartz veins occur in fault zones. The gold mineralization is spotty in a ;angue of banded quartz, iron oxides, and ferruginous calcite. Economic ıuantities occurred only where concentrated by weathering and oxidation. 3old placers were found in the washes below these occurrences. The man-;anese mineralization occurs in fissure fillings, irregular masses, and narrow eams mixed with calcite, quartz, and brecciated wall rock, in lenticular ›odies along fault and breccia zones in Tertiary, andesitic volcanic rocks.

The gold deposits and placers were found by Mexican prospectors as early s the 1860s and have been worked in a small way by others since that time. The manganese deposits were prospected and mined in the 1950s when the ;overnment manganese buying station for low-grade ores was established at Venden. In the late 1950s, concentrating plants were established near the 3olorado River to upgrade the ore to 40% plus manganese concentrates. All he manganese operations closed down when the government buying program nded.

The total gold ore mined probably never exceeded 52 tons of high grade, ssaying as much as 6 ounces per ton and thus containing some 62 ounces of old and 10 ounces of silver for a total value of abou $8,786. Estimated and ecorded production of placer gold would be some 323 ounces with minor ilver. The production of manganese ore may have been as much as 31,000 or nore long tons, mostly 20-30% Mn that was largely concentrated to 40% Mn r better, but some picked 40% Mn also was shipped directly.

The possibilities of large-scale economic ore deposits in the Trigo district o not look promising.

'uma Mining District

The Yuma mining district covers a small area to the southeast of the city of 'uma, in southwestern Yuma County (Figure 2). The settlement of Yuma ates back to at least 1854 and was one of the earliest in Arizona. It was first alled Colorado City, and then Arizona City, before acquiring its present ame. Almost from its founding, the settlement has been an important center or mining activity in southwestern Arizona and for the riverboat and later the ailroad transport of supplies and ore shipments for the mines.

The Yuma district lies in the relatively flat-lying Colorado River valley 'ith only a few outcropping knobs of granitic to gneissic rock rising through ıe Tertiary and Quaternary sediments from the underlying basement com-

plex. The intrusive or metamorphic rocks are probably Precambrian but were recrystallized in Laramide or Tertiary time. Wilson (1933) considered those outcrops as Precambrian to Mesozoic and on the Geologic Map of Yuma County (1960) as Mesozoic granite and related crystalline intrusive rocks. This designation also was used on the 1969 Geologic Map of Arizona. Recent work by the U. S. Geological Survey (Mattick, Olmsted, and Zohdy, 1973, and Olmsted, Loeltz, and Irelan, 1973) has furnished more detail on the structural features and formations in the area.

Only one deposit of gold-bearing quartz, occurring in fractures and faults in the gneiss, has been reported in the district. The total production from this mine would be some 466 tons of ore containing about 99 ounces of gold and 10 ounces of silver for a total value of some $3,000.

The district is not considered as favorable for any large, economic metallic mineral deposits.

KING OF ARIZONA MINE

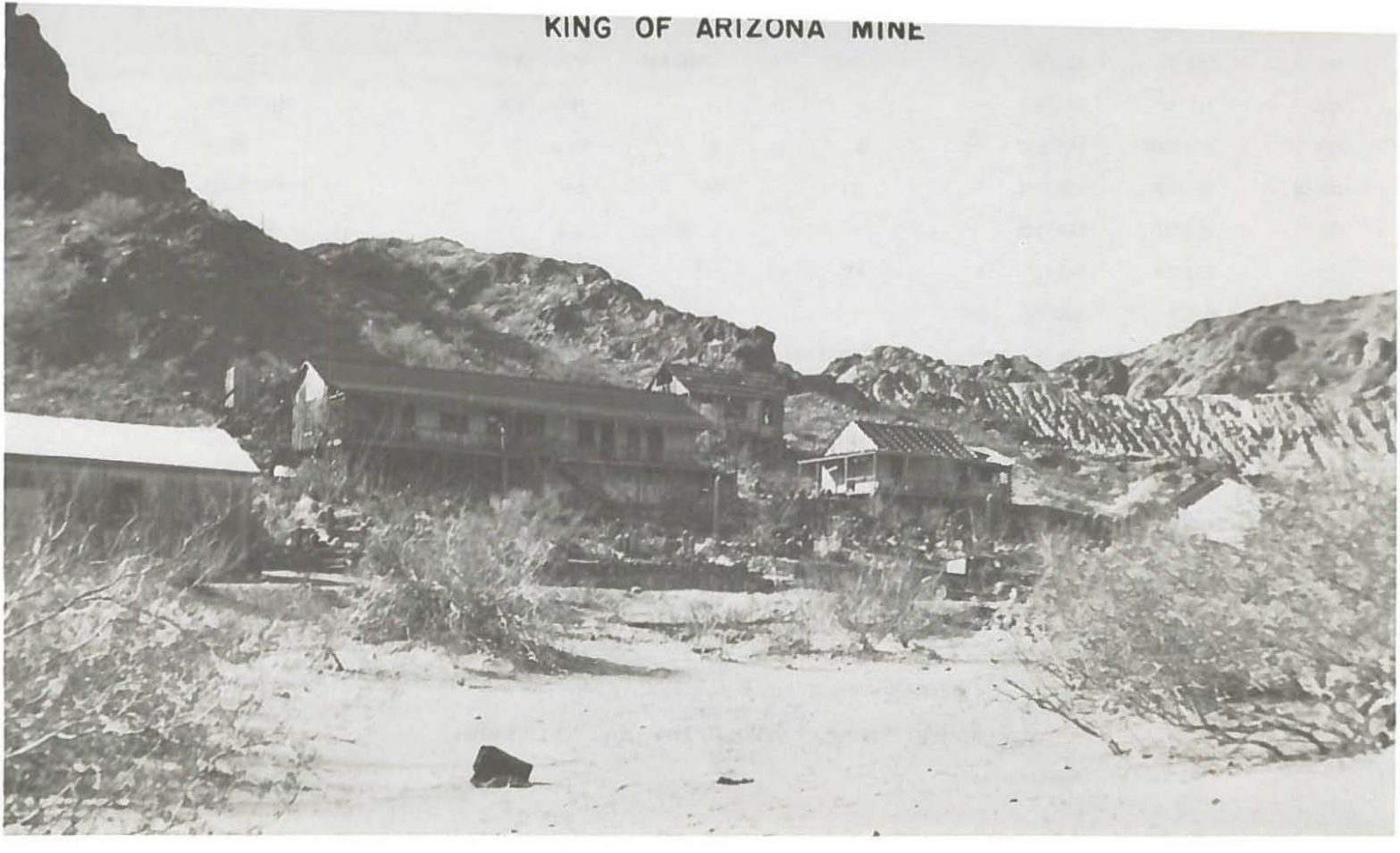


TABLE 1
PRODUCTION SUMMARY OF BASE AND PRECIOUS METALS
THROUGH 1974
(Including estimates for years data not available)

MINING DISTRICT	Ore (thousands of short tons)	Copper (thousands of lbs.)	Lead (thousands of lbs.)	Zinc (thousands of lbs.)	Gold (ozs.)	Silver (hundreds of ozs.)	Total (thousands of dollars)
Alamo	(824 tons)	44	54	—	66	984	14
Alamo Springs	(165 tons)	2	—	—	115	120	3
Castle Dome	121	72	21,393	76	9,003	497,911	2,015
Cienega	19	1,834	(288 lbs.)	—	11,707	3,364	656
Cunningham Pall	9	1,545	(45 lbs.)	—	4,436	2,344	430
Dome (Gila City)	—	—	—	—	26,006	1,180	545
Ellsworth	14	771	24	9	2,695	14,703	231
Fortuna	213	(98 lbs.)	—	—	134,489	10,655	2,801
Harquahala	160	90	121	—	131,063	89,501	2,857
Kofa	779	2	7	—	229,154	103,757	4,822
La Cholla	(294 tons)	41	—	—	9,796	3,817	253
Laguna	(556 tons)	(98 lbs.)	—	—	8,777	1,761	188

La Paz	11	15	4	—	[illegible]	[illegible]	[illegible]
La Posa	(415 tons)	16	—	—	181	308	8
Middle Camp-Oro Fino	(866 tons)	(473 lbs.)	122	6	9,958	973	239
Midway	(212 tons)	9	—	—	45	35	4
Mohawk	(61 tons)	2	22	—	7	21,346	14
Muggins	(410 tons)	(567 lbs.)	—	—	2,999	616	69
Neversweat	(187 tons)	9	43	—	111	1438	11
New Water	(518 tons)	35	—	—	—	514	6
Plomosa	26	1,052	688	130	24,994	129,205	1,172
Santa Maria	1405	45,350	—	—	1,128	34,606	12,041
Sheep Tank	17	2	—	—	20,904	39,731	735
Silver	52	(1,555 lbs.)	2,914	30	2,098	1,603,319	1,847
Tank Mountains	(50 tons)	—	—	—	250	10	5
Trigo Mountains	(52 tons)	—	—	—	385	13	9
Yuma	(466 tons)	—	—	—	99	9	3
Totals	2,831	50,894 (25,447 tons)	25,392 (12,696 tons)	251 (126 tons)	730,363	2,587,790	33,116

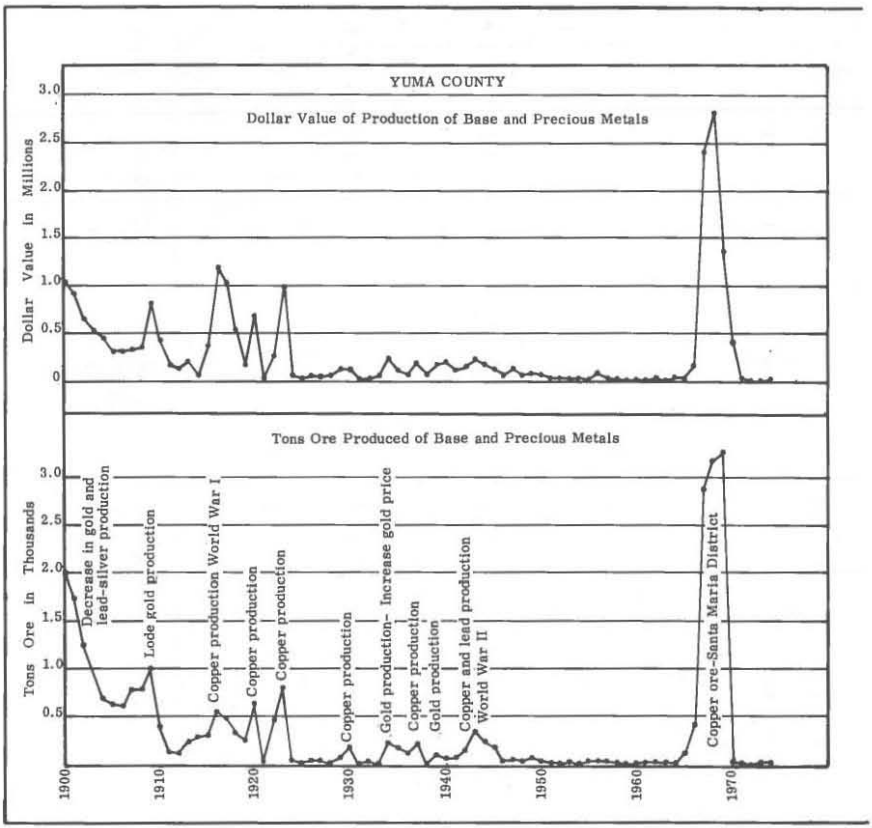


Figure 1. Graphs of production and value

TABLE 2
INDEX OF MINING PROPERTY NAMES

NAME	DISTRICT
ABC mine	Trigo Mountains
Abe No. 10 (see Haack mine group)	Castle Dome
Adams mine group	Castle Dome
Adams prospect	Eagle Tail
Addie group (see Silver Prince mine)	Neversweat
Ah-Ve-Aha (see Apache mine)	La Paz
Alamo group	Alamo Springs
Algodones - Nip No. 2 (see Haack mine group)	Castle Dome
Alonah group	Alamo Springs
Amelia mine	Silver and Eureka
American Flag group (see Little Giant group)	Cunningham Pass
Andrus claims	Trigo Mountains
Angelus mine	Santa Maria
Annie (Anna) mine	Castle Dome
Apache Chief mine group	Plomosa
Apache mine	La Paz
Argus and Maryland mine group	Santa Maria
Arizona Drift mine (see La Cholla placers)	La Cholla
Arizona McGinnis mine	Cienega
Arizona Midway mine	Midway
Arizona Northern (see Glory Hole mine)	Ellsworth
Arizona Pride (see Little Butte mine)	Plomosa
Arizona Pride mine	Cienega
Ballif (see True Blue mine group)	Ellsworth
Barbie (see Hovatter claim group)	Sheep Tanks
Barite - Nip No. 1 (see Haack mine group)	Castle Dome
Barite No. 3 (see Happy Day No. 3 mine)	Plomosa
Battleship Copper mine	Midway
Bell Crown mine	Ellsworth
Bell of Arizona mine	Plomosa
Bentonite mine	Plomosa
Bernarde mine	Alamo
Big Chief (see Renegade mine)	Plomosa
Big Dome - Dusty No. 4 (see Buckeye vein group)	Castle Dome
Big Eye, Outlook, and Lookout mines	Castle Dome
Big Horn group (see Moro mine group)	Santa Maria
Big Horn prospect	Alamo Springs
Big Jim (see Cleveland - Chicago group)	Castle Dome
Bill Taft group prospects	Gila Bend Mountains
Billy Mack mine group	Cienega
Bishop (Triple H. mine group)	Trigo Mountains
Black Band mine	Alamo
Black Beauty mine	Plomosa
Black Bird mine group	Plomosa
Black Bitch (see Spring mine group)	Alamo
Black Buck and Buckhorn mines	Eagle Tail
Black Cat and Minnezona mines	Ellsworth
Black Chief mine	Plomosa

Table 2, Cont.

NAME	DISTRICT
Black Dahlia mine	Kofa
Black Diamond mine group	Trigo Mountains
Black Hawk mine	Eagle Tail
Black Jack mine	Trigo Mountains
Black Joe mine	Castle Dome
Black King mine	Tank Mountains
Black Mesa mine	Plomosa
Black Mountain mine group	Plomosa
Black Mule (see Happy Day No. 3 mine)	Plomosa
Black Reef (see Centroid mine group)	Cunningham Pass
Black Rock mine	Silver and Eureka
Black Top mine	Castle Dome
Blue Bell (see Mystery Hill mine group)	Alamo
Blue Bird (see Dandy mine group)	Ellsworth
Blue Eagle, Bunker Hill, and Four Winds mine group	Harquahala
Blue Moon (see Coronation mine group)	Plomosa
Blue Slate mine group	Plomosa
Bombay (see Hovatter claim group)	Sheep Tanks
Bonanza and Evylin mine group	Cunningham Pass
Bonanza (Harquahala) and Golden Eagle mine group	Harquahala
Bright Star mine	Plomosa
Bronza - Hardrock (see Haack mine group)	Castle Dome
Buckeye vein group	Castle Dome
Bullard mine group	Cunningham Pass
Bullion mine group	Plomosa
Bunker Hill prospects	Harquahala
C.O.D. group	Alamo Springs
Caledona (see Buckeye vein group)	Castle Dome
Camp Creek prospect	Gila Bend Mountains
Capilano mine	Cienega
Carnation mine	Cienega
Cash Entry group (see Little Giant group)	Cunningham Pass
Cass (see H. H. and L. mine group)	Trigo Mountains
Castle Dome (see Buckeye vein group)	Castle Dome
Castle Dome gold placers	Castle Dome
Cemitosa prospect	Alamo Springs
Centroid mine group	Cunningham Pass
Chappo placers (see La Cholla placers)	La Cholla
Charlie Sam group (see Rob Roy mine)	Kofa
Chicago group (see Rob Roy mine)	Kofa
Chief of Dome (see Hull or Rialto mine group)	Castle Dome
Cibola No. 1 mine	Trigo Mountains
Cibola No. 3 mine	Trigo Mountains
Cibola No. 7 mine	Trigo Mountains
Cibola No. 8 mine	Trigo Mountains
Cindy mine	Plomosa
Cinnabar mine	La Cholla
Clara mine	Santa Maria
Clayton (see Mystery Hill mine group)	Alamo

Table 2, Cont.

NAME	DISTRICT
Cleveland-Chicago group	Castle Dome
Clip mine	Silver and Eureka
Collins prospect	Eagle Tail
Colorado River placers	Silver and Eureka
Columbia (see Bullard mine group)	Cunningham Pass
Continental (see Mineral Hill mine group)	Santa Maria
Copper Basin (see Wenden King mine group)	Cunningham Pass
Copper Bottom mine	La Cholla
Copper Chief (see Darling mine)	La Paz
Copper Giant mine	La Paz
Copper Glance mine	Castle Dome
Copper Hill (see Centroid mine group)	Cunningham Pass
Copper Hill (see Coronation mine group)	Plomosa
Copper King (see Heart's Desire mine)	Plomosa
Copperopolis (see Wenden King mine group)	Cunningham Pass
Copperopolis (see Apache Chief mine group)	Plomosa
Copper Prince (see Signal mine group)	Santa Maria
Copper Queen (see Arizona McGinnis mine)	Cienega
Copper Queen (see Moore mine group)	New Water
Copper Top (see Rio Vista Southside mine)	Cienega
Coronation mine group	Plomosa
Critic mine	Cunningham Pass
Cuprite mine group	Cunningham Pass
Dandy Boy group (see Adams mine group)	Castle Dome
Dandy mine group	Ellsworth
Darling mine	La Paz
Davis & Fleming mine groups	Cunningham Pass
Desert (see Centroid mine group)	Cunningham Pass
Desert Dwarf (see Poorman mine)	La Posa
Desert mine	Ellsworth
Desert mine placers (see Granite Wash Mountains placers)	Ellsworth
Diana (see Mystery Hill mine group)	Alamo
Diana (see Hull or Rialto mine group)	Castle Dome
Dives (see Saxon mine)	Silver and Eureka
Dome placers	Dome
Dona Kay mine	Ellsworth
Double Eagle mine	La Posa
Douglas (see Hull or Rialto mine group)	Castle Dome
Doyle mine	Alamo
Dutch Henry (see Granite Wash Mountains placers)	Ellsworth
Dutchman mine	Plomosa
Eagle Eye (see Moore mine group)	New Water
Eagle Nest mine	Cienega
Eagle Tail group or Golden State mine	Eagle Tail
Emerald group (see Cuprite mine group)	Cunningham Pass
Engesser prospect (see Johnnie prospect)	Tank Mountains
Eureka (see Riverview mine)	Silver and Eureka
Eureka-Mizpah (see Iron Wood mine)	Kofa
Evening Star mine group	Kofa

Table 2, Cont.

NAME	DISTRICT
Excelsior mine	Plomosa
Farrar Gulch placers	La Paz
Firestone group (see Bright Star mine)	Plomosa
Flora Temple mine	Castle Dome
Flying Dutchman (see Dutchman mine)	Plomosa
Fools Folly mine	Trigo Mountains
Fortuna mine	Fortuna
Frisco, Betty Lee, and Ella J. mines	La Posa
Gentry Lead-Silver mine	Eagle Tail
Geronimo North & South mines	Silver and Eureka
Geyser or Silent King mine	Alamo Springs
Gibson Manganese mine	Castle Dome
Gleason (see King of Arizona mine)	Kofa
Glory group (see Lion Hill mine group)	Cienega
Glory Hole mine	Ellsworth
Gold Belt (see Goodman mine group)	La Paz
Gold Dyke mine group	Harquahala
Gold Eagle (see Desert mine)	Ellsworth
Golden (see Dandy mine group)	Ellsworth
Golden Mound (see Desert mine)	Ellsworth
Golden Orbit (see True Blue mine group)	Ellsworth
Golden Ray mine group	Cienega
Golden Star mine group	Cunningham Pass
Gold Leaf, Rattlesnake, and Rosebud mine group	Harquahala
Gold Nugget mine	Plomosa
Golden Harp prospect	Tank Mountains
Golden Queen (see Las Flores mine group)	Laguna
Gold Leaf (see Double Eagle mine)	La Posa
Gold Reef prospect	Silver and Eureka
Goodenough (see Apache Chief mine group)	Plomosa
Goodman mine group	La Paz
Grand Central mine	Trigo Mountains
Granite Wash Mountains placers	Ellsworth
Great Central (see Planet [New Planet] mine group)	Santa Maria
Green Hill mine	Ellsworth
Green Streak mine	Midway
Guadalupe (see Gold Nugget mine)	Plomosa
H. H. and L. mine group	Trigo Mountains
Haack mine group	Castle Dome
Haack No. 1 & No. 2 (see Haack mine group)	Castle Dome
Hall mine	Ellsworth
Hamilton (see Midnight mine)	Kofa
Happy Day No. 3 mine	Plomosa
Happy Jean group (see Bernarde mine)	Alamo
Harris group (see Centroid mine group)	Cunningham Pass
Hartzig (see Leadville mine group)	Middle Camp-Oro Fino
Heart's Desire	Plomosa
Hercules mine	Harquahala
Hidden Treasure mine	Harquahala

:able 2, Cont.

JAME	DISTRICT
Iilltop (see Hovatter claim group)	Sheep Tanks
Iope (see Cleveland-Chicago group)	Castle Dome
Iopkins (see Buckeye vein group)	Castle Dome
Iovatter claim group	Sheep Tanks
Iull (see Hull or Rialto mine group)	Castle Dome
Iull or Rialto mine group	Castle Dome
Iumdinger mine	Plomosa
ndependence (see Quartette mine)	Kofa
ndia (see Las Flores mine group)	Laguna
ron Cap group (see Wenden King mine group)	Cunningham
ron Queen & Copper Prince mine groups	Plomosa
ron Queen, Gila Monster, etc. placers	Plomosa
ron Wood mine	Kofa
XL prospect	Alamo Springs
'ohnnie prospect	Tank Mountains
:. P. (see Triple H mine group)	Trigo Mountains
'ackson Copper (see Heart's Desire mine)	Plomosa
'ames G. Blaine (see Clip mine)	Silver and Eureka
'anuary group (see Montana-Arizona mine)	Alamo
'ewel Anne mine group	Ellsworth
'ude mine group	Yuma
'ulian (Julius) mine group	Middle Camp-Oro Fino
Kaiserdoom group (see Spring mine group)	Alamo
Katy Ross group (see Rob Roy mine)	Kofa
Keiser barite mine	Plomosa
King of Arizona mine	Kofa
Kofa gold placers	Kofa
Kofa Queen mine	Alamo Springs
La Angora	La Paz
Le Cholla placers	La Cholla
La Colorado or Lincoln mine group	Castle Dome
Laguna Dam placers and prospects	Laguna
La Paz placers	La Paz
Lady Edith and Yuma-New Chance No. 4 (see Buckeye vein group)	Castle Dome
Las Flores mine group	Laguna
Las Flores placers	Laguna
Last Chance and Copper Coin mines	La Posa
Last Resort (see Doyle mine)	Alamo
Lead Camp (see Southern Cross mine)	Plomosa
Leadville mine group	Middle Camp-Oro Fino
Linda Extension (see Little Dome mine)	Castle Dome
Linda K mine	Plomosa
Linda group (see Sonora mine group)	Castle Dome
Lion Hill mine group	Cienega
Little Butte mine	Plomosa
Little Dome mine	Castle Dome
Little Giant Extension (see Cuprite mine group)	Cunningham Pass
Little Giant mine groups	Cunningham Pass
Luck Lead (see Southern Cross mine)	Plomosa
Lucky mine group	Santa Maria

Table 2, Cont.

NAME	DISTRICT
Lucky Strike prospect	Gila Bend Mountains
McKay prospect	Dome
McPhaul area placers	Laguna
McPhaul prospect	Dome
M & A (see Andrus claims)	Trigo Mountains
Mable (Mabel) mine group	Castle Dome
Magic group (see Hidden Treasure mine)	Harquahala
Magnesite mine	Alamo
Mammon mine group	Cienega
Mammon-Zeolite (see Mammon mine group)	Cienega
Mammoth, Chicago, and Copper Glance mine group	Midway
Manganese King group (see Black Band mine)	Alamo
Manganite mine	Alamo
Mariguitta mine	Middle Camp-Oro Fino
Mars and Mescal mine group	Harquahala
Mendevil claim	Silver and Eureka
Metate and Confusion mine groups	La Paz
Middle Camp gold placers	Middle Camp-Oro Fino
Midnight mine	Kofa
Mildred or Hart (see Linda K mine)	Plomosa
Mildred group (see Mystery Hill mine group)	Alamo
Miller (see Buckeye vein group)	Castle Dome
Mineral Hill mine group	Santa Maria
Mohawk (see Bullard mine group)	Cunningham Pass
Montana-Arizona mine	Alamo
Montezuma (see Copper Glance mine)	Castle Dome
Moore mine group	New Water
Moro mine group	Santa Maria
Mountain Chief (see Darling mine)	La Paz
Mudersback (see Excelsior mine)	Plomosa
Muggins Mountains uranium prospects	Muggins District
Myrtle (see Black Diamond mine group)	Trigo Mountains
Mystery Hill (see Coronation mine group)	Plomosa
Mystery Hill mine group	Alamo
National Debt mine	Plomosa
New Cleveland (see Cleveland-Chicago group)	Castle Dome
New Oil-New Chance No. 1 (see Buckeye vein group)	Castle Dome
New Standard mine	Cienega
Newmont group (see Apache Chief mine group)	Plomosa
New Year Nos. 2 & 3 (see H. H. and L. mine group)	Trigo Mountains
Night Hawk, White Dike, & Colorado mine groups	Plomosa
Norma (see Buckeye vein group)	Castle Dome
North Star mine	Kofa
Oakland mine	Sheep Tanks
Old Frenchman (see Humdinger mine)	Plomosa
Old Maid mine	Plomosa
Old Noel (see Mars and Mescal mine group)	Harquahala

'able 2, Cont.

AME	DISTRICT
)ld Selby Bonanza (see Riverview mine)	Silver and Eureka
)ro Fino gold placers	Middle Camp-Oro Fino
'acific & Mandan claims	Silver and Eureka
'adre Kino (see Saxon mine)	Silver and Eureka
'andino or Panadero (see Las Flores mine group)	Laguna
'apago mine	Silver and Eureka
'ee Wee mine group	Ellsworth
'eggy B mine	Trigo Mountains
'erry Chrysoprase	Plomosa
'erseverance (see Quartette mine)	Kofa
'hoenix and Yuma mine groups	Plomosa
'icacho (see Humdinger mine)	Plomosa
'ittsburg Harqua Hala (see San Marcos mine group)	Harquahala
'lanet (New Planet) mine group	Santa Maria
'ocahontas (see Hull or Rialto mine group)	Castle Dome
Railroad (see Hull or Rialto mine group)	Castle Dome
'oorman and Goodman mines	Plomosa
'oorman mine	La Posa
'ride (see Arizona Pride mine)	Cienega
'rincess and Hamburg mines	Silver and Eureka
'uckett (see Mable [Mabel] mine group)	Castle Dome
'uzzler (see Adams mine group)	Castle Dome
'uzzler prospect	Tank Mountains
Quartette mine	Kofa
Quartzite tungsten (see Tungsten Hill mine)	La Paz
Quartz King (see Rio Vista Southside mine)	Cienega
R. & A. (see Ramsey mine)	Plomosa
Ramsey prospect	Tank Mountains
Ramsey mine	Plomosa
Rand prospect	Alamo Springs
Red Bird prospect	Eagle Tail
Red Cloud mine	Silver and Eureka
Red Cross (Norton) mine	Mohawk
Red Hill (see Renegade mine)	Plomosa
Regal prospect	Alamo Springs
Renegade mine	Plomosa
Renner mine	Mohawk
Resolution group (see Sheep Tank mine)	Sheep Tank
Revenue mine group	Santa Maria
Rico (see Lion Hill mine group)	Cienega
Rio del Monte mine	Harquahala
Rio Vista Northside mine	Cienega
Rio Vista Southside mine	Cienega
Riverview mine	Silver and Eureka
Road's End (see Black Band mine)	Alamo
Robinson group (see Centroid mine group)	Cunningham Pass
Rob Roy mine	Kofa
Rosie (see Triple H. mine group)	Trigo Mountains
Ruby (see Billy Mack mine group)	Cienega
Ruby No. 1 & No. 2 (see Cleveland-Chicago group)	Castle Dome

Table 2, Cont.

NAME	DISTRICT
Salome Strike (see Glory Hole mine)	Ellsworth
San Marcos mine group	Harquahala
San Pablo (see McPhaul area placers)	Laguna
Saxon mine	Silver and Eureka
Scotchman (see Bullion mine group)	Plomosa
Scott Lode (see Goodman mine group)	La Paz
Shamrock mine	Plomosa
Sheba mine	Ellsworth
Sheep Tank mine	Sheep Tank
Sierra Blanca (see Keiser barite mine)	Plomosa
Signal mine group	Santa Maria
Silver Clip (see Clip mine)	Silver and Eureka
Silver Dollar (see Adams mine group)	Castle Dome
Silverfields (see Jude mine group)	Yuma
Silver Glance claim	Silver and Eureka
Silver King claim	Silver and Eureka
Silver Prince mine	Neversweat
Socorro mine	Harquahala
Sonora mine group	Castle Dome
Southern Cross mine	Plomosa
Southwest Muggins Mountains gold placers	Muggins
Spring mine group	Alamo
Squaw T mine	Ellsworth
Stafford mine	Plomosa
Starr (see Dandy mine group)	Ellsworth
Success (see Apache Chief mine group)	Plomosa
Sue mine	Cienega
Sunnyside (see Bernarde mine)	Alamo
Surprise (see Hull or Rialto mine group)	Castle Dome
Swansea (see Signal mine group)	Santa Maria
Three Musketeers mine	Ellsworth
Thumb Butte (see Copper Glance mine)	Castle Dome
Trager or Agate (see Las Flores mine group)	Laguna
Trigo gold placers	Trigo Mountains
Triple H. mine group	Trigo Mountains
True Blue mine group	Ellsworth
Tungsten Giant mine group	Harquahala
Tungsten Hill mine	La Paz
Tungsten mine group	Kofa
Tunnel Springs (Ramshorn) prospect	Alamo
Uncle Sam (see Darling mine)	La Paz
Velmaette (see Tungsten Hill mine)	La Paz
Vindicator group (see Little Giant group)	Cunningham Pass
Vinegarroon Wash gold placers	Muggins
W. & O. (see Mammon mine group)	Cienega
Wellton Hills mine	La Posa
Wenden mine group	Cunningham Pass
Wenden King mine group	Cunningham Pass
White Marble quarry	Harquahala
Why Not, Clipper, and Gold mine groups	Harquahala
Wilkinson group (see Cuprite mine group)	Cunningham Pass

Table 2. Cont.

NAME	DISTRICT
William Penn (see Buckeye vein group)	Castle Dome
Wilson (see San Marcos mine group)	Harquahala
Yellow Bird mine placers (see Granite Wash Mountains placers)	Ellsworth
Yum Yum mine	La Cholla
Yuma mine	Ellsworth

TABLE 3

INDEX OF MINING PROPERTY OPERATIONS

NAME	PROPERTY	DISTRICT
Adams	Dutchman mine	Plomosa
Adams	Adams mine group	Castle Dome
Allen	Billy Mack mine group	Cienega
All State Mining Company	Desert mine	Ellsworth
American-Arizona Metals Company	Carnation mine	Cienega
American Coarse Gold Corporation	Middle Camp gold placers	Middle Camp-Oro Fino
American Smelting & Refining Company	Signal mine group	Santa Maria
Amplex Corporation	Black Bird mine group	Plomosa
Anozira Mining Co.	Sheep Tanks mine	Sheep Tanks
Apache Chief Mining Company	Apache Chief mine group	Plomosa
Apache Metals, Incorporated	Apache Chief mine group	Plomosa
Apache Mines Syndicate	Apache Chief mine group	Plomosa
Aplington	Apache Chief mine group, Bell of Arizona, Bright Star mine	Plomosa
Aplington	Three Musketeers mine	Ellsworth
Aplington & Ehlers	Apache Chief mine group	Plomosa
Arizona Apache Mines Company	Apache Chief mine group	Plomosa
Arizona Bouse Copper Company	Little Butte mine	Plomosa
Arizona Consolidated Mining Company	Frisco, Betty Lee, and Ella J. mines	La Posa
Arizona Double Eagle Corporation	Double Eagle mine	La Posa
Arizona Lead Company	Haack mine group	Castle Dome
Arizona Leadville Mines Company	Leadville mine group	Middle Camp-Oro Fino
Arizona McGinnis Copper Company	Arizona McGinnis mine	Cienega
Arizona Midway Copper Co.	Arizona Midway mine	Midway
Arizona Operating Company	Copper Bottom mine	La Cholla
Arizona Ranch & Metals Company	Mineral Hill mine group	Santa Maria
Arizona Revenue Copper Company	Revenue mine group	Santa Maria
Arizona Standard Copper Company	New Standard mine	Cienega
Arizona Success Mining Company	Apache Chief mine group	Plomosa

Table 3, Cont.

NAME	PROPERTY	DISTRICT
Associated Mines Company	Little Butte mine	Plomosa
Baker & King Copper Mining Company	Carnation mine	Cienega
Bannard	Last Chance and Copper Coin mines	La Posa
Barrett & Robinson	Copper Giant mine	La Paz
Barrio	Iron Wood mine	Kofa
Bartlett	Julian (Julius) mine group	Middle Camp-Oro Fino
Battan	Pacific and Mandan claims	Silver and Eureka
Bellus	Bentonite mine	Plomosa
Bernarde	Bernarde mine	Alamo
Big Eye Mining Company	Big Eye, Outlock, and Lookout mines	Castle Dome
Big Eye Mining & Milling Company	Big Eye, Outlook, and Lookout mines	Castle Dome
Billy Mack Mining Company	Billy Mack mine group, Lion Hill mine group	Cienega
Black Giant Mines Company	Little Giant mine groups	Cunningham Pass
Black Mesa Mining Company	Ramsey mine	Plomosa
Black Reef Copper Company	Centroid mine group	Cunningham Pass
Black Rock Mining & Reduction Co.	Black Rock mine	Silver and Eureka
Blake & Associates	Princess and Hamburg mines	Silver and Eureka
Blue Sky Mining Company	Coronation mine group	Plomosa
Bonanza and Golden Eagle Mining Company	Bonanza (Harquahala) and Golden Eagle mine group	Harquahala
Bonanza Central Mining Company	Bonanza and Evylin mine group	Cunningham Pass
Bonanza Mining Company	Bonanza (Harquahala) and Golden Eagle mine group	Harquahala
Bonanza Mining Company	Bonanza and Evylin mine group	Cunningham Pass
Boone	Critic mine	Cunningham Pass
Botzum & Associates	Capilano mine	Cienega
Bouse & McMahon	Blue Slate mine group, Dutchman mine, Little Butte mine	Plomosa
Bouse Development Company	Little Butte mine	Plomosa
Boyd & Napel	Mystery Hill mine group	Alamo
Bretz	Las Flores mine group	Laguna
Brewer	Black Mountain mine group, Southern Cross mine	Plomosa

Table 3, Cont.

NAME	PROPERTY	DISTRICT
Brewer	Moore mine group	New Water
Britania Gold Mines, Incorporated	Black Cat and Minnezona mines	Ellsworth
Britt & Edgerton	Silver Prince mine	Neversweat
Brown	Peggy B mine, Triple H. mine group	Trigo Mountains
Brown	Apache Chief mine group	Plomosa
Brown	Doyle mine, Spring mine group	Alamo
Browning	Silver Prince mine	Neversweat
Brusco	Three Musketeers mine	Ellsworth
Buckanon	Critic mine	Cunningham Pass
Bullard	Bullard mine group, Critic mine	Cunningham Pass
Bunker	Blue Eagle, Bunker Hill, and Four Winds mine group	Harquahala
Bunker	Hall mine	Ellsworth
Butler	Billy Mack mine group	Cienega
Burton	Jude mine group	Yuma
Burton	Fortuna mine	Fortuna
Cadwaller	Sonora mine group	Castle Dome
Campbell	Blue Eagle, Bunker Hill, and Four Winds mine group, Gold Dyke mine group	Harquahala
Capilano Holdings Incorporated	Capilano mine	Cienega
Cargill	Silver Glance claim	Silver and Eureka
Carlson	Yum Yum mine	La Cholla
Carper et alia	Why Not, Clipper, and Gold mine groups	Harquahala
Carr	Moore mine group	New Water
Carrigan	New Standard mine	Cienega
Carter	Black Dahlia mine	Kofa
Castle Dome Exploration & Development Co.	Copper Glance mine	Castle Dome
Castle Dome Mining Company	Cleveland-Chicago group, Hull or Rialto mine group	Castle Dome
Castle Dome Mining & Smelting Company	Buckeye vein group, Flora Temple mine, Hull or Rialto mine group	Castle Dome
Catalina Gold Mining Company	Oro Fino gold placers	Middle Camp-Oro Fino

Table 3, Cont.

NAME	PROPERTY	DISTRICT
Centroid Consolidated Mines	Centroid mine group	Cunningham Pass
Childress & Wright	Cleveland-Chicago group	Castle Dome
Chrisholm	Arizona Midway mine	Midway
Christian	Black Mesa mine	Plomosa
Cinnabar Development Company	Cinnabar mine	La Cholla
Clara Consolidated Gold & Copper Mining Co.	Clara mine, Moro mine group, Signal mine group	Santa Maria
Clara-Swansea Mining Company	Signal mine group	Santa Maria
Clausen	Copper Bottom mine	La Cholla
Cline & Hartz	Hercules mine	Harquahala
Cobrita Mines Company	Sheba mine	Ellsworth
Cohoe & Rowland	Jewel Anne mine group	Ellsworth
Colonial Mining Company	Cinnabar mine	La Cholla
Consolidated Arizona Mines	Centroid mine group	Cunningham Pass
Consolidated Arizona Smelting Company	Signal mine group	Santa Maria
Consolidated Mines Syndicate	Centroid mine group	Cunningham Pass
Contreras	Jewel Anne mine group	Ellsworth
Cooper	Mariquitta mine	Middle Camp-Oro Fino
Cooper	Little Giant mine groups	Cunningham Pass
Copper Chief Mines Company	Darling mine	La Paz
Copple & McIntosh	Frisco, Betty Lee, and Ella J. mines	La Posa
Corey	Old Maid mine	Plomosa
Cornejo	Carnation mine, Eagle Nest mine	Cienega
Corona Copper Compnay	Mammoth, Chicago, and Copper Glance mine group	Midway
Coronation Mining Company	Coronation mine group	Plomosa
Coronation Mining Company	Mystery Hill mine group	Alamo
Cowell & Brown	Southern Cross mine	Plomosa
Craig	Planet (New Planet) mine group	Santa Maria
Craig & Baldwin	Angelus mine	Santa Maria
Cripple Crew Mining Company	Bullard mine group	Cunningham Pass
Crocket & Gibbons	Montana-Arizona mine	Alamo
Crowder	Copper Glance mine	Castle Dome

Table 3, Cont.

NAME	PROPERTY	DISTRICT
Crowder & Green	Big Eye, Outlook, and Lookout mines	Castle Dome
Cunningham Pass Copper Mining Company	Critic mine	Cunningham Pass
Cuprite Investment Company	Cuprite mine group	Cunningham Pass
Curtis	Clara mine	Santa Maria
Daniels	Metate and Confusion mine groups	La Paz
Dasco Mines Corporation	Doyle mine	Alamo
Davis	Davis and Fleming mine groups	Cunningham Pass
Davis, Luke, & McElrath	Oakland mine	Sheep Tanks
Death Valley Arcalveda Consolidated Mines Co.	Socorro mine	Harquahala
R. A. Delano Company	Mineral Hill mine group	Santa Maria
De Luce	Buckeye vein group, Cleveland-Chicago group, Flora Temple mine, Haack mine group, Hull or Rialto mine group, Little Dome mine, Sonora mine group	Castle Dome
Dennis	Golden Ray mine group	Cienega
Denton	Arizona Pride mine	Cienega
Desert Lead Company	Haack mine group, Hull or Rialto mine group	Castle Dome
Desert Mining Company	Desert mine	Ellsworth
Desert Mining Company	Centroid mine group	Cunningham Pass
Desert Mining & Development Company	Centroid mine group	Cunningham Pass
Dobbins	Linda K mine	Plomosa
Dona Kay Mining Company	Dona Kay mine	Ellsworth
Doyle & Smith	Black Band mine	Alamo
Doyle Brothers	Doyle mine	Alamo
Draper	Mendevil claim	Silver and Eureka
Ducker & Wilson Brothers	Little Butte mine	Plomosa
Dillard	Sheep Tanks mine	Sheep Tanks
Donnelly & Walcott	Bullard mine group	Cunningham Pass
Draghi	Wellton Hills mine	La Posa
Edward Bros.	Critic mine	Cunningham Pass
Eichelberger & Rivers	Apache Chief mine group	Plomosa
Elan Mining Company	Fortuna mine	Fortuna

Table 3, Cont.

NAME	PROPERTY	DISTRICT
Elmer	Squaw T mine	Ellsworth
El Pluma Mines, Incorporated	Mystery Hill mine group	Alamo
El Tigro Mining Company	Mystery Hill mine group	Alamo
Empire Arizona Consolidated Copper Co.	Carnation mine, Eagle Nest mine	Cienega
Empire Arizona Copper Company	Carnation mine, Eagle Nest mine	Cienega
Empire Arizona Mining Company	Carnation mine, Eagle Nest mine	Cienega
Enderton	Fortuna mine	Fortuna
Essential Minerals Limited	Sonora mine group	Castle Dome
Evans	Spring mine group	Alamo
Excelsior Gold & Copper Company	Excelsior mine	Plomosa
Fails	Black Dahlia mine	Kofa
Farrow	Copper Giant mine	La Paz
Fay Mining Company	Jude mine group	Yuma
Feighton	Critic mine	Cunningham Pass
Ferguson	Riverview mine	Silver and Eureka
Findley	Midnight mine	Kofa
Fisher	Spring mine group	Alamo
Fisher Enterprises, Incorporated	White Marble quarry	Harquahala
Fleming	Three Musketeers mine	Ellsworth
Fleming & Aplington	Green Streak mine	Midway
Floreen & Associates	Three Musketeers mine	Ellsworth
Fornis	Cindy mine	Plomosa
Fortuna Mines Corporation	Fortuna mine	Fortuna
Frazier	Wellton Hills mine	La Posa
French	Mystery Hill mine group	Alamo
Fries	Quartette mine	Kofa
Fuher	Double Eagle mine	La Posa
Gallo	Amelia mine	Silver and Eureka
Garrick	Bullard mine group	Cunningham Pass
Gary & Adams	Green Hill mine	Ellsworth
Georgekin	Billy Mack mine group	Cienega
Gerlack	Black Jack mine	Trigo Mountains

Table 3, Cont.

NAME	PROPERTY	DISTRICT
Geronimo Mining Co.	Silver King claim	Silver and Eureka
Gibson	Black Diamond mine group	Trigo Mountains
Gibson	Midnight mine, Tungsten mine group	Kofa
Gibson	Black Joe mine	Castle Dome
Gifford & Ferguson	Copper Glance mine	Castle Dome
Gilbert & Schmidt	Socorro mine	Harquahala
Glenn & Fleming	Bright Star mine	Plomosa
Glory Hole Bonanza Mines Company	Glory Hole mine	Ellsworth
Godbe Brothers	Old Maid mine	Plomosa
Gold Dome Mining Company	Las Flores mine group	Laguna
Golden Ray Mining Company	Golden Ray mine group	Cienega
Golden Star Mining and Milling Company	North Star mine	Kofa
Gold Hill Dredging Company	Tungsten Hill mine	La Paz
Goldzona Scotchman Mining Company	Bullion mine group	Plomosa
Gandolfo & Sanquinetti	Buckeye vein group, Flora Temple mine, Hull or Rialto mine group	Castle Dome
Graner	Dutchman mine	Plomosa
Graves	Mystery Hill mine group	Alamo
Gray	True Blue mine group	Ellsworth
Great Western Gold & Copper Company	Blue Slate mine group, Dutchman mine	Plomosa
Grossback	Dutchman mine	Plomosa
Grossman	La Cholla placers	La Cholla
Grover	Big Eye, Outlook, and Lookout mine	Castle Dome
Haack	Cleveland-Chicago group, Haack mine group, Little Dome mine, Sonora mine group	Castle Dome
Hanna	Red Cloud mine	Silver and Eureka
Hardt	Grand Central mine	Trigo Mountains
Hare	Spring mine group	Alamo
Harris	Centroid mine group	Cunningham Pass
Harris	Billy Mack mine group	Cienega
Harqua Hala Gold Mining Company	Bonanza (Harquahala) and Golden Eagle mine group	Harquahala

Table 3, Cont.

NAME	PROPERTY	DISTRICT
Harquahala Mining Company	Bonanza (Harquahala) and Golden Eagle mine groups	Harquahala
Harquahala Operating Company	Bonanza (Harquahala) and Golden Eagle mine group	Harquahala
Harrison & Doyle	Black Band mine	Alamo
Harritt & Davis	Carnation mine	Cienega
Hart	Linda K mine	Plomosa
Hasedel Mining Compnay	Desert mine	Ellsworth
Hatch	Critic mine, Wendon King mine group	Cunningham Pass
Hay	Billy Mack mine group	Cienega
Hayden & Farmosano	Mystery Hill mine group	Alamo
Hayler Mining Industries	Moro mine group	Santa Maria
Health & Wealth Club, Inc.	Sue mine	Cienega
Heckler	Heart's Desire mine	Plomosa
Hedgepeth	Jude mine group	Yuma
Helcion Mines, Incorporate	La Cholla placers	La Cholla
Herbert	Centroid mine group	Cunningham Pass
Hercules Gold Mining Company	Hercules mine	Harquahala
Hess, Hess & Lilly	H. H. and L. mine group	Trigo Mountains
Hickman	Apache Chief mine group	Plomosa
Hindman	Poorman mine	La Posa
Hodge	Cleveland-Chicago group	Castle Dome
Hoffmeister	Old Maid mine	Plomosa
Holmes & Nichelson	Fortuna mine	Fortuna
Homestake Mining Company	Sonora mine group	Castle Dome
Honey	Wenden mine group	Cunningham Pass
Horton & Knapp	Red Cloud mine	Silver and Eureka
Hovatter	Hovatter claim group	Sheep Tanks
Hovatter	Moore mine group	New Water
Howell, Seely, & Johnson	Hidden Treasure mine	Harquahala
Hubbard & Bowers	Clip mine, Red Cloud mine	Silver and Eureka
Hubbard & Bowers	Bonanza (Harquahala) and Golden Eagle mine group	Harquahala

Table 3, Cont.

NAME	PROPERTY	DISTRICT
Hudgens	Gold Leaf, Rattlesnake, and Rosebud mine group	Harquahala
Hudson	Adams mine group, Big Eye, Outlook, and Lookout mines, La Colorado or Lincoln mine group	Castle Dome
Huffman	Rob Roy mine	Kofa
Hull Mines	Hull or Rialto mine group	Castle Dome
Huss	Silver King claim	Silver and Eureka
Hussen	Copper Bottom mine	La Cholla
Huthmacher	National Debt mine	Plomosa
Huthmacher	Battleship Copper mine	Midway
Huthmacher & Dilts	Pee Wee mine group	Ellsworth
Huthmacher & Frisbee	Bullard mine group	Cunningham Pass
Hutton & Earp	Why Not, Clipper, and Gold mine groups	Harquahala
Ibox Mines Company	Sheep Tanks mine	Sheep Tanks
Illinois-Arizona Copper Company	Billy Mack mine group, Lion Hill mine group	Cienega
Iron Tree Mining Company	Little Butte mine	Plomosa
Ironwood & Arizona Development Company	Yuma mine	Ellsworth
Jackson & Lount	Heart's Desire mine	Plomosa
James & Associated	Wenden King mine group	Cunningham Pass
Jerome Wenden Copper Company	Mars and Mescal mine group	Harquahala
Johnson	Hidden Treasure mine, Why Not, Clipper, and Gold mine groups	Harquahala
Jones	Silver King claim	Silver and Eureka
Jones	Argus and Maryland mine group	Santa Maria
Jones	Silver Prince mine	Neversweat
Jones	Bonanza (Harquahala) and Golden Eagle mine group	Harquahala
Jones	Little Giant mine groups	Cunningham Pass
Jones	Mable (Mabel) mine group	Castle Dome
Joplin Lead Company	Hull or Rialto mine group	Castle Dome
Josephi	Cuprite mine group	Cunningham Pass
Kaltenback	Annie (Anna) mine	Castle Dome

Table 3, Cont.

NAME	PROPERTY	DISTRICT
Kane	Cuprite mine group	Cunningham Pass
Keiser	Keiser barite mine	Plomosa
Keith	Pacific and Mandan claims	Silver and Eureka
Ketcherside	Big Eye, Outlook, and Lookout mines	Castle Dome
Kimball Leasing Company	Planet (New Planet) mine group	Santa Maria
King	Bullion mine group	Plomosa
George King & Company	Iron Queen & Copper Prince mine groups, Iron Queen, Gila Monster, etc. placer	Plomosa
King & Holm	Little Butte mine	Plomosa
King of Arizona	King of Arizona mine	Kofa
Kirk & Lea	H. H. and L. mine group	Trigo Mountains
Klix	Apache Chief mine group	Plomosa
Klix	Socorro mine	Harquahala
Knowles & Young	Gold Reef prospect	Silver and Eureka
Knox & Little	Keiser barite mine	Plomosa
Kofa Mining Syndicate	King of Arizona mine	Kofa
Kofa Queen Mining & Milling Company	Kofa Queen mine	Alamo Springs
La Cholla Mining Company, Ltd.	Middle Camp gold placers	Middle Camp-Oro Fino
La Fortuna Gold Mining & Milling Company	Fortuna mine	Fortuna
Laguna	La Colorado or Lincoln mine group	Castle Dome
E. C. Lane	Signal mine group	Santa Maria
La Posa Development Company	La Cholla placers	La Cholla
Lee	Bullard mine group	Cunningham Pass
Lesher	Desert mine	Ellsworth
Liberator Mines Company	Yuma mine	Ellsworth
Linda K. Mining Company	Linda K. mine	Plomosa
Linden	Frisco, Betty Lee, and Ella J. mines	La Posa
Linder & Findley	Evening Star mine group	Kofa
Lion Hill Gold Mining Company	Lion Hill mine group	Cienega
Little Butte Amalgamated Mines Company	Little Butte mine	Plomosa
Little Butte Syndicate	Little Butte mine	Plomosa

Table 3, Cont.

NAME	PROPERTY	DISTRICT
Livingston	Night Hawk, White Dike, & Colorado mine groups, Renegade mine	Plomosa
Loma Grande Mining Company	Little Butte mine	Plomosa
Lucky Tiger Combination Gold Mining Company	Carnation mine, Eagle Nest mine	Cienega
Long & Gilbert	Why Not, Clipper, and Gold mine groups	Harquahala
McCaddon	Mable (Mabel) mine group	Castle Dome
McCauley	Sheba mine	Ellsworth
McCanley & Orberg	Rio del Monte mine	Harquahala
McDaniels & Harrison	Fortuna mine	Fortuna
McDonald	Blue Slate mine group	Plomosa
McDonald	Hercules mine	Harquahala
McDonald	Bonanza and Evylin mine group, Wenden mine group	Cunningham Pass
McFarland & Hullinger	Metate and Confusion mine groups	La Paz
McMillen & Hendrix	La Cholla placers	La Cholla
McMillan Brothers	Yum Yum mine	La Cholla
McPhaul	McPhaul area placers	Laguna
McVay Mining Company	Pee Wee mine group	Ellsworth
Mack	Billy Mack mine group, Sue mine	Cienega
Madden	Black Mesa mine	Plomosa
Maddux	Doyle mine	Alamo
Maitland	Fortuna mine	Fortuna
Mammon Copper Company	Mammon mine group	Cienega
Mammon Gold & Copper Company	Mammon mine group	Cienega
Manganese Corporation (Company) of America	Black Bird mine group, Black Chief mine	Plomosa
Manganese Mining & Milling Co.	Cibola No. 3 mine	Trigo Mountains
Mariquita Gold Mining Company	Black Mesa mine	Plomosa
Marshall	Moore mine group	New Water
Marvel Mining Comapny	Bullard mine group, Little Giant mine groups	Cunningham Pass
Mathews	Tungsten Giant mine group	Harquahala
Mathews	Bullard mine group	Cunningham Pass

Table 3, Cont.

NAME	PROPERTY	DISTRICT
Mattson & McDonald	Golden Star mine group	Cunningham Pass
Mayhew Mining Company	Cleveland-Chicago group	Castle Dome
Meyers	Tungsten mine group	Kofa
Meyers & Lazure	Hidden Treasure mine	Harquahala
Middle Camp Placer Gold, Incorporated	Middle Camp gold placers	Middle Camp-Oro Fino
Miller	Bonanza and Evylin mine group	Cunningham Pass
Miller & Christofferson	Ramsey mine	Plomosa
Miller & Hopkins	Buckeye vein group	Castle Dome
Miller & Nagle	Buckeye vein group	Castle Dome
Mills	Billy Mack mine group	Cienega
Minerals Corporation of America	Yuma mine	Ellsworth
Ming & McPherson	Silver Glance claim	Silver and Eureka
Mirabel	Tungsten Giant mine group	Harquahala
Modesti	Las Flores mine group	Laguna
Modesti	La Colorado or Lincoln mine group	Castle Dome
Mohave Mining Company	Apache mine	La Paz
Mohigan Copper Company	Bullion mine group	Plomosa
Montana-Arizona Copper Company	Montana-Arizona mine	Alamo
Montoya	Black Jack mine	Trigo Mountains
Moon Mountain Gold Mining Company	Apache mine	La Paz
Morrow	Arizona McGinnis mine	Cienega
Nassan Mining Company	Quartette mine	Kofa
National Lead Company	Black Mountain mine group, Happy Day No. 3 mine	Plomosa
Navajo Mines Company	Desert mine	Ellsworth
Neahr	Black Top mine	Castle Dome
Neal Mining Co.	Geronimo North & South mines, Princess & Hamburg mines, Saxon mine	Silver and Eureka
New Planet Copper Mining Company	Plant (New Planet) mine group	Santa Maria
New World Mining Company	Little Butte mine	Plomosa
New York & Plomosa Mining Company	Iron Queen & Copper Prince mine groups, Iron Queen, Gila Monster, etc. placers	Plomosa

Table 3, Cont.

NAME	PROPERTY	DISTRICT
Nickle	Silver Prince mine	Neversweat
Nohlcheck	Critic mine, Cuprite mine group	Cunningham Pass
Nohlecheck & Hummel	Hidden Treasure mine	Harquahala
Northwest Leasing & Development Company	Planet (New Planet) mine group	Santa Maria
Norton	Red Cross (Norton) mine	Mohawk
Horton, Crawford, & Lambie	Princess and Hamburg mines	Silver and Eureka
Nottbusch	Silver Prince mine	Neversweat
Nuevo Mundo Mountain mines	Mars and Mescal mine group	Harquahala
Oberstine	Bonanza (Harquahala) and Golden Eagle mine group	Harquahala
O'Brien	Copper Giant mine	La Paz
Old Apache Mines Company	Apache Chief mine group	Plomosa
Old Maid Mining Company	Old Maid mine	Plomosa
Ore Concentrates, Incorporated	Mystery Hill mine group	Alamo
Osborne	Revenue mine group	Santa Maria
Osborne	Arizona Pride mine, Mammon mine group, Sue mine	Cienega
Osborne & Botzum	Lion Hill mine group, Rio Vista Southside mine	Cienega
Osborne & Ransford	Rio Vista Northside mine	Cienega
Paisano Mining Company	Renegade mine	Plomosa
Paxton	Billy Mack mine group	Cienega
Pedstel & Everhardy	Last Chance and Copper Coin mines	La Posa
Penn Metals Incorporated	Black Rock mine, Red Cloud mine	Silver and Eureka
Perry	Black Beauty mine	Plomosa
Perry & Morley	Ramsey mine	Plomosa
Pickining Mining Company	Black Mesa mine	Plomosa
Pioche & Arizona Copper & Gold Mining Co.	Heart's Desire mine	Plomosa
Pittsburg Harqua Hala Gold Mining Company	San Marcos mine group	Harquahala
Planet Copper Mining Company	Planet (New Planet) mine group	Santa Maria
Plomosa Placer Company	Iron Queen, Gila Monster, etc. placers	Plomosa
Polhamus	Planet (New Planet) mine group	Santa Maria
Polhamus & Company	Flora Temple mine	Castle Dome

Table 3, Cont.

NAME	PROPERTY	DISTRICT
Powell, Kast, & Johnson	Hidden Treasure mine	Harquahala
Powers, J. F.	Cibola No. 7 mine	Trigo Mountains
Powers, N. & J. F.	Cibola No. 1 mine, Cibola No. 3 mine, Cibola No. 8 mine	Trigo Mountains
Powdered Metals Corporation	Mineral Hill mine group	Santa Maria
Prescott	Cuprite mine group	Cunningham Pass
Protection Gold & Copper Company	Blue Slate mine group, Dutchman mine	Plomosa
Pryor	Saxon mine	Silver and Eureka
Quartette Mining Company	Quartette mine	Kofa
Quartzite Mining Company	Julian (Julius) mine group	Middle Camp-Oro Fino
Quartz King Gold Mining Company	Rio Vista Southside mine	Cienega
Quick	Mystery Hill mine group	Alamo
R. & A. Mining Company	Ramsey mine	Plomosa
Ramsey	Ramsey mine	Plomosa
Ramsey Consolidated Mines Company	Ramsey mine	Plomosa
Ramsing & Linton	Spring Mine group	Alamo
Ranier Mines Corporation	Critic mine	Cunningham Pass
Record Mines Company	Excelsior mine	Plomosa
Red Cloud Consolidated Mines Company	Red Cloud mine	Silver and Eureka
Red Cloud Mining & Milling Company	Red Cloud mine	Silver and Eureka
Red Cloud Mining Company	Red Cloud mine	Silver and Eureka
Renner	Silver Prince mine	Neversweat
Renner & Sam	Renner mine	Mohawk
Reyco Development Corporation of Arizona	Moro mine group	Santa Maria
Rialto Company	Hull or Rialto mine group	Castle Dome
Richman	Apache Chief mine group, Shamrock mine	Plomosa
Riley	Mendevil claim, Silver Glance claim	Silver and Eureka
Riley & Holmes	Black Rock mine, Red Cloud mine	Silver and Eureka
Rio del Monte Mines, Incorporated	Rio del Monte mine	Harquahala
Rio del Monte Mining Company	Rio del Monte mine	Harquahala
Rio Vista Mines	Rio Vista Southside mine	Cienega
Riverview Mines Company	Riverview mine	Silver and Eureka

Table 3, Cont.

NAME	PROPERTY	DISTRICT
Roberts	Black Band mine	Alamo
Rob Roy Development Company	King of Arizona mine, Rob Roy mine	Kofa
Rocker	Riverview mine	Silver and Eureka
Rogers	Magnesite mine, Mystery Hill mine group	Alamo
Rogers & Albere	Montana-Arizona mine	Alamo
Rogers & Lee	Blue Slate mine group	Plomosa
Rogers & Farrington	Hercules mine	Harquahala
Ruby Gold & Copper Company	Billy Mack mine group	Cienega
Ruggles	Black Top mine	Castle Dome
Salome Development Company	San Marcos mine group	Harquahala
Salome Gold Company	Why Not, Clipper, and Gold mine groups	Harquahala
Sam	Iron Wood mine	Kofa
Sandoval & Associates	La Angora mine	La Paz
San Pablo Mining Company	Las Flores mine group	Laguna
Scott	Poorman and Goodman mines	Plomosa
Scott	Goodman mine group	La Paz
Scott Lode Mines, Incorporated	Goodman mine group	La Paz
Selby	Riverview mine	Silver and Eureka
Self, Cockrum, & McNelly	ABC mine	Trigo Mountains
Sentenac Mines Company	Riverview mine	Silver and Eureka
Shamrock Mining Company	Shamrock mine	Plomosa
Shanley	Hercules mine	Harquahala
Shapp & Whitehorse	Sheba mine	Ellsworth
Sharp	Hercules mine	Harquahala
Sheba Mining Company	Sheba mine	Ellsworth
Sheep Tanks Consolidated Mines Company	Sheep Tanks mine	Sheep Tanks
Sheep Tanks Mining Company	Sheep Tanks mine	Sheep Tanks
Shiner, Fields, & Bates	Clip mine	Silver and Eureka
Sibley	San Marcos mine group	Harquahala
Signal Copper Company	Signal mine group	Santa Maria
Silver Mines Consolidated Company	Clip mine	Silver and Eureka
Silver Star Mining Company	Ramsey mine	Plomosa

Table 3, Cont.

NAME	PROPERTY	DISTRICT
Simpson	Gold Nugget mine	Plomosa
Simpson & Kock	Julian (Julius) mine group	Middle Camp-Oro Fino
Sitton	Lucky mine group	Santa Maria
Smith	Heart's Desire mine, Gold Nugget mine	Plomosa
Smith	Last Chance and Copper Coin mines	La Posa
Smith	San Marcos mine group, Why Not, Clipper, and Gold mine groups	Harquahala
Smith	Mable (Mabel) mine group	Castle Dome
Smith	Magnesite mine	Alamo
Smith & Ellis	Phoenix and Yuma mine groups	Plomosa
Snipes, Smith, Jarroll, & Richardson	Fools Folly mine	Trigo Mountains
Snyder	Yuma mine	Ellsworth
Snyder	Centroid mine group	Cunningham Pass
Socorro Gold Mining Company	Socorro mine	Harquahala
Southern Arizona Mines Company	Clara mine	Santa Maria
Southern California Chemical Company	Yuma mine	Ellsworth
Southern Cross Mining Company	Southern Cross mine	Plomosa
Southwest Corporation of Missouri	Dutchman mine	Plomosa
Spry	Yuma mine	Ellsworth
Stafford Mining Company	Stafford mine	Plomosa
Stehle	Blue Eagle, Bunker Hill, and Four Winds mine group	Harquahala
Stent	Critic mine	Cunningham Pass
Stovall	Spring Mine group	Alamo
Stovall & Associates	Doyle mine	Alamo
Strategic Metals Mines	Carnation mine, Eagle Nest mine	Cienega
Stephans	Adams mine group	Castle Dome
Sterling Silver Mines Consolidated	Amelia mine	Silver and Eureka
J. P. Stewart & Associates	Black Diamond mine group, Black Jack mine	Trigo Mountains
Sturgess	Black Joe mine, Copper Glance mine	Castle Dome
Sturgess-Worthington Mining Company	Black Top mine	Castle Dome
Success Copper Mining Company	Apache Chief mine group	Plomosa

Table 3, Cont.

NAME	PROPERTY	DISTRICT
M. M. Sundt Construction Company	Ramsey mine	Plomosa
Sunshine Mining Company	Black Bird mine group	Plomosa
Superior Companies	White Marble quarries	Harquahala
Swansea Arizona Mines Company	Signal mine group	Santa Maria
Swansea Consolidated Gold & Copper Mining Company	Signal mine group	Santa Maria
Swansea Development Company	Signal mine group	Santa Maria
Swansea Lease, Incorporated	Clara mine, Signal mine group	Santa Maria
Swenson (Svenson)	Frisco, Betty Lee, and Ella J. mines, Poorman mine	La Posa
Swires	Apache Chief mine group	Plomosa
Tate	Manganite mine	Alamo
Taylor	Hull or Rialto mine group	Castle Dome
Tegler	Moro mine group	Santa Maria
Tenny	Andrus claims	Trigo Mountains
Tenny	Cindy mine	Plomosa
Thompson	Clip mine	Silver and Eureka
Thumb Butte Copper Company	Copper Glance mine	Castle Dome
Timmons & Gutchmaker	Jude mine group	Yuma
Todd & Allen	Black Diamond mine group	Trigo Mountains
Todd & Smith	Black Diamond mine group	Trigo Mountains
Townsend	Black Bird mine group, Black Chief mine, Black Mountain mine group	Plomosa
Townsend Mining Company	Mystery Hill mine group	Alamo
Treuer	Darling mine	La Paz
Troy	Desert mine	Ellsworth
True Blue Mining Syndicate	True Blue mine group	Ellsworth
Tulsa Minerals Corporation	Hidden Treasure mine	Harquahala
United Mines of Arizona	Little Butte mine	Plomosa
United Silver Mines Co. of Yuma	Amelia mine, Clip mine	Silver and Eureka
U. S. Marble	White Marble quarry	Harquahala
Valenzula	Black Mesa mine	Plomosa

Table 3, Cont.

NAME	PROPERTY	DISTRICT
Venhoff	Billy Mack mine group	Cienega
Verdugo Mines Company	True Blue mine group	Ellsworth
Vicksburg Development Company	Desert mine	Ellsworth
Victor & Bell Crown Mining Company	Bell Crown mine	Ellsworth
Vindicator Mining Company	Little Giant mine groups	Cunningham Pass
Waite	Las Flores mine group	Laguna
Wall	Hull or Rialto mine group, Little Dome mine, Sonora mine group	Castle Dome
Wardwell & Osborne Copper Mines Company	Mammon mine group	Cienega
Watson	Carnation mine	Cienega
Webster	Bell of Arizona mine	Plomosa
Wenden Copper Mining Company	Wenden mine group	Cunningham Pass
Wendondale Gold Mining Company	Little Giant mine groups	Cunningham Pass
Western Exploration & Development Co.	Andrus claims, Black Diamond mine group, Black Jack mine, Triple H mine group	Trigo Mountains
Whitaker	Heart's Desire mine	Plomosa
Whitehouse & Shapp	Wenden mine group	Cunningham Pass
Whiting	Little Butte mine	Plomosa
Whitt	Mammon mine group	Cienega
Wiley Brothers	Little Butte mine	Plomosa
Wilkinson	Cuprite mine group	Cunningham Pass
Wilkinson & Walsh	Hidden Treasure mine	Harquahala
William Brothers	Night Hawk, White Dike, & Colorado mine groups	Plomosa
Willamtho Company	Ramsey mine	Plomosa
Williams	Apache Chief mine group, Excelsior mine	Plomosa
Williams	Capilano	Cienega
Wilton-Grant Ores & Metals Company	Clara mine, Moro mine group	Santa Maria
Winchester	Desert mine	Ellsworth
Wish Mining & Milling Company	Fortuna mine	Fortuna
Wood & Huthmacher	Three Musketeers mine	Ellsworth
Woolley	Carnation mine	Cienega

Table 3, Cont

NAME	PROPERTY	DISTRICT
Worcester	Gold Leaf, Rattlesnake, and Rosebud mine group, San Marcos group	Harquahala
Worley Mercantile Company	Heart's Desire mine	Plomosa
Wray	Sue mine	Cienega
Young	Cleveland-Chicago group	Castle Dome
Yuma Consolidated Company	Iron Queen, Gila Monster, etc. placers	Plomosa
Yuma Copper Company	Yuma mine	Ellsworth
Yuma Metals Inc.	Saxon mine	Silver and Eureka
Yuma Warrior Mining Company	Bonanza (Harquahala) and Golden Eagle mine group	Harquahala
Zappia	Red Cross (Norton) mine	Mohawk

TABLE 4

INDEX OF MINING PROPERTY

MINING DISTRICT AND MINES	LOCATION T.	R.	Sec.	MINERAL PRODUCTS	GEOLOGY	TYPE OF OPERATION AND PRODUCTION	REFERENCES
I. Alamo District (Eastern Buckskin Mountains and northeastern corner of Yuma County) Figure 3	9-11N	11-14W	---	Mn, Pb, Cu, Ag, Au, F, (Se)	1. Manganese mineralization occurring in lensing and often overlapping layers, seams, nodules and disseminations in sandstone and clay beds of Tertiary age. 2. Copper and lead mineralization with silver and gold in fissure veins in the Precambrian gneiss complex, closely associated with a thrust fault plane between the Precambrian and blocks of later formations.	Manganese deposits noted early but first claims located in 1916. Total manganese ore production would be at least 160,000 long tons shipped direct or concentrated to higher grade for purchase by government. The base and precious metal deposits were first worked in the late 1800's and intermittently through 1955. The total production would be some 824 tons of ore containing about 27 tons of lead, 22 tons of copper, 984 ounces of silver and 66 ounces of gold.	Lasky & Webber, 1949, ABM file data
1. Montana-Arizona mine (January group; Crockett & Gibbons, Rogers & Albere, Montana-Arizona Copper Co.)	10N	13W	SE¼ 18	Cu, Ag, Au	Copper carbonates, with some copper sulfides in depth, in several fissure veins in deformed and faulted Precambrian schist and gneiss. Some Laramide monzonite intrusions and relict metamorphosed Paleozoic limestone exposures. Local high gold values.	Worked intermittently, from about 1902 to 1937, by double compartment shaft and levels, producing some 170 tons of ore averaging about 6% Cu, 0.8 oz. Ag/T and 0.1 oz. Au/T.	Copper Handbook, 1908 ABM file data
2. Bernarde mine (Happy Jean group, Sunnyside; Bernarde)	10N	13W	NW¼ 19	Cu, Ag, Au	Oxidized copper mineralization with gouge and breccia along a thrust fault plane which placed Precambrian schist and gneiss over Tertiary sedimentary and volcanic beds.	Worked intermittently, mainly from a tunnel, from 1912 to 1936, producing some 138 tons of ore averaging about 1% Cu, 0.1 oz. Ag/T and 0.1 oz. Au/T.	ABM file data
3. Black Band mine (Manganese King group, Road's End; Harrison & Doyle, Roberts, Doyle and Smith)	10N	14W	W Cen. 36	Mn	Mainly pyrolusite, mixed with sandstone and calcite, in relatively short, lensing, overlapping bands, separated by barren sandstone of Tertiary age.	Worked by tunnel, cuts, and open pit, producing a small tonnage at about 10% Mn in the 1950's.	Farnham & Stewart, 1958, p. 70 ABM file data
4. Doyle mine (Last Resort; Doyle Bros., Stovall & Associates, Brown, Maddux, Dasco Mines Corp.)	10N	14W	NE¼ 36	Mn	Pyrolusite, psilomelane, and manganite, with brecciated igneous and sedimentary rock fragments and calcite, in Tertiary sandy sediments, similar to Artillery Peak area, that underlie, unconformably, Precambrian gneiss. Strong fault, and sheer zones. Manganese mineralization varies greatly in thickness. Best ore closely associated with strong shearing and close to thrust fault plane.	Open pit mining, in the middle to late 1950s, produced some 70,000 long tons of 15-16% Mn. Some 1,460 long tons of 40%+ Mn produced in 1958 by concentration.	Farnham & Stewart, 1958, p. 68-70 ABM file data

5. Magnesite mine (Rogers, Smith)	11N	12W	SW ¼ 16	Mn	Manganese mineralization, probably mixed pyrolusite and psilomelane, in a flat-lying lense or large pod in Tertiary sedimentary bed above a basalt flow.	Open pit mining produced over 900 long tons of 22% Mn in 1953-1954.	Lasky & Webber, 1949, Farnum & Stewart, 1958, p. 71
6. Manganite mine (Tate)	11N	12W	NE ¼ 16	Mn	Pyrolusite and psilomelane in 6 to 12 foot lensing layers in Tertiary sandstone overlying a sill-like basalt member.	Open pit mining produced a small amount of low grade manganese ore in 1953.	Lasky & Webber, 1949 Farnham & Stewart, 1958, p.71
7. Spring mine group (Kaiserdoom group, Black Bitch; Evans, Fisher, Hare, Brown, Stovall, Ramsing and Linton	11N	11W	W Cen & E Cen 21, & NW ¼ & S Cen 22	Mn	Psilomelane and pyrolusite mineralization in grit and clay in flat-lying, overlapping, lenticular layers and sheet-like seams, 4-12 feet thick, in Tertiary sedimentary beds. Manganiferous beds underlain by shale and overlain by volcanic ash, basalt and alluvium. Some disseminated nodules. Ore zone extensive and variable in grade.	First located in 1918 but mined mainly by open pit from 1953 through 1958, producing more than 90,000 long tons of 4-5% Mn which was milled to more than 8,000 long tons of 25% Mn. Some select 40% Mn also produced.	Jones, 1920, p 183-184 Wilson & Butler, 1930, p. 102-103 Laskey & Webber, 1949 Farnum & Stewart, 1958, p. 70-71 ABM file data
8. Mystery Mill mine group (Clayton, Diana May, East Side, Mildred group, Blue Bell; Graves, Rogers, Haydon and Farmosano, Quick, El Tigro Mg. Co., El Pluma Mines. Inc., Townsend Mg. Co., French, Conoination Mg. Co., Boyd and Napel, Ore Concentrates, Inc.)	10N	13W	W Cen & SE ¼ 17, E Cen & Cen 18	Cu, Ag, Au, Pb, F, (Se)	Copper carbonates and silicates, with local lead carbonate, in fissure veins associated with strong silicification and some epidote, fluorite, and selenite, in altered Precambrian schist and gneiss along a fault zone. Scattered erosional remnants of Paleozoic limestone with intrusive plugs and dikes of Laramide monzonite containing Paleozoic limestone inclusions.	First worked in the late 1800's, and sporadically through 1945, producing over 500 tons of ore averaging about 3% Cu, 2 oz. Ag/T, 0.5% Pb, and 0.1 oz. Au.	ABM file data
II. Alamo Springs District (Northern Kofa or S. H. Mountains) Figure 4	1N-1S	16W-18W	---	Cu-, Au-	1. Generally weak and spotty, oxidized copper mineralization in small, irregular veins and seams along shear or fault zones in andesite porphyry or closely associated granitic intrusive, along a major northwest-striking structural zone. Examples are the Alamo group (No. 1-T1N, R16W, N. Cen. Sec. 15) and Alanah group (No. 2-T1N, R16W, N. Cen. Sec. 23). All protracted locations.	Relatively shallow shafts, tunnels, trenches and pits, mostly worked in early 1900's. Some 65 tons of 1.4% Cu with minor silver and 100 tons of .80 oz. Au/T and 1 oz. Ag/T reported as produced but some gold probably sold to ore buyers from numerous prospects and placer operations.	McConnell, 1911, p. 143-147 Jones, 1916, p. 151-164 Wilson, 1933, p. 116-121 Wilson, 1934 (Rev. 1967), p. 143 ABM file data

Alamo Springs District, Table 4 Cont.

MINING DISTRICT AND MINES	LOCATION T.	R.	Sec.	MINERAL PRODUCTS	GEOLOGY	TYPE OF OPERATION AND PRODUCTION	REFERENCES
					2. Spotty, finely divided, free gold in fractures and breccia with gouge, calcite, and iron and manganese oxides, in andesitic volcanics. Examples are Cemitosa (No. 4-T1N, R16W, W. Cen. 12), Rand (No. 9-T1N, R17W, NE¼ Sec. 26), Geyser or Silent King (No. 6-T1N, R17W, NW¼ Sec. 25), IX L (No. 7-T1N, R17W, W. Cen. Sec. 25), Regal (No. 10-T1N, R17W, NE¼ Sec. 36), C. O. D. (No. 5-T1N, R16W, SW¼ Sec. 32, Big Horn (No. 3-T1S, R16W, SW¼ Sec. 11), Kofa Queen (No. 8-T1S, R17W, NW¼ Sec. 8), and Tunnel Springs or Ramshorn (No. 11-T1N, R17W, N. Cen. Sec. 31). All protracted locations. 3. Minor placer gold in washes close to gold deposits		
III. Castle Dome District (Castle Dome and Middle Mountains) Figure 5	4S-6S	17W-20W	---	Pb, Ag, F, Ba, Mn, Zn, Cu, Au, V-, Mo- (Be, Sb, Se, As, U)	1. Tabular, lensing, and irregular masses of argentiferous galena, superficially altered to anglesite, cerussite, and lead oxides, in often banded gangue of crystalline fluorite, calcite, barite, and minor quartz, in numerous northwest to north-striking, steeply-dipping, lensing veins along fault zones, fractures and dike contacts, in metamorphosed Mesozoic shale, impure limestone, and sandy beds, intruded by a dense swarm of diorite dikes and slightly later quartz porphyry intrusive dikes and irregular masses. Locally, some hydrozincite, smithsonite, wulfenite, vanadinite, and mimetite in vugs and solution channels. Wall rocks altered to quartz, calcite, and sericite with some chloritization of shale with disseminated pyrite. 2. Gold and silver values, in irregular quartz veins, with local crystalline calcite, manganiferous calcite, and manganese oxides, in strongly brecciated shear zones in Cretaceous andesite and rhyolite flows and tuff, near contact with Laramide granitic intrusive or in the intrusive.	One of the oldest and most productive mining districts in Yuma County. Possibly worked by Spanish or French as early as late 1700's or early 1800's. Since 1870's, almost continual large and small operations from numerous, relatively shallow shafts, open cuts, and with reworking of old dumps and stope fills. Total estimated and recorded mine production of base and precious metals through 1974 would be some 121,000 tons of ore containing at least 10,697 tons of lead, about 498 thousand ounces of silver, 2 thousand ounces of gold, 38 tons of zinc, and 36 tons of copper. The production of by-product lump and gravel fluorspar would be some 3,300 tons. About 400 long tons of manganese oxide ore has been reported as shipped. Placer gold production, mostly prior to 1900, is estimated as more than 7000 ounces	Blake, 1880, 1881 a & b Nevius, 1912 Allen & Butler, 1921 Thompson, 1925 Wilson, 1933, 1951, a & b Burchard, 1934 Holt, 1942 Stewart & Pfister, 1960 ABM Bull. 180, 1969, p. 200, 354 ABM file data

					3. Spotty chalcocite, copper carbonates, and minor lead and zinc mineralization along fracture zones in Mesozoic shale, limestone, and arkose. 4. Discontinuous, lenticular bodies of manganese oxides in shear veins in Cretaceous or Tertiary andesitic volcanics. 5. Gold placers in dry washes below Big Eye and associated vein deposits.		
1. Adams mine group (Dandy Boy group, Puzzler, Silver Dollar; Adams, Stephans, Hudson)	4S	18W	SW¼ 31 Protracted	Pb, Ag, F, V-, Mo-, Cu-	Irregular and spotty masses of coarsely crystalline galena, usually coated with anglesite, cerussite, and lead oxides, in a gangue of crystalline fluorite and brown to black calcite with iron-stained gouge and brecciated wall rock, in lensing fault zones, up to 8 feet wide, cutting Mesozoic shale, metamorphosed to slate. Intrusions of diorite-porphyry dikes and a few small irregular masses of quartz porphyry. Vanadinite and wulfenite found locally in vugs in the mineralized zones and some minor oxidized copper minerals.	Several relatively shallow shafts with minor level workings. Operated sporadically, mainly in the Puzzler mine, from early 1900s through about 1952, producing some 240 tons of ore averaging about 49% Pb, 18 oz. Ag/T and very little Au and Cu.	Wilson, 1933, p. 101-102; 1951, p. 113 ABM file data
2. Annie (Anna) mine (Kaltenback)	5S	20W	Cen 19 Protracted	Pb, Ag, Zn, Ba, Cu-, Au-	Spotty, partly oxidized, argentiferous galena and sphalerite, with few spots and streaks of malachite, in a gangue of barite and limonite-stained gouge, in a silicified fault zone cutting a wide, sericitized diorite porphyry dike intruding Mesozoic shale.	300 foot tunnel operation, worked mainly in the 1920s. Total production would be a few tens of tons of ore averaging about 60% Pb, 36 oz. Ag/T and very minor Au and Cu. Vein contained up to 12% Zn but not recovered.	Wilson, 1933, p. 76; 1951, p. 114 ABM file data
3. Big Eye, Outlook, and Lookout mines (Big Eye Mg. Co., Big Eye Mg. & Mllg. Co., Ketcherside, Grover, Crowder & Green, Hudson)	4S	18W	NE & Cen 34 Protracted	Au, Ag, Cu-, Pb-, Zn-	Spotty gold and silver values, with minor, largely oxidized, base metals, in narrow, lenticular, shallow ore shoots of brecciated quartz with stringers of crystalline and manganiferous calcite, in a brecciated fault zone cutting steeply-dipping, kaolinized and chloritized Cretaceous andesite flows, intruded by a rhyolite porphyry dike and apparently faulted against badly shattered Mesozoic quartzite. A relatively small outcrop of intrusive Laramide syenite lies along the strike of the zone and probably underlies the volcanics in a much wider area.	Tunnel, shaft; and open cut operations. Worked sporadically from about 1910 through 1951, producing a total of some 2370 tons of ore averaging about 0.9 oz. Au/T, 8 oz. Ag/T and minor Cu and Pb.	Wilson, 1933, p. 102-104; 1934 (Rev. 1967), p. 148-149 ABM file data

Castle Dome District, Table 4 Cont.

MINING DISTRICT AND MINES	LOCATION T.	R.	Sec.	MINERAL PRODUCTS	GEOLOGY	TYPE OF OPERATION AND PRODUCTION	REFERENCES
4. Black Joe mine (Gibson, Sturgess) (outside district map)	5S	17W	N Cen 2 Protracted	Mn	Numerous, lenticular, pockety, and narrow pyrolusite stringers with calcite, in shattered Cretaceous or Tertiary andesitic volcanics along a shear zone. Mined ore ran about 8 % Mn.	Worked by shallow shaft and open cuts. Small lots of picked 30% Mn shipped in the 1950s.	ABM file data
5. Black Top mine (Neahr, Ruggles, Strugess-Worthington Mg. Co.) (outside district map)	4S	17W	S Cen 35 Protracted	Mn	Pyrolusite and psilomelane in discontinuous, lenticular shoots of stringers and pods, with calcite, quartz, and rock fragments, in fracture veins cutting Cretaceous or Tertiary andesitic volcanics.	Open cut operations. Prospected in WW I period and produced some 384 long tons of 26% Mn ore in 1954 and 1955.	Farnham & Stewart, 1958, p. 85
6. Castle Dome mine group (Several claim groups and individual mines with changing names, and owners or operators, including Flora Temple, Buckeye vein group, Sonora group, Little Dome, Hull or Rialto group, Cleveland-Chicago group, and La Colorado or Lincoln group as detailed below. Major owners and operators included Polhamus & Co., Miller & Nagel, Miller & Hopkins, Castle Dome Mg. & Smtg. Co., Gondolfo & Sangninetti, De Luce, Modesti, Castle Dome Mg. & Mllg. Co., Van Wagner, Dome Exploration Co., Reorganized United Mines Co., Haack, Hull, Dome Leasing Co., Arizona Lead Co., Joplin Lead Co., Wall, and Desert Lead Co.)	4S 4S 4S 5S	19W 19W 18W 19W	SW¼ 24, NW¼ to SE¼ 25, & 36 SW¼ 30 & NW¼ 31 NE¼ 1 All Protracted	Pb, Ag, F, Ba, V-, Mo-, Zn-, Au-, Cu- (As, Se, Be, Sb)	Argentiferous galena, superficially altered to anglesite, cerussite, and lead oxides, often banded with varicolored crystalline fluorite, barite, calcite, occasional gypsum, and minor quartz, in lensing veins along fault zones and splits cutting or along contacts of Mesozoic shale, slate and limestone, with swarms of intrusive diorite porphyry and quartz porphyry dikes and masses of probable Laramide age. Minor, local copper and zinc mineralization is often present and also locally some hydrozincite, smithsonite, wulframite, vanadinite, and mimatite occurs in vugs and solution channelways. The ores are in sheet-like masses, irregular vein-like bunches, and some solid masses and appear to have a limited depth of some 200 to 350 feet. Wall rocks have been altered to quartz and sericite with some chloritization and weak pyritization of the sedimentary beds. Veins and mineralization developed best where closely associated with diorite porphyry dikes.	Open cuts and extensive stoping from numerous shafts. Relict workings, trails, and slag heaps suggest early work by Spaniards and/or French miners in late 1700s or early 1800s. Main operations date from about 1863 and have continued on large and small scale almost yearly through at least 1974. Total estimated and recorded production of base and precious metals from primary mining and reworking of dumps and old stope fills would amount to about 106,000 tons of ore averaging about 10% Pb, 5 oz. Ag/T, and minor Au, Cu, and Zn. By-product lump and gravel fluorspar produced is estimated at some 3,300 tons.	Blake, 1880, 1881 a & b Nevius, 1912 Allen & Butler, 1921 Thompson, 1925 Wilson, 1933; 1950; 1951 Burchard, 1934 Holt, 1942 Stewart & Pfister, 1960 ABM Bull. 180, 1969 p. 200, 354 ABM file data

a. Buckeye vein group (Castle Dome, New Dil-New Chance No. 1, Lady Edith and Yuma-New Chance No. 4, and Big Dome-Dusty No. 4, formerly partly covered by Hopkins, Norma, Caledona, William Penn, and Miller; Miller & Nagle, Miller & Hopkins, Castle Dome Mg. & Smltg Co., Gondolfo & Sanguinetti, De Luce, and numerous later lessees and operators.	4S	19W	S Cen 25, N Cen to S Cen 36 Protracted	Same as above	Lensing and branching vein zone traceable for some 5000 feet, few inches to several feet wide. Surface largely covered by up to 200 feet of gravel. Wall rocks of Mesozoic shale cut by large diorite porphyry and smaller quartz porphyry dikes, with veins best developed near or on contact of two types of dikes. Irregular and discontinuous oresboots, possibly related to cross fractures. Locally abundant fluorite as in the Big Dome-Dusty No. 4 claim.	Extensive stoping of ore shoots down to at least 250 feet from numerous incline shafts. Castle Dome claim patented in 1876. Most mining done prior to 1890 but old fills and dump reworked later for lead-silver and fluorspar. Vein group contributed a major share of total production of the district since before 1870.	Blake 1880, 1881 a & b Nevius, 1912 Wilson, 1933, p. 95-96; 1951, p. 110-111 ABM file data
b. Cleveland-Chicago group (New Cleveland, Big Jim, Hope, Ruby No. 1 & No. 2; Hodge, De Luce, Haack, Young, Mayhew Mg. Co., Castle Dome Mg. Co., K & W Mg. Co., Childress & Wright)	4S	18W	SW¼ 30 & NW¼ 31 Protracted	Same as above	Spotty, rich masses of partly oxidized, argentiferous galena in a gangue of crystalline and banded calcite, fluorite, and minor barite, in a lensing fissure vein up to 3 feet wide and at least 1400 feet long. Wall rocks are well-bedded, steeply dipping Mesozoic shale and impure limestone, cut by diorite porphyry and quartz porphyry dikes. Most of outcrop concealed by gravel. Ore down to about 300-350 feet. Barite later than fluorite.	Series of relatively shallow shafts and stopes down at least 300 feet. Largely worked out but stope fill and dumps reworked in early 1930s and late 1940s and again in 1966-1967. Total production would be over 2000 tons of 20% Pb and 5 oz. Ag/T. Some minor Zn, Cu and Au recovered.	Wilson, 1933, p. 100-101; 1951, p. 112-113 ABM file data
c. Flora Temple mine (Polhamus & Co., Castle Dome Mg. & Smltg Co., Gondolfo & Sanguinette, De Luce, and several leasing operators)	4S	19W	N Cen 36 Protracted	Same as above	Lenses and shoots of rich, argentiferous galena, up to 10 feet wide, separated by barren or weakly mineralized zones, with barite, calcite, and fluorite gangue, in veins along well-defined faults with strong cross-fracturing in Mesozoic slate and diorite porphyry and quartz porphyry dikes. Mantle of surface gravel included numerous nuggets of partly altered argentiferous galena just above the rock pediment. Economic mineralization apparently limited to about 200 feet in depth	Irregular, partially filled stopes mined from numerous old shafts. Second claim patented in Arizona (1871) and largely mined out prior to 1880. Stope fill and dumps reworked later for lead-silver and fluorspar. One of major producing mines.	Blake, 1880; 1881 a & b Wilson, 1933, p. 90-92; 1951, p. 106-107 ABM file data
d. Haack mine group (Haack No. 1 & No. 2, Barite-Nip No. 1, Bronza-Hardrock, Algodones-Nip No. 2, and Abe No. 10; De Luce, Haack, Arizona Lead Co., Desert Lead Co.)	4S 4S	19W 18W	SE¼ 25, NW¼ 31 Protracted	Same as above	Spotty, partially oxidized, argentiferous galena with minor oxidized copper and zinc mineralization and gangue of crystalline calcite, fluorite, and barite in narrow, lensing, fissure veins in Mesozoic shale intruded by large and small dikes and masses of diorite and quartz porphyry.	Prospected and miped sporadically from late 1800's by means of shallow shafts, pits, and cuts. Some 20,000 tons of ore averaging about 6% Pb and 2 ox. Ag/T was produced from old fill and dumps in the 1940's.	ABM file data

Castle Dome District, Table 4 Cont

MINING DISTRICT AND MINES	LOCATION T.	R.	Sec.	MINERAL PRODUCTS	GEOLOGY	TYPE OF OPERATION AND PRODUCTION	REFERENCES
e Hull or Rialto mine group (Chief of Dome, Diana, Hull, and Surprise claims, formerly Douglas, Railroad, and Pocahontas; Castle Dome Mg. & Smltg Co., Gondolfo & Sanquinetti, De Luce, Castle Dome Mg. Co., Hull Mines, Rialto Co., Joplin Lead Co., Wall, Desert Lead Co., Taylor)	4S	19W	SW¼ 24, N Cen 25 Protracted	Same as above	Irregular masses of partly oxidized, argentiferous galena in a gangue of fluorite and calcite, up to 12 feet wide, and over some 2000 feet in length, in a lensing vein along a fault zone, with intersecting faults, containing gouge and mineralization. Some wulfenite and associated vanadinite and vanadiferous mimetite in open cavitities. Wall rocks are Mesozoic shale, limestone, and sandstone, strongly sericitized with some silicification and chloritization, cut by diorite porphyry dikes. Surface exposures limited by gravel cover of pediment.	Stoped and filled from series of shafts down to about 200 feet. Diana claim patented in 1899. Most ore mined prior to 1900 but lessees reworked fill and dumps up to 1960. Total production would be some 20,000 or more tons of ore.	Blake, 1880, 1881 a & b Wilson, 1933, p. 99-100; 1951, p. 111-112 ABM file data
f. La Colorado or Lincoln mine group (Modesti, Laguna, Hudson)	5S	19W	E Cen 12 Protracted	Same as above	Spotty bunches and pockets of partly-oxidized, argentiferous galena in a gangue of calcite, fluorite, and minor barite, with copper staining, in lensing, one-to 8-foot-wide veins along fissures at the contacts of Mesozoic shale and limestone with diorite porphyry dikes. Wall rocks show strong silicification and sericitization. Ore shoots extend downward about 200 feet.	Stoping operations from shafts in late 1800's into early 1900's and fill and dumps reworked in the late 1940's. Total estimated and recorded production would be some 1400 tons of ore averaging about 43% Pb and 38 oz. Ag/T. Some fluorspar also shipped.	Wilson, 1933, p. 102; 1957, p. 114 ABM file data
g. Little Dome mine (Linda Extension; De Luce, Haack, Wall)	4S	19W	S Cen 36 Protracted	Same as above	Irregular masses and stringers of partly oxidized, argentiferous galena in a gangue of crystalline fluorite, calcite, and gouge, cut by veinlets of crystalline to massive barite, in a lensing vein, two or more feet wide, along a fault zone cutting Mesozoic shale and a large diorite porphyry dike. Shale and diorite porphyry cut by small quartz porphyry dikes. Vein splays out to north and south and best ore where fault intersected by oblique fractures. Surface covered by thin veneer of gravel.	Relatively shallow stoping from shafts carried out intermittently from 1880's and rich stope fill and dumps reworked in 1930's and possibly later.	Wilson, 1933, p. 96, 98-99; 1951, p. 110 ABM file data

h. Sonora mine group (Linda group; De Luce, Haack, Essential Minerals Ltd., Cadwaller, Wall, Homestake Mg. Co.	4S 19W 5S 19W Protracted	S½ Cen 36 N Cen 1	Same as above	Irregular veins & masses of partly oxidized argentiferous galena in a gangue of banded, blocky calcite, crystalline fluorite, bladed to massive barite, and minor quartz, in lensing veins, a few inches to 5 or more feet wide, along wavy fault zones cutting bands of steeply dipping Mesozoic shale, alternating with a series of diorite porphyry and quartz porphyry dikes. Some hydrozincite, gypsum, calcite, quartz, lead and zinc carbonates, and wulframite found in solution channels on upper levels. Veins in quartz porphyry below 250 foot level are narrow and unproductive. Wall rocks silicified, carbonatized and sericitized with altered pyrite metacrysts. Altered, placer galena nodules occur in the variable depth of surface gravels over the veins just above the rock pediment. Galena reportedly showed high silver values.	One of principal producers of the district from 1800's to recent years, worked from shafts and stoped out down to about 250 feet below the surface. Stope fill and dumps reworked for lead and silver and group was a major producer of fluorspar.	Wilson, 1933, p. 92-95; 1951, p. 107-108 Burchard, 1934 ABM file data
7. Castle Dome gold placers	4S 18W Protracted	SE¼ & NE¼ 34, N Cen 35	Au	Spotty placer gold in gravels at or near bedrock in gulches draining from numerous small gold-bearing veins in Big Eye mine area.	Discovered in 1884 and worked sporadically by Mexican dry washers prior to 1900 and by others later. Total estimated production probably more than 7000 ounces gold.	Wilson, 1933, p. 90; 1961, p. 23 Johnson, 1972, p. 71 ABM file data
8. Copper Glance mine (Thumb Butte, Montezuma; Thumb Butte, Copper Co., Crowder, Gifford & Ferguson, Sturgess; Castle Dome Explor. & Dev. Co.)	5S 18W Protracted	SE¼ 19	Cu, Ag, Au, Pb-, Zn-	Spotty chalcocite, partly altered to copper carbonates, with minor lead and zinc mineralization, in irregular calcite-quartz veins cutting Mesozoic shale, limestone and arkose and some green chloritic schists, possibly from altered andesitic volcanics. North-south mineralized zone about 20 feet wide. Original outcrop said to contain very high-grade silver values.	Shallow shafts and open cuts worked sporadically in 1880's and from 1918 to 1930 and in 1956 and 1966, producing a total of some 135 tons of ore averaging about 7% Cu, 11 oz. Ag/T, 0.1 oz. Au/T and 0.2% Pb.	Wilson, 1933, p. 84, 89 & 90 ABM file data
9. Gibson Manganese mine (outside district map)	5N 17W Protracted	N Cen 2	Mn	Irregular, pyrolusite lenses with manganiferous calcite and brecciated wall rock, in a shear zone cutting Cretaceous or Tertiary andesitic volcanics. Shattered volcanics contain 5-6% Mn along sides of zone.	Worked by shallow shaft and open cuts with several truck loads of 30% Mn shipped in the 1950s.	ABM file data

Castle Dome District, Table 4 Cont

MINING DISTRICT AND MINES	LOCATION T.	R.	Sec.	MINERAL PRODUCTS	GEOLOGY	TYPE OF OPERATION AND PRODUCTION	REFERENCES
10. Mable (Mabel) mine group (Puckett; Smith, McCadden, Jones)	4S	18W	W Cen 31 Protracted	Pb, Ag, F, Ba-, V-, Mo-	Spotty pockets and irregular masses of partly oxidized argentiferous galena in a gangue of crystalline calcite, fluorite, and minor barite in irregular, lensing, narrow, fissure veins in Mesozoic shales cut by diorite porphyry and quartz porphyry dikes. Minor wulfenite and vanadinite in vugs and solution channels.	Small stopes from numerous shafts worked sporadically from 1880's with total estimated and recorded production of some 200 tons of ore averaging about 20% Pb, 8 oz. Ag/T, 0.2 oz. Au/T, and 0.2% Cu.	Wilson, 1933, p. 102; 1951, p. 113-114 ABM file data
IV. Cienega District (West end of the Buckskin Mts) Figure 6	9N-11N	17W-19W	---	Cu, Au, Ag, Pb-, Hg-, W-, Ba-	Small, pockety, replacement bodies containing copper silicates, carbonates, and oxides with iron oxides and spotty gold values, usually closely associated with faults, fractures, and shear zones in thrust-faulted blocks of partly metamorphosed Paleozoic and Mesozoic limestones, shales, and quartzites, lying unconformably on Precambrian metamorphics, or in Precambrian metamorphics thrusted over Paleozoic and Mesozoic sediments. Some high grade gold pockets found and, reportedly, cupriferous pyrite and copper sulfides occur in depth.	Numerous scattered tunnels, shafts, and surface workings. Prospected and mined sporadically from the late 1800's to 1969. Total estimated and recorded production would be some 19,000 tons of ore containing about 917 tons of copper, 11,707 ounces of gold, 3,364 ounces of silver and a few hundred pounds of lead.	Bancroft, 1911, p. 73-78 Blanchard, 1913 Darton, 1925, p. 215-218 Ross, 1923, p. 179-180 Wilson, 1934 (Rev. 1967), p. 126-127 Al-Hashimi, 1965 Fernandez, 1965 Zambrano, 1965 ABM file data
1. Arizona McGinnis mine (Copper Queen: McGinnis, Arizona McGinnis Copper Co., Morrow	10N	18W	S Cen 9, NW¼ 16, NE¼ 17	Cu, Au, Ag	Spotty cuprite, malachite, and chrysocolla in stringers and replacements in metamorphosed Paleozoic limestone along and below thrust-faulted Precambrian quartz schist. Ore occurs in irregular and shallow shoots with some rich pockets of gold.	Shaft, tunnel, and open cuts. Worked in 1913, 1917, and 1926-1927, producing some 170 tons of ore averaging about 9% Cu, 0.6 oz. Au/T and 0.1 oz. Ag/T.	Mines and Copper Handbook, 1918 ABM file data
2. Arizona Pride mine (Pride; Denton, Osborne)	9N	17W	N Cen 4 Protracted	Au, Ag, Cu-	Small, irregular veins, disseminations, tabular replacements, and breccia fillings of azurite and malachite, with hematite, in thin marble layers on or near the intersection of faults and fractures with a thrust fault contact zone bringing Paleozoic limestone over Precambrian metamorphics. Some concentration of gold near the surface and chalcopyrite reported in depth.	Prospected and worked sporadically from a shaft, from early 1900's, but with only a few tens of tons of ore produced, averaging about 2 oz. Au/T, 0.2 oz. Ag/T and a little Cu.	Fernandez, 1965 ABM file data

3. Billy Mack mine group (Ruby; Mack, Ruby Gold & Copper Co., Billy Mack Mg. Co., Illinois Arizona Copper Co., Butler, Georgekin, Allen, Paxton, Harris, Hay, Venhoff, Mills)	10N	19W	S Cen 24	Cu, Au, Ag	Scattered bunches, discontinuous pockets, and irregular replacements of specular and spongy hematite and limonite containing small pockets and masses of malachite and chrysocolla, and threads and disseminations of free gold in porous quartz. Mineralization controlled by fracture intersections in metamorphosed Paleozoic limestone along a steeply dipping thrust fault zone bringing Precambrian metamorphics over the sediments. Local quartz monzonite and diabase dikes.	Extensive tunnel and shaft operations worked sporadically from the early 1900's. Mining, mainly from 1909 to 1919 and 1943 to 1960, produced some 3000 tons of ore averaging about 4.5% Cu, 0.6 oz. Au/T, and 0.2 oz. Ag/T.	Bancroft, 1911, p. 74-76 Copper Handbook, 1911; 1912-1913 Mines and Copper Handbook, 1918; 1920 Wilson, 1924 (Rev. 1967), p. 126 Zambrano, 1965 ABM file data
4. Capilano mine (Botzum & Assoc., Capilano Holdings Inc., Williams)	10N	19W	NE¼ 26	Au, Ag, Cu-	Small and pockety gold, with some oxidized copper mineralization with quartz, in silicified brecciated wall rock along a thrust fault zone between metamorphosed Paleozoic limestone and Precambrian schistose quartzite.	Shaft and surface cuts. Worked sporadically from early 1900's but with only very limited production of rich gold and silver ore and minor copper.	Wilson, 1934 (Rev. 1969), p. 127 ABM file data
5. Carnation mine (Watson, Empire Arizona Consolidated, Copper Co., Empire Arizona Copper Co., Harritt & Davis, Empire Arizona Mg.. Co., Strategic Metals Mines, Lucky Tiger Combination Gold Mg. Co., Cornejo, Baker & King Copper Mg. Co., American-Arizona Metals Co., Woolley)	10N	18W	NW¼ 21	Cu, Au, Ag	Spotty and irregular lenses and pods of chrysocolla, malachite and azurite, associated with hematite carrying gold values, in irregular, vuggy, silicous replacement bodies in folded and faulted, metamorphosed Paleozoic or Mesozoic limestone, and also in irregular stringers, fractures, and breccia fillings in a strong, wide, silicified, thrust fault zone that brought Precambrian metamorphic rocks over the Paleozoic sediments. Strong folding and fracturing with numerous irregular quartz veins. Quaternary-Tertiary basalt capping to east.	Main incline shaft and shallow shafts, tunnels, and open cuts. Prospected and mined intermittently from early 1900's to 1970's, producing some 8000 tons of ore averaging about 4% Cu, 0.2 oz. Au/T and 0.05 oz. Ag/T.	Bancroft, 1911, p. 76-77 Mines Handbook, 1918 Zambrano, 1965 ABM file data
6. Eagle Nest mine (Empire Arizona Consolidated Copper Co., Empire Arizona Copper Co., Empire Arizona Mg. Co., Strategic Metals Mines, Lucky Tiger Combination Gold Mg. Co., Cornejo)	10N	18W	W Cen 16	Cu, Au, Ag	Generally similar to Carnation deposit in geology and mineralization but with less iron oxides and relatively more secondary copper. Spotty ore bodies closely associated with the thrust fault zone and sheared, faulted, fractured, and brecciated, metamorphosed Paleozoic-Mesozoic sediments and thrust-faulted, overlying Precambrian metamorphics.	Shaft and surface cuts. Prospected and worked along with Carnation from early 1900's to 1950s and produced some 4000 tons of ore averaging about 3.5% Cu, 0.2 oz. Au/T and minor Ag.	Mines Handbook, 1918 Zambrano, 1965 ABM file data
7. Golden Ray mine group (Dennis, Golden Ray Mg. Co.)	10N	19W	E Cen 24	Au, Cu, Ag	Spotty copper silicate and carbonate with hematite, in irregular replacement bodies in folded and faulted Paleozoic limestone along thrust fault zone bringing Precambrian metamorphics over the Paleozoic sediments.	Tunnel and shaft workings. Produced some 175 tons of ore averaging about 0.56 oz. Au/T, 1.5% Cu and 0.2 oz. Ag/T in 1940-1941 and 1949-1950.	ABM file data

EXPLANATION

Quaternary and Tertiary alluvium **(Qs,QTs)**

Quaternary volcanics (may include Tertiary volcanics) **(Qv,QTv,Qb,QTb)**

Tertiary and Laramide volcanics and sedimentaries **(Tv,Ts,Tsv,Ls,Lv,Tk**

Mesozoic, Laramide and Tertiary intrusives **(Mi,Li,Ti)**

Cretaceous or Tertiary volcanics **(Kv-Tv)**

Mesozoic sedimentaries and metamorphics **(Ms,Mm)**

Paleozoic sedimentaries (may include some Mesozoic) **(Ps,PMs)**

Precambrian metamorphics and intrusives **(p€m,p€i)**

Contact

Fault

Thrust or Reverse Fault (teeth on upper plate)

Mine or prospect (numbers refer to table or text)

Mine or prospect (mineral occurrence reported)

Explanation of Geologic Symbols

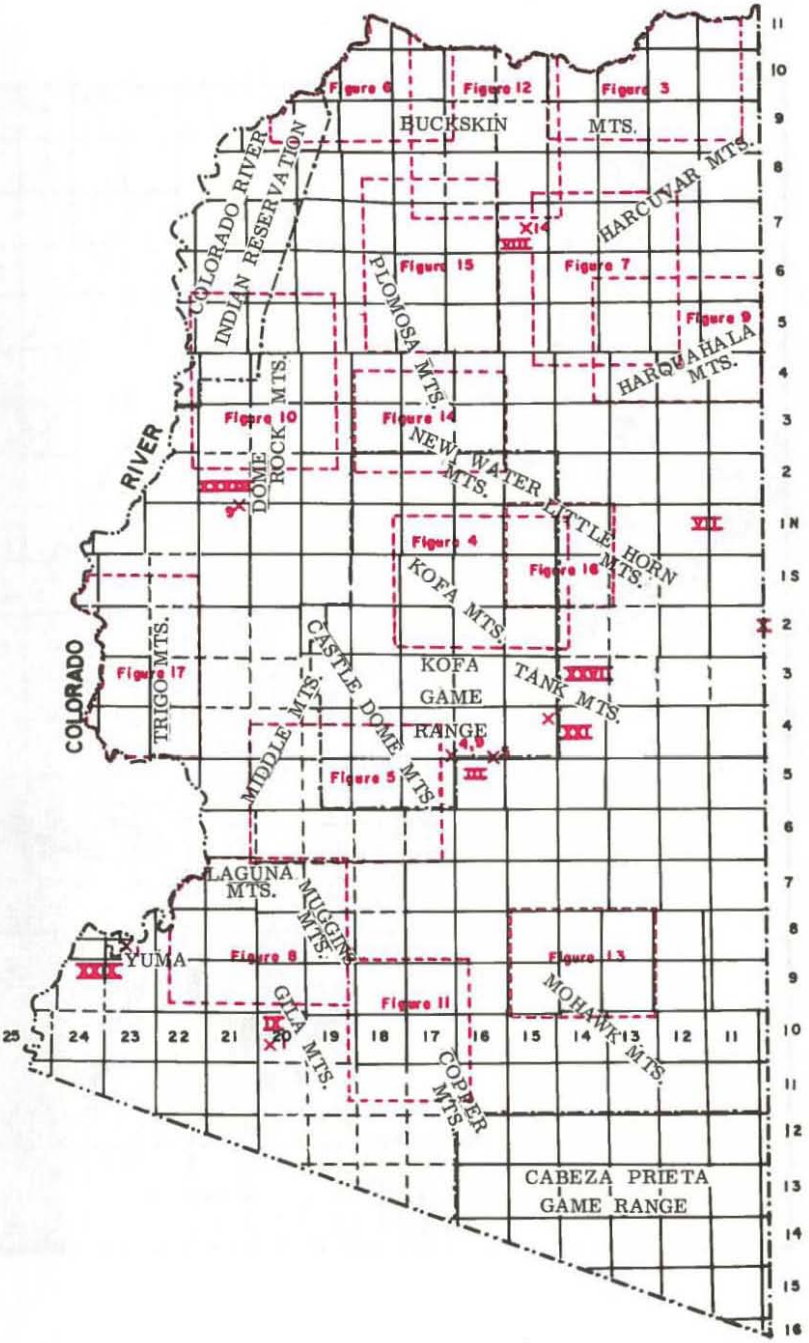
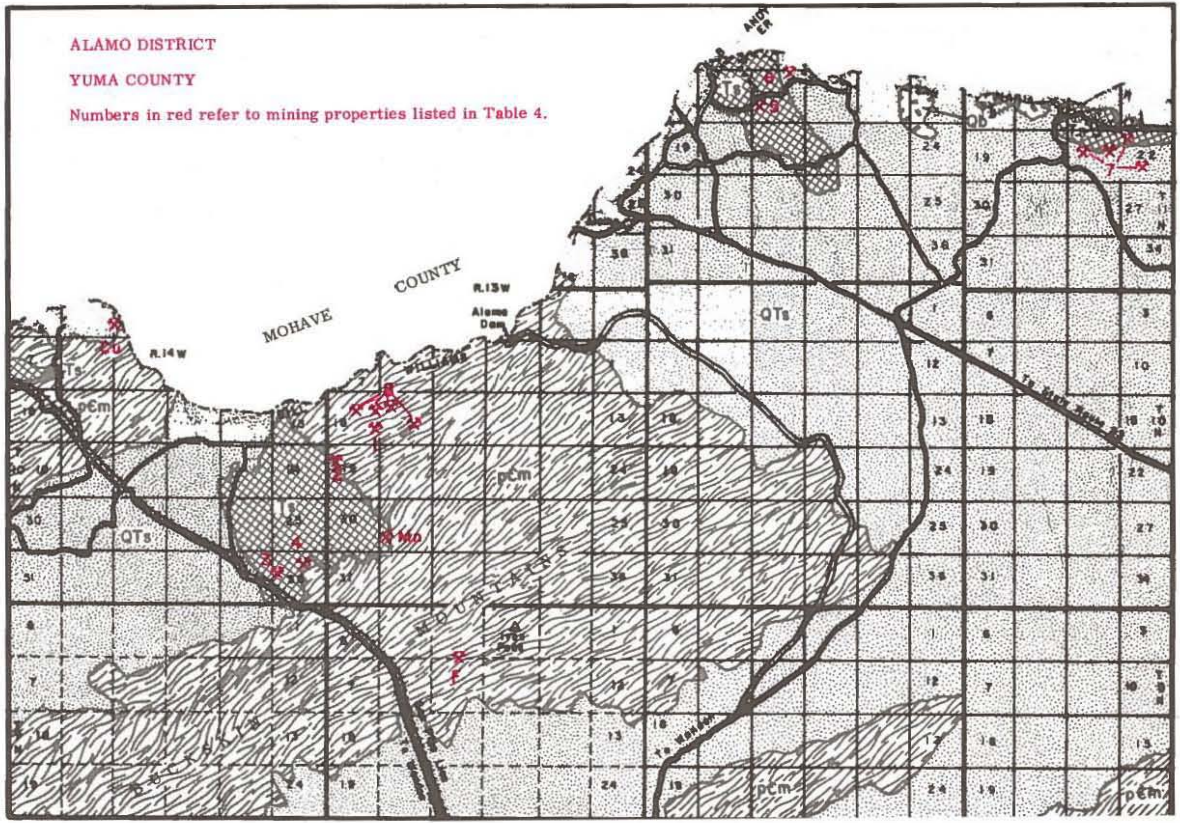


Figure 2. Index Map of Mining Districts in Yuma County


ALAMO DISTRICT
YUMA COUNTY
Numbers in red refer to mining properties listed in Table 4.
MOHAVE
COUNTY
R.13W
R.14W
Alamo Dam
QTs
Ts
pCm
Mo
To Wickenburg

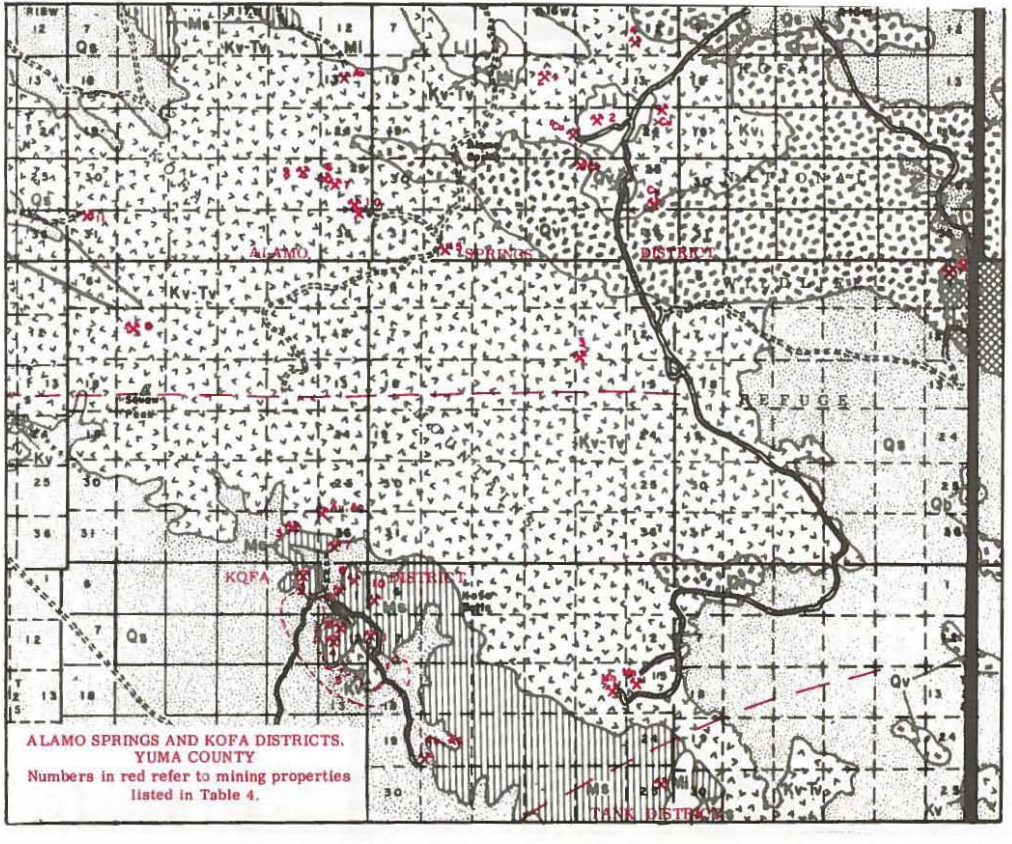
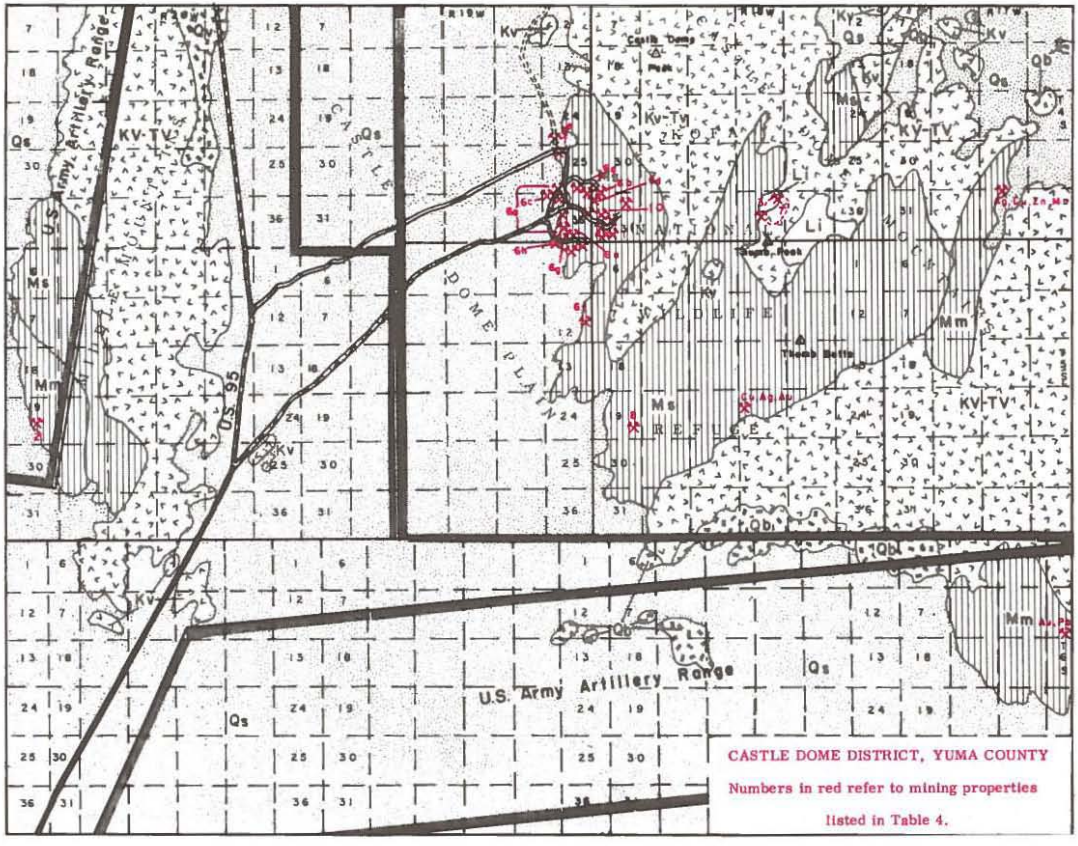


Figure 4. Alamo Springs and Kofa districts



CASTLE DOME DISTRICT, YUMA COUNTY

Numbers in red refer to mining properties listed in Table 4.

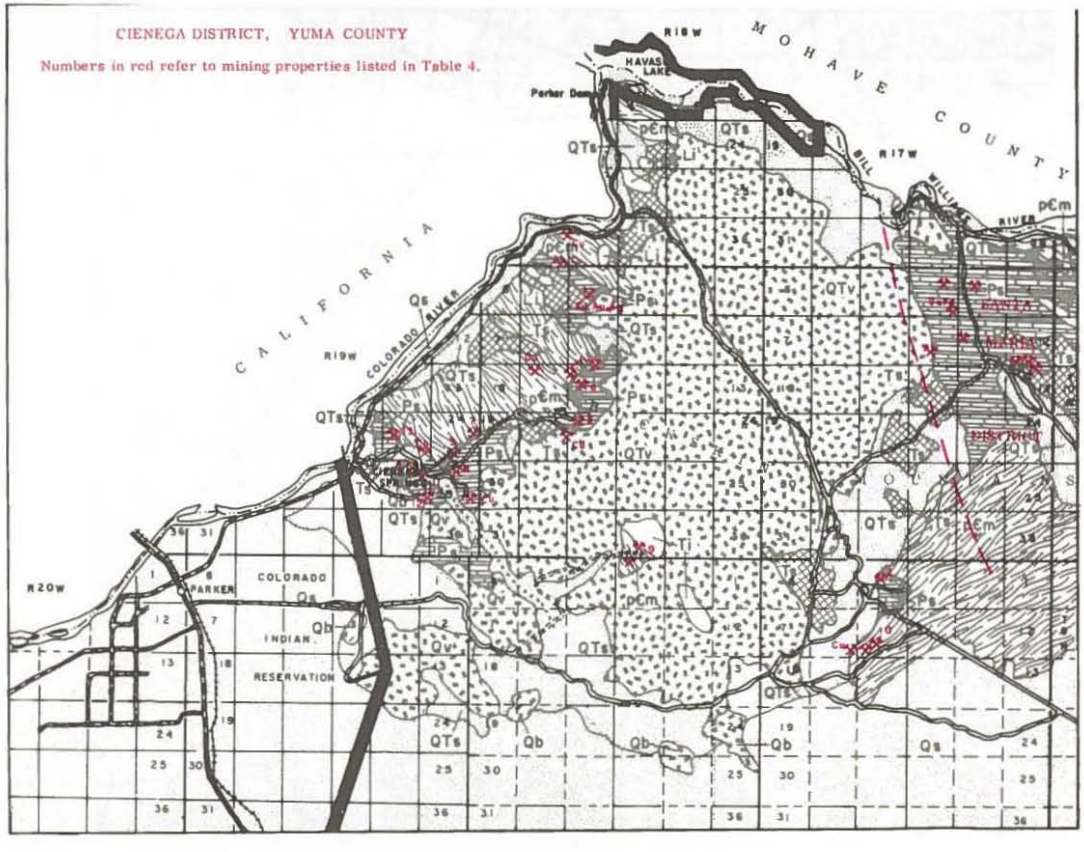
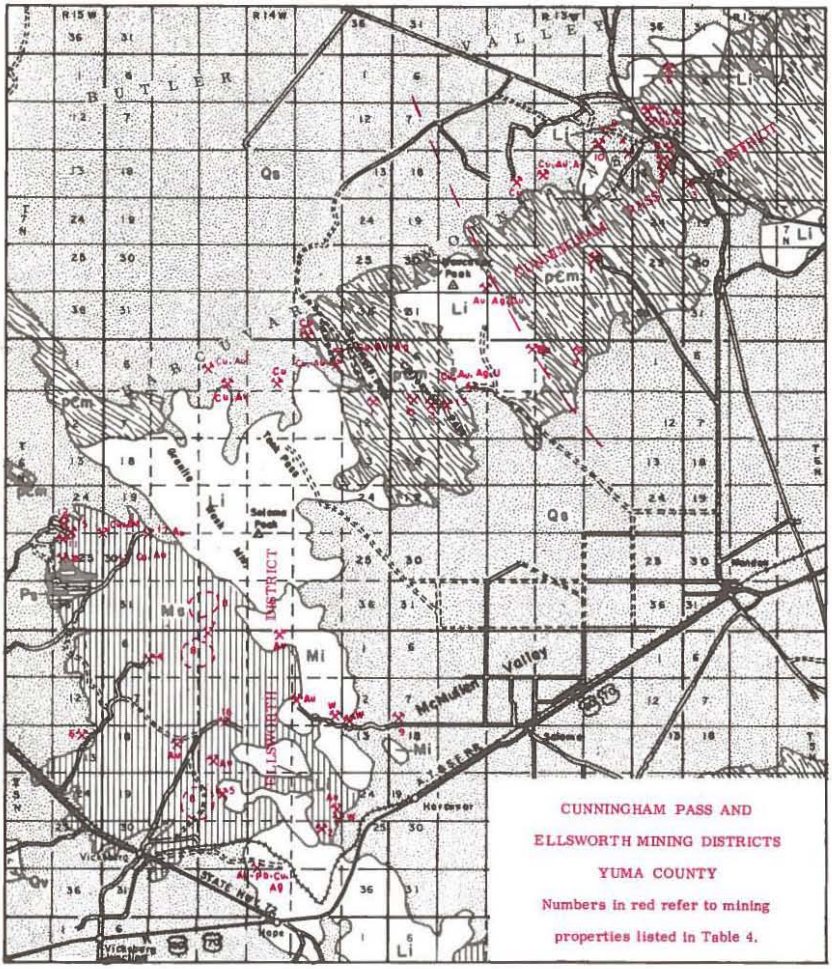


Figure 6. Cienega District



CUNNINGHAM PASS AND ELLSWORTH MINING DISTRICTS YUMA COUNTY

Numbers in red refer to mining properties listed in Table 4.

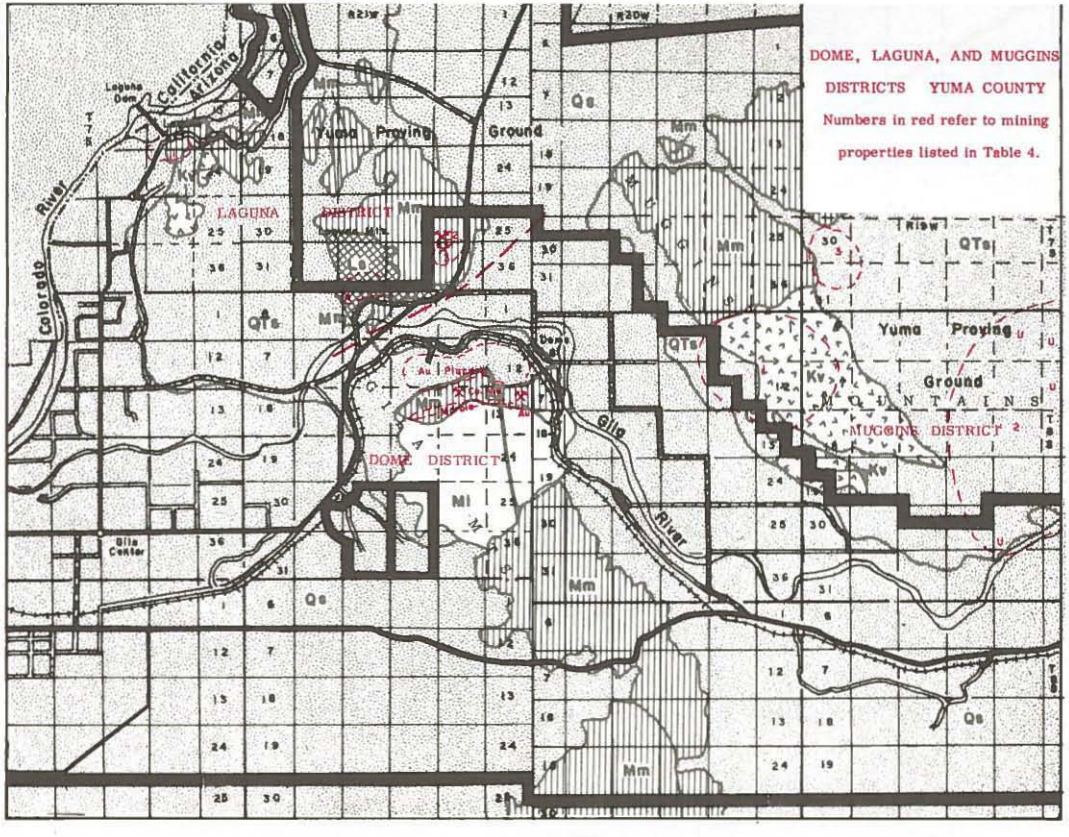
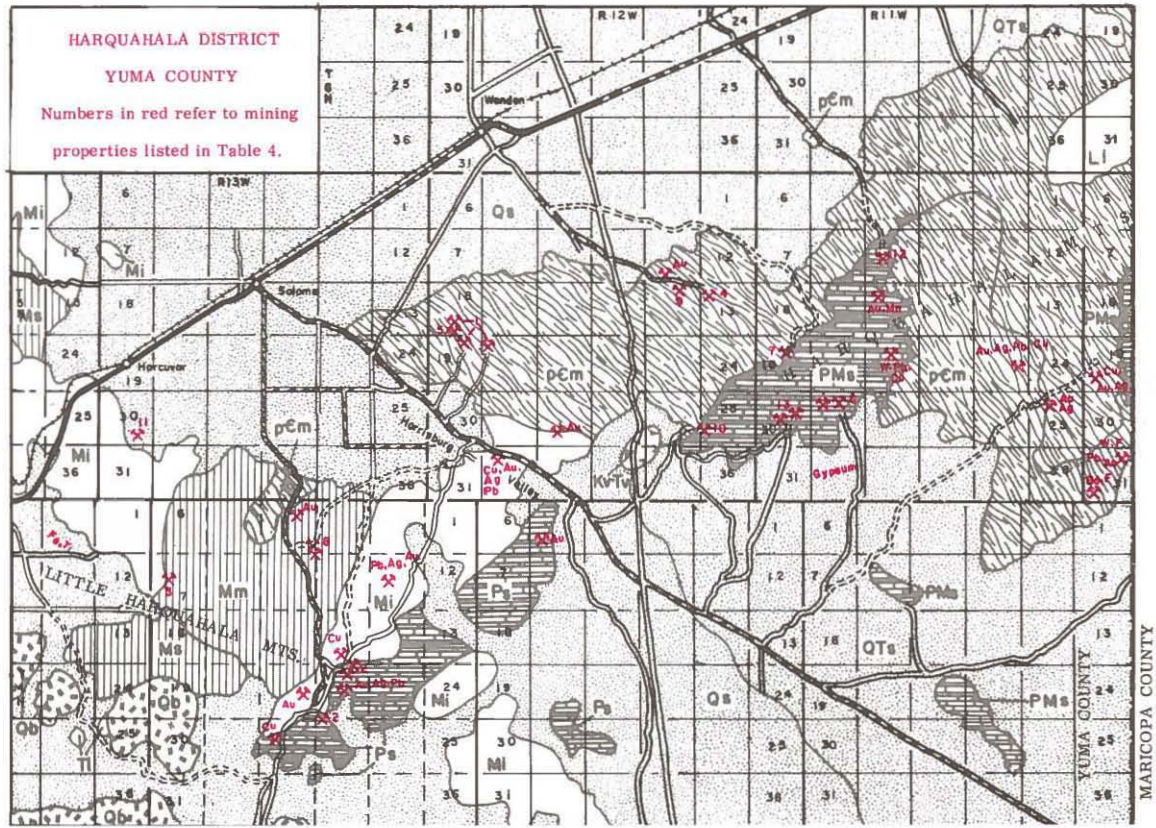


Figure 8. Dome, Laguna, and Muggins districts


HARQUAHALA DISTRICT
YUMA COUNTY
Numbers in red refer to mining properties listed in Table 4.
R13W
R12W
R11W
T 6 N
Wenden
Salome
Hercuvar
Harrisburg
Valley
LITTLE HARQUAHALA MTS.
Mm
Ms
Mi
Qs
pЄm
PMs
QTs
Ps
Qb
Ti
Kv-Tv
Li
Gypsum
YUMA COUNTY
MARICOPA COUNTY

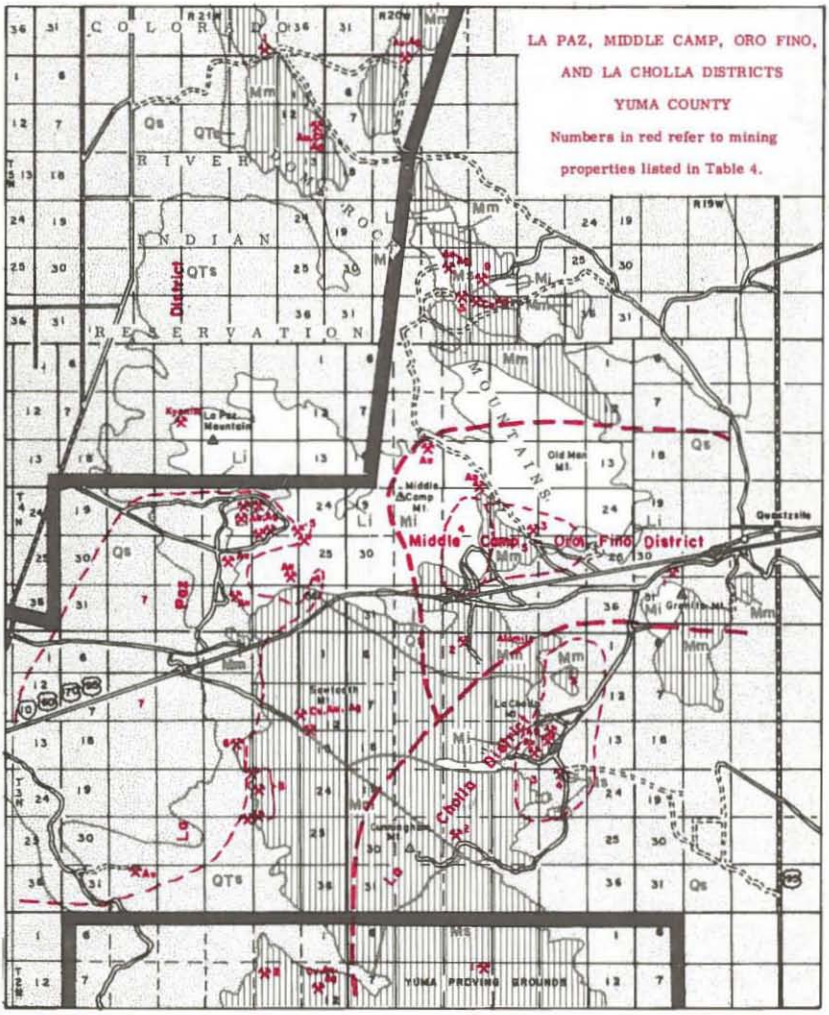


Figure 10. La Paz, Middle Camp-Oro Fino, and La Cholla districts

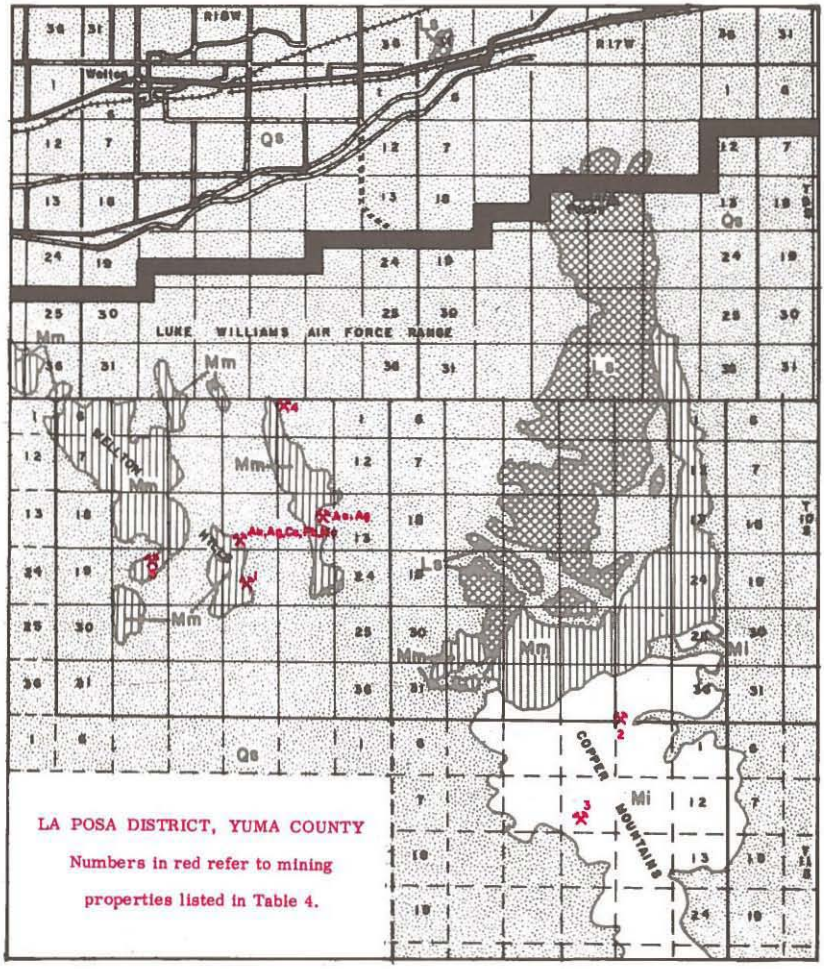


Figure 11. La Posa District

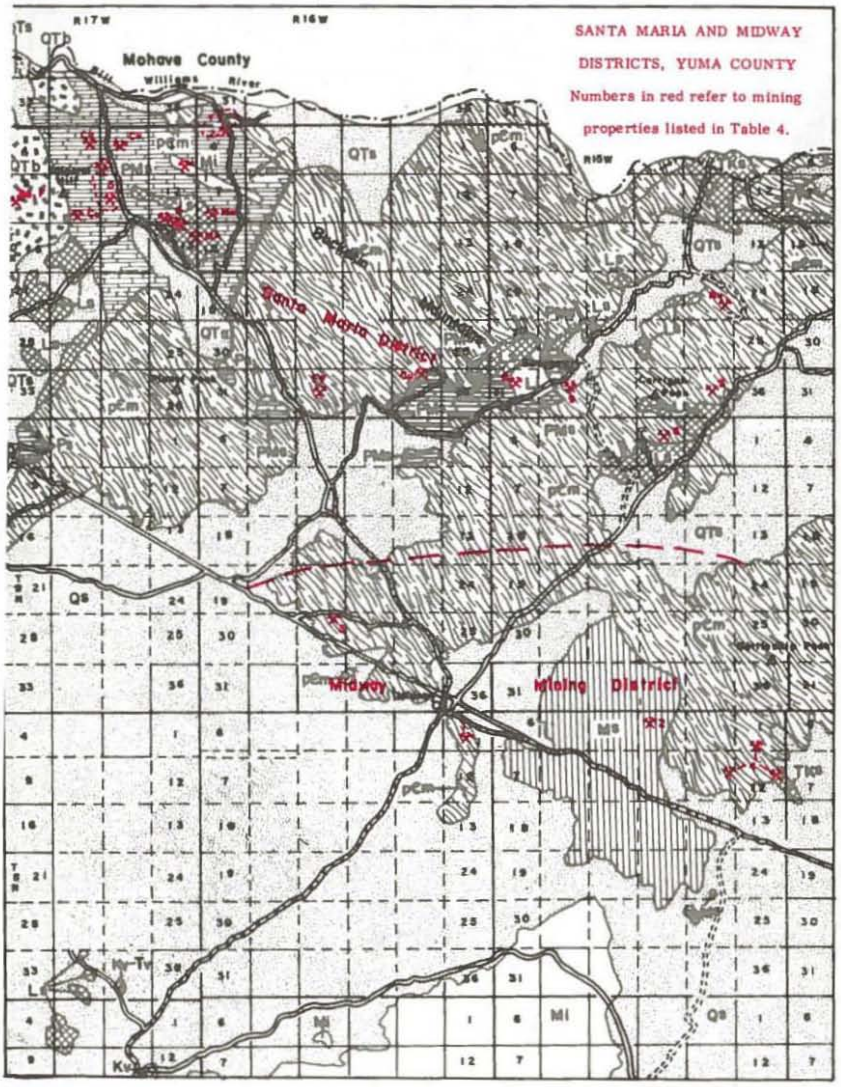
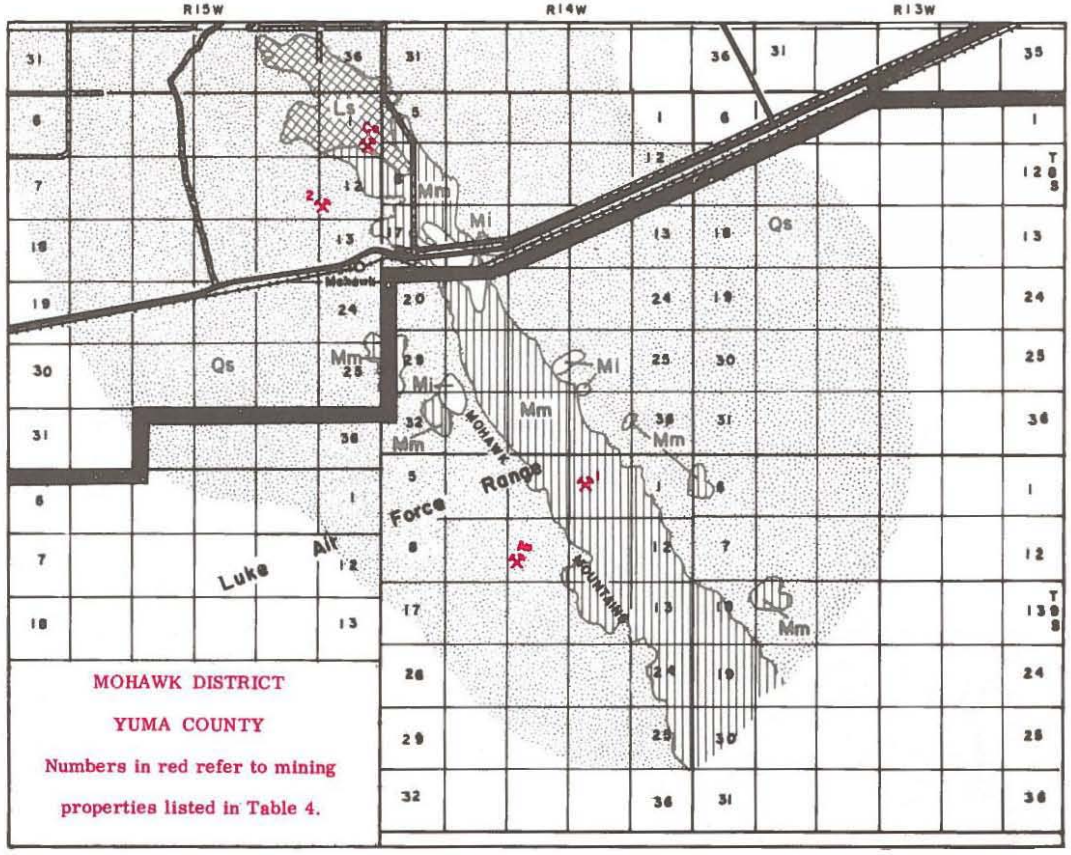


Figure 12. Midway and Santa Maria districts



MOHAWK DISTRICT

YUMA COUNTY

Numbers in red refer to mining properties listed in Table 4.

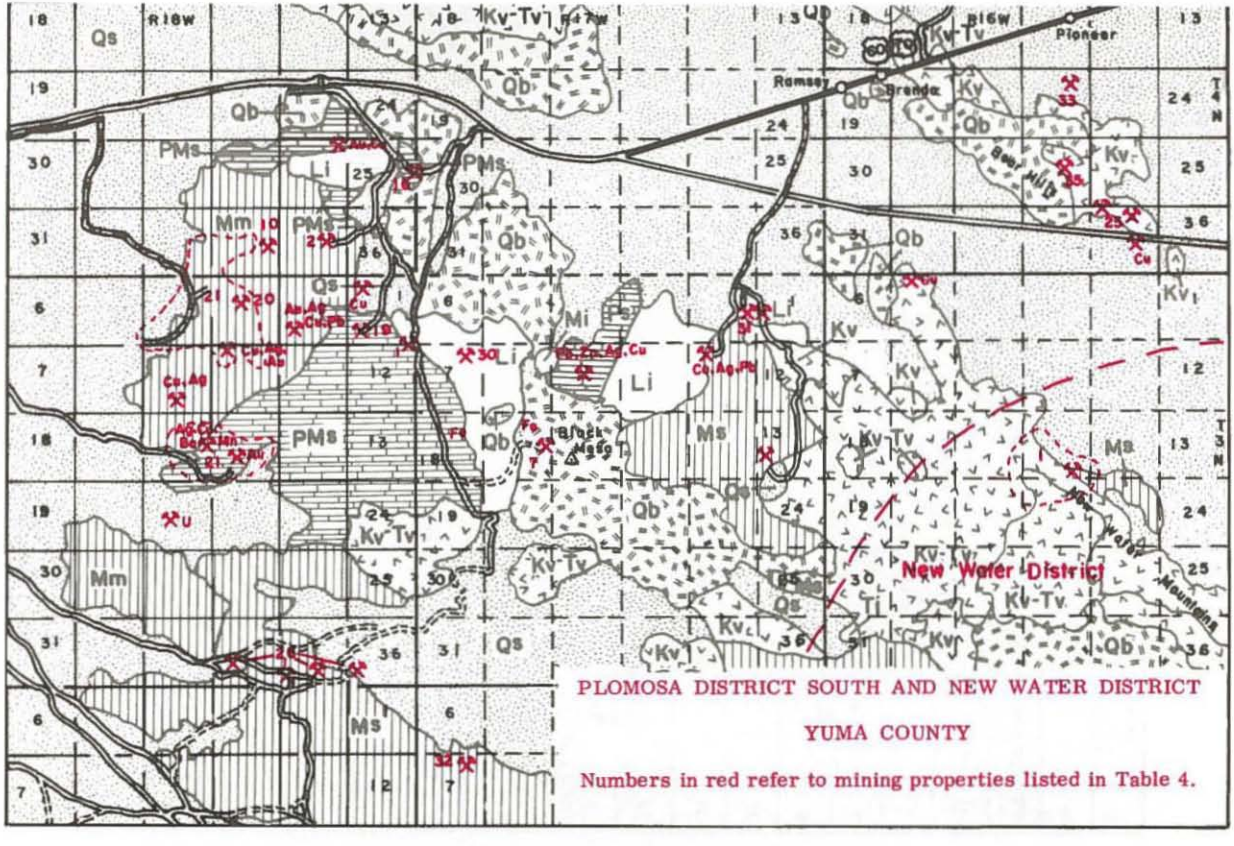


Figure 14. New Water and Plomosa(South) districts

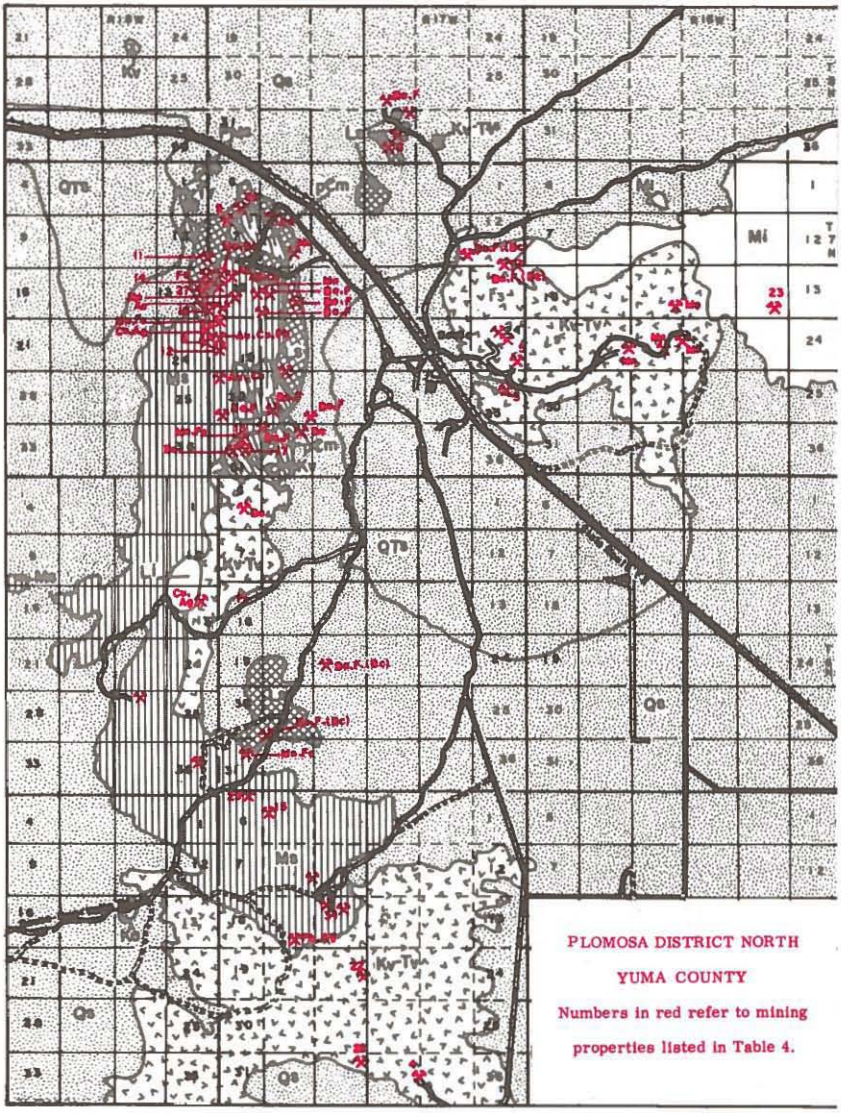


Figure 15. Plomosa (North) District

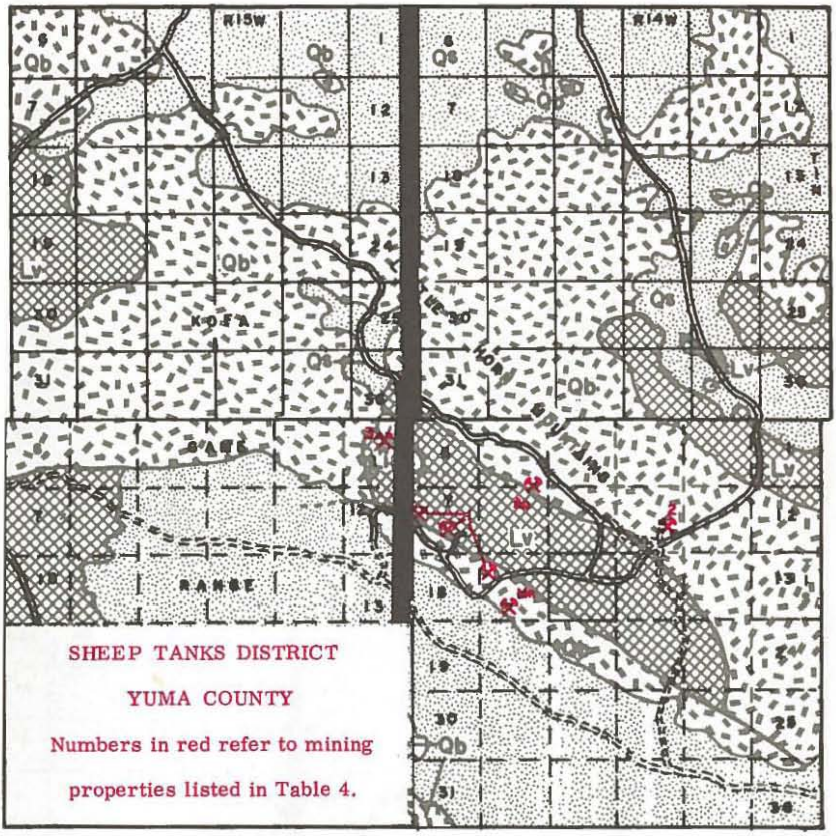
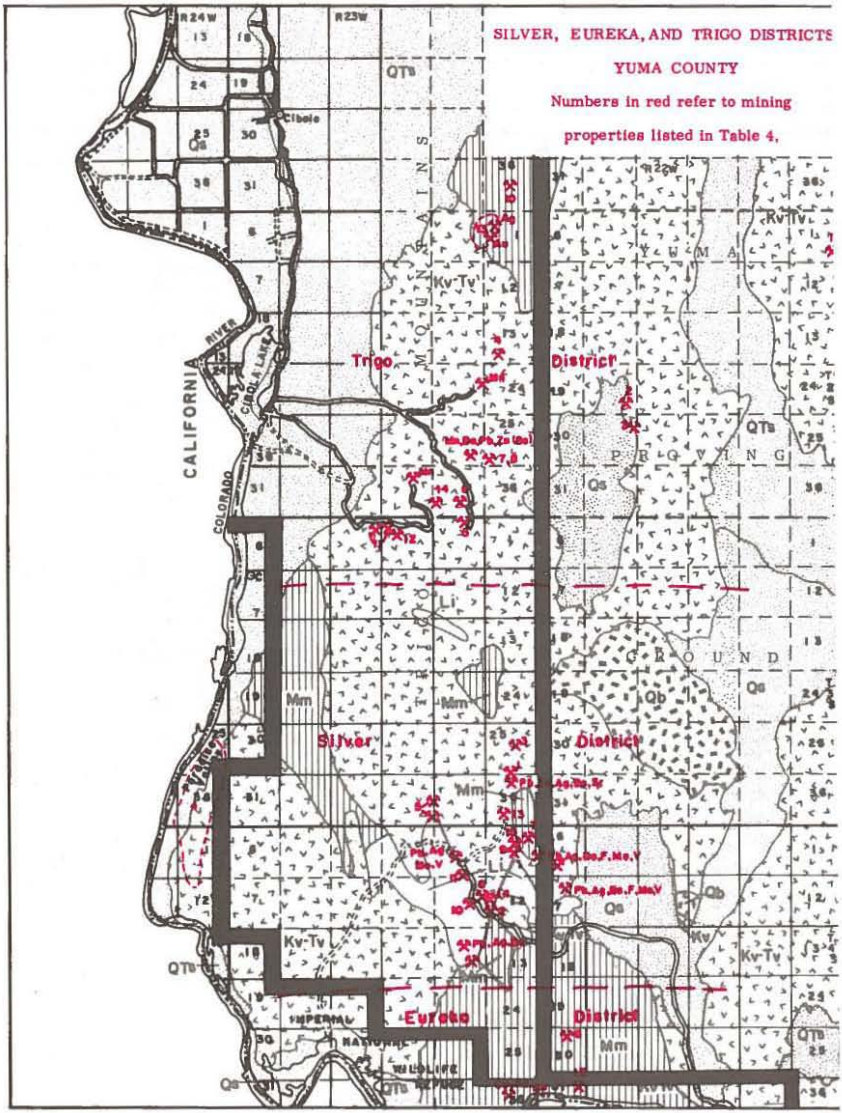
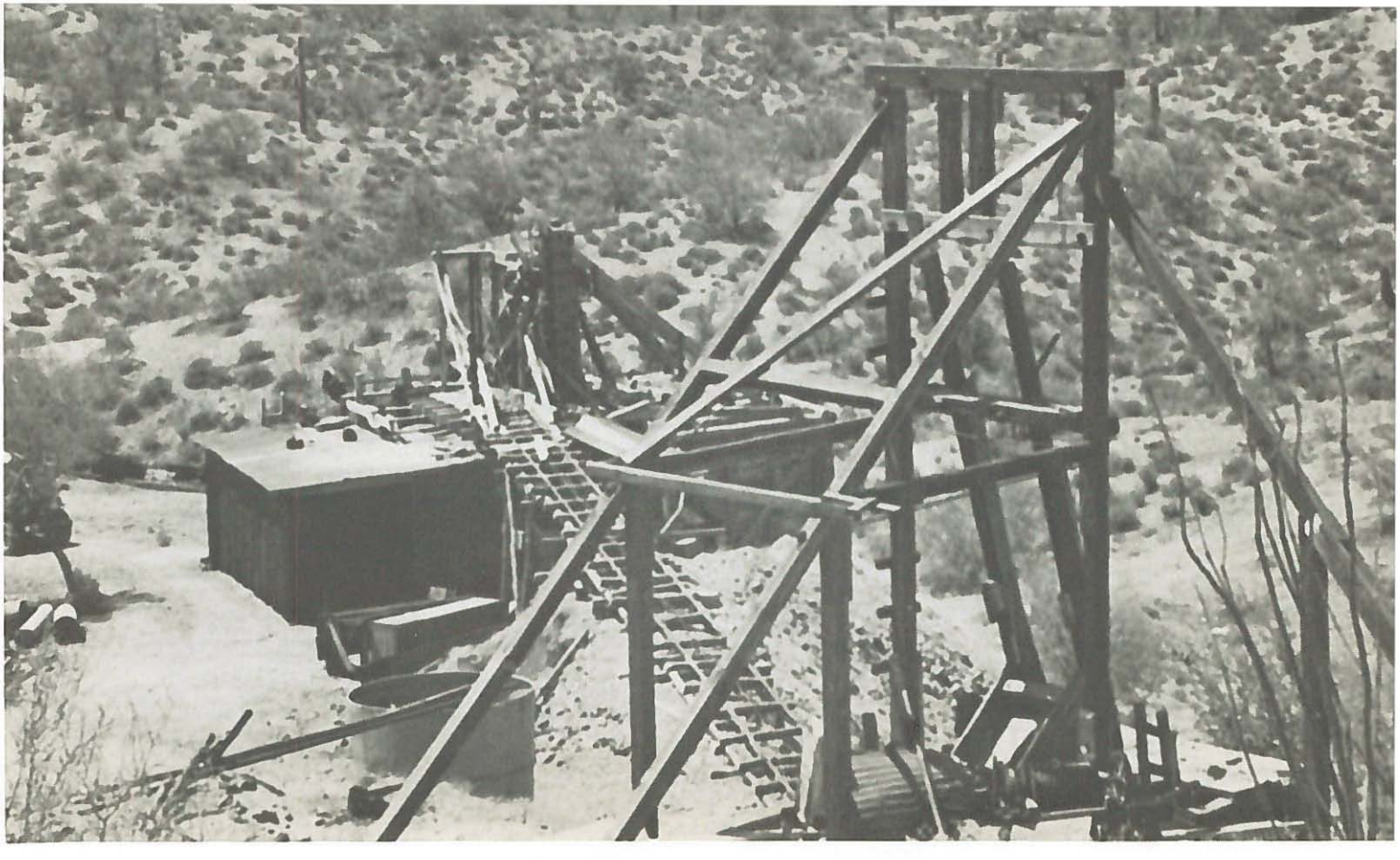


Figure 16. Sheep Tanks District


SILVER, EUREKA, AND TRIGO DISTRICTS
YUMA COUNTY
Numbers in red refer to mining
properties listed in Table 4.
R24W
R23W
R22W
Cibola
CALIFORNIA
COLORADO
RIVER
Trigo
District
Silver
District
Eureka
District
Kv-Tv
Mm
Qs
Qb
QTs
Kv
IMPERIAL
NATIONAL
WILDLIFE
REFUGE



Cienega District, Table 4 Cont.

MINING DISTRICT AND MINES	LOCATION T.	R.	Sec.	MINERAL PRODUCTS	GEOLOGY	TYPE OF OPERATION AND PRODUCTION	REFERENCES
8. Lion Hill mine group (Glory group, Rico; Billy Mack Mg. Co., Illinois-Arizona Copper Co., Lion Hill Gold Mg. Co., Osborne & Botzum)	10N	19W	N Cen 25	Au, Ag, Cu	Small pockets of hematite containing spotty copper silicate and carbonates in brecciated rock and replacements of metamorphosed Paleozoic limestone which was folded into an anticlinal structure and strongly fractured. Ore deposits controlled by fracturing and bedding. Some high grade gold pockets in iron oxide.	Tunnel operations. Prospected and worked intermittently from early 1900's but production mainly from 1917-1920, 1928-1933, 1937-1938 and in 1943. Total production would be some 700 tons of ore averaging about 2.4 oz. Au/T, 0.2 oz. Ag/T and 0.4% Cu.	Mines and Copper Handbook, 1920 Wilson, 1934 (Rev. 1967), p. 126-127 Zambrano, 1965 ABM file data
9. Mammon mine group (Mammon-Zeolite, W&O; Wardwell & Osborne Copper Mines Co., Mammon Gold & Copper Co., Mammon Copper Co., Osborne, Whitt)	10N 9N	18W 18W	S Cen 34 N Cen 3	Cu, Au, Ag	Hematite fracture and breccia filling with spotty narrow and lensing oxidized copper mineralization and minor gold and silver along shear zone between Precambrian metamorphics and Quaternary-Tertiary intrusive; and along schistosity in the Precambrian metamorphics. Occurrence is surrounded by Quaternary-Tertiary basalts.	Tunnel and shaft workings. Prospected and mined sporadically from about 1901, producing over 800 tons of ore averaging about 4.5% Cu, 0.07 oz. Au/T and 0.16 oz. Ag/T.	Bancroft, 1911, p. 77-78 Mines Handbook, 1926 ABM file data
10. New Standard mine (Carrigan, Arizona Standard Copper Co.)	9N	17W	SW¼ 9 Protracted	Cu, Fe, Ag, Au	Irregular, tabular, replacement bodies and some vein and breccia fillings of hematite cut by stringers and disseminations of copper carbonates, in Precambrian gneiss and schist and Paleozoic limestone overlying the Precambrian metamorphics along a probable thrust fault zone. Reported chalcopyrite and bornite in depth.	Shaft and open cut workings. Prospected and worked sporadically from early 1900's to about 1924 but only a few high grade shipments made.	Mines Handbook, 1924 Fernandez, 1965 ABM file data
11. Rio Vista Northside mine (Osborne & Ransford)	10N	19W	NE¼ 26	Cu, Au, Ag	Lenticular bodies of brecciated rock with cementing hematite containing spotty chrysocolla, malachite, limonite, and some flaky gold in a wide, silicified breccia zone, probable along a thrust fault between metamorphosed Paleozoic limestone and Precambrian schistose quartzite.	Shaft, tunnel, and open cut workings. Prospected and mined intermittently, mainly in 1918-1919 and 1929-1933, Producing some 100 or more tons of ore averaging about 5% Cu, 0.5 oz. Au, and 0.3 oz. Ag/T.	Wilson, 1934 (Rev. 1967), p. 127 Zambrano, 1965 ABM file data
12. Rio Vista Southside mine (Quartz King, Copper Top; Quartz King Gold Mg. Co. Rio Vista Mines, Osborne & Botsum)	10N	19W	SE¼ 26	Cu, Au, Ag	Spotty ore shoots of copper carbonates and silicate with hematite, in a brecciated rock and quartz gangue along parallel vein-like bodies in a nearly vertical, wide shear zone in folded metamorphosed Paleozoic-Mesozoic sediments, along an anticline close to a thrust fault zone. Some diabase dike intrusions.	Shaft and tunnel workings. Prospected and mined intermittently from early 1900's to 1950's, producing some 100 or more tons of ore averaging about 8% Cu, 0.4 oz. Au/T and 0.1 oz. Ag/T.	Bancroft, 1911, p. 73-74 Zambrano, 1965 ABM file data

13. Sue mine (Mack, Osborne, Wray, Associated Mg. Co., Health & Wealth Club, Inc.)	10N	19W	W Cen 23	Cu, Au, Ag	Spotty and irregular copper mineralization, oxidized near the surface and with relict, partly replaced sulfides in depth, with hematite, in a gangue of quartz, calcite and barite in a brecciated zone cutting silicified and metamorphosed Paleozoic-Mesozoic limestone and Precambrian metamorphics, probably close to a thrust fault zone.	Tunnel and small workings. Prospected and mined sporadically from late 1860's to 1963, producing some 400 tons of ore averaging about 3.5% Cu, 0.2 oz. Au/T and 0.1 oz. Ag/T.	Wilson, 1934 (Rev. 1967) p. 127 Zambrano, 1965 ABM file data
V. Cunningham Pass District (Central Harcuvar Mountains in vicinity of Cunningham Pass) Figure 7	6N-7N	12W-13W	---	Cu, Au, Ag, Fe, Ba, Pb-, U-	Spotty, but often high grade, pockets and streaks of copper-gold-silver mineralization with quartz, iron oxides, siderite, calcite, and barite in strong lensing, intersecting fissure veins and along contacts or in cross-cutting aplite, pegmatite, diabase, and granite porphyry dikes. Strong oxidation and secondary enrichment near the surface. Wall rocks are Precambrian metamorphics intruded by dikes and probably underlain by Laramide intrusive. Probable strong, wide, fault zone, strikes northwest through Cunningham Pass.	Numerous scattered shafts, tunnels and open cut workings, opened up since the early 1900's by companies and lessees. Total estimated and recorded production would be some 9,000 or more tons of ore containing about 773 tons of copper, 4436 ounces of gold, 2344 ounces of silver, and a few pounds of lead.	Bancroft, 1911, p. 115-119 Tovote, 1918 ABM file data
1. Bonanza & Evylin mine group (McDonald, Miller, Bonanza Mg. Co., Bonanza Central Mg. Co.)	7N	13W	NW¼ 26	Cu, Au, Ag, Fe, U-	Spotty copper-gold-silver mineralization with strong iron oxides and quartz in irregular, lensing veins associated with wide zone of parallel and persistent diabase dikes, cutting Precambrian gneiss along a strong northwest-striking shear zone. Weak uranium mineralization found on fracture.	Shafts with underground workings down to 500 feet. Discovered about 1900 but worked mainly and sporadically from 1937 through 1952, producing some 713 tons of ore averaging about 2% Cu, 0.22 oz. Au/T and 0.2 oz. Ag/T	USAEC PRR, A-P-301, 1954-55 ABM Bulletin 182, 1970, p. 288 ABM file data
2. Bullard mine group (Mohawk, Columbia; Bullard, Donnelly & Walcott, Lee, Huthmacher & Frisbee, Mathews, Garrick, Cripple Crew Mg. Co., Marvel Mg. Co.)	7N	13W	N Cen 13	Cu, Au, Ag, Fe, Ba-	Lenses and pockets of bornite and chalcopyrite with gold and silver values and associated quartz, iron oxide, and some barite, in a strong northwest-striking fissure vein. Oxidized down some 400 feet from surface with narrow leached zone and sulfides below. Wall rocks are Precambrian gneiss intruded by granite and cut by diorite and other dikes.	Claims patented in 1907 and mined intermittently, from tunnels and shafts, into 1960 by various lessees and owners. Total production would be some 2000 tons of ore averaging about 6.6% Cu, 0.3 oz. Au/T and 0.3 oz. Ag/T. Second largest producer in district.	Tovote, 1918 ABM file data
3. Centroid mine group (Robinson group, Copper Hill, Desert, Black Reef, Harris group; Desert Mg. & Dev. Co., Black Reef Copper Co., Desert Mg. Co., Consolidated Arizona Mines, Consolidated Mines Syndicate, Centroid Consolidate Mines, Herbert, Harris, Synder)	7N	12W	W½ 18	Cu, Au, Ag, Fe	Chalcopyrite, bornite, chalcocite, chrysocolla, cuprite and copper carbonates, with quartz, hematite, siderite and wall rock breccia, in lenses and pods in strong, lensing, iron rich, northwest-striking veins along mineralized faults and shear zones cutting the Precambrian metamorphics. Intruded by later granitic and diorite dikes. Wall rock chloritized. Strong leaching, oxidation, and enrichment in upper part of veins.	Shaft, tunnel, and open cut workings. Prospected in late 1800's and early 1900's but mined, mainly and sporadically, from about 1916 to 1949. Total production would be some 410 tons of ore averaging about 2.4% Cu, 0.38 oz. Au/T and 0.5 oz. Ag/T.	Mines and Copper Handbook, 1918, 1920, 1924 ABM file data

Cunningham Pass District, Table 4 Cont.

MINING DISTRICT AND MINES	LOCATION T.	R.	Sec.	MINERAL PRODUCTS	GEOLOGY	TYPE OF OPERATION AND PRODUCTION	REFERENCES
4. Critic mine (Bullard, Boone, Cunningham Pass Copper Mg. Co., Stent, Feighton, Ranier Mines Corp., Nohlcheck, Hatch, Buckanan, Edward Bros.)	7N	13W	SE¼ 11 NE¼ 14	Cu, Au, Ag, Fe, Ba	Chrysocolla, copper carbonates, cuprite and native copper, with chalcopyrite and chalcocite in depth, in a gangue of hematite, quartz, barite, and brecciated wall rock, in spotty pockets and irregular lenses in a strong northwest-striking fissure vein cutting Precambrian metamorphics. Intrusions of granite and diorite. Fissure vein cuts schists and shows postmineral faulting. Schists show disseminated pyrite and hematite along walls. Some pegmatite dikes. More quartz and jasper in gangue in depth. Water encountered at about 300-foot depth.	Discovered in 1860's and patented in 1907. Shaft and tunnel operations with workings down some 485 feet. Mined almost continuously from 1907 through 1953, producing some 4600 tons of ore averaging about 10% Cu, 0.6 oz. Au/T and 0.2 oz. Ag/T. The major producer of the district.	Bancroft, 1911, p. 116-119 Copper Handbook, 1910-11 Mines and Copper Handbook, 1918 Tovote, 1918 ABM file data
5. Cuprite mine group (Wilkinson group, Emerald group, Little Giant Extension; Wilkinson, Josephi, Kane, Cuprite Investment Co., Prescott, Nohlcheck)	7N	13W	NW¼ 13	Cu, Au, Ag, Fe, Ba	Spotty, oxidized copper mineralization, with high gold values, associated with strong showings of specular hematite in fissure veins along a strong northwest-striking fault zone, cutting Precambrian metamorphics. Intrusions of diorite and granitic dikes. Chalcoprite, stringers of chalcocite, associated with siderite and barite, in depth. High gold values in specular hematite near the surface.	Originally prospected in early 1900's and worked intermittently by shallow tunnels, open cuts and shafts from 1903 through 1942, producing some 430 tons of ore averaging about 5.5% Cu, 0.65 oz. Au/T, and 0.3 oz. Ag/T.	Copper Handbook, 1912-1913 ABM file data
6. Davis & Fleming mine groups (Davis)	7N	13W	NE¼ 1	Cu, Au, Ag, Fe	Spotty, oxidized copper and gold values associated with specular hematite and limonite along fissure veins in Precambrian metamorphics.	Shallow shaft, adit, and open cut workings, mined intermittently, about 1912-1918, producing some 120 tons of ore averaging about 10% Cu, 0.3 oz. Au/T and 1 oz. Ag/T.	ABM file data
7. Golden Star mine group (Mattson & McDonald)	6N	13W	NE¼ 3	Cu, Au, Ag, Fe	High-grade gold with oxidized copper mineralization in strong hematite fissure vein cutting Precambrian metamorphics cut by diabase and granitic dikes and intruded by Laramide granite.	Generally shallow shafts, tunnel, and surface cuts worked intermittently from 1935 through 1940, producing some 270 tons of ore averaging about 2% Cu, 0.62 oz. Au/T, and 0.4 oz. Ag/T.	ABM file data
8. Little Giant mine groups (American Flag group, Cash Entry group, Vindicator group; Wendondale Gold Mg. Co., Vindicator Mg. Co., Black Giant Mines Co., Jones, Cooper, Marvel Mg. Co.)	7N	13W	SE¼ 12	Cu, Au, Ag, Fe, Ba	Spotty, high-grade, copper mineralization, with gold, associated with hematite, quartz, calcite, and barite in northwest-striking fissure veins along major fault zone, cutting Precambrian granite-gneiss complex. Cuprite, bornite, and chalcopyrite in high-grade, narrow streaks and some dissemi-	Shaft and tunnel operations worked sporadically from early 1900's to 1954, producing over 500 tons of ore averaging about 14.6% Cu, 0.2 oz. Au/T and 0.5 oz. Ag/T.	Copper Handbook, 1906 Mines and Copper Handbook, 1918, 1920 ABM file data

9. Wenden mine group (McDonald, Whitehouse & Shapp, Wenden Copper Co., Wenden Copper Mg. Co., Honey)	7N	13W	Cen. 11	Cu, Au, Ag, Fe	Spotty copper-gold mineralization in pockets and disseminations in a gangue of hematite streaks, quartz, and calcite, with bornite and chalcopyrite with siderite in depth, along a strong fault or shear zone cutting Precambrian metamorphics intruded by diorite dikes and close to a Laramide granitic intrusive.	Numerous shafts and underground workings. Prospected and mined from about 1899 to 1941, producing some 120 tons of ore averaging about 9% Cu, 0.3 oz. Au/T and 0.4 oz. Ag/T.	Mines and Copper Handbook, 1918 ABM file data
10. Wenden King mine group (Copper Basin, Copperopolis, Iron Cap group; Hatch, James & Assoc.)	7N	13W	SW¼ 11	Cu, Au, Ag, Fe	Spotty copper-gold mineralization in stringers and pockets, with strong hematite, along shears and fractures in a major shear zone cutting Precambrian metamorphics intruded by dioritic and granitic dikes.	Shaft operations. Prospected and mined from early 1900's to 1956, producing some 100 tons of ore averaging about 6% Cu, 1 oz. Au/T and 0.2 oz. Ag/T.	ABM file data
VI. Dome (Gila City) District (North end of Gila Mountains) Figure 8	8S	21W	---	Au, Ag, Marble, Cu-	1. Gold-bearing Quaternary gravels, up to 15 feet thick, in gulches, benches, and terraces over Tertiary sediments on a north-sloping pediment faulted against Mesozoic schist and gneiss of the mountain mass (T8S, R21W, secs. 10 through 12; protracted). Source of gold probably from numerous small and pockety, low-grade gold-quartz veins. 2. Zone of variable marble interbedded with schist and quartzite, about 150 feet wide, in metamorphosed Mesozoic sedimentary beds, crossing the north end of the Gila Mountains (T8S, R21W, secs. 12 through 15, protracted). Some relatively pure marble. 3. Spotty and weak oxidized copper and gold mineralization in irregular, lensing, quartz veins cutting metamorphosed Mesozoic sediments. McKay prospect (T8S, R21W, NE¼ sec. 13, protracted) and McPhaul prospect (T8S, R21W, N cen. sec. 14, protracted).	Mostly dry placer operations, worked mainly from 1858 to about 1865, and sporadically, on smaller scale, mainly from 1931-1943 and 1946-1950. Estimated and recorded production would be close to 26,000 ounces gold with about 1,200 ounces of silver. There has been very little production of marble or recorded production of copper or gold from the shallow prospects.	Wilson, 1933, p. 181-189, 200-201, 202-207, 208-210 Wilson, 1961, p. 18-21 Johnson, 1972, p. 67-69 ABM file data
VII. Eagle Tail District (Eagle Tail Mountains and Cemetery Ridge) Figure 2	2N-1S	11W-12W	---	Cu-, Pb-, Zn-, Au-, Ag-, Mn, Fe-, Ba-, actinolite asbestos	1. Spotty and weak, mostly oxidized, copper, lead, and zinc mineralization with some gold and silver values, in veins, veinlets, pods and disseminations with quartz, calcite, and barite gangue, in fissure and fracture zones cutting Cretaceous or Tertiary volcanics and Precambrian intrusive. Examples are Eagle Tail group or Golden State mine (T2N, R11W, NW¼ sec. 28, protracted) and Gentry Lead-Silver mine (T1N, R11W, N cen. 2, protracted).	Mostly shallow prospects. No recorded production of base and precious metals. About 40 tons of sorted 22% Mn ore produced in 1953. Actinolite asbestos not believed to be of commercial value.	Wilson, 1933, p. 142-143 Farnham & Stewart, 1958, p. 84 ABM file data

Eagle Tail District, Table 4 Cont.

MINING DISTRICT AND MINES	LOCATION T.	R.	Sec.	MINERAL PRODUCTS	GEOLOGY	TYPE OF OPERATION AND PRODUCTION	REFERENCES
					2. Spotty and weak copper mineralization and staining, with minor gold and silver, and a gangue of iron and manganese oxides, quartz, gouge, and brecciated wall rock along fractures and faults cutting Mesozoic schist, Precambrian granite, and Cretaceous or Tertiary rhyolite porphyry and hornblendite dikes. Examples are the Collins prospect (T1S, R11W, W cen. sec. 28), the Red Bird prospect (T1S, R11W, NE¼ sec. 30), and the Adams prospect (T1N, R12W, E cen. sec. 34, protracted). 3. Spotty pyrolusite and psilomelane, mixed with jasper, calcite, and quartz, in irregularly-spaced lenticular bodies of stringers and veins in brecciated Cretaceous or Tertiary andesite flows and tuff and in gneissic granodiorite intruded by granite. (Black Hawk mine - T1S, R12W, NE¼ sec. 12 & E cen. 10, protracted; Black Buck & Buckhorn - T1N, R12W, NE¼ sec. 33). 4. Long fiber but very brittle asbestiform actinolite in lensing veins in Mesozoic schist near irregular dikes consisting mainly of actinolite, partly altered to chlorite, and veinlets and masses of magnetite. Location is east of Deadman Tank.		
VIII. Ellsworth District (Western Harcuvar and Granite Wash Mountains) Figure 7	5N-7N	13W-15W	---	Au, Cu, Ag, W, Ba, Fe, F-, U-, Mo-, Mn-	1. Numerous, irregular, splitting, and lensing veins of quartz, siderite, calcite, and brecciated rock containing spotty oxidized and sulfide copper mineralization, with gold and silver, often with strong iron oxides at the surface, in Precambrian schist and gneiss intruded by granite and later cut by numerous dikes of diorite, andesite and rhyolite. 2. Contact metamorphic deposits of copper mineralization in faulted Paleozoic limestone blocks and adjoining Mesozoic sedimentary formations, intruded by Laramide granite and numerous basic and acidic dikes.	Numerous small prospects and mines scattered through the district from east of Cottonwood Pass, through Tank Pass and along the length of the Granite Wash Mountains. District prospected and worked sporadically from late 1800s for gold, copper, lead, and tungsten. Total estimated and recorded production of mined base and precious metals would be some 14,000 tons of ore containing about 385 tons of copper, 2350 ounces of gold, 14,700 ounces of silver,	Bancroft, 1911, p. 23-24, 95-104 Ciancanelli, 1965 ABM Bull. 182, 1970, p. 288 ABM file data

Continued

					3. Spotty copper and/or lead mineralization, mostly oxidized, in irregular veins and pockets in Mesozoic sediments or Laramide granitic intrusive, cut by basic and acidic dikes. 4. Tungsten mineralization, with minor copper, associated with quartz lenses in faulted and metamorphosed Paleozoic limestone and underlying Mesozoic sediments, intruded by Laramide granite and cut by diabase dikes. Some associated placer tungsten. 5. Small, spotty, barite lenses in fissure veins associated with brecciated rock in Precambrian metamorphics cut by dikes. Minor fluorite. Associated iron and manganese oxides. 6. Gold placers in washes below mineralized areas in Granite Wash Mountains. 7. Weak uranium values from unidentified uranium mineral or minerals associated with secondary copper and iron in fissures and faults cutting Precambrian metamormorphics and Laramide intrusive granite at Doland mine (T6N, R13W, SE¼ sec. 5).	12 tons of lead and 4.5 tons of zinc. Tungsten production has been about 10 tons of tungsten oxide (WO_3). Small shipments of barite ore have been made. The gold placer operations over many years, mostly sporadic and minor; may have produced some 300 or more ounces of gold.	
1. Bell Crown mine (Victor & Bell Crown Mg. Co.)	6N 14W N Cen 12 Protracted	Cu, Au, Ag, Fe	Spotty and irregular paystreaks of copper and high gold mineralization along a northwest-striking shear vein cutting Precambrian metamorphics, intruded by Laramide granite, both cut by basic and acidic dikes. Strong iron oxides with siderite, quartz and minor calcite gangue.	Worked on small scale with tunnels and shafts from 1910 through 1919, producing some 170 tons of ore averaging about 6% Cu, 0.8 oz. Au/T and 0.1 oz. Ag/T.	Copper Handbook, 1910-11, 1912-13 Mines and Copper Handbook, 1918, 1920 ABM file data
2. Black Cat and Minnezona mines (Britania Gold mines, Inc.)	5N 14W N Cen 26 Protracted	Pb, Au, Ag, Cu-	Fissure vein in Mesozoic granitic intrusive. Mostly oxidized lead mineralization, with high gold values, in spotty small pockets.	Tunnel and shaft operations, prospected and worked intermittently from about 1917 through 1930, producing a few tens of tons of ore averaging about 5% Pb, 0.6 oz. Au/T and 0.2 oz. Ag/T.	ABM file data
3. Bunker prospect	6N 13W NE¼ 7 Protracted	Ba, Cu-	Narrow, lensing, fault vein containing spotty masses of barite plates associated with iron-stained cherty gouge and minor copper staining, in Precambrian metamorphic rocks.	Surface cut operations produced one carload of 71.7% handsorted $BaSO_4$.	Stewart & Pfister, 1960 p. 80-81

Ellsworth District. Table 4 Cont.

MINING DISTRICT AND MINES	LOCATION T.	R.	Sec.	MINERAL PRODUCTS	GEOLOGY	TYPE OF OPERATION AND PRODUCTION	REFERENCES
4. Dandy mine group (Starr, Golden, Blue Bird; Wilson Bros., Kimball & Thompson)	5N	14W	E Cen 6 Protracted	Au, Cu, Ag, Pb-, Zn-	Irregular, quartz-fissure veins, with spotty copper, gold, silver, lead, and zinc mineralization, cutting Mesozoic sediments cut by intrusive dikes.	Shaft and open cut operations from early 1900s to 1941, producing some 190 tons of ore averaging about 0.6 oz. Au/T, 3% Cu, and 4 oz. Ag/T.	ABM file data
5. Desert mine (Golden Mound, Gold Eagle, Winchester, Vicksburg Development Co., Desert Mg. Co., Navajo Mines Co., Lesher, Hasedel Mg. Co., Troy, All State Mg. Co.)	5N	14W	Cen 21 Protracted	Au, Cu, Ag, Pb, Mo-, Fe-	Wide zone of quartz and calcite veins and stringers, and amorphous quartz, carrying spotty, high-grade gold values and oxidized copper and minor lead-molybdenum mineralization with iron oxides, following schistosity of metamorphosed Mesozoic sediments. Some rhyolite and phonolite extrusives and aplite and basic dikes.	Prospected and worked from early 1900's through 1950 from small shafts, open cuts, and tunnel. Production would be some 700 or more tons of ore averaging about 0.3 oz. Au/T, 2% Cu and 5 oz. Ag/T.	Bancroft, 1911, p. 102 Mines and Copper Handbook, 1918 ABM file data
6. Dona Kay mine (Dona Kay Mg. Co.)	5N	15W	N Cen 13	Cu, Ag, Au	Spotty copper, silver, and gold mineralization, mostly oxidized, with quartz gangue in an irregular deposit in a fissure zone in metamorphosed Mesozoic sediments cut by intrusive dikes.	Shaft operations. Produced some 100 tons of 0.8% Cu, 0.8 oz. Ag/T and 0.03 oz. Au/T in 1956.	ABM file data
7. Glory Hole mine (Arizona Northern, Salome Strike; Glory Hole Bonanza Mines Co.)	5N 6N	14W 14W	SW¼ 33 NW¼ 4 Protracted	Au, Ag, Fe, Cu-, Pb-, Mn-	Numerous, irregular, contorted, and discontinuous quartz veins, and large masses of quartz. Some veins with high-grade gold pockets, and gangue of siderite, iron oxides, and some manganese oxides. Some local chalcopyrite and galena. Country rock is metamorphosed Mesozoic sediments. Mineralization is in a wide fissure or shear zone.	Surface pocket of high-grade gold ore in 1909 started short-lived boom but subsequent exploration failed to develop much additional ore. Total production would probably be no more than about 450 ounces of gold with some silver and copper.	Bancroft, 1911, p. 98-101 ABM file data
8. Granite Wash Mountains placers (Desert mine placers, Yellow Bird mine placers, Dutch Henry; mostly small individual operators)	5N 5N 6N	14W 14W 14W	20-21 4-5 32-33 Protracted	Au	Gold-bearing gravels in many small gulches, derived from numerous small gold-quartz lenses in the Mesozoic schist.	Placers worked mainly prior to 1900 and intermittently since that time. A rough estimate of total production would be some 300 ounces of gold with some alloyed silver.	Bancroft, 1911, p. 98, 102 Johnson, 1972, p. 74-75 ABM file data
9. Green Hill mine (Gary & Adams)	5N	13W	SW¼ 7	W, Cu-	Sparse, sporadic scheelite grains and masses in narrow discontinuous quartz veins in Mesozoic granitic intrusive. Narrow, discontinuous diabase dikes. Copper oxides and staining.	Pits and shaft. Some 7 tons of scheelite ore shipped in mid-1950s to Quartzsite for milling.	Dale, 1959, p. 10-11

10. Hall mine (Bunker)	6N	14W	N Cen 7	Ba, Cu-	Platy barite with iron-stained, cherty gangue and minor copper staining, in a narrow vein along a fault in Precambrian schist. Some ore ran 71.7% Ba SO_4.	Surface workings. Produced several carloads of handpicked barite ore in 1938.	Wilson & Roseveare, 1949, p. 11 Stewart & Pfister, 1960, p. 79-80
11. Jewel Anne mine group (Contreras, Cohoe, & Rowland)	6N	15W	NW 25	W, Ba, Fe, Cu-	Disseminated blebs and pockets of scheelite with quartz, siderite, barite, iron oxide and copper staining in small narrow stringers in silicified Paleozoic marble cut by faulting. Associated diabase dikes.	Open cut, adit, pits, and tunnel working. Some 100 or more tons of 0.5 to 0.7% WO_3 produced since mid-1950s.	Dale, 1959, p. 17 ABM file data
12. Pee Wee mine group (McVay Mg. Co., Huthmacher & Dilts)	6N	15W	SW¼ 24	W, Zn-, Fe-	Sparse, sporadic, scheelite grains, pods, and crystals in narrow quartz veinlets in Laramide granitic intrusive underlying Precambrian schist and Paleozoic marble. Some iron oxide, willemite, sphalerite and traces of other minerals noted. Good tungsten placer material.	Shallow shafts, adits, tunnels and open cuts. Production in mid- and late 1950's was about 3,237 pounds of tungsten concentrates averaging about 71% WO_3.	Dale, 1959, p. 15-16
13. Sheba mine (Shapp & Whitehouse, Cobrita Mines Co., McCauley, Sheba Mg. Co.)	6N	13W	NW¼ 8 Protracted	Cu, Au, Ag, Fe	Spotty copper sulfides and secondary copper mineralization in irregular quartz-siderite veins in a strong northwest-striking fissure zone cutting Precambrian schist intruded by diorite, andesite, and rhyolite dikes.	Tunnel and shaft operations. Prospected and worked intermittently from early 1900's through 1942, producing some 100 tons of ore averaging about 4% Cu, 0.2 oz. Au/T and 0.4 oz. Ag/T.	ABM file data
14. Squaw T mine (Elmer)	7N	15W	N Cen 27	W, Cu (Be)	Sparse, sporadic scheelite in pockets and pods near contact of micaceous and calcareous schist and marblized limestone overlying granite. Numerous diabase and rhyolite dikes and some barren quartz veins.	Shallow cuts and pits. Worked sporadically in early and middle 1950's and produced some 125 units of WO_3.	Dale, 1959, p. 18-19
15. Three Musketeers mine (Brusco, Wood & Huthmacher, Aplington, Floreen & Assoc.) Fleming)	6N	15W	SW¼ 24	W	Small grains and pods of scheelite in discontinuous quartz lenses in Mesozoic calcareous schist and in quartz-fissures veins in Laramide granitic intrusive. Strong fracturing and associated diabase dikes.	Worked from shafts, adits, pits, tunnels and open cuts from 1951 to present time, producing some 1200 tons of ore yielding about 600 units of WO_3.	Dale, 1959, p. 11-15 ABM file data
16. True Blue mine group (Golden Orbit, Ballif; Gray, True Blue Mg. Syndicate, Verdugo Mines Co.)	5N	14W		Au, Ag, Cu	Pockety gold with silver and small lenses of copper carbonates, oxides & sulfides, associated with quartz seams in a northwest-striking, brecciated zone in interbedded limestone, shale, argillites, and quartzites of probable Mesozoic age. Diabase intrusives and intrusive Laramide granitic rocks nearby. Sylvanite reported.	Shaft, tunnel, and open cut workings developed from 1917 and mainly from 1931 through 1939. Total production would be some 200 tons of ore averaging about 0.7 oz. Au/T, 0/6 oz. Ag/T and 1% Cu.	ABM file data

Ellsworth District, Table 4 Cont.

MINING DISTRICT AND MINES	LOCATION T.	R.	Sec.	MINERAL PRODUCTS	GEOLOGY	TYPE OF OPERATION AND PRODUCTION	REFERENCES
17. Yuma Mine (Ironwood & Arizona Dev. Co., Yuma Copper Co., Spry, Liberator Mines Co., Snyder, Minerals Corp. of America, So. Calif. Chemical Co.)	6N	14W	SE¼ 19 NE¼ 30 Protracted	Cu, Ag, Au, Fe	Mostly oxidized copper mineralization in contact metamorphosed limestone beds in metamorphosed Mesozoic sediments intruded by Laramide granite and cut by acidic and basic dikes. Strong iron gossans from primary magnetite and pyrite, with quartz stringers, calcite, and contact metamorphic minerals. Wall rocks fractured and strongly chloritized and epidotized.	Shaft, tunnel, and open cut workings. Prospected and mined intermittently but mainly from 1942 through 1963, producing some 8600 tons of ore averaging about 2.3% Cu, 0.3 oz. Ag/T, and 0.03 oz. Au/T.	Copper Handbook, 1909 Bancroft, 1911, p. 95-97 ABM file data
IX. Fortuna District (Central and Southern Gila Mountains) Figure 2	9S-11S	19W-20W	---	Au, Ag, Cu-, Mica-, Fe-, Mn-, W-, (Be, Ta, Nb; Th, Rare Earths)	1. Free gold, often with minor copper mineralization and pyrite, with a gangue of quartz, calcite, iron oxides, and manganese oxides, in irregular, lensing veins in fault and fracture zones in Mesozoic schist. Some traces of tungsten. 2. Muscovite mica and samarskite in irregular pegmatites in small intrusive of Laramide granite (T 10S, R 20W, N cen. sec. 22, protracted). 3. Placer gold, mainly from old tailings.	One major shaft mine and several small prospects worked sporadically from the early 1890's to about 1951. Estimated and recorded production would be some 213,500 tons of ore, almost all from the Fortuna mine, containing about 134,429 ounces of gold, 10,650 ounces of silver and 98 pounds of copper. Sporadic placer operations, mainly on old tailings of the Fortuna mine, yielded about 60 ounces of gold with some minor silver. There has been no commercial production of mica or other rarer minerals from the pegmatites.	Blake, 1897, 1898 Wilson, 1933, p. 181-202; 1934 (rev. 1967), p. 151-156 ABM file data
1. Fortuna mine (La Fortuna Gold Mg. & Mlg. Co., Fortuna Mines Corp., Elan Mg. Co., McDaniels & Harrison, Enderton, Holmes & Nichelson, Wish Mg. & Mlg. Co., Maitland, Burton)	10S	20W	N Cen 21 Protracted	Au, Ag, Fe, Cu-	Free gold with silver in rounded grains and as thin irregular veinlets with limonite or pyrite, with traces of copper, in fractured quartz in a branching chimney-like ore body along a fissure zone in Mesozoic schist. Wall rocks are carbonatized and silicified. Many branching and intersecting faults.	Shaft mining operations, mainly from 1896 through 1904, and sporadically up into 1941. Total estimated and recorded production would be some 213,000 tons of ore averaging about 0.63 oz. Au/T, 0.05 oz. Ag/T and a few pounds of copper.	Blake, 1897, 1898 Wilson, 1933, p. 189-199; 1934 (rev. 1967), p. 152-155 ABM file data
X. Gila Bend Mountains District (Gila Bend Mountains) Figure 2	2S	11W	---	Au, Pb, Fe, F, Cu-, Mo-	1. Spotty gold, with minor copper, in weathered zones in quartz lenses or silicified zones with strong iron oxides, in Precambrian schist intruded by granitic masses and andesitic to granitic dikes, or in granitic masses. Examples are the Bill Taft group,	Shallow shafts with drifts and open cuts. Prospects found in early 1900's and worked sparingly in later years. No recorded production but may have produced a few ounces of gold.	Wilson, 1933, p. 145-147

					Taft mine and Little Jane prospect - T2S, R11W, SW¼ sec. 11; Lucky Strike prospect - T2S, R11W, N cen. sec. 12; and Camp Creek prospect - T2S, R11W, W cen. sec. 1. 2. Irregular bunches of galena, partly oxidized to anglesite and cerussite, with fluorite and quartz, and minor wulfenite and lead oxide, in fractures in a fault zone cutting Precambrian schist with chert bands.		
XI. Harquahala District (Harquahala and Little Harquahala Mountains) Figure 9	4N-5N	10W-13W	---	Au, Ag, Pb, Cu, W, Fe, Mn, Zn, Ti, Gypsum, Marble, Quartzite	1. Pockety and irregular deposits containing gold with variable amounts of silver, copper, lead, and zinc, associated with iron oxides and gypsum where oxidized and auriferous pyrite in depth, in brecciated, lenticular, quartz-jasper veins along faults and shear zones cutting tilted, folded, and faulted Paleozoic and possibly Mesozoic and Precambrian metamorphosed formations. Intrusions of Laramide granitic bodies and aplitic and more basic dikes. Strong deformation. 2. Spotty, and mostly minor, tungsten mineralization associated with discontinuous quartz lenses and veins in altered granite and metamorphosed rocks. 3. Gold placer deposits, mainly in gulches in the Little Harquahala Mountains near the Bonanza (Harquahala) mine. 4. Seams and irregular replacement bodies of manganese oxides, often associated with iron oxides, along fracture zones in metamorphosed Paleozoic or Mesozoic limestone. 5. Titaniferous magnetite sand in alluvium on southwest peneplain of Little Harquahala Mountains (T4N, R14W). 6. Marble and quartzite deposits in metamorphosed Paleozoic formations. 7. An irregular, lensing, white, crystalline bed, 1 - 12 feet thick, of gypsum in folded Permian (?) limestone (SW¼ T5N, R11W).	Numerous large to small mines and prospects worked from shafts, tunnels, adits, and open cuts. Operations date back to 1880's and continued intermittently to recent times. Total estimated and recorded production of precious and base metals would be some 160,000 tons of ore containing about 130,582 ounces of gold, 89,500 ounces of silver, 45 tons of copper, 61 tons of lead and minor zinc. About 615 ounces of placer gold with some silver was produced, mostly prior to 1900. Some 1100 short ton units of tungsten oxide has been reported shipped from the district as well as a few lots of sorted 20% manganese ore. For many years marble and quartzite, mainly for crushed stone, has been quarried. The titaniferous magnetite sand has not been exploited. Some gypsum produced for agricultural use.	Bancroft, 1911, p. 104-115 Wilson, 1934 (rev. 1967), p. 128-133; 1961, p. 32 Farnham & Stewart, 1958, p. 83-84 Dale, 1959, p. 3-11 Harrer, 1964, p. 137 Townsend, 1962, p. 18 Funnell & Wolfe, 1964, p. 191 ABM Bull. 180, 1969, p. 376 Varga, 1976 ABM file data

Harquahala District, Table 4 Cont.

MINING DISTRICT AND MINES	LOCATION T	R,	Sec.	MINERAL PRODUCTS	GEOLOGY	TYPE OF OPERATION AND PRODUCTION	REFERENCES
1. Blue Eagle, Bunker Hill, and Four Winds mine group. (Bunker, Stehle, Campbell)	5N	12W	SW¼ 18, NE¼ 19, W Cen 20	Au, Ag, W, Fe, Cu-	1. Pockety and irregular deposits of siliceous gold-silver ore in brecciated quartz lenses and veins, usually associated with iron oxides, in fissure zones cutting Precambrian metamorphic schist, gneiss and quartzite. Minor associated copper. 2. Stringers, blebs, and narrow discontinuous seams of scheelite along cleavage or fissure zones, with quartz, in Precambrian metamorphics.	Shaft, adit, and open cut operations, worked intermittently from the early 1900s through 1956. Production of precious metals, mainly as high silica-gold flux ore, would be some 430 tons averaging about 0.4 oz. Au/T and 0.6 oz. Ag/T. Some 1100 short ton units of 60% WO_3 produced in the 1950s.	Dale, 1959, p. 6-7 ABM file data
2. Bonanza (Harquahala) and Golden Eagle mine group (Hubbard & Bowers, Bonanza Mg. Co., Harqua Hala Gold Mg. Co., Yuma Warrior Mg. Co., Harquahala Operating Co., Bonanza & Golden Eagle Mg. Co., Jones, Oberstine)	4N	13W	SW¼ 22, NW¼ 27, NE¼ 22	Au, Ag, Pb, Cu, Zn-	Rich, pockety shoots of gold with minor silver in a gangue of iron oxides, shattered quartz, calcite, and gypsum in oxidized zone, above about 300-foot depth, in shear zones and shattered quartzite in strongly folded and faulted Paleozoic sedimentary beds intruded by Laramide quartz monzonite. In depth, gold values mainly in auriferous pyrite with some copper and lead sulfide mineralization, in fracture veins in underlying crushed and fractured quartz monzonite. Veins often flat dipping with larger and richer deposits in the shattered quartzite.	Shaft, tunnel, and open cut operations. Extensive stoping in oxidized zone. Discovered in 1888 and worked intermittently on large scale to 1918. Subsequently on small scale, largely by reworking dumps and tailings, to 1964. Total estimated and recorded production would be some 150,000 tons of ore averaging about 0.85 oz. Au/T, 0.53 oz. Ag/T and minor lead and copper.	Bancroft, 1911, p. 105-109 Wilson, 1934 (rev. 1967), p. 128-131 ABM file data
	Protracted						
3. Gold Dyke mine group (Campbell)	4N	13W	NE¼ 7	W, Au, Ag, Fe, Mn	Small, sporadic pockets of scheelite with iron and manganese oxides in discontinuous quartz veins in extensively fractured Laramide granitic intrusive. Diabase dikes. Some gold mineralization prospected in the veins in early 1900's.	Shallow open cuts, trenches, and shafts. Worked in early 1900's for Au and some ore shipped. In 1951 some 100 short ton units of 60% WO_3 produced.	Dale, 1959, p. 7 ABM file data
	Protracted						
4. Gold Leaf, Rattlesnake, and Rosebud mine group (Hudgens, Worcester)	5N	12W	NW¼ 13 13	Au, Ag, Fe, Cu-	Spotty, high-grade gold values with minor copper oxides in lensing quartz, brecciated wall rock, and iron oxides in a shear zone cutting Precambrian granitic gneiss.	Shaft and tunnel workings. Prospected in late 1800's but worked mainly from 1930 through 1941, producing some 400 tons of ore averaging about 0.6 oz. Au/T, 0.2 oz. Ag/T and minor copper.	ABM file data

5. Hercules mine (Hercules Gold Mg. Co., Shanley, McDonald, Rogers & Farrington, Cline & Hurtz, Sharp)	5N	12W	S Cen 18	Au, Ag, Cu, Fe	Gold and silver mineralization, with local copper, in brecciated, discontinuous, banded, quartz-jasper fissure veins cemented by limonite from oxidation of auriferous pyrite and chalcopyrite. Wall rock is a Precambrian quartz diorite gneiss intruded by quartz diorite dikes and overlain by Precambrian calcareous schist.	Incline shaft, adits, and open cut operations. Worked prior to 1900 and sporadically from 1934 through 1950, producing a total of some 2670 tons of ore and siliceous gold flux averaging about 0.25 oz. Au/T, 0.27 oz. Ag/T, and 1½ tons of copper.	Bancroft, 1911, p. 109-110 Wilson, 1934 (rev. 1967), p. 132 ABM file data
6. Hidden Treasure mine (Magic group; Myers & Lazure, Johnson, Nohlecheck & Hummel, Powell, Kast & Johnson, Howell, Seely & Johnson, Warren, Wilkinson & Walsh, Tulsa Minerals Corp.)	5N	11W	N Cen & NW¼ 29	Au, Ag, Cu-, Pb-, Zn-, Mn-, Fe-	Free gold particles with silver in irregular cellular masses of limonite and calcite, local chrysocolla, oxidized lead and zinc minerals and manganese oxides in seams and tabular replacements along a fault or shear zone in Paleozoic or Mesozoic quartzite and silicified limestone. Wall rock intensely silicified with some sericitization.	Shaft, tunnel, and open cut workings. Located in 1932 and mined somewhat sporadically through 1967, producing some 1775 tons of ore averaging about 0.95 oz. Au/T, 3.9 oz. Ag/T and minor Cu, Pb, and Zn. In 1953-1954, several small lots of 20% Mn shipped to Wendon stockpile.	Wilson, 1934 (rev. 1967), p. 133 Farnham & Stewart, 1958, p. 83 ABM file data
7. Mars & Mescal mine group (Old Noel; Nuevo Mundo Mountain Mines, Jerome Wenden Copper Co.)	5N	11W	NW¼ 19	Cu, Au, Ag, Fe	Irregular lenses of oxidized copper mineralization with silver and gold, in brecciated diorite, cherty limestone and heavy batches of iron oxides, along a fissure zone bordering a diorite dike in a complex Precambrian granite-schist alternating with altered distorted Paleozoic or Mesozoic limestone. Series of northwest-striking diorite dikes along fissure zone.	Tunnel operations, mainly in 1916 through 1918, producing some 110 tons of ore averaging about 11% Cu, 0.15 oz. Au/T and 0.3 oz. Ag/T.	ABM file data
8. Rio del Monte mine (Rio del Monte Mg. Co., McCauley & Orberg, Rio del Monte Mines Inc.)	4N	13W	SE¼ 4 Protracted	Au, Ag, Cu, Pb, Zn, Fe	Lenticular shoots of quartz and limonite containing oxidized copper minerals and gold, and lenses and pods of partly oxidized lead and zinc mineralization in vuggy quartz, in irregular veins cutting Precambrian granitic-gneiss capped by some volcanic flows.	Shaft operations. Known as early as 1899 but worked mainly, intermittently, from 1913 through 1949, producing some 350 tons of ore averaging about 0.23 oz. oz. Au/T, 0.7 oz. Ag/T, 0.3% Cu and 0.2% Pb. Zn not recovered.	ABM file data
9. San Marcos mine group (Pittsburg Harquahala, Wilson; Salome Development Co., Pittsburg Harquahala Gold Mg. Co., Smith, Sibley, Worcester)	5N	12W	N Cen 14	Au, Ag, Fe, Cu-	Spotty high-grade gold, with minor silver and copper mineralization, in oxidized zone with quartz, brecciated wall rock and abundant iron oxides. Lenses of gold-bearing quartz and minor sulfides in depth, in lensing veins along shear zone in Precambrian granitic rock intruded by basic dikes and aplites. Strongly sheared zone.	Shaft workings. Located in late 1890's and worked intermittently through 1934, producing some 300 tons of ore from mine and dumps averaging about 2 oz. Au/T, 0.3 oz. Ag/T and minor copper.	Bancroft, 1911, p. 113-115 Wilson, 1934 (rev. 1967), p. 132 ABM file data

Harquahala District, Table 4 Cont.

MINING DISTRICT AND MINES	LOCATION T.	R.	Sec.	MINERAL PRODUCTS	GEOLOGY	TYPE OF OPERATION AND PRODUCTION	REFERENCES
10. Socorro mine (Socorro Gold Mg. Co., Death Valley Arcalveda Consol. Mines Co., Gilbert & Schmidt, Klix)	5N	12W	SW¼ 25	Au, Ag, Fe, Pb-, Cu-	Mostly oxidized, gold-bearing pyrite in quartz and iron oxides above the 250 foot level and scattered pyrite in quartz and wall rock, pockets of galena, and minor oxidized copper minerals below, in an irregular, lensing fissure vein in Paleozoic or Mesozoic quartzite, limestone and shale intruded by Laramide granite and related dikes. Vein is vuggy, brecciated, and recemented by silica and jasper.	Shaft, tunnel, and open cut operations. Worked intermittently from early 1900's through 1960, producing some 4800 tons of ore averaging about 0.2 oz. Au/T, 0.1 oz. Ag/T and a small amount of Pb.	Pratt, 1902 Smith, 1907 Bancroft, 1911, p. 111-113 Wilson, 1934 (rev. 1967), p. 131 ABM file data
11. Tungsten Giant mine group (Mathews, Mirabel)	5N	13W	SE ¼ 30	W, Fe	Sparse, sporadic scheelite in discontinuous, fractured, quartz veins, with iron oxides and minor pyrite and muscovite, cutting Laramide granite.	Shaft, pit, and open cut operations. From early to mid-1950's, produced some 1.7 tons of 66 - 73% WO_3 concentrates.	Dale, 1959, p. 7-8
12. White Marble quarry (U. S. Marble, Fisher Enterprises Inc., Superior Companies)	5N	11W	Cen 9	Marble, Quartzite	Irregular, contorted, and bonded metamorphosed Paleozoic sedimentary limestone and quartzite beds, cut locally by diabase dikes.	Quarry operations. Has produced considerable amounts of crushed marble and quartzite.	Townsend, 1962, p. 390 ABM file data
13. Why Not, Clipper, and Gold mine groups (Salome Gold Co.; Carper et alia; Huttan & Earp; Johnson; Smith, Long & Gilbert)	5N	11W	Cen & E Cen 30	Au, Ag, Cu, Fe	Spotty gold with silver and copper mineralization and iron oxides, quartz, and calcite, in irregular fissure veins in Paleozoic-Mesozoic metamorphosed sediments intruded by dikes.	Tunnel and open cut operations. Worked mainly from 1932 through 1939, producing some 370 tons of ore averaging about 3.3 oz. Au/T, 1.8 oz. Ag/T and 1.8% Cu.	ABM file data
XII. Kofa District (Southern Kofa Mountains) Figure 4	15- 2S	Ib W- 17 W	---	Au, Ag, Mn, W, Cu-, Pb-, F-	1. Spotty but often high-grade, fine-grained, gold and silver mineralization in lensing quartz-calcite, brecciated rock, fissure veins cutting Cretaceous or Tertiary andesite and Mesozoic schist or slate. Minor copper and lead and often considerable manganese and local fluorite. Strong silicification of wall rock. 2. Erratic and irregular manganese oxides in fracture zones in fragmented Cretaceous or Tertiary andesitic volcanics. 3. Spotty stringers, pods, and disseminated grains of scheelite, associated with quartz and iron oxides, in fracture zones in fragmented volcanics and schist.	Two major mines and numerous prospects and small mines operated mainly in late 1800s and early 1900s, with small intermittent operations through 1954. Total estimated and recorded production of precious and base metals through 1974 would be some 779,500 tons of ore containing about 227,500 ounces of gold, 103,700 ounces of silver, 3 tons of lead and one ton of copper. Over 1000 ounces of placer gold recovered. Manganese production was about 230 long tons of 27% Mn and about 94 short ton units of WO_3 also	Blake, 1898 Jones, 1916 a Thompson, 1925 Wilson, 1933, p. 106-116; 1934 (rev. 1967), p. 136-143 ABM file data

1. Black Dahlia mine (Carter, Fails)	2S	16W	NW¼ 7	Mn	Pyrolusite, with minor psilomelane and manganite, in irregular, disconnected bodies of veinlets and bunches, with calcite, in fracture zones in fragmented Cretaceous or Tertiary andesite, capped by rhyolite.	Open cut operations. Produced some 230 long tons of 27% Mn in 1953-1954.	Farham & Stewart, 1953, p. 84-85 ABM file data
2. Evening Star mine group (Linder & Findley)	2S	17W	NE¼ 2	Au, Ag, Fe, W-	Spotty, weak, and irregular, fine-grained gold with sparse scheelite grains in a quartz-iron oxide gangue along fissures and fractures in metamorphic Mesozoic schist and shale cut by rhyolite and pegmatitic dikes.	Shaft and tunnel operations, mainly in the early 1900s, for gold and later prospected for tungsten. Small production of gold ore.	Dale, 1959, p. 28-29 ABM file data
3. Iron Wood mine (Eureka-Mizpah; Sam, Barrio)	1S	17W	Cen. 35 Protracted	Au, Ag, Cu-	Spotty gold, silver, and minor copper mineralization in iron-stained quartz in parallel fault veins, cutting Cretaceous andesite flows intruded by pegmatitic dikes, sills and plugs.	Shaft operations. Worked intermittently from 1901 through 1941, producing some 534 tons of ore averaging about 0.5 oz. Au/T and 0.4 ounces Ag/T.	ABM file data
4. King of Arizona mine (Gleason; King of Arizona Mg. Co., Rob Roy Development Co., Kofa Mg. Syndicate)	2S	17W	Cen 12	Au, Ag	Fine-grained, free gold with silver mineralization in a layered quartz gangue in an irregular fissure vein in a large shear zone cutting Cretaceous or Tertiary rhyolite volcanics and silicified, brecciated andesite. Many quartz and manganiferous calcite stringers. Vein width increases with depth but with decreasing values.	Extensive underground workings and stopes from surface to 750 foot level. From late 1880s-1910, and sporadically through 1937, produced some 739,300 tons of ore averaging about 0.23 oz. Au/T and 0.1 oz. Ag/T.	Blake, 1898 Jones, 1916a Wilson, 1933, p. 109-113; 1934 (rev.), p. 137-139 Thompson, 1925 ABM file data
5. Kofa gold placers (various small operations)	2S	16W 17W	7 & 8 1, 2 11, & 13	Au, Ag-	Relatively coarse placer gold in washes, a few feet to seventy feet above bedrock, within boulder and erosional fragment· alluvium derived from weathering of gold veins in metamorphosed sediments.	Mostly small dry washing operations. Total production may have been about 2,500 ounces of gold with some silver, mostly extracted prior to 1900.	Jones, 1916 Wilson, 1933, p. 121, 1961, p. 23-23 Johnson, 1972, p. 73-74 ABM file data
6. Midnight mine (Hamilton; Findley, Gibson)	2S	17W	NE¼ 1	W, Au-, Pb-	Sparse, lensing pockets of scheelite in parallel, discontinuous iron and manganese stained quartz lenses in fractured and fissured Mesozoic schist intruded by monzonite porphyry and pegmatite dikes. Sparse gold in some quartz. Minor phosporous and lead in concentrates.	Shallow surface workings. Originally prospected for gold and later for tungsten, producing some 40 short ton units of WO_3 from picked 1% WO_3 ore.	Dale, 1959, p. 27-28 ABM file data
7. North Star mine (Golden Star Mining & Milling Co.)	1S	17W	Cen 36 Protracted	Au, Ag	Fine-grain, free gold with minor silver and finely divided and disseminated pyrite in high-grade shoots and chimneys in a lode-like vein of silicified and altered Cretaceous or Tertiary andesite breccia, quartz, and banded chalcedony. Some adularia. Vein is along fault zone with andesite on hanging wall and Mesozoic calcareous schist or slate on footwall.	Extensive underground workings from shafts. Discovered in 1906 and worked from 1907 to late 1911, producing some 38,735 tons of ore averaging about 1.4 oz. Au/T and 0.6 oz. Ag/T. Much additional high-grade ore stolen during operations.	Jones, 1916 a Thompson, 1925 Wilson, 1933, p. 113-116; 1934 (rev. 1967), p. 139-141 ABM file data

Kofa District, Table 4 Cont.

MINING DISTRICT AND MINES	LOCATION T.	R.	Sec.	MINERAL PRODUCTS	GEOLOGY	TYPE OF OPERATION AND PRODUCTION	REFERENCES
8. Quartette mine (Independence, Perseverance; Fries, Quartette Mg. Co., Ely, Nassan Mg. Co.)	2S	17W	Cen 1	Au, Ag, Cu-	Fine-grained, free gold with silver and minor copper mineralization with iron and manganese stained quartz in an irregular fracture zone cutting Cretaceous or Tertiary andesite.	Shaft and open cut operations, mined sporadically in 1914-1917, 1935-1936, and 1940, producing some 550 tons of ore averaging about 1.3 oz. Au/T, 2 oz. Ag/T and 0.2% Cu.	ABM file data
9. Rob Roy mine (Katy Ross group, Chicago group, Charlie Sam group; Rob Roy Development Co., Huffman)	2S	17W	N Cen 12	Au, Ag	Spotty, irregular, and generally weak gold-silver values with quartz in lensing fracture veins cutting Cretaceous or Tertiary andesite.	Shallow shafts are pits. Worked mainly in 1934-1935 and in 1941, producing some 435 tons of ore averaging only a little better than 0.1 oz. Au/T and 0.05 oz. Ag/T.	ABM file data-
10. Tungsten mine group (Meyers, Gibson)	2S	16W	W Cen 6 Protracted	W, Au-, Ag-, Pb-, Cu-	Narrow stringers, pods, and disseminated small grains of scheelite with sparse copper and lead sulfides in quartz lenses along fractures in Mesozoic schist at base of Cretaceous or Tertiary andesite and cut off by quartz monzonite dike to the east. Sparse and spotty gold.	Shaft and pit operations. Originally prospected for gold and later in 1950's for tungsten. Some 54 short ton units of WO_3 produced from picked 1% WO_3 ore.	Dale, 1959, p. 26-27
XIII. La Cholla District (Eastern slope of Dome Rock Mountains south of Quartzite) Figure 10	2N-4N	19W-20W	---	Au, Ag, Cu, Pb-, Zn-, Hg-, Mo-, Dumortierite-, Kyanite, Andalustite-, Sillimanite-, (Sb)	1. Gold placer deposits in unsorted gravel of rock fragments, mainly cemented by lime carbonates, on a sloping rock pediment. 2. Spotty and irregular copper, lead, zinc, gold, and silver mineralization, mainly along faults and fractures, in quartz veins in metamorphic Mesozoic schist and gneiss. 3. Spotty disseminated, mercury mineralization with minor base and precious metals in fissure veins in Mesozoic schist.	Mainly dry placer operations, from the 1860's to the 1950's, producing some 9,464 ounces of gold containing about 690 ounces of silver. Several small mines and prospects for base and precious metals, worked mainly in the 1930's and 1940's produced some 294 tons of ore containing about 332 ounces gold, 3,127 ounces of silver, and 20 tons of copper. Some 116 or more flasks of mercury were produced from 1908 to 1914.	Bancroft, 1911, p. 73-86 Lausen & Gardner, 1927, p. 24-35 Wilson, 1961, p. 27-30 ABM file data
1. Cinnabar mine (Colonial Mg. Co., Cinnabar Development Co.)	2N	20W	NE Cor. 9	Hg, Cu-, Au-, Ag-, Pb-, Mo-	Spotty, disseminated cinnabar with minor metacinnabar, malachite, chrysocolla, gold, silver and sparse wulfenite with brecciated quartz, gouge, calcite, and siderite and strong iron oxide staining, in a fault fissure in Mesozoic metamorphic schist.	Discovered in 1880's but only worked from shafts and open cuts from 1904 through 1914, producing roughly 116 or more flasks of mercury.	Bancroft, 1910, p. 151-153; 1911, p. 82-84 Lausen & Gardner, 1927, p. 29-31 Wilson, 1941 ABM file data
2. Copper Bottom mine (Arizona Operating Co., Clausen, Hussen)	3N	20W	NW¼ 28	Cu, Au, Ag	High-grade streaks and pods of tetrahedrite and free gold in vein dikes of quartz along a strong shear or fault zone cutting metamorphosed Mesozoic limy sediments.	Worked sporadically from early 1910's through 1941, from tunnels and shaft, producing some 100 tons of ore averaging about 19% Cu, 1.6oz. Au/T, and 27 oz. Ag/T	Mines Handbook, 1924 ABM file data

3. La Cholla placers (Chappo placers, Arizona Drift mine; Grossman, Helcion Mines, Inc., La Posa Development Co., McMillen & Hendrix)	3N	20W	NE¼	Au, Ag	Fine to moderately coarse-grained gold with alloyed silver in unsorted aggregate of subangular to slightly rounded fragments of slate, schist, and quartzite, more or less firmly cemented with lime carbonate or siliceous cement, resting on a gently east-sloping pediment cut on tilted slate or schist. Best values along channels at bedrock. Gold derived from numerous irregular, small, auriferous quartz veins and stringers in Mesozoic metamorphics.	Mostly dry placer operations on bench gravels, and shallow underground workings from shafts on old channels on bedrock. Crushing usually required. Total estimated and recorded production from 1860 to recent time would amount to some 9.5 thousand ounces gold with 900 ounces silver.	Hekes & Tate, 1913 Jones, 1916 b, p. 53 Berger, 1932 Gardner & Johnson, 1934 Mining Journal, 1939, v. 22, no. 23, p. 19 Minerals Yearbook, 1940, p. 209 Wilson, 1961, p. 29-30 ABM file data
4. Yum Yum mine (Carlson, McMillan Bros.)	3N	20W	N Cen 23	Au, Ag, Cu-	Small quartz veinlets and stringers with spotty gold, silver and minor copper mineralization along bedding planes in Mesozoic sediments.	Shaft and tunnel operations. Produced some 176 tons of ore averaging about 1 oz. Au/T, 0.2 oz. Ag/T and a few hundred lbs. of Cu., from 1936 through 1942.	ABM file data
XIV. Laguna (Las Flores) District (Laguna Mountains) Figure 8	7S-8S	21W-22W	---	Au, Ag, Cu-	1. Gold placer deposits in washes and gulches derived from small, irregular, gold-bearing quartz veins in Mesozoic schist. 2. Spotty gold with silver and minor copper mineralization in irregular quartz veins and stringers, in zones of shearing and brecciation in Mesozoic schist.	Several placer operations, mines, and prospects worked in times past. Total estimated and recorded production of placer gold and silver would be some 7,500 ounces of gold and 1,100 ounces of silver. From mines and prospects, some 556 tons of ore yielded about 324 ounces of gold, 661 ounces of silver and minor copper.	Wilson, 1933, p. 211-217; 1961, p. 21-22 Johnson, 1972, p. 69-70 ABM file data
1. Laguna Dam placers & prospects (Various operators in the past)	7S	22W	S ½ 14 N ½ 23	Au, Ag	Coarse placer gold and nuggets occurred in gulches, draining from northwest slope of Laguna Mountains; in pot holes on benches above the river; and in the Colorado River, where dam constructed. Gold originated from local quartz veins in Mesozoic schist and granitic gneiss near river margin.	Placer operations and prospecting since 1860's to 1940's with an estimated and reported production of several thousand ounces of gold with minor silver.	Mining Review, 1910, v. 12, no. 10, p. 33 Wilson, 1933, p. 217; 1961, p. 22 ABM file data
2. Las Flores mine group (Traeger or Agate, Golden Queen, Pandino or Panadero, and India; Gold Dome Mg. Co., Waite, Bretz, San Pablo Mg. Co., Modesti)	7S	21W	SW ¼ 26, NW ¼ 35	Au, Ag, Fe, Cu-, Mn-	Free, often ragged, gold with silver and minor copper, in lenticular and brecciated quartz veins, usually containing abundant iron oxides and some manganese oxides, siderite, gypsum and gouge, along fault or fracture zones in Mesozoic schist cut by dikes and irregular masses of granite and pegmatite.	Relatively shallow shafts, tunnels, and open cut operations. Worked intermittently from 1860's to about 1940, producing some estimated and recorded 500 tons of ore averaging about 0.4 oz. Au/T, 0.1 oz. Ag/T, and 198 lbs. of copper.	Raymond, 1872, p. 272 Wilson, 1933, p. 214-216; 1934 (rev. 1967), p. 149-151 ABM file data
3. Las Flores placers (Various small operators in the past)	7S	21W	NW ½ 35	Au, Ag	Spotty placer gold in gulches and old channels in pediment along southeastern foot of the Laguna Mountains, derived from the gold-bearing quartz veins in Mesozoic schist.	Scattered small placer operations carried out from about the late 1850's to the 1950's. Total estimated and recorded production would be a few thousand ounces of gold with minor silver.	Raymond, 1872, p. 272 Wilson, 1933, p. 217; 1961, p. 21-22 ABM file data

Laguna (Las Flores) District, Table 4 Cont.

MINING DISTRICT AND MINES	LOCATION T.	R.	Sec.	MINERAL PRODUCTS	GEOLOGY	TYPE OF OPERATION AND PRODUCTION	REFERENCES
4. McPhaul area placers (San Pablo; McPhaul, various small operators in past)	7S 8S	21W 21W	S½ 33 N½ 4	Au, Ag	Scattered gold placer deposits in gulches, along old channels in pediment, and on inter-arroyo benches near base of gravels overlying tilted Tertiary sediments. Gold derived from local gold-quartz veins in Mesozoic schist.	Intermittent placer mining since about the late 1850's, mostly by dry washing. Total estimated and recorded production would be several thousand ounces of gold with minor silver.	Wilson, 1933, p. 216-217; 1961, p. 21 Mining Journal, 1941 ABM file data
XV. La Paz (Weaver) District (West side and northern Dome Rock Mountains) Figure 10	2N- 6N	20W- 21W	---	Au, Ag, W, Mn, Cu, Pb, Kyanite-, Th-, Rare Earth-.	1. Gold placer deposits, in gravels of numerous gulches and in terrace gravels bordering the washes, derived from small, lensing, gold-bearing quartz veins and veinlets in Mesozoic and early Tertiary metamorphic and granitic rocks. 2. Spotty gold and silver mineralization with some base metals in quartz fissure veins in Mesozoic metamorphic rock, intruded by Mesozoic or early Tertiary granitic rock. 3. Sporadic tungsten mineralization in contact metamorphic deposits along faults or intrusive contacts and associated with marble beds in Mesozoic metamorphic beds. 4. Manganese oxides in irregular bodies along bedding plane fractures in Mesozoic metamorphic rocks.	Extensive placer operations in gulches and on terraces from 1860's, mainly prior to 1900. Several relatively small scattered mining operations for precious and base metals from late 1800's to about 1960. Tungsten and manganese prospecting and mining carried on during periods of premium prices. Total estimated and recorded placer production would be around 100,000 ounces of gold with about 25,000 ounces of silver. Mine production of precious and base metals would amount to some 11,200 tons of ore containing about 2,400 ounces of gold, 1000 ounces of silver, 8 tons of copper, and 2 tons of lead. Some 5000 tons of tungsten ore containing about 0.4% WO_3 and some 400 long tons of 41-51% Mn also produced.	Bancroft, 1911, p. 78-86 Jones, 1916 b, p. 45-57 Wilson, 1934, (rev. 1967), p. 135-136 Wilson, 1961, p. 25-29 Johnson, 1972, p. 76-78 ABM file data
1. Apache mine (Ah-ve-Aha; Moon Mt. Gold Mg. Co., Mohave Mg. Co.)	6N	21W	SE¼ 35	Au, Ag	Spotty gold and silver mineralization with minor, partly oxidized sulfides in lensing quartz vein along a fracture zone in Mesozoic metamorphic rocks intruded by a small Laramide rhyolitic plug.	Shaft and tunnel operations, worked from 1935 through 1950, producing some 330 tons of ore averaging about 2.4 oz. Au/T and 0.4 oz. Ag/T.	ABM file data
2. Copper Giant mine (Farrow, Barrett & Robinson, O'Brien)	2N	21W	NW¼ 11 Protracted	Cu, Ag, Au	Gold-bearing quartz, impregnated with malachite, chrysocolla, and chalcocite, in lensing quartz fissure veins in Mesozoic schist having local thin beds of quartzite and marblized limestone.	Shaft operations. Patented in 1901 and ore originally shipped by boat to Selby. Worked in early 1900's and late 1950's, producing some 100 tons of ore averaging about 4% Cu, 3 oz. Ag/T and 0.2 oz. Au/T.	ABM file data

3. Darling mine (Copper Chief, Mountain Chief, Uncle Sam; Copper Chief Mines Co., Treuer)	5N	20W	NE¼ 33	W, Cu-, Au-	Weak copper carbonates and silicates, after cupriferous pyrite, and spotty scheelite, associated with contact metamorphic mineralization, especially epidote, along a fault contact of Mesozoic schist and marblized limestone.	Shaft and open cut workings. Prospected since 1910 but only mined for tungsten in 1955, producing some 180 pounds of 73.7% WO_3.	Dale, 1959, p. 21-23 ABM file data
4. Farrar Gulch placers (Many early individual operators)	4N	21W	S Cen 25 NW¼ 36	Au, Ag, Fe	Rough and angular gold nuggets and fine particles, often with iron oxide attached, and with magnetite concentrates in variable thicknesses of angular rock fragments, boulders, sand, and clay. Unsorted to consolidated near the surface but consolidated and cemented in depth. Source was gold-quartz veins near head of Farrar Gulch.	Richest and most productive placer of the area, with old excavations, shafts and tunnels. Mainly worked out prior to 1900, producing over 50,000 oz. of gold with considerable silver.	Browne, 1868 Jones, 1916 b, p. 50-51 Wilson, 1961, p. 26-28
5. Goodman mine group (Gold Belt, Scott Lode; Scott, Scott Lode Mines, Inc.)	4N	21W	SE¼ 23 to NW¼ 25	Au, Ag, Cu, Pb (Th, Rare Earths)	Spotty free gold and gold-bearing pyrite, with some copper and lead, in a lensing massive quartz vein with iron oxide in a long shear zone cutting Mesozoic quartz-epidote schist. Thorium and rare earths noted in shear zone.	Numerous shafts and tunnels worked from 1860 thru 1914 and intermittently through 1940. Total estimated and recorded production would be some 11,000 tons of ore averaging about 0.33 oz. Au/T and 0.02 oz. Ag/T. No copper and lead recovered.	Jones, 1916, p. 55 Wilson, 1934 (rev. 1967), p. 136 ABM file data
6. La Angora mine (Sandoval & Assoc.)	3N	21W	Cen 15	Mn	Irregular, lensing pods and stringers of pyrolustie with unreplaced wall rock and calcite in Mesozoic limestone along a bedding plane fracture.	Open pit operation. Produced some 150 tons of 44% Mn ore in mid-1950's.	Farnham & Stewart, 1958, p. 82-83 ABM file data
7. La Paz placers (Many early individual operators)	3N 4N	21W-22W 21W	---	Au, Ag	Gold-bearing gravels, often containing large nuggets, in various large and small washes throughout the area, with best values near a dissected pediment on Mesozoic metamorphics intruded by Laramide granitic intrusives. Source of gold was numerous gold-bearing quartz veins in the Mesozoic metamorphics.	Placers found in 1862 and worked extensively until 1864 and intermittently on small scale since then. Total estimated and recorded production would be over 50,000 oz. of gold plus some silver.	Browne, 1868 Heikes & Vale, 1913 Jones, 1916b, p. 45-52 Wilson, 1961, p. 25-29 Johnson, 1972 ABM file data
8. Metate & Confusion mine groups (Daniels, McFarland & Hullinger)	3N	21W	NE¼ 22 E Cen 23 NE¼ 27 NW¼ 26	Mn	Pyrolusite, psilomelane, and manganite in irregular, discontinuous, replacement deposits along minor folds and in fissures in Mesozoic limestone beds, often under caliche and fanglomerate cover. Some ore high grade.	Open cut and shallow shaft operations in mid- and late 1950's. Produced some 250 or more tons of 41-51% Mn.	Farnham & Stewart, 1958, p. 82 ABM file data

La Paz District, Table 4 Cont.

MINING DISTRICT AND MINES	LOCATION T.	R.	Sec.	MINERAL PRODUCTS	GEOLOGY	TYPE OF OPERATION AND PRODUCTION	REFERENCES
9. Tungsten Hill mine (Quartzite tungsten, Jackpot and Velmaette groups; Gold Hill Dredging Co.)	5N	20W	W Cen 27	W	Sporadic scheelite in garnet-epidote tactite along Mesozoic quartz-biotite schist and limestone contact and in related fractures where cut by quartz veins	Shaft, adit and open cut operations worked in 1943-1944 and in 1950's, producing some 4000 or more tons of about 0.4% WO_3 ore.	Dale, 1959, p. 20-21 ABM file data
XVI. La Posa (Wellton) District (Wellton Hills, Copper Mountains) Figure 11	9S-11S	17W-18W	---	Cu, Au, Ag, Fe	1. Lensing, irregular quartz veins along fissure zones in Mesozoic schist, gneiss, and granite with spotty oxidized copper and gold. 2. Small gold placer deposits.	Mostly small surface prospects and shallow mines, operated sporadically from late 1800's, and a few minor gold placer operations. Total mine production would be some 415 tons of ore containing about 8 tons of copper, 153 ounces of gold and 300 ounces of silver. Only about 28 ounces of gold with 8 ounces of silver have been reported as produced from placer operations.	Bryan, 1925, p. 62-63, 190, 196-197 Wilson, 1933, p. 164-168, 172-176 ABM file data
1. Double Eagle mine (Gold Leaf; Arizona Double Eagle Corp; Fuher)	10S	18W	Cen 22	Au, Ag, Cu-	Spotty gold with minor oxidized copper mineralization in a lensing, fractured, and iron stained quartz vein, in a sericitized breccia zone in strongly faulted Mesozoic gneiss.	Shaft and adit tunnel operations. Worked intermittently from late 1880's to early 1930's, producing some 50 or more tons of ore averaging about 1.6 oz. Au/T, 0.8 oz. Ag/T and 0.3% Cu.	Wilson, 1933, p. 173-174 ABM file data
2. Frisco, Betty Lee, & Ella J. mines (Arizona Consolidated Mg. Co., Swenson, Copple & McIntosh, Linden)	11S	17W	NW¼ 2	Cu, Au, Ag, Fe	Spotty chrysocolla and malachite in veinlets and coatings, in lensing and banded, coarsely crystalline, quartz-hematite-sericite veins along a fissure zone in Mesozoic granite. Quartz cut by calcite veins and wall rocks silicified and sericitized.	Shaft and tunnel operations. Worked intermittently from early 1910's through 1939, producing some 145 tons of ore averaging about 2% Cu, 0.3 oz. Au/T and 1.4 oz. Ag/T.	Wilson, 1933, p. 166-167 ABM file data
3. Last Chance & Copper Coin mines (Pedstel & Everhandy, Smith, Bannard)	11S	17W	S Cen 10	Cu, Au, Ag, Fe	Small pockets containing finely divided gold and irregular bunches of chrysocolla, copper pitch, and iron oxides, with gypsum and jarosite, in brecciated quartz and sericite, in fissure zone in Mesozoic granite.	Shaft and tunnel operations. Worked sporadically in 1920's and 1930's, producing some 30 tons of ore averaging about 7% Cu, 0.4 oz. Au/T, and 0.1 oz. Ag/T.	Wilson, 1933, p. 167 ABM file data
4. Poorman mine (Desert Dwarf; Eaton, Svenson, Hindman)	10S	18W	NW¼ 2	Au, Ag	Spotty pockets of gold in banded and iron-streaked quartz, gouge, and breccia in a fault zone cutting massive Mesozoic gneiss. Aplitic dikes.	Shaft operations. Worked sporadically from 1897 through 1940, producing some 100 tons of ore averaging about 0.25 oz. Au/T and 0.1 oz. Ag/T.	Wilson, 1933, p. 174 ABM file data

Protracted

Protracted

5. Wellton Hills mine (Draghi; Frazier)	10S	18W	NE¼ 20	Au, Ag, Cu-	Spotty gold with silver and minor oxidized copper mineralization in an irregular, lensing, quartz vein, with iron staining, in a strong fault zone of breccia and gouge cutting banded Mesozoic gneiss. Narrow aplitic dikes.	Tunnel operations. Worked sporadically over many years. Major production in mid-1930's of some 365 tons of ore averaging about 0.54 oz. Au/T and 0.2 oz. Ag/T.	Wilson, 1933, p. 174-175 ABM file data
XVII. Middle Camp-Oro Fino District (La Cholla Wash and Tributaries in the Dome Rock Mountains) Figure 10	3N-4N	19W-20W	---	Au, Ag, Pb, Cu, Zn, alunite (Bi, Sb)	1. Gold placer deposits in seams of gravel close to bedrock in washes and benches on tilted, beveled Mesozoic shale, schist, and slate and on Mesozoic granite along upper reaches of La Cholla Wash and tributaries. 2. Spotty gold, silver, lead, copper, and zinc mineralization in quartz veins and stringers or in bedded deposits along structural planes in Mesozoic metamorphics or granite. 3. Natroalunite in schistose and porphyritic dacite intruding Mesozoic schist in Sugar Loaf Peak. (T3N, R20W, NW¼ sec. 3)	Numerous dry and wet placer operations, mostly from gravel in pits, shafts, and trenches, by small operators. Large scale operations generally unsuccessful. Small mines and prospects. Total estimated and recorded placer gold recovered, from 1860's through 1974, would be some 12,000 ounces of gold with 1,500 ounces of silver. Mine production for same period would be some 866 tons of ore containing about 320 ounces of gold, 250 ounces of silver, 61 tons of lead, 9 tons of zinc and a small amount of copper.	Bancroft, 1911, p. 85-86 Heikes & Yale, 1913 Jones, 1916 b, p. 52-57 Gardner & Johnson, 1935 Wilson, 1961, p. 30-31 Johnson, 1972, p. 78-80 ABM file data
1. Julian (Julius) mine group (Simpson & Kock Mg. Co., Quartzite Mg. Co., Bartlett)	4N	19W	SE¼ 30	Au, Ag, Cu-, Pb-, Zn-	Spotty gold and silver, with minor oxidized base metal sulfides, in quartz veins and stringers along a fracture zone in Mesozoic granite, intruded by later pegmatitic dikes.	Shaft operations. Old mine reworked from 1937 through 1940, producing a probable total of some 350 tons of ore averaging about 0.55 oz. Au/T and 0.1 oz. Ag/T.	ABM file data
2. Leadville mine group (Hartzeg; Arizona Leadville Mines Co.)	3N	20W	N Cen 4 Protracted	Pb, Zn, Ag, Au, Cu (Bi, Sb)	Lensing bands of disseminated and high grade bodies of anglesite and galena along shattered, iron stained-quartz stringers and in schist planes, with calcite and siderite, in a shear zone cutting Mesozoic schistose rhyolite.	Incline shaft operations. Worked in 1947-1948, producing some 360 tons of ore averaging about 17% Pb, 0.7% Zn, 0.5 oz. Ag/T, 0.06 oz. Au/T and minor Cu.	Cooper, 1962 ABM file data
3. Mariquitta mine (Various operators, Cooper)	4N	20W	SE¼ 22	Au, Ag, Cu-, Pb-, Zn-	Spotty gold with silver and very minor oxidized base metals in a crushed, iron-stained, lensing quartz vein along a fracture or fault zone in Mesozoic schist intruded by Laramide quartz monzonite. Strong epidote and chlorite in wall rocks.	Shaft and surface operations. Worked intermittently from late 1800's to 1940's, producing some 180 tons of ore averaging about 0.6 oz. Au/T and 0.3 oz. Ag/T.	Bancroft, 1911, p. 81-82 Jones, 1916b, p. 56 Wilson, 1934(rev. 1967), p. 136 ABM file data

Middle Camp-Oro Fino District, Table 4 Cont.

MINING DISTRICT AND MINES	LOCATION T.	R.	Sec.	MINERAL PRODUCTS	GEOLOGY	TYPE OF OPERATION AND PRODUCTION	REFERENCES
4. Middle Camp gold placers (Many early workers, Middle Camp Placer Gold, Inc., La Cholla Mg. Co. Ltd., American Coarse Gold Corp.)	4N	20N	SW¼ (mainly sections 21 and 28, protracted)	Au, Ag	Gold with silver in gravels near bedrock with some hard caliche. Gold coarser near mountains and on old terraces. Best values in gravel channels and crevices in bedrock Mesozoic schist but gravel mainly from granitic rock. Source was numerous small gold-bearing quartz veins and stringers on Middle Camp Mountain.	Numerous small dry placer operations with surface, pit, and shaft workings, from 1860's to recent times. Several large scale operations generally unsuccessful. Total estimated and reported production would be some 6,000 ounces of gold with 750 ounces of silver.	Heikes & Yale, 1913, p. 257-259 Jones, 1916b, p. 53 Wilson, 1961, p. 31 Johnson, 1972, p. 79 ABM file data
5. Oro Fino gold placers (Numerous early workers, Catalina Gold Mg. Co.)	4N	20W	SE¼	Au, Ag, Pb, W, Fe	Generally fine-grained particles of gold, often with or in hematite, in unconsolidated gravels down to about 12 feet and below in caliche-cemented gravel up to 18 feet thick. Some rounded nuggets of galena and scheelite in southern part of placer ground. Gravel is largely slate or schist. Best values found in narrow gravel seams. Washing produced black sands high in iron.	Placer operations with pits, trenches, and underground workings by numerous small operators over many years. Large-scale operations generally not successful. Total estimated and recorded production would be some 6,000 ounces of gold with 750 ounces of silver.	Heikes & Yale, 1913, p. 157-259 Jones, 1916b, p. 52-53 Wilson, 1961, p. 30-31 Johnson, 1972, p. 79 ABM file data
XVIII. Midway District (South-central edge of the Buckskin Mountains) Figure 12	8N-9N	15W-16W	---	Cu, Au, Ag, Fe, Marble, Ba, F	1. Spotty, oxidized, copper mineralization with minor sulfides in Precambrian schist and Mesozoic sediments or as limestone replacements, usually associated with hematite or with quartz, barite, and fluorite along fracture or fault zones. 2. Varicolored marble, probably metamorphosed Paleozoic or Mesozoic limestone.	Several small prospects and mines worked intermittently since early 1900's. Total production would be some 212 tons of ore containing about 4.5 tons of copper, 45 ounces of gold, and 35 ounces of silver. No commercial production of marble reported.	Bancroft, 1911, p. 120-122 ABM file data
1. Arizona Midway mine (Arizona Midway Copper Co., Chisholm)	8N	16W	S Cen 1	Cu, Au, Ag, Marble	Spotty, oxidized, copper mineralization in Precambrian schist containing limestone bands. Some high grade copper pods. Limited exposures of varicolored marble bounded by schist.	Shallow workings and prospects developed around 1917 but very limited if any production.	ABM file data
2. Battleship Copper mine (Huthmacher)	8N	15W	NW¼ 3 Protracted	Cu, Ag, Fe	Spotty, oxidized, copper mineralization with minor sulfides in irregular, hematite-rich, replacement lens in flat-lying shale beds of metamorphosed Mesozoic sediments, overlying Precambrian schists.	Limited surface workings prospected in early 1900's and small amount of high-grade copper ore shipped.	ABM file data
3. Green Streak mine (Fleming & Aplington)	9N	16W	NE¼ 28 Protracted	Cu, Au, Ag	Spotty oxidized copper mineralization in a quartz vein cutting Precambrian gneiss and schist.	An old shaft mine reopened and worked from 1953 through 1954, producing some 200 tons of ore averaging about 1.3% Cu, 0.2 oz. Au/T and 0.1 oz. Ag/T.	ABM file data

	4. Mammoth, Chicago & Copper Glance mine group (Corona Copper Co.)	8N	15W	SE¼ 1, E Cen 12, E Cen 13 Protracted	Fe, Cu, Ag, Au, Ba-, F-	Spotty, oxidized, copper mineralization with strong hematite and quartz and local barite, minor fluorite, and traces of sulfides in irregular fault-veins or replacement deposits in Precambrian gneiss and schist and granitic breccia, cut by pegmatite, aplite and amphibolite dikes. Some epidote and chlorite.	Prospected by shafts from 1890's into early 1900's, producing a small amount of ore averaging about 16% Cu, 0.8 oz. Au/T and 1.3 oz. Ag/T in 1907.	Bancroft, 1911, p. 120-122 Harrer, 1964, p. 127 ABM file data
XIX.	Mohawk District (Mohawk Mountains) Figure 13	8S-9S	14W-15W	---	Ag, Pb, Ba, Au-, Cu-, Mo-, F-	1. Spotty lead sulfide, siliceous silver, and weak oxidized copper mineralization, in quartz veins in fault and breccia zones cutting Mesozoic schist and granitic gneiss. 2. Lensing barite with minor fluorite in veins in Mesozoic gneiss.	Small prospects and mines worked intermittently since early 1900's. The total production of base and precious metals would be some 61 tons of ore containing about 21,346 ounces of silver, 11 tons of lead, and minor copper and gold. Some 18 cars of barite ore have been produced.	Wilson, 1933, p. 148-154 ABM file data
	1. Red Cross (Norton) mine (Norton, Zappia)	9S	14W	W Cen 2	Pb, Ag, Fe, Cu-, Au-	Spotty, high-grade, argentiferous lead mineralization with veinlets of oxidized copper and calcite in a lensing quartz vein with limonite, breccia, and gouge, in a fault zone in Mesozoic schist. Iron oxides, and irregular bodies of gypsum and copper-stained calcite. Strong sericitization and silicification of wall rocks.	Shaft and open cut operations. Worked sporadically from about 1910 to 1941, producing some 60 tons of ore averaging about 300 oz. Ag/T, 8% Pb, and minor Cu and Au.	Wilson, 1933, p. 152 ABM file data
	2. Renner mine (Renner & Sam)	8S	15W	SE¼ 11, SW¼ 12	Ba, F-, Ag-	Lensing masses of barite crystals with minor fluorite, within crystalline calcite, in a fault zone bordered by irregular layers of chlorite and calcite. Minor silver values in calcite. Wall rock is Mesozoic granitic gneiss.	Open cut and underground operations. Shipped some 18 carloads of barite in 1929 and 1930.	Wilson, 1933, p. 152-153 Brobst, 1958, p. 106 Stewart & Pfister, 1960, p. 88
XX.	Muggins District (Muggins Mountain) Figure 8	7S-8S	19W-20W	---	Au, Ag, Cu, U, bentonite	1. Relatively small, scattered, gold placer deposits in dry washes and in Tertiary cemented gravels, derived from free gold in quartz veins and veinlets in Mesozoic gneiss and schist. 2. Minor free gold and local copper mineralization associated with quartz veins and pegmatite dikes. 3. Bentonitic clay in old upper lake beds. 4. Indicated uranium mineralization in volcanic tuff and lacustrine sediments.	Numerous small placer and prospecting operations since the 1860's. Total estimated and recorded placer production would amount to some 1000 ounces of gold with about 200 ounces of silver. Mine production of base and precious metal ore would not amount to more than about 100 tons, containing some 22 ounces of gold, and a few ounces of silver and pounds of copper. No bentonitic clay or uranium have been produced commercially.	Wilson, 1933, p. 218-220; 1961, p. 22-23 USAEC Prelim. Rec. Rpts. ABM file data

Muggins District, Table 4 Cont.

MINING DISTRICT AND MINES	LOCATION T.	R.	Sec.	MINERAL PRODUCTS	GEOLOGY	TYPE OF OPERATION AND PRODUCTION	REFERENCES
1. Southwestern Muggins Mts. gold placers (Numerous small operators)	8S-8S	19W-20W	NW¼ NE¼	Au, Ag	Spotty gold nuggets and particles in ancient bars in thick cemented conglomerate, intercalated with Cretaceous rhyolitic lava flows, and in stream beds draining south and southwest from Klothos Temple (Coronation Peak), Long Mountain, and Muggins Peak. Gold probably derived from gold bearing quartz veins in Mesozoic metamorphic gneiss, schist, and granite exposed in the northwestern part of range.	Sporadic placer operations from 1860's, in numerous washes and canyons, with main production probably prior to 1900.	Wilson, 1961, p. 22-23 ABM file data
2. Muggins Mountains Uranium prospects (Dizzly Lizy, Wooley group, Lake Bed, Red Knob, Isley-Lillard, St. Louis group, etc)	7S-8S	18W-19W	28 & 32 6 & 7 1, 2, 10, 12, & 35	U	Traces of uranophane, autunite, pyromorphite, carnotite, and unidentified uranium minerals in Tertiary volcanic tufts and ash, opalized mudstone, and other lacustrine sediments. Probable origin was tuffaceous volcanic rhyolite.	Discovered by field examinations. No production.	USAEC Prelim. Rec. Rpts. ABM file data
3. Vinegarroon Wash gold placers (Numerous operators)	7S	19W-20W	W Cen E Cen	Au, Ag	Gold-bearing gravels, with reported rich pockets, in the headwater forks of Vinegaroon Wash. Gold derived from disintegration of older gold placers in cemented Cretaceous gravels and quartz veins in adjacent Mesozoic schist and gneiss.	Sporadic placer operations, mostly prior to 1900.	Wilson, 1961, p. 23 ABM file data
XXI. Neversweat (Palomas Mts.) District (Neversweat Ridge and Palomas Mountains) Figure 2	4S-5S	12W-15W	---	Pb, Ag, Au, Cu, Ba, F	1. Narrow barite veins containing argentiferous galena with gypsum and minor copper in brecciated fault zones in Mesozoic schist. 2. Small amounts of oxidized copper mineralization in narrow, silicified and brecciated fault zones, with limonite, in Mesozoic granite and granite gneiss. 3. Small placer deposits of gold in washes, probably derived from gold-bearing quartz stringers.	Scattered prospects and small mining operations, mostly dating back to early 1900's and worked sporadically. Production, mainly from Silver Prince or Nottbusch mine, would be some 187 tons of ore containing about 21.5 tons of lead, 1406 ounces of silver, 5 tons of copper and 14 ounces of gold. Placers yielded some 97 oz. Au and 32 oz. Ag.	Wilson, 1933, p. 128-130 ABM file data
1. Silver Prince mine (Addie group; Nottbusch, Jones, Renner, Britt & Edgerton, Nickle, Browning)	4S	15W	SE¼ 15	Pb, Ag, Au, Cu, Ba, F	Irregular bunches of argentiferous galena with barite, minor fluorite, silver chlorides and sulfide, and oxidized copper in lensing veins in brecciated fault zones in Mesozoic schist, intruded by irregular dikes and bodies of rhyolite and andesite.	Shaft operations. Worked intermittently from early 1900's through 1968, producing some 187 tons of ore averaging about 14% Pb, 7 oz. Ag/T, 2% Cu and 0.08 Au/T.	Wilson, 1933, p. 128 Stewart & Pfister, 1960, p. 84-87 ABM file data

XXII.	New Water District (New Water Mountains) Figure 14	2N-3N	16W-16W	---	Cu, Ag, Pb, Fe	Spotty chrysocolla and other oxidized copper and lead mineralization in joints and fractures along fault zones in Cretaceous andesitic volcanics capped by Cretaceous welded rhyolitic tuff and breccia.	Mostly prospect shafts, pits, and open cuts over wide area, worked mainly in early 1940's, producing some 518 tons of ore containing about 175 tons of copper and 514 ounces of silver.	ABM file data
	1. Moore mine group (Eagle Eye, Copper Queen; Carr, Marshall, Brewer, Hovatter)	3N	16W	15, 16, 17 & 22	Cu, Ag, Fe	Oxidized copper mineralization with limonite in joints, fractures, and local small high-grade chimneys in epidotized porphyritic andesite and breccia along fault and shear zones.	Relatively shallow shaft and surface workings. From 1941 through 1944, produced some 480 tons of ore averaging about 3.7% Cu and 1 oz. Ag/T.	ABM file data
XXIII.	Plomosa District (Plomosa Mountains, Bouse Hills, Black Mesa, Bear Hills, and Livingston Hills) Figures 14 and 15	2N-8N	16W-18W	---	Au, Ag, Cu, Pb, Zn, Mn, Ba, Fe, W, Bentonite, Chrysophase, (Be)	1. Major gold placer deposits in washes from erosion of numerous quartz veins and veinlets in metamorphic rocks. 2. Spotty, partly oxidized, copper and gold mineralization with minor lead and zinc, and with quartz, and iron and manganese oxides in irregular fault and fracture veins in metamorphosed Mesozoic sediments, probably Cretaceous, shale, sandstone, conglomerate, and limestone; Precambrian metamorphics, and Cretaceous or Tertiary volcanics, with intrusions of Laramide diorite and granite. 3. Manganese oxides in irregular lenticular bodies and veinlets with variable amounts of iron oxides, calcite, barite, gypsum, and traces of beryllium along fracture and breccia zones in Cretaceous or Tertiary andesitic volcanics. 4. Barite and fluorite in veins along faults and fractures in Cretaceous or Tertiary volcanic flows and agglomerates. 5. Spotty pods and stringers of copper, lead, and zinc mineralization with silver and minor gold and with associated iron and manganese, in faulted Paleozoic limestone blocks and in irregular veins in Cretaceous or Tertiary andesite volcanics, cut by Laramide quartz monzonite intrusives. 6. Gold and silver mineralization in irregular veins along fractures and fault zones associated with quartz stringers and Laramide diorite and granite porphyry dikes in Mesozoic schist.	Numerous scattered small mines and prospects in northern and southern parts of the district. Deposits and placers known and worked intermittently from at least the early 1860's. Estimated and recorded production of base and precious metals from lode mines would be some 26,000 tons of ore containing about 526 tons of copper, 344 tons of lead, 65 tons of zinc, 7,000 ounces of gold, and 127,400 ounces of silver. Placer production of gold would be about 18,000 ounces with 1,800 oz. silver. Some 9000 long tons of low-grade manganese ore, 500 tons of iron ore, 2700 tons of barite ore, 1 ton of tungsten concentrates, and small amounts of bentonitic clay also have been produced. Some chrysophrase sold as gem material.	Bancroft, 1911, p. 87-95 Jones, 1916 b, p. 53-54 Wilson, 1934 (rev. 1967), p. 134-135; 1961, p. 29, 31-32 Miller, 1966, 1970 Miller & McKee, 1971 ABM file data Jemmet, 1966

Plomosa District, Table 4 Cont.

MINING DISTRICT AND MINES	LOCATION T.	R.	Sec.	MINERAL PRODUCTS	GEOLOGY	TYPE OF OPERATION AND PRODUCTION	REFERENCES
					7. Sporadic scheelite in quartz veinlets in calcareous Mesozoic schist close to Laramide granitic intrusives. 8. Irregular impure iron oxides, usually associated with manganese, in contact metamorphic deposits in Paleozoic limestone beds close to intrusives. 9. Bentonitic clay in probable lake bed sediments. 10. Minor chryophase in stringers in rhyolite.		
1. Apache Chief mine group (Success, Goodenough, Copperopolis, Newmont group; early Spanish and/or French operators, Eichelberger & Rivers, Success Copper Mg. Co., Arizona Success Mg.Co., Hickman, Richman, Apache Mines Syndicate, Old Apache Mines Co., Arizona Apache Mines Co., Aplington & Ehlers, Williams, Aplington, Apache Metals, Inc., Brown, Klix, Swires, Apache Chief Mg. Co.) Figure 14	3N	18W	NE¼ 12	Cu, Ag, Au, Fe, Pb-, Zn-	Spotty copper and silver mineralization with minor gold, lead, and zinc, largely oxidized, in irregular, small, lensing fingers, pods, and ore shoots along a shear zone with quartz in a thrust-faulted jumble of contact metamorphosed Paleozoic limestone, Mesozoic continental red beds, and Laramide conglomerates, intruded by diorite dikes and small quartz porphyry intrusives. Enrichment of copper and silver by oxidation. Strong iron gossan.	Shaft and tunnel operations with extensive underground workings. Total estimated and recorded production from intermittent operations, from at least the early 1860's through 1967, would be some 2100 tons of ore averaging about 11% Cu, 12 oz. Ag/T and 0.03 oz. Au/T. About 700 lbs. of Pb also produced.	Copper Handbook, 1908, 1910-11 Mines Handbook, 1924, 1926 ABM file data
2. Bell of Arizona mine (Aplington, Webster) Figure 14	4N	18W	E Cen 35	Au, Ag	Spotty gold and silver mineralization in quartz stringers and pods in a fracture zone in Precambrian quartz monzonite.	Shallow shaft workings. From 1937 through 1941 and in 1961 produced a total of some 205 tons of ore averaging about 0.4 oz. Au/T and 0.1 oz. Ag/T.	ABM file data
3. Bentonite mine (Bellus) Figure 15	7N	17W	W Cen 25	Bentonitic clay	Bentonitic clay in alluvium. Probably old lake bed. Quality unknown but probably swelling type and derived from alteration of tuffaceous sediments.	Shallow surface workings. Reportedly produced a few hundred tons for local use as drilling muds in the 1940's.	Wilson & Rosevearve, 1949, p. 15 ABM Bull. 180, p. 329 ABM file data
4. Black Beauty mine (Perry) Figure 15	5N	17W	NE¼ 34	Mn	Pyrolusite, psilomelane, and manganite, with some calcite and chalcedonic quartz, as strands and irregular masses in several lensing, parallel veins along brecciated shear zones in alternating Cretaceous or Tertiary andesite flows and tuffs.	Open cut operations. Worked in early 1950's, producing some 490 long tons of 20%± Mn ore concentrated to 40%+ Mn in a portable mill.	Farnham & Stewart, 1958, p. 72 ABM file data

5. Black Bird mine group (Townsend, Manganese Co. of America, Sunchine Mg. Co., Amplex Corp.) Figure 15	7N	17E	SE¼ 24	Mn (Be)	Manganite, psilomelane and minor pyrolusite in a network of seams, veinlets and irregular bunches, with calcite and brecciated rock, in irregular fracture zones in Cretaceous or Tertiary andesitic porphyry and tuffaceous agglomerate. Manganese float on the surface. Traces of beryllium in ore.	Open cut, trench, and pit operations. Worked in early 1950's, producing some 20,000 to 30,000 long tons of low-grade ore concentrated to some 2,800 long tons of 22% Mn. About 670 long tons of sorted 17% Mn ore also shipped.	Farnham & Stewart, 1958, p. 72 ABM file data
6. Black Chief mine (Townsend, Manganese Corp. of America) Figure 15	7N	18W	E Cen 24	Mn, Fe	Irregular, lenticular masses and strands of manganese oxides mixed with iron oxides and calcite in breccia, along a fracture vein in metamorphosed Mesozoic sedimentary rocks.	Adit and tunnel operations. Produced a small amount of high grade, picked manganese ore during World War II, and some 2000 long tons mined and milled in 1953. Most ore not amenable to upgrading due to iron content.	Farnham & Stewart, 1958, p. 74 Harrer, 1964, p. 121
7. Black Mesa mine (Christian, Valenzuela, Mariquita Gold Mg. Co., Madden Pickining Mg. Co.) Figure 14	3N	17W	E Cen 17	Pb, Ag, Cu, Ag, Au	Spotty cerrusite, anglesite, galena, chrysocolla, malachite, and brochantite, with siderite, quartz, ankerite, calcite and limonite in lensing replacement deposits in steeply dipping Paleozoic limestone beds. Cellular boxwork and vugs. Some native copper and cerargyrite.	Shaft and tunnel operations. Worked in late 1940's, early 1950's and in 1964, producing some 51 tons of ore averaging about 25% Pb, 13 oz. Ag/T, 2% Cu, and 0.02 oz. Au/T.	ABM file data
8. Black Mountain mine group (Brewer, National Lead Co., Townsend) Figure 15	8N	17W	Cen 34	Ba, F, Cu-	Barite, with variable fluorite and copper staining, mixed with wall rock in fissure veins, voids, and in replacements in strongly fractured Cretaceous or Tertiary andesitic agglomerate and tuff.	Open cut and shaft operations. Worked in late 1940's, producing some 2500 tons of 75% $BaSo_4$ and 14% CaF_2.	Stewart & Pfister, 1960, p. 59-62 ABM file data
	Protracted						
9. Blue Slate mine group (Bouse & McMahon, Rogers & Lee, McDonald, Protection Gold & Copper Co., Great Western Gold & Copper Co.) Figure 15	7N	17W	NW¼ 7	Cu, Au, Ag, Fe	Spotty copper, as carbonates and silicste, enriched by secondary enrichment, with coarse-grained, vuggy quartz, limonite, and hematite, and crushed rock, in strong fissure vein in metamorphosed Mesozoic sandy shale cut by diorite porphyry dikes.	Relatively shallow shafts and surface cuts. Worked intermittently, from about the early 1900's through 1932, producing some 130 tons of ore averaging about 3% Cu, 1 oz. Au/T and traces of silver.	Bancroft, 1911, p. 94 Wilson, 1934 (rev. 1967), p. 135 Jemmett, 1966 ABM file data
10. Bright Star mine (Firestone group; Aplington, Glenn & Fleming) Figure 14	4N	18W	SE¼ 34	W	Spotty, fine-grained disseminations and small crystals of scheelite in discontinuous quartz veinlets and in fractured Mesozoic calcareous schist.	Shaft, adit, and surface cuts. Worked sporadically in 1940's and 1950's but produced only some 17 units of WO_3.	Dale, 1959, p. 23-24
11. Bullion mine group (Scotchman; Goldzona Scotchman Mg. Co., King, Allison, Mohigan Copper Co.) Figure 15	7N	18W	SE¼ 12	Cu, Au, Ba, Fe, Mn	Spotty lenses and streaks of leached and oxidized copper mineralization, with local chalcocite enrichment, in fissure veins in metamorphosed Mesozoic schist and limestone cut by diorite porphyry dikes. Barite, quartz, calcite, hematite and manganese oxides in gangue.	Shaft operations. Worked mainly from 1915 through 1918, producing some 50 or more tons of ore averaging about 11% Cu and 0.09 oz. Au/T.	Mines Handbook, 1918, 1920 Jemmett, 1966 ABM file data

Plomosa District, Table 4 Cont.

MINING DISTRICT AND MINES	LOCATION T.	R.	Sec.	MINERAL PRODUCTS	GEOLOGY	TYPE OF OPERATION AND PRODUCTION	REFERENCES
12. Cindy mine (Fornis, Tenny) Figure 15	7N	17W	W Cen 19	Mn	Lenses of psilomelane and pyrolusite mixed with siliceous limestone and calcite along a bedding plane fracture in metamorphosed Mesozoic limestone.	Open cut operations. Worked in 1953, producing some 144 long tons of sorted 25% Mn.	Farnham & Stewart, 1958, p. 76
13. Coronation mine group (Mystery Hill, Blue Moon, Copper Hill; Coronation Mg. Co., Blue Sky Mg. Co.) Figure 15	7N	17W	Cen 31	Cu, Ag, Au	Spotty copper, silver, and gold mineralization, largely oxidized, in irregular quartz veins along fractures in Precambrian gneiss.	Shallow shaft operations. Worked mainly in late 1940's and early 1950's, producing some 115 tons of ore averaging about 1.8% Cu, 0.13 oz. Ag/T and 0.07 Au/T.	ABM file data
14. Dutchman mine (Flying Dutchman; Adams, Bouse & McMahon, Great Western Gold & Copper Mg. Co., Protection Gold & Copper Co., Southwest Corp. of Missouri, Grossback, Graner) Figure 15	7N	17W	NW¼ 18	Au, Cu, Ag, Fe	Spotty, very fine-grained to visible flaky gold, with oxidized copper mineralization and staining, in a steeply dipping fault zone cutting metamorphic Mesozoic hematitic shale. Lenticular orebody formed from oxidation and enrichment in fault zone.	Shaft operations, worked sporadically from early 1900's through 1941, producing some 1050 tons of ore averaging about 0.8 oz. Au/T, 1% Cu and 0.1 oz. Ag/T.	Wilson, 1934 (rev. 1967), p. 134-135 Jemmett, 1966 ABM file data
15. Excelsior mine (Mudersback; Excelsior Gold & Copper Co., Record Mines Co., Williams) Figure 15	5N	17W	W Cen 5	Cu, Fe, Ag, Au	Pockety chalcopyrite, bornite, and pyrite in a pyrometasomatic deposit, oxidized near the surface, with a garnet epidote gangue and strong hematitic-copper carbonate gossan. The irregular deposit is in faulted and deformed metamorphosed Mesozoic limestone interbedded with schist and intruded by quartz monzonite.	Relatively shallow shafts, tunnels, and open cuts. Worked intermittently from early 1900's through 1930, producing some 700 tons of ore averaging about 4.4% Cu, 0.67 oz. Ag/T, and 0.03 oz. Au/T.	Bancroft, 1911, p. 91-92 Copper Handbook, 1910-1911 Mines and Copper Handbook, 1918, 1920 ABM file data
16. Gold Nugget mine (Guadalupe; Smith, Simpson) Figure 14	4N	18W	E Cen 25	Au, Ag, Pb, Cu, Fe	Free, coarse gold with some cerussite, anglesite, galena, and minor oxidized copper in a quartz-limonite gangue in a stringer vein in a fault zone in Paleozoic quartzitic sediments cut by diorite dikes. Possibly some pyrargyrite.	Shaft operations. Worked in early 1900's with minor production and from 1935 through 1951, producing an estimated 100 tons of ore averaging about 1 oz. Au/T, 2 oz. Ag/T, 1% Pb and 0.1% Cu.	Bancroft, 1911, p. 89-90 ABM file data
17. Happy Day No. 3 mine (Black Mule, Barite No. 3; National Lead Co.) Figure 15	7N	17W	Cen 31	Ba, F	Irregular, lensing barite and fluorite in fault veins and breccia zones in rhyolitic volcanics, interbedded with metamorphosed Mesozoic sediments.	Open cut operations around 1938, producing more than 100 tons of ore averaging about 80% $BaSO_4$ and 3.5% CaF_2.	Stewart & Pfister, 1960, p. 70-71

18. Heart's Desire mine (Jackson Copper, Copper King; Jackson, & Lount, Jackson, Smith, Pioche & Arizona Copper & Gold Mg. Co., Worley Mercantile Co., Whitaker, Heckler) Figure 15	7N	18W	SE¼ 13	Cu, Pb, Ag, Au	Spotty, lensing, oxidized copper, lead, silver, and gold mineralization, with sulfides at depth, along a fault zone at intersections with cross fractures, in metamorphosed Mesozoic schist, with interbedded andesite and cut by diorite dikes.	Shaft and surface operations. Worked from early 1900's to about 1914, producing some 200 tons of ore averaging about 7% Cu, 2% Pb, 3 oz. Ag/T and 1.6 oz. Au/T.	ABM file data
19. Humdinger mine (Picacho, Old Frenchman) Figure 14	3N	18W	SW¼ 1	Pb, Ag	Spotty pods and veinlets of argentiferous galena, partly altered to anglesite and sooty argentite, in zone of strong pyritic mineralization along a thrust fault in metamorphosed Mesozoic sediments, with basic and acid dikes, and capped by Laramide sediments.	Shaft and adit operations by French as early as 1840 and reportedly produced some 300 tons of high-grade lead-silver ore in 1863-1864.	ABM file data
20. Iron Queen & Copper Prince mine groups (George King & Co., N. Y. & Plomosa Mg. Co.) Figure 14	3N	18W	Cen 3	Au, Ag, Cu	Spotty, gold, silver, and oxidized copper mineralization in irregular quartz veins and veinlets in highly deformed, schistose, silicified and epidotized Paleozoic or Mesozoic sediments with interbedded, altered andesite cut by aplitic dikes.	Shallow shafts and open cuts. Worked in the early 1900's and produced some 1720 tons of ore averaging about 0.3 oz. Au/T, 1 oz. Ag/T and 0.6% Cu.	ABM file data
21. Iron Queen, Gila Monster, etc. placers (Various early operators, George King, N. Y. & Plomosa Mg. Co., Yuma Consolidated Co., Plomosa Placer Co.) Figure 14	3N 4N	18W 18W	3, 4, 9 & 16 34	Au, Ag	Placer gold in old drainage channels in conglomerate of cemented rock fragments of schist, granite, and quartz of variable thickness, resting on strongly deformed schistose rock of undetermined origin, metamorphosed Precambrian metavolcanics or Paleozoic-Mesozoic sediments. Placers also in washes from reworked older placer deposits.	Shallow shafts and tunnels. Crushing often required before dry washing. Wet placer operations not successful. Worked from 1860 into 1950's, with estimated and recorded production by companies and individuals of some 18,000 oz. of gold with about 1,800 oz. silver.	Bancroft, 1911, p. 87-88 Root, 1912 Heikes & Yale, 1913 Jones, 1916 b Keiser, 1916 Mining & Scientific Press, 1916 Plummer, 1916 Maltman, 1917 Wilson, 1961, p. 31-32 Johnson, 1972 ABM file data
22. Keiser barite mine (Sierra Blanca; Keiser, Knox & Little) Figure 15	5N	17W	E Cen 21 Protracted	Ba, F	Barite with fluorite in lenses along a fault fissure in Cretaceous or Tertiary andesitic volcanics. Some chemical grade barite present.	Shaft operations. Worked in 1930's with some two cars of high-grade barite ore shipped.	Stewart & Pfister, 1960, p. 77
23. Linda K mine (Mildred or Hart; Dobbins, Hart, Linda K Mg. Co.) Figure 15	7N	16W	SE¼ 14	Mn	Pyrolusite, psilomelane, and manganite with calcite and breccia in seams and veinlets in fracture zones in Cretaceous or Tertiary andesitic volcanics covering Mesozoic granite.	Shaft and open cut operations. Some 30 long tons of high-grade Mn shipped in 1918 and 1500-2000 long tons mined and milled in 1953-1954 to produce 238 long tons of 32% Mn concentrates.	Farnham & Stewart, 1958, p. 73-74

Plomosa District, Table 4 Cont.

MINING DISTRICT AND MINES	LOCATION T.	R.	Sec.	MINERAL PRODUCTS	GEOLOGY	TYPE OF OPERATION AND PRODUCTION	REFERENCES
24. Little Butte mine (Arizona Pride; Bouse & McMahon, Arizona Bouse Copper Co., King & Holm, United Mines of Arizona, Little Butte Amalgamated Mines Co., Little Butte Syndicate, Associated Mines Co., Wiley Bros., Ducker & Wilson Bros., New World Mg. Co., Whiting, Bouse Development Co., Iron Tree Mg. Co., Loma Grande Mg. Co.) Figure 15	7N	17W	NW¼ 8	Au, Ag, Cu, Fe, Mn	Irregular and spotty bunches, shoots, and stringers of specular hematite containing chrysocolla, malachite, and azurite, with quartz gangue. Thin platy gold on microfractures. Ore along a strong fault and at fault intersections with cross fractures, at contact of Mesozoic or Laramide interbedded shale, limestone and welded tuff with Precambrian gneiss. Strong brecciation with replacement of wall rocks by manganese and iron oxides. Deep oxidation.	Shaft operations. Developed and worked sporadically from early 1900's through 1955. Total production would be some 5800 tons of ore averaging about 0.45 oz. Au/T, 0.16 oz. Ag/T and 2% Cu.	Bancroft, 1911, p. 93-95 Mines and Copper Handbook, 1918 Harrer, 1964, p. 124 Jemmett, 1966 ABM file data
25. National Debt mine (Huthmacker) Figure 14	4N	16W	NW¼ & N Cen 35	Mn (Be)	Lenticular bodies and irregular, discontinuous masses of pyrolusite and psilomelane with brecciated wall rock and calcite along fracture zones in Cretaceous or Tertiary andesitic tuff and agglomerate remnant in rhyolite. Traces of beryllium reported.	Adit and open cut operations. Worked from 1953 into 1955, producing some 815 long tons of sorted 20% Mn ore.	Farnham & Stewart, 1958, p. 83
26. Night Hawk, White Dike, & Colorado mine groups (Livingston, William Bros.) Figure 14	3N	18W	S½ 34, S½ 35, SW¼ 36	W, Au, Ag, Cu-, Pb-	Sporadic high-grade pockets, scattered crystals, and small masses of scheelite, associated with tourmaline, minor copper mineralization, and gold in quartz veins and stringers along a belt of Mesozoic sediments including limestone, quartzite, and schist. Some lead mineralization at east end of zone.	Shaft, adit, and open cut operations. Worked for gold and tungsten. Estimated production would be a few tons of hand-sorted ore and concentrates containing 15-60% WO_3. Some small amounts of gold, silver, and copper ore also produced.	Dale, 1959, p. 24-25 ABM file data
27. Old Maid mine (Godbe Bros., Old Maid Mg. Co., Hoffmeister, Corey) Figure 15	7N	18W	E Cen 13	Au, Ag, Cu-	Spotty, fine-grain gold in hematite and vuggy quartz with some oxidized copper mineralization, in narrow, lensing and irregular veins, complexly faulted, in metamorphosed Mesozoic sedimentary beds, intruded by porphyry dikes.	Shaft operations. Developed and worked sporadically from early 1900's through 1938, producing some 150 tons of ore averaging about 2.6 oz. Au/T, 0.6 oz. Ag/T and 0.1% Cu.	Mines Handbook, 1926 Wilson, 1934(rev. 1967), p. 135 ABM file data
28. Perry Chrysoprase Figure 15	5N	17W	NE¼ 33 Protracted	Greenish chalcedony	Narrow, irregular stringers of chrysoprase in Cretaceous or Tertiary volcanics (rhyolite?).	Shallow trenches and pits. Reportedly sold $2000 worth of material in 1958-1960.	ABM file data
29. Phoenix and Yuma mine groups (Old operators, Smith & Ellis) Figure 15	5N	17W	N Cen 6 Protracted	Fe	Stringers and massive replacement bodies of hematite in a faulted complex of metamorphosed Mesozoic limestone, and Precambrian gneiss and schist, assaying some 61% Fe, 8% SiO_2 and low sulfur and phosphorus	Open pit operations. In 1917 some 19 cars of iron ore shipped to Columbia Steel in California.	Harrer, 1964, p. 124

30. Poorman & Goodman mines (Scott) Figure 14	3N	17W	NE¼ 7 Protracted	Au, Ag, Fe	Gold-quartz vein, with limonite after pyrite, in a shear zone in highly metamorphosed and deformed mixture of Precambrian to Mesozoic sediments and volcanics.	Shaft operation. Worked about 1909 through 1911, producing close to 100 tons of ore averaging about 3.8 oz. Au/T and 0.8 oz. Ag/T.	ABM file data
31. Ramsey mine (R. & A.; Ramsey, R. & A. Mg. Co., Willamtho Co., Black Mesa Mg. Co., Perry & Morley, Ramsey Consolidated Mines Co., Miller & Christofferson, Silver Star Mg. Co., M. M. Sundt Construction Co.) Figure 14	3N	17W	E Cen 2 Protracted	Ag, Pb, Zn, Cu, Au, Ba, V. Sr, Mn, Fe	Spotty, but often locally high-grade, oxidized, lead, silver, zinc and copper mineralization with barite, celestite, vanadinite, and manganese and iron oxides, in a relatively wide vein zone of fractures and fissures, strongly brecciated, along the contact of Mesozoic limestone, quartzite, sandstone, and shale with Cretaceous or Tertiary rhyolite flows and tuff.	Shaft and tunnel operations. Discovered in 1921 and worked nearly continuously through 1969, producing some 8400 tons of ore averaging about 35 oz. Ag/T, 1% Pb, 0.5 % Zn, 0.1% Cu and minor Au.	ABM file data
32. Renegade mine (Red Hill, Big Chief; Livingston, Paisano Mg. Co.) Figure 14	2N	17W	NE¼ 7	Au, Ag, Pb, Cu-	Spotty gold, silver, lead, and minor copper mineralization in a lensing quartz vein along a fault zone in Mesozoic sediments.	Shaft and tunnel operations. Worked sporadically from 1936 through 1942, producing some 90 tons of ore averaging about 0.6 oz. Au/T, 0.8 oz. Ag/T and 0.4% Pb.	ABM file data
33. Shamrock mine (Shamrock Mg. Co., Richmond) Figure 14	4N	16W	NE¼ 22	Cu, Ag, Au, Mn, Pb	Oxidized, argentiferous, copper mineralization, with manganese and minor lead, in a jasper gangue along a fault-vein in Cretaceous or Tertiary andesite and andesite porphyry.	Shaft operations. Discovered in 1905 and worked mainly from 1909 through 1918, producing some 210 tons of ore averaging about 6% Cu, 39 oz. Ag/T and 0.01 oz. Au/T.	Copper Handbook, 1910-1911 Mines and Copper Handbook, 1918 Mines Handbook, 1920 Ariz. Mining Journal, Aug., 1919, p. 15 ABM file data
34. Southern Cross mine (Lucky Lead, Lead Camp; Cowell & Brown, Brewer, Southern Cross Mg. Co.,) Figure 15	5N	17W	NW¼ 16	Pb, Ag, Zn, Cu, Au, Fe	Spotty stringers and pods of galena, cerussite, chrysocolla, and malachite, with quartz and iron oxides, in a strong fault zone cutting metamorphosed Mesozoic sedimentary series of limestone and quartzite intruded by diabase dikes and plug.	Shaft operations. Worked in 1900's and in 1948 through 1958, producing some 1370 tons of ore averaging about 14% Pb, 4 oz. Ag/T, 1.4% Zn, 0.03 oz. Au/T, and 0.1% Cu.	Bancroft, 1911, p. 90-91 ABM file data
35. Stafford mine (Stafford Mg. Co.) Figure 14	4N	16W	Cen 27	Au, Cu, Ag	Spotty, oxidized, gold and copper mineralization with quartz in a fissure vein in Cretaceous or Tertiary andesitic volcanics.	Shaft and tunnel operations Worked from 1908 through 1911, producing some 150 tons of ore averaging about 0.34 oz. Au/T and 0.5% Cu.	ABM file data

Table 4, Cont.

MINING DISTRICT AND MINES	LOCATION T.	R.	Sec.	MINERAL PRODUCTS	GEOLOGY	TYPE OF OPERATION AND PRODUCTION	REFERENCES
XXIV. Santa Maria District (Planet, Swansea, Bill Williams, Mineral Hills Wash: Central Buckskin Mountains) Figure 12	9N-11N	15W-17W	---	Cu, Fe, Mn, Au, Ag (Ti, Ni, V, Cr, Co, Zn, Pb, Ga, Zr, St, Be)	1. Oxidized and sulfide copper mineralization in irregular, lensing, and often massive iron oxide replacement bodies in bedded, faulted, folded, and tilted Paleozoic limestone, marble, and dolomite and in Precambrian schist, usually close to the faulted and brecciated contact of carbonate beds with Precambrian gneiss and schist. 2. Hematite and specularite, usually with irregular deposition of oxidized copper mineralization and some gold, in irregular, lensing, replacement bodies or along faults in Paleozoic carbonate rocks or Precambrian metamorphics close to brecciated contacts. 3. Manganese oxides, associated with iron oxides, in irregular bodies along shear zones in Paleozoic quartzite and limestone and along Paleozoic limestone beds. 4. Free gold in fractures in Paleozoic or Precambrian quartzite. 5. Small spotty gold placers along washes.	Several large scale open pit and shaft operations and many smaller mines and prospects worked since 1860's to recent times. Total estimated and recorded mine production of base and precious metals would be some 1.4 million tons of ore containing about 23 thousand tons of copper, 1008 ounces of gold, and 35 thousand ounces of silver. No commercial production of iron ore has been made but about 400 long tons of manganese ore and concentrates (20-34% Mn) have been shipped. Placer gold operations have accounted for some 120 ounces of gold with 12 ounces of silver.	Higgins, E., 1910 Bancroft, 1911, p. 46-67 Wilson et alia, 1934 (rev. 1967), p. 127-128 Harrer, 1964, p. 125-126 ABM file data
1. Angelus mine (Craig & Baldwin)	10N	17W	SE¼ 1	Au, Ag, Fe	Finely divided particles of gold in irregular streaks and small, discontinuous pockets of brecciated to pulverized sugary quartz with abundant iron oxide and sericite in a brecciated zone in siliceous Paleozoic or Precambrian schistose quartzite.	Shaft and tunnel operations. Known at least as early as early 1900's but worked mainly in 1930's. Total production could be as much as 100 tons of ore averaging about 1 oz. Au/T and 0.2 oz. Ag/T.	Bancroft, 1911, p. 51 Wilson et alia, 1934, (rev. 1967), p. 128 ABM file data
2. Argus & Maryland mine group (Jones)	10N	16W	N Cen 6	Cu, Fe, Au, Ag	Irregular lenses of cupriferous hematite in replacement bodies in Paleozoic carbonate rocks along or above the brecciated and schistose contact with underlying Precambrian metamorphics.	Tunnel operations. Worked sporadically in early 1900's and in 1916 produced some 250 tons of ore averaging about 3% Cu, 0.4 oz. Au/T and 0.2 oz. Ag/T. Later production grouped with New Planet output.	Cummings, 1946 Harrer, 1964, p. 130-133 ABM file data

3. Clara mine (Clara Consolidated Gold & Copper Mg. Co., Wilton-Grant Ores & Metals Co., Swansea Lease, Inc., So. Arizona Mines Co., Curtis)	10N	15W	Cen 35	Cu, Ag, Au, Fe	Chrysocolla, with some chalcocite, in a lensing replacement body of hematite along brecciated contact or fault plane between Precambrian metamorphics and a thin lense of Paleozoic limestone. Jasper along contact. Some leaf gold reported.	Tunnel and shaft operations. Worked intermittently from 1911 through 1940, producing some 50,000 tons of ore averaging about 4.7% Cu with minor silver and gold.	Bancroft, 1911, p. 67 Mines and Copper Handbook, 1920 ABM file data
4. Lucky mine group (Sitton)	10N	17W	S Cen 12 to N Cen 13	Mn, Fe	Manganese oxides mixed with iron oxides in irregular replacement lenses in Paleozoic limestone and in fractures, seams, veinlets, and irregular bunches. Carbonate beds underlain by sandstone and Precambrian metamorphics.	Open cut operations. In 1953-1954, produced some 275 long tons of sorted, crude 20.6% Mn ore and 97 long tons of 33.6% Mn concentrates.	Farnham & Stewart, 1958, p. 67-68
5. Mineral Hill mine group (Continental; various small operators, R. A. DeLano Co., Arizona Ranch & Metals Co., Powdered Metals Corp.)	10N	17W	SE¼ 2, NE¼ & E Cen 10, & NW¼ 11	Cu, Fe, Ag-, Au-(Be)	Malachite, azurite, and chrysocolla in fractures, small veins, and disseminated in irregular replacement lenses of specular hematite, often massive and thick, in metamorphosed folded and faulted Paleozoic limestone and limy shale overlying Precambrian gneiss.	Numerous pits, open cuts, adits, and shafts worked sporadically, from early 1900's through 1970, for copper, gold, and iron. Considerable exploration drilling. Total production would be close to 1 million tons of ore averaging about 1.7% Cu with minor amounts of gold and silver.	Bancroft, 1911, p. 55-59 Harrer, 1964, p. 127-130 ABM file data
6. Moro mine group (Big Horn group; Clara Consolidated Gold & Copper Mg. Co., Wilton-Grant Ores & Metals Co., Reyco Development Corp. of Ariz., Tegler, Hayler Mg. Industries.)	9N	15W	Cen 3	Cu, Ag-, Au-, Fe	Copper silicates and carbonates, minor chalcocite, and sparse leaf gold, with abundant calcite, quartz, gypsum and hematite along the contact between underlying Precambrian gneiss and overlying band of Paleozoic limestone, capped by Laramide tuff and sandstone.	Shaft and tunnel operations. Worked sporadically from early 1900's to mid-1950's, producing some 2300 tons of ore averaging about 3% Cu and minor silver and gold.	Bancroft, 1911, p. 65-66 ABM file data
7. Planet (New Planet) mine group (Great Central; Polhamus, Planet Copper Mg. Co., New Planet Copper Mg. Co., Northwest Leasing & Development Co., Kimball Leasing Co., Craig)	10N 11N	16W 16W	NW¼ 6 S Cen 31	Cu, Fe, Ag-, Au-	Copper carbonates and silicates, with some copper sulfides and pyrite in depth, carrying minor gold and silver, in disseminations and veinlets in irregular, lensing, replacement bodies of specular and massive hematite. Wall rock is brecciated Paleozoic limestone and shale, along an apparent strong flat fault zone, with gouge, quartz, calcite, and feldspar and above Precambrian metamorphics.	Numerous scattered shafts, tunnels, adits and open cuts. Worked sporadically from 1863 through 1937, producing at least 60,000 tons of ore averaging about 10% Cu, and minor Ag and Au. Harrer estimates some 1.25 million tons of 60% Fe ore in reserves.	Bancroft, 1911, p. 47-55 Mines and Copper Handbook, 1918 Harrer, 1964, p. 130-133 ABM file data
8. Revenue mine group (Osborne, Arizona Revenue Copper Co.)	10N	15W	Cen 31	Cu, Fe, Ag, Au	Oxidized copper mineralization in lensing hematite replacement bodies in folded and faulted Paleozoic limestone along a fault contact with underlying Precambrian metamorphic rocks. Some Laramide intrusive granite close-by.	Shaft operations. Worked intermittently in 1910's, producing some 200 tons of ore averaging about 2% Cu and minor gold.	ABM file data

Santa Maria District, Table 4 Cont.

MINING DISTRICT AND MINES	LOCATION T.	R.	Sec.	MINERAL PRODUCTS	GEOLOGY	TYPE OF OPERATION AND PRODUCTION	REFERENCES
9. Signal mine group (Copper Prince; Swansea; Signal Copper Co., Clara Consolidated Gold & Copper Mg. Co., Swansea Consolidated Gold & Copper Mg. Co., Swansea Arizona Mines Co., Swansea Lease, Inc., Consolidated Arizona Smelting Co., Clara-Swansea Mg. Co., E. C. Lane, Amer. Smltg & Refining Co., Swansea Development Co.)	10N	15W	N Cen 32	Cu, Fe, Ag, Au	Oxidized copper mineralization, disseminated and in veinlets in several large, irregular, lensing, hematite replacement bodies, with some chalcopyrite, bornite, and pyrite in depth, and mixed with quartz, chlorite, and epidote. Ore bodies are in basal section of a fault block of folded Paleozoic limestone and amphibolite schist along a fault zone on top of Precambrian gneissic rock.	Shart operations and extensive underground workings. Known and prospected since 1880's and produced intermittently, through 1944, some 352,000 tons of ore averaging about 3% Cu, 0.09 oz. Ag/T and minor Au.	Bancroft, 1911, p. 62-65 Copper Handbook, 1910-11, 1912-13 Mines and Copper Handbook, 1918 Mines Handbook, 1922 Harrer, 1964, p. 134-135 ABM file data
XXV. Sheep Tanks District (Little Horn Mountains) Figure 16	1N-1S	14W-15W	---	Au, Ag, Mn, Fe, Cu, Pb-, Ba-(Be)	1. Gold and silver with local, minor, lead and copper mineralization in irregular vein deposits along fault zones cutting Tertiary volcanics. 2. Irregular manganese oxides in stringers, pods, and overlapping lenses along shear zones in Tertiary volcanics. 3. Minor gold placers.	Numerous prospects, but few producing mines, worked from about 1909 through 1950, producing some 17,411 tons of precious and base metal ore containing about 20,900 ounces of gold, 39,730 ounces of silver and one ton of copper. Some 250 long tons of low-grade manganese ore and a few ounce of placer gold also produced.	Wilson, 1933, p. 131-141; 1934 (rev. 1967), p. 143-147 Cousins, 1973 ABM file data
1. Hovatter claim group (Barbie, Bomboy, Hilltop; Hovetter)	15	14W	W Cen & S Cen 7, NW¼ 17	Mn	Pyrolusite and psilomelane, mixed with calcite and brecciated wall rock, in stringers, pods, and overlapping lenses, in irregular veins and flat tabular bodies in a large zone of shears in Tertiary andesite flows.	Open cut operations. Produced some 250 tons of sorted 18% Mn ore in 1953-1954.	Farnham & Stewart, 1958, p. 87
	Protracted						
2. Oakland mine (Davis, Luke & McElrath)	15	14W	SE¼ 10	Au, Ag, Fe	Spotty gold with silver in narrow, lenticular, quartz-carbonate stringers with limonite-filled pockets and gouge in a brecciated zone in Tertiary andesite volcanics below Quaternary basalt. Vein walls are chloritized, carbonatized and locally sericitized.	Several shallow shafts. Sporadic mining from 1941 through 1950 produced some 15 tons of ore averaging about 12.5 oz. Au/T and 3.7 oz. Ag/T.	Wilson, 1933, p. 140-141; 1934 (rev. 1967), p. 146-147 ABM file data
	Protracted						

3. Sheep Tanks mine (Resolution group; Sheep Tanks Mg. Co., Ibex Mines Co., Anozira Mg. Co., Sheep Tanks Consolidated Mines Co., Dillard)	15	15W	NE¼ 1 Protracted	Au, Ag, Cu, Mn, Ba, Pb, (Be)	Gold and silver, local oxidized copper, and spotty, local argentiferous lead mineralization in lensing, irregular masses and streaks with a gangue of quartz, pyrolusite, brecciated wall rock, iron oxides and barite in fault and shear veins cutting Tertiary andesitic volcanics intruded by diorite porphyry. Intense silicification, chloritization, and sericitization of wall rocks.	Shaft, tunnel, and open pit operations. Discovered in early 1900's but not developed until 1926. Sporadic production, from 1929 through 1942, amounted to some 17,400 tons of ore averaging about 1.2 oz. Au/T, 2.3 oz. Ag/T and some copper. No lead or manganese reported as produced.	Wilson, 1935, p. 136-140; 1934 (rev.1967), p. 143-146 Mills, E. W., 1945 Romslo & Ravitz, 1947 Farnham & Stewart, 1958, p. 86-87 ABM file data
XXVI. Silver and Eureka Districts (Southern Trigo Mountains) Figure 17	3S-4S	22W-24W		Pb, Zn, Ag, Au-, Cu-, Ba, F, Mo-, V, Dumortierite, Kyanite, (Sr) Fe, W, Cs, Cd, Bi, Cr, Be, Se, Sb, Mn, As, Rd)	1. Argentiferous lead, zinc, and minor copper and iron mineralization, deeply oxidized, in a gangue of quartz, calcite, limonite, barite and fluorite, in spotty, irregular, and lensing ore shoots along well defined fissure veins and at fissure intersections, in Cretaceous - Tertiary volcanics intruded by Laramide grano = diorite stocks. 2. Gold placer deposits gravels and bars. 3. Copper - silver - gold mineralization in fault-fissure veins in schist. 4. Dumortierite with minor Kyanite in erosional boulders. 5. Weak and spotty scheelite in a local fault fissure vein.	Numerous small mines worked sporadically from about 1865, but mostly from 1879 through 1880's. Total estimated and recorded production of base and precious metals would be at least some 52,343 tons of ore containing about 1,460 tons of lead, 1.6 million ounces of silver, 940 ounces of gold, 15 tons of zinc and less than 1 ton of copper. The Colorado River placers produced about 1160 oz. Au and 100 oz. Ag. Possibly minor tungsten produced.	Raymond, 1872 Hamilton, 1884 Thompson, 1925 Wilson, 1933, p. 50-72 Cooper, 1962 Parker, 1966
1. Amelia mine (Gallo; Sterling Silver mines Consolidated, United Silver Mines Co. of Yuma)	3S	23W	S Cen 25	Ag, Pb, Zn, Fe, Ba, Sr	Argentiferous lead and zinc carbonates and lead oxide in cavity fillings, with a gangue of quartz, black calcite, iron oxides, barite and celestite in fissure fillings along normal faults cutting Tertiary andesitic to dacitic flows, breccia, and agglomerates. Strong brecciation, silicification and carbonatization of wall rocks.	Underground operations to the surface. Worked in 1880's and reportedly produced considerable high-grade silver ore at that time but exact amount unknown.	Wilson, 1933, p. 59-60 Parker, 1966
2. Black Rock mine (Black Rock Mg. & Reduction Co., Penn Metals Inc., Riley & Holmes)	4S	23W	SE¼ 11, SW¼ 12	Zn, Pb, Ag, F	Zinc carbonate and argentiferous lead carbonate, oxide, and sulfate and local residual galena, in irregular, cellular masses in a gangue of manganese and iron-stained calcite, vuggy quartz and fine-grained fluorite, in lensing ore shoots in Cretaceous or Tertiary schist and hornfels, intruded and metamorphosed by granodiorite. Average ore reported to be 4.9% Pb, 9.8% Zn and 6.7 oz. Ag/T. Zinc not assayed or recovered.	One of earliest discoveries and patented in 1880. Shaft, adit and pit operations produced rich Pb-Ag ore from 1883 to 1887 but amount unknown. In 1941 produced some 1300 tons of ore averaging about 5.3% Pb, 1.7 oz. Ag/T and minor Cu and Au. Dump retreated in 1948-1949 together with other dumps.	Hamilton, 1884, p. 73 Wilson, 1933, p. 67-68 Parker, 1966 ABM file data

Silver and Eureka Districts, Table 4 Cont.

MINING DISTRICT AND MINES	LOCATION T.	R.	Sec.	MINERAL PRODUCTS	GEOLOGY	TYPE OF OPERATION AND PRODUCTION	REFERENCES
3. Clip mine (Silver Clip, Jas. G. Blaine; Hubbard & Bowers; Thompson, Shiner, Fields, & Bates; Silver Mines Consolidated Co.; United Silver Mines Co. of Yuma)	3S	23W	Cen 25	Pb, Ag, V, Fe, Mn, Sr, Ba, F, Cu- (Cl, Br)	Argentiferous, oxidized lead mineralization with silver chloride and bromide, vanadinite, and some malachite in a gangue of ferruginous and manganiferous calcite, quartz, fluorite, barite, pyrolusite, iron oxides, celestite, gouge, and brecciated wall rock, in a lensing vein in a fault zone cutting Tertiary andesitic to dacitic flows, tuffs, and breccias. Deep wall rock alteration to chlorite, limonite, and calcite as well as silicification. Ore pinches out in depth. Ore reportedly ran 20 to 140 oz. Ag/T with very minor Au.	Adit and shaft workings with stoping to the surface. Mined mainly in 1883-1887 and to lesser degree in 1925 through 1929. Total estimated and reported production would be some 25,000 tons of ore averaging about 46 oz. Ag/T. No reported recovery of lead.	Hamilton, 1884, p. 238 Wilson, 1933, p. 56-59 Parker, 1966 ABM file data
4. Colorado River placers (Various operators)	3S 4S	23W 23W	25 & 36 1 & 2	Au	Gold placers in bench gravels, arroyo bottoms, and ancient bars and channels of drainage from the Trigo Mountains and along the ancestral Colorado River, in the Paradise Valley area south of Lighthouse Rock.	Dry washing operations. Worked intermittently in late 1880's, during 1930's, and from 1950 through 1966. Estimated and reported production would be some 800-1000 ounces of gold with 80-100 ounces of silver.	Burchard, 1882 Wilson, 1961, p. 25 Johnson, 1972, p. 75-76 ABM file data
5. Geronimo North & South mines (Unknown operators, Neal Mg. Co.)	3S	23W	E Cen & SE¼ 34	Pb, Zn, Ag, Fe, Mo, V, F	Argentiferous lead sulfate and carbonate, zinc carbonate, lead oxide, wulfenite, and partly altered streaks of galena in irregular bunches or in vugs in irregular lensing veins along faults cutting Tertiary - Cretaceous rhyolite tuffs and andesitic flows. Northern part of deposit is in fault contact with granodiorite. Gangue is iron oxides, manganiferous calcite, quartz, and fluorite. Ore said to average 6% Pb and 8 oz. Ag/T.	Shaft and tunnel operations. No known early history or recorded production but some rich Pb-Ag ore probably mined in 1880's.	Wilson, 1933, p. 64-65 Parker, 1966
6. Gold Reef prospect (Knowles & Young)	4S	22W	NW¼ 30	W, Fe	Spotty scheelite with iron oxides, quartz, and calcite in a narrow vein in a fault fissure zone in Mesozoic metamorphic quartz-sericite schist intruded by Tertiary rhyolitic to aplitic dikes. Sericitic alteration of wall rock.	Shallow prospect pits. Possible small production in 1953.	Wilson, 1941, p. 21 Dale, 1959, p. 29-30 Parker, 1966
7. Mendevil claim (Draper; Riley)	4S	23W	NE¼ 1	Pb, Ag, Ba, Sr.	Spotty lead carbonate and oxide with silver, in vugs in calcite, in irregular veins containing barite, celestite, calcite, and vuggy quartz in a fault zone separating metamorphosed Mesozoic schist from Tertiary andesitic volcanics. Vein walls chloritized. Some spots average 5% Pb and 15 oz. Ag/T.	Shallow trenches and pits. Patented in 1887. No reported production but some high-grade ore may have been produced.	Wilson, 1933, p. 60 Parker, 1966
	Protracted						

8. Pacific and Mandan claims (Keith, Batton)	4S 23W E Cen 11 Protracted	Pb, Ag, Fe, Mn	Spots of lead carbonate and small altered nodules of galena with silver in banded quartz and masses of iron oxides, pyrolusite, and calcite along a silicified fault zone in metamorphic Mesozoic schist intruded by Laramide diorite.	Shaft operations. Patented in 1887 and produced some silver ore in the 1880's.	Wilson, 1933, p. 68
9. Princess and Hamburg mines (Blake; Norton, Crawford & Lambie; Neal Mg. Co.)	4S 23W Cen 1 Protracted	Pb, Zn, Ag, Ba, F, Sr, Fe, Mo, V	Nuggets of argentiferous lead carbonate, sulfate, and oxide intermingled with zinc carbonate and reportedly some galena, argentite, and cerargyrite, with vanadinite and wulfenite in vugs, in a gangue of calcite and brecciated and silicified wall rock cemented with calcite, barite, celestite, quartz, fluorite, and irregular masses of iron oxide. Irregular fissure filling in fault zone cutting metamorphic Mesozoic schist intruded by Laramide granodiorite and capped by Tertiary dacite flows and pyroclastics.	Shaft operations. Worked during 1880's. Princess produced substantial but unrecorded amounts of silver ore. No record of production from Hamburg.	Blake, 1881a Wilson, 1933, p. 63 Parker, 1966
10. Papago mine (Another early mine with various operators)	4S 23W Cen 11 Protracted	Pb, Ag, Zn, F, Mn, Fe, Mo, V (Cl, Br)	Geology and mineralization reported to be similar to Red Cloud mine but more manganiferous. Irregular vein along fault zone separating Tertiary volcanic tuffs and andesite flows from Laramide granodiorite. Outcrops mantled by gravels of wash. Reportedly assayed up to about 8% Pb and 18 oz. Ag/T.	Shaft operations. Discovered by placer miners in early 1880's and reportedly produced considerable silver ore at that time.	Wilson, 1933, p. 70 Parker, 1966
11. Red Cloud Mine (Red Cloud Mg. Co., Horton & Knapp, Hubbard & Bowers, Red Cloud Consolidated Mines Co., Hanna, Penn Metals Inc., Red Cloud Mg. & Milg. Co., Riley & Holmes)	4S 23W S Cen 2 Protracted	Pb, Zn, Ag, V, Mo, Mn, Fe, Cu-, Mn-, Ba-, F-, W- (Cl, Br)	Irregular masses and vug linings of argentiferous lead and zinc carbonates with pyrolusite, vanadinite, wulfenite and minor malachite, nodules of partly altered argentiferous galena, and disseminated masses of silver chloride and bromide, in a gangue of iron oxides, quartz, fluorite, clacite, gouge and brecciated wall rock. Vein occurs in an irregular fault zone between Tertiary andesite breccia, dacite porphyry, rhyolitic to dacitic tuffs and lapilli tuffs and Laramide granodiorite to quartz diorite intrusive. Wall rocks silicified, sericitized, and carbonatized. Best ore at intersections of fault and cross fractures. Ave. grade reported as 5-6% Pb and 10 oz. Ag/T.	Shaft operations. One of earliest operations in district, dating back to early 1880's and patented in 1885. The total estimated and recorded production would be some 21,000 tons of ore averaging about 18 oz. Ag/T and 5.5% Pb and minor Au. Some Pb, Zn, and Ag recovered from dumps in 1949.	Hamilton, 1881, p. 73; 1884, p. 238 Mines and Copper Handbook, 1920 Thompson, 1925 Wilson, 1933, p. 65-67 Parker, 1966 ABM file data

Silver and Eureka Districts, Table 4 Cont.

MINING DISTRICT AND MINES	LOCATION T.	R.	Sec.	MINERAL PRODUCTS	GEOLOGY	TYPE OF OPERATION AND PRODUCTION	REFERENCES
12. Riverview mine (Eureka, Old Selby Bonanza; Selby, Ferguson, Sentenac Mines Co., Riverview Mines Co., Rocher)	4S	22W	NE¼ 31	Pb, Ag, Zn, Au, Fe	Pockety ore shoots of lead and zinc carbonates with scattered bunches and narrow veins of galena and iron-rich sphalerite in a gangue of iron oxides, manganiferous to ferruginous calcite, brecciated wall rock, and gouge in lensing fault zone veins cutting metamorphic Mesozoic schist. Walls show pyrite metacrysts and pronounced silicification and chloritization.	Shaft, tunnel, and open cut operations. Worked intermittently, since about 1875. Total estimated and recorded production would be some 150 tons of ore averaging about 14% Pb, 6 oz. Ag/T, 8% Zn, and 0.2 oz. Au/T.	Wilson, 1933, p. 71 ABM file data
13. Saxon mine (Dives, Padre Kino; Pryor, Neal Mg. Co., Yuma Metals Inc.)	3S	23W	SW¼ 36	Pb, Ag, Zn, Fe, Mn, Be, Sr	Irregular fissure and massive cavity fillings of argentiferous lead and zinc carbonates with a gangue of iron oxides, manganese oxide, barite, celestite, manganiferous calcite, quartz, and gypsum along a fault zone separating Tertiary dacitic and andesitic lavas, rhyolite tuffs and lapilli tuffs from Laramide contact metamorphosed intrusive and granitized rock. Probably some silver chloride.	Shaft, tunnel, and pit operations. Developed from early days but probably did not produce much more than 6-10 tons of ore averaging about 48% Pb and 67 oz. Ag/T, mostly in 1919-1920 from shallow workings.	Wilson, 1933, p. 62-63 Parker, 1966 ABM file data
14. Silver Glance claim (Cargill, Riley, Ming & McPherson)	4S	23W	E Cen 11 Protracted	Pb, Ag, Fe	Geology and mineralogy similar to Black Rock mine. Small lead of quartz, iron oxide, manganiferous calcite with spotty bunches of partly oxidized galena and cavities filled with limonite and wulfenite crystals in a broad, brecciated fault zone offset by transverse faults and with siliceous cement. Wall rocks are metamorphosed schist.	Tunnel and shaft operations. Patented in 1881 and may have produced some silver ore in early days.	Wilson, 1933, p. 68, 70 Parker, 1966
15. Silver King claim (Huss, Jones, Geronimo Mg. Co.)	4S	23W	Cen 1 Protracted	Pb, Ag, Mo, Fe, V, F, Ba, Sr, Cu	Narrow, pockety, quartz-fluorite veins with irregular masses of iron oxide, residual galena, and lead sulfate, carbonate, and oxide, in a wide brecciated fault zone in silicified and carbonatized contact metamorphosed Tertiary volcanics.	Tunnels and shaft operations. Probably found early but not worked extensively. Produced some 50 tons of ore in 1923 and 1948 averaging about 27% Pb, 9 oz. Ag/T and minor Au.	Wilson, 1933, p. 64 Stewart & Pfister, 1960. p. 88-89 Parker, 1966 ABM file data

XXVII.	Tank Mountains District (Tank Mountains) Figure 2	2S-4S	13W-16W	---	Au, Mn, Fe, Cu-	1. Scattered short, lenticular, and narrow, gold-bearing quartz, carbonate, iron oxide and minor, partly oxidized, copper and iron sulfide veins in fissure zones in Mesozoic granitic intrusive and metamorphic schist, with dioritic to rhyolitic dikes. Wall rocks are sericitized, silicified, and carbonatized. Gold concentrated by weathering in near-surface iron oxides and quartz. Principal examples are the Johnnie or Engesser prospect (T2S, R16W, NE¼ sec. 25, protracted) and the Golden Harp, Ramey, and Puzzles prospects (T4S, R13W, E center and SE¼ sec. 7). 2. Separate and discontinuous, lenticular pods of pyrolusite, psilomelane, and manganiferous calcite in fissure zones in Tertiary andesitic flows, tuffs, and breccia. (Black King mine, T2S, R15W, Central sec. 25 and NW sec. 36) 3. Small gold placers in various washes resulting from the erosion of the gold-bearing quartz-carbonate-iron oxide veins, notably in the northwestern area near the Engesser prospect and in the southeastern area near the Golden Harp, Ramey, and Puzzles prospects.	Mostly shallow pit, shaft and open cut operations. The gold-quartz veins and gold placers were discovered by prospectors in the late 1800's and worked sporadically since then. The total production from these veins would be some 50 tons of ore containing about 50 ounces of ounces of gold with 10 ounces of silver recovered by panning and amalgamation. Possibly as much as 200 ounces of gold was recovered by dry placer operations. Manganese production was about 50 long tons of 25-30% Mn.	Burckard, 1884, 1886 Wilson, 1933, p. 123-127; 193 (rev. 1967), p. 147-148; 196 p. 24-25 Farnham & Stewart, 1958, p. 85-86 Johnson, 1972, p. 71-73 ABM file data
XXVIII.	Trigo Mts. (Cibola) District (Northern & Central Trigo Mountains) Figure 17	1N-3S	27W-23W	---	Mn, Au, Ag	1. Manganese oxides in lenticular shoots and bodies within fault zone breccias in Tertiary volcanics overlying Mesozoic schists. 2. Spotty gold in quartz-limonite fissure veins cutting Mesozoic schist, intruded by narrow granitic-porphyry dikes. 3. Gold placer deposits in washes below area of gold veins.	Original operations on small gold veins and placers in 1890's but manganese deposits received little attention until 1950's when buying stations established for low-grade material. Only about 52 tons of mined gold ore has been produced accounting for not more than some 62 ounces of gold and 10 ounces of silver. Placer operations may have produced some 323 ounces of gold with minor silver. The total production of manganese ore would be some 7,000 long tons of 40% or more Mn and 24,000 long tons of 20-30% Mn.	Wilson, 1933, p. 72-73 Farnham & Stewart, 1958, p. 78-82 Parker, 1966 ABM Bull. 180, p. 211-225 ABM file data

Trigo Mountains (Cibola) District, Table 4 Cont.

MINING DISTRICT AND MINES	LOCATION T.	R.	Sec.	MINERAL PRODUCTS	GEOLOGY	TYPE OF OPERATION AND PRODUCTION	REFERENCES
1. ABC mine (Self, Cockrum & McNelly)	2S	22W	SE¼ 1 Protracted	Mn	Psilomelane in brecciated wall rock in parallel shear veins in Tertiary andesitic volcanics.	Open cut operations, worked in 1948-1950 and in 1954-1955, producing some 400 long tons of about 41% Mn.	Farnham & Stewart, 1958, p. 81 ABM Bull. 180, p. 219 ABM file data
2. Andrus claims (M & A; Tenny, Western Exploration & Development Co.)	2S	22W	SE¼ 20 Protracted	Mn	Psilomelane in bunches and veinlets along a fracture zone in Tertiary andesitic volcanics.	Open cut and pit operations. Some 50 - 100 long tons of sorted 40%± Mn ore shipped and 3000 long tons of low grade Mn ore sent for experimental concentration.	Farnham & Stewart, 1958, p. 81 ABM file data
3. Black Diamond mine group (Myrtle; Gibson, Todd & Smith, J. P. Stewart & Associated, Todd & Allen, Western Exploration & Development Co.)	2S	22W	E Cen 29 Protracted	Mn, Pb-, Zn-	Pyrolusite and psilomelane, mixed with calcite and brecciated rock, in lenticular shoots along an extensively brecciated shear zone in Tertiary andesite porphyry. Trace amounts of lead and zinc.	Open cut, shaft, and adit operations. Worked from 1953 through 1959, producing some 4600 long tons of plus 40% Mn and 9000 long tons of about 30% Mn.	Mining World, Vol. 19, Dec. 1957, p. 65 Farnham & Stewart, 1958, p. 80-81 ABM file data
4. Black Jack mine (Montoya, Gerlack, J. P. Stewart & Associates, Western Exploration & Development Co.	2S	23W	SW¼ 13 Protracted	Mn	Manganese oxides in disconnected, lenticular shoots, with calcite and brecciated rock, along a fracture zone in Tertiary andesitic volcanics.	Open cut and shaft operations. Worked from 1954 through 1959, producing some 650 long tons of plus 40% Mn sorted ore.	Farnham & Stewart, 1958, p. 81 ABM file data
5. Cibola No. 1 mine (N. & J. F. Powers)	3S	23W	N Cen 2	Mn	Pyrolusite with some manganite and psilomelane, mixed with calcite and quartz, in lenticular shoots, fracture fillings, and narrow seams cementing brecciated wall rock along an extensive and wide, brecciated zone at the fault contact between Mesozoic granitic schist and Tertiary andesitic volcanics.	Incline shaft operations. Worked from 1953 through 1954, producing some 2000 long tons averaging about 30% Mn.	Mining World, Vol. 19, Dec. 1957, p. 65 Farnham & Stewart, 1958, p. 79 ABM file data
6. Cibola No. 3 mine (N. & J. F. Powers, Manganese Mg. & Mlig. Co.)	2S	23W	S Cen 35 Protracted	Mn	Pyrolusite with manganite and psilomelane, mixed with quartz and calcite, in irregular shoots in a lensing brecciated zone in Tertiary andesitic volcanics.	Adit and shaft operations. Worked from about 1953 through 1958, producing some 500 tons of 30 - 40% Mn ore.	Farnham & Stewart, 1958, p. 79 ABM file data
7. Cibola No. 7 mine (J. F. Powers)	2S	23W	SW¼ 25 Protracted	Mn	Pyrolusite mixed with wall rock breccia and calcite in a steeply dipping fracture zone with disconnected, lenticular, mineralized lenses in Tertiary andesitic volcanics.	Shaft, tunnel, and open cut operations. Worked from 1955 into 1959, producing some 4000 long tons averaging about 30% Mn.	ABM file data
8. Cibola No. 8 mine (N. & J. F. Powers)	2S	23W	SW¼ 25 Protracted	Mn	Pyrolusite with calcite, other carbonates, and wall rock breccia in discontinuous, lenticular shoots along a strong fracture zone cutting Tertiary andesitic volcanics.	Shaft and open stope operations. Worked from 1953 to 1956, producing some 3000 long tons of 25 - 30% Mn ore.	Farnham & Stewart, 1958, p. 79-80 ABM file data

9.	Fools Folly mine (Snipers, Smith, Jarroll, and Richardson) (Not shown on district map)	1N	21W	W Cen 1 E Cen 2	Mn	Pyrolusite mixed with brecciated wall rock in shoots along a fracture zone in Tertiary andesitic volcanics.	Shaft, adit, and open cut operations. Worked as early as 1930 and later in 1954-1955, producing some 300 long tons averaging about 20% Mn.	Farnham & Stewart, 1958, p. 82
10.	Grand Central mine (Mexican operators, Hardt)	1S	23W	Cen 36 Protracted	Au, Ag-	Spotty, high-grade gold with minor silver, with banded quartz, iron oxides, ferruginous calcite, pyrite crystals and bunches, in cavities and fracture fillings along a fault zone cutting Mesozoic schist, intruded by granite porphyry dikes. Other similar deposits 1 to 2 miles to south (Jupiter, Boardway).	Shaft and open cut operations. Worked sporadically in early to late 1890's and again in 1930's. Total estimated and reported production from all the deposits would be some 52 tons of ore averaging better than 1 oz. Au/T and minor silver.	Wilson, 1933, p. 72; 1934 (rev. 1967), p. 148 ABM file data
11.	H. H. and L. mine group (Cass, New Year Nos. 2 & 3; Hess, Hess & Lilly, Kirk & Lea)	3S	23W	NW¼ 3, NE¼ 4	Mn	Psilomelane and pyrolusite in irregular, disconnected masses and veinlets in brecciated and silicified Tertiary andesitic volcanics along fault zones.	Open pit operations. Worked in 1953 and 1954, producing some few hundred long tons of 20-40% Mn ore.	Farnham & Stewart, 1958, p. 80 Parker, 1966 ABM file data
12.	Peggy B mine (Brown)	3S	23W	NE¼ 3	Mn	Pyrolusite, mixed with calcite and brecciated wall rock, in lenticular shoots along a fracture vein in Tertiary andesitic volcanics.	Shaft operation. Worked in 1954-1955, producing some 100 long tons of 20-30% Mn ore.	Farnham & Stewart, 1958, p. 80 Parker, 1966
13.	Trigo gold placers (Various operators)	2S	23W	1 & 2	Au	Spotty gold placer deposits in stream beds draining from small gold quartz veins in Mesozoic schist.	Dry placer operations on small scale, and intermittently, from as early as 1860's into 1940's. Possibly as much as some 323 ounces of gold were recovered containing a few ounces of silver.	Wilson, 1961, p 25 Johnson, 1972, p. 75-76 ABM file data
14.	Triple H mine group (Rosie, J. P.; Bishop, Brown, Western Exploration & Development Co.)	2S	23W	SE¼ 39, SW 35	Mn	Manganese oxides, with calcite and brecciated wall rock, in irregular bunches and lenses along strong fracture zones in Tertiary andesitic volcanics.	Open cut and adit operations. Worked intermittently from 1954 through 1959, producing some 2000 long tons of low grade Mn ore for concentration.	Farnham & Stewart, 1958, p. 80 ABM file data
XXIX.	Yuma District (Yuma area)	8S-9S	23W	---	Au, Ag, Fe	Gold-bearing quartz veins and stringers along fault and fractures in Mesozoic or Laramide granitic gneiss.	One mine operation as noted below.	Wilson, 1933, p. 221 ABM file data
1.	Jude mine group (Silverfields; Hedgepeth, Timmons & Gutchmaker, Burton, Fay Mg. Co.) Figure 2	8S	23W	N Cen 34	Au, Ag, Fe	Gold-bearing, iron-stained quartz, with local pyrite and pockets of limonite, in stringers and veins along fractures and faults in Mesozoic or Laramide gneiss.	Shaft and open cut operations. Worked originally in early 1900's and later in 1939-1940, and 1947, producing some 450 tons of ore averaging about 0 3 oz. Au/T with minor Ag.	

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STATE OF ARIZONA
BUREAU OF GEOLOGY AND MINERAL TECHNOLOGY

The Arizona Bureau of Geology and Mineral Technology was established in 1977 by an act of the State legislature. This act represents a reorganization of the Arizona Bureau of Mines which first was created in 1915 and placed under the authority of the Arizona Board of Regents. This authority has not changed. The Bureau continues its service in the fields of geology, metallurgy, and mining in response to public inquiries, state agency requirements, and various research grants. In order to carry out these functions, two basic branches now are recognized:

Geological Survey Branch

This branch is charged with the responsibility of acquiring, disseminating, and applying basic geologic data that are designed to (a) enhance our understanding of Arizona's general geologic and mineralogic history and to assist in determining the short and long range influences these have on human activity, and (b) assist in developing an understanding of the controls influencing the locations of metallic, nonmetallic and mineral fuel resources in Arizona.

Mineral Technology Branch

This branch conducts research and investigations into, and provides information about, the development of Arizona's mineral resources, including the mining, metallurgical processing, and utilization of metallic and nonmetallic mineral deposits. These activities are directed toward the efficient and safe recovery of Arizona's mineral resources as well as insuring that recovery and treatment methods will be compatible with the basic environmental needs of the state.

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