

A RECONNAISSANCE IN THE KOFA MOUNTAINS, ARIZONA.

By EDWARD L. JONES, Jr.

INTRODUCTION.

LOCATION.

The isolated mountainous area here designated the Kofa Mountains lies in the central part of Yuma County, Ariz. These mountains cover an area of approximately 200 square miles and are surrounded by broad, gently aggraded plains that separate them from other detached mountains, of which the Plomosa and Chocolate mountains and the Castle Dome Range are the nearest. The Kofa mining district, from which the mountains derive their name, is in the southern part of the range.

HISTORY.

Although southwestern Arizona had been prospected for many years, particularly in the early sixties, when the La Paz placers, 40 miles northwest of the Kofa Mountains, were actively worked, this area received little attention until the discovery of the King of Arizona ore body in 1896. The King of Arizona mine produced ore continuously from the date of its opening to the summer of 1910, when the ore became of too low grade for profitable treatment. The mine produced gold and silver bullion to the amount of \$3,500,000, gold greatly predominating in value. The surface ore of the mine was extremely rich, much of it being worth \$1 a pound. Ore of this grade was packed or hauled to Mohawk, on Gila River, and there treated in a small cyanide mill. In 1899 a 225-ton mill was built at the mine and was operated until the mine closed.

In 1906 the North Star ore body, $1\frac{1}{2}$ miles north of the King of Arizona, was discovered by Felix Mayhew and sold shortly afterward to the Golden Star Mining Co. for \$350,000. Development was soon started, and by 1908 this company had erected a cyanide mill which it operated until August, 1911, when the ore became of too low grade to work. The mine produced, according to statistics published by this Survey in Mineral Resources of the United States, approximately \$1,100,000 in gold and silver. The deserted camp of Kofa centers around the King of Arizona mine, and the settlement of

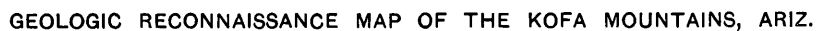
Polaris about the North Star mine. The discovery of the North Star gave renewed impetus to prospecting in the Kofa Mountains, with the result that promising indications were found in their northern part and the small camp of Ocotillo was established. No ore has been shipped from the prospects near Ocotillo, and the development is as yet insufficient to show the extent of the deposits. One prospect has been developed to a depth of 300 feet, but with this exception the deposits are explored by shallow shafts and short tunnels, and at the present time assessment work only is being done.

ACCESSIBILITY.

The supply and shipping point of the King of Arizona and North Star mines was Mohawk station, 45 miles distant on the Southern Pacific Railroad, but since the closing of the mines the southern part of the area is more accessible from Dome, 50 miles distant, where adequate transportation facilities may be had. In hot weather two full days are required to make the trip by team from Dome to the mines, but by automobile the time may be reduced to four hours. The railroad point nearest to the northern part of the area is Vicksburg, on the Atchison, Topeka & Santa Fe Railway, from which a fair but little-used wagon road runs south for 30 miles across the desert to Alamo Spring, at the head of a wash draining to the north. The road beyond the spring to Ocotillo and to other prospects in the northern part of the mountains is in poor condition and in many places is merely an ill-defined trail in the gulch bottoms. There are no roads directly connecting the northern and southern parts of the area, but on the La Posa plain, on the west side of the Kofa Mountains, a road from Quartzsite leads to Kofa and Polaris. (See fig. 12.)

The prospects in the northern part of the area were examined by the writer in April, 1914, during a 10 days' trip from Vicksburg in company with Mr. C. E. Zeigler. The King of Arizona and North Star mines were examined on a 2 days' trip from Dome. There are probably many small prospects scattered over the mountainous region that intervenes between the northern and southern parts of the area examined, but the uncertainty of the water supply and the shortness of the time allotted to this work prevented a more extensive reconnaissance.

The region is unsurveyed, the position of the mountains being indicated approximately on the Land Office map by hachures. The accompanying map (Pl. V) is based in part on a traverse line starting from the Cemitosa Tanks, extending to Ocotillo, and thence going southeastward to the Big Horn and adjoining prospects. The locations of the King of Arizona and North Star mines were projected from the Land Office map.



GEOGRAPHY.

The higher summits of the Kofa Mountains rise probably 2,000 feet above the surrounding plains, but many of the outlying knolls and mesas have a relief of a few hundred feet only. The Cemitosa Tanks, at the north end of the mountains, are approximately 1,900 feet in elevation, and Kofa, at the south end, is 1,700 feet. The mountains

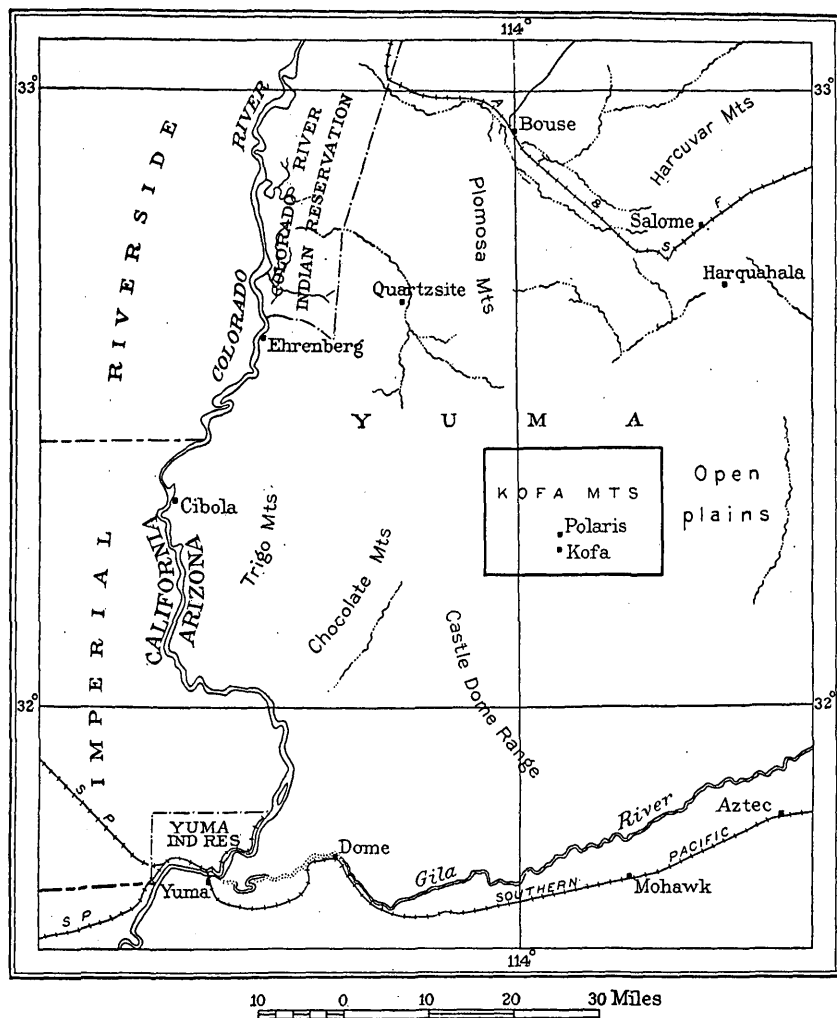


FIGURE 12.—Index map showing location of the Kofa Mountains, Ariz.

have no definite trend; they are composed of volcanic rocks that are intricately dissected into flat-topped mesas of small extent or into jagged spires and other fantastic erosional forms. Numerous sandy stream channels or "washes" radiate from the mountainous area to the surrounding plains, where their identity is completely lost. Rock waste deposited by these intermittent streams forms long, gentle

slopes extending out from the base of the mountains. Only rarely, during severe storms, do these channels carry surface waters, but here and there holes eroded in the bedrock, called "tanks," contain a small supply during certain months of the year. This source of water, however, is not to be depended on. Alamo Spring furnishes a small but constant flow of potable water. The water supply of the King of Arizona and North Star mines was obtained from wells reported to be 1,070 feet deep, sunk in the plain about 5 miles distant and 600 feet lower in elevation. The prospectors living in Ocotillo and other places remote from these sources collect during the brief rainy season such water as they can.

The climate of the region is extremely arid and the vegetation is scanty. In the washes are scattered mesquite and ironwood trees, and the hill slopes support several varieties of cactuses and small thorny shrubs. Such trees as exist are suitable only for fuel, and the supply in the vicinity of prospects is soon depleted.

GEOLOGY.

The Kofa Mountains are composed of extrusive igneous rocks which rest on an eroded surface of much older rocks. These older rocks are exposed in low foothills in the northern and southern parts of the mountainous area. The volcanic rocks are probably of Tertiary and Quaternary age. The older rocks consist of metamorphosed sediments with associated pegmatites, thought to be of pre-Cambrian age, intruded by granite and dike rocks of probable Mesozoic age.

VOLCANIC ROCKS.

Rhyolites and andesites with accompanying tuffs, breccias, and local thin beds of grit are overlain by olivine basalts which cap the mesas. The thickness of these volcanic rocks exposed in the Kofa Mountains is probably 2,000 feet. A light-colored thin fragmental rhyolite on the eroded surface of the older intrusive rocks was noted near the Cemitosa Tanks. Overlying it are thick flows of maroon to brownish andesites and associated tuffs and breccias. For the most part the flows are horizontal, but on some of the peaks light-colored tuff beds between layers of darker material dip at steep angles. Near the North Star mine flow bands in the andesite are well developed, but over most of the area examined the lavas give little indication of flow structure. The rhyolite tuff, of general light color, contains sparsely disseminated crystals of orthoclase, quartz, and biotite.

Andesites of gray, red, brown, and intermediate shades constitute a large part of the lava series. They vary in texture from fine-grained dense rocks with few phenocrysts to those having abundant phenocrysts. The phenocrysts are predominantly feldspar, mostly altered to calcite, but locally biotite is an abundant constituent of the rock.

Tests on some of the unaltered feldspars indicate that they have the composition of labradorite. The groundmass is a microcrystalline feldspar aggregate, colored with iron oxide. Olivine is a sparse though variable constituent of the andesites, becoming more abundant toward the top of the series. The occurrence of this mineral indicates a close relation, and possibly a gradation in composition, between the andesite and the overlying basalt.

The basalt flows are 300 feet or more thick in places. Although, as suggested, the lower flows appear to be closely related to the underlying andesites, the upper flows are made up of typical black vesicular basalt. This consists of a groundmass of calcic feldspar laths and augite grains inclosing large crystals of olivine, some of which show alteration to serpentine, inclosed by rims of iron oxide.

INTRUSIVE ROCKS.

An intrusive mass of granite exposed in a belt 1 mile wide occurs west of the Cemitosa Tanks. It is cut by diorite dikes, some of which are 100 feet wide. Between the King of Arizona and North Star mines narrow dikes of monzonite porphyry traverse the highly metamorphosed sediments and associated pegmatites. The intrusive rocks, though locally altered along shear zones, are not dynamically metamorphosed and are believed to be much younger than the metamorphosed sediments.

The granite is medium grained and is composed of quartz, feldspar, hornblende, and alteration products and a few accessory minerals. The feldspars consist of orthoclase and a perthitic intergrowth of orthoclase and albite. In some of the sections the feldspars are largely altered to sericite. Hornblende is a variable constituent of the rock, though nowhere abundant, and it is commonly altered to epidote and chlorite. Magnetite was noted as a secondary mineral in one of the sections.

No fresh specimens of diorite were obtained. The rock is coarsely granular, and large hornblende and calcic feldspar crystals are apparent to the eye.

The monzonite porphyry has a fine dark-gray groundmass, in which are numerous small feldspars and more sparsely distributed amphibole phenocrysts. The feldspars consist of orthoclase and broadly striated plagioclases, probably andesine, in about equal amount. The feldspars are altered in part to sericite and calcite. The amphibole is green in color and is partly altered to chlorite and calcite.

SEDIMENTARY ROCKS.

At the south end of the Kofa Mountains, between the North Star and King of Arizona mines, highly metamorphosed sediments crop out at the base of the lava flows and are the principal rocks of a

small ridge between these two points. A dark pyritiferous metamorphosed shale or slate forms the footwall of the North Star vein, and medium-grained quartzose biotite schists crop out on the ridge. Small irregular intrusions of pegmatite occur in these schists.

ORE DEPOSITS.

CLASSES.

The ore deposits of the Kofa Mountains consist of gold-bearing brecciated zones and veins in andesite, copper replacements along shear zones in granite, disseminated galena in monzonite porphyry dikes, and placer deposits. The deposits of the first group are regarded as of Tertiary age, and those of the second and third groups of probable Mesozoic age. The placer deposits have resulted from the disintegration of auriferous veins in the metamorphosed rocks.

GOLD DEPOSITS IN ANDESITE.

GENERAL CHARACTER.

Brecciated zones and veins in andesite were noted in the areas examined in the northern and southern parts of the Kofa Mountains, but only in the King of Arizona and North Star mines have ore bodies of economic importance been developed. These zones, with the exception of the North Star vein, trend from southeast to east, with southwesterly or southerly dips from 45° to vertical. The North Star vein trends east but dips 60° N. The zones vary from a few feet to 60 feet in width. Some are notably persistent along their strike; the North Star vein, it is said, can be traced for several miles, and the Geyser vein is traceable for $1\frac{1}{2}$ miles. The vein matter consists of brecciated andesite, usually silicified and accompanied by stringers of calcite and quartz. Quartz commonly occurs as a pseudomorphic replacement of calcite. An examination with the microscope reveals adularia in the secondary quartz of the North Star vein, and this mineral was noted also in a specimen from the Geyser vein. Manganese occurs in these deposits contained in brownish calcite or as stains in the vein matter.

MINES AND PROSPECTS.

The King of Arizona and North Star mines are in the Kofa mining district, while the prospects in the northern part of the mountains, as judged from location notices of mining claims, are in the Alamo (unorganized) district.

KOFA DISTRICT.

KING OF ARIZONA MINE.

The King of Arizona mine is at the south end of the Kofa Mountains, in a small outlying group of hills, separated from another hilly area by a low saddle. The collar of the shaft is approximately 1,700 feet in

elevation, or about 200 feet above the surrounding plain and 200 feet below the highest point in this detached area. The property comprises four claims, on two of which ore has been developed. At the time of the writer's visit the mine had been closed for four years and the workings were in part inaccessible and generally in a bad state of repair below the 100-foot level. Mr. Eugene S. Ives, of Tucson, Ariz., kindly supplied notes regarding the value of ore and cost of treatment and other data, and Mr. R. M. Brighton gave information concerning methods of mill treatment. The mine is developed by an inclined shaft 750 feet deep, drifts at the 100-foot level, and an adit at the level of the collar of the shaft. The shaft is driven on the hanging-wall side a short distance south of the outcrop of the vein and approximately 100 feet lower. The drifts extend east and west and follow the vein; some of those to the west are over 2,000 feet long, but the drifts east of the shaft are not longer than 200 feet. A steam hoist in good condition is still in position at the shaft, but the cyanide mill is now dismantled.

The mineralized zone or lode trends between N. 60° W. and west and dips at an angle of 60° S. This zone can not be traced beyond the limits of the detached hill area. Its identity is lost a few hundred feet east of the mine shaft, but west of the shaft the vein is covered by two claims of the King of Arizona group, and it probably extends for a considerable distance beyond them. On the King of Arizona claims the vein is stoped out to the surface for 1,500 feet along its strike. The stoped areas are from a few feet to 30 feet wide and the ore body is said to average 12 feet in width. There is no mine dump, as all the material was run through the mill. The footwall of the vein is generally a well-defined slickensided plane, but the hanging wall is more indefinite. The ore body contained many small fissures and small slip planes, and most of them are parallel to the trend of the ore body, but several lie at angles with the vein, generally coming in from the hanging-wall side, and make horses of barren material. About 200 feet east of the shaft strong cross fissures filled with calcite apparently limit the ore; for development has not proceeded beyond this point.

The lode matter is a brecciated, generally brown to maroon andesite porphyry. The dense fine-grained groundmass contains altered white plagioclase feldspars and small, sparsely distributed, highly altered ferromagnesian minerals. The andesite is partly silicified, particularly where the fissuring is closely spaced. Stringers of quartz and calcite traverse the lode in all directions. They vary from those of knife-blade thickness to those several feet thick. The small veinlets are composed of quartz crystals, but in those 1 inch or more thick the walls are commonly lined with small quartz crystals and calcite occupies the middle. The calcite is brown to black in color and is highly

manganiferous. The lode matter is stained with iron and manganese oxides. The gold is said to occur free but in a very finely divided state. None was noted in the specimens collected from the vein and dump. The disintegration of the lode has produced no placer deposits.

The ore is valuable chiefly for its gold, but it also contains silver, the two metals being present in the ratio of approximately 58 to 1 in value. The ore at the surface was very rich, and many tons of it valued at \$2,000 a ton was mined. The average tenor was \$40 a ton. The metal content of the ore body steadily decreased with increasing depth until at the deepest workings, 750 feet below the surface, the gold and silver content averaged less than \$3 a ton. At this figure the ore could not be treated profitably and the mine was closed. The walls of the ore body diverge with increasing depth, and Mr. Ives states that at the bottom of the shaft they are 80 feet apart.

The ore treatment was extremely simple, no complicated or expensive methods being necessary. After being dry-crushed through jaw crushers and rolls, to pass a 20 by 16 mesh, the ore was loaded into vats of 250-ton capacity and there leached with cyanide solution for a period of nine days. The strength of the solution was 4½ pounds cyanide to the ton of water. The gold and silver were precipitated in zinc boxes and the precipitate smelted into bars. The sands and slimes were not separated, as in ordinary cyanide practice, but notwithstanding this, the average extraction was reported to be 93 per cent. It is said that the cost of development work, stoping, and milling, including general expenses and taxes, amounted during the last few years of operations to about \$2.80 a ton, and therefore material below \$3 in assay value could not be treated profitably. The mill treated an average of 200 tons a day.

NORTH STAR MINE.

The North Star mine is near the base of a lava-capped mesa about 1½ miles north of the King of Arizona, at an elevation of approximately 2,000 feet. Between the outlying hill area in which the King of Arizona mine is located and the North Star there is much low-lying ground covered with outwash deposits.

The mine was operated by the Golden Star Mining Co., and development on the property was started in 1907, one year after its reported discovery. At this time a test lot of 17½ tons of ore from the surface yielded \$9,774 in gold and silver. In August, 1908, a 50-ton cyanide and crushing plant had been installed and production had begun. Later the capacity of the mill was increased to 100 tons a day. The mine was closed in August, 1911, owing to a falling off in the metal content of the ore body and the high cost of ore treatment.

The mine is developed by two inclined shafts, No. 1 and No. 2, 90 and 500 feet deep, respectively, and by drifts and crosscuts on the vein at each 100-foot level. An adit from the footwall side connects with the first level from No. 2 shaft. The total length of development work is about 3,500 feet. The shaft is equipped with a steam hoist. The ore is treated in the combination amalgamation and cyanide mill after being reduced to sufficient fineness through crushers and rolls and finally in tube mills. The water supply was obtained like that of the King of Arizona—from wells over 1,000 feet deep in the desert plain about 5 miles south of the mine.

The ore body of the North Star mine is in a lode or vein of silicified andesite breccia and quartz which strikes east and dips about 60° N. The lode is 10 feet in average width at the North Star. It crops out several feet above the country rock, and from the mine it can plainly be seen extending for a considerable distance to the east and west. It is said that it can be traced for several miles and marks in a general way the base of the southern hills of the Kofa Mountains. At the mine the hanging wall is a pink flow-banded biotite andesite, and the footwall a dark calcareous shale or slate of probable pre-Cambrian age. The shale in places contains finely disseminated pyrite. The lode probably occurs along a fault.

The vein matter is of striking appearance. Near the surface angular fragments of the pink andesite, in places altered to green and gray tints, are cemented to an extremely hard rock by banded chalcedonic quartz, the bands being well shown by the deposition of minute crystals of sulphides, most if not all of which are pyrite. Pyrite also occurs disseminated sparingly through the altered andesite. Small vugs in this material are lined with sparkling quartz crystals. Under the microscope the chalcedonic quartz is seen to be accompanied by adularia in variable amounts, but nowhere in the slides examined in this mineral as abundant as the quartz. A green micaceous mineral is developed in the altered andesite, as well as a little chlorite and epidote.

The ore is valuable chiefly for its gold content, but it also contains small amounts of silver in about the ratio of its occurrence in the King of Arizona ore. The gold is said to occur free and very finely divided, associated with the fine sulphides in the chalcedonic quartz.

As interpreted from the assay chart of the mine, the high-grade ore bodies occur in shoots or chimneys which pitch to the east. They are of variable width, and the gold content deteriorates rapidly with increasing depth until at the fifth level the average tenor of the ore is below that required for its profitable treatment—\$14 a ton. Assays in the drifts beyond the enriched parts of the lode show gold and silver in variable amounts, with a probable average value of \$2 a ton. The surface ore of the North Star mine was of exceptionally high

grade. One streak of ore on the footwall was said to have been worth from \$6 to \$20 a pound, and ore to the value of thousands of dollars was stolen. The stoped-out parts of the ore bodies averaged 10 feet in width. No. 2 shaft was sunk on the lode in the approximate center of a shoot of high-grade ore over 500 feet long, the tenor of which exceeded \$50 a ton. On the second level the high-grade ore occurs in several small shoots separated by ledge matter of relatively low grade. On the third, fourth, and fifth levels these shoots appear to have joined to form a shoot which is comparable in length to that of the first level, but which shows a rapidly decreasing metal content.

The ore of the North Star mine differs markedly from that of the King of Arizona mine in the absence of calcite and in the abundance of chalcedonic quartz and pyrite, factors which make it far less amenable to cyanidation. Several processes are necessary in order to reduce the ore to sufficient fineness to release the gold content. The cost of mining and milling is said to be \$14 a ton. The disintegration of the North Star lode has produced no placer deposits.

ALAMO DISTRICT.

Brecciated zones in andesite in the northern part of the range have been prospected only in recent years, most of the location notices of claims being dated in 1908. As yet no large, rich ore shoot has been developed in any of these zones, but one prospect shows a high-grade ore streak, and encouraging results have been obtained from several others.

GEYSER PROSPECT.

The Geyser prospect, formerly known as the Silent King, is on one of several claims on a ledge of brecciated andesite porphyry near Ocotillo. The developments consist of an inclined shaft about 300 feet deep with short drifts and crosscuts on the 140-foot and 200-foot levels. The shaft is sunk at an angle of 45° on the hanging wall of the lode. The country rock in the vicinity of Ocotillo is predominantly a reddish andesite porphyry, with smaller masses of rhyolites and andesite tuffs and thin grit beds. The lode or brecciated zone in the andesite porphyry trends about N. 80° W. and dips 45° S. It can be traced for about $1\frac{1}{2}$ miles, the I. X. L. prospect being located near its eastern extremity and the Rand near its western extremity. The lode ranges in width from a few feet to 60 feet on the Geyser claims, where for 2,000 feet it forms a prominent ledge, in places 30 feet high. The brecciated andesite porphyry is replaced by silica in varying amounts. In some places angular fragments 1 foot or more in diameter are replaced to form banded greenish rocks; in others small porphyry fragments are little altered. White, coarsely crystalline calcite occurs abundantly in the lode, particularly on the footwall, where there are many stringers and veinlets as much as 1 foot

wide. The lode near the hanging wall contains iron-stained kaolinized material in the numerous slips and seams and as the cementing substance of the breccia. Pseudomorphic quartz after lamellar calcite occurs in the hanging wall, and it indicates a deposition of calcite earlier than that deposited in the footwall.

The gold occurs free. It is more abundant along the hanging wall than along the footwall and is particularly associated with the iron-stained kaolinized material. A high-grade ore band of iron-stained breccia is several feet wide at the surface, but gradually thins out to a seam about 1 foot wide along a small fault plane at a depth of 90 feet, and it was not observed below the 140-foot level. A specimen of ore from the hanging wall on the 200-foot level shows abundant small particles of gold contained in a thin film of iron-stained kaolinized material enveloping a lamellar crystalline aggregate of pseudomorphic quartz after calcite. The average value of the ore from this prospect was not learned, but a small quantity of sorted ore is said to have assayed \$140 a ton. No ore shipments have been made from the property.

RAND PROSPECT.

The Rand prospect is near the west end of the Geyser lode, which is about 5 feet wide and is prospected by a shallow shaft and a drift. The ore is a brecciated biotite andesite cemented principally by calcite, with some iron-stained material from which gold can be panned. The andesite fragments are dense and more or less silicified. They contain small nodules and veinlets of chalcedonic quartz, and small rust-stained cavities apparently result from the weathering of pyrite.

I. X. L. PROSPECT.

The I. X. L. prospect is near the east end of the Geyser lode. The developments consist of an inclined shaft 35 feet deep, driven on iron-stained breccia that is said to contain fine gold. Much of the lode matter is a breccia of small andesite fragments cemented by fine-grained secondary quartz. Calcite veins of later age, some of them 6 inches wide, cut this breccia. Under the microscope a thin section of the breccia shows a few adularia crystals in the secondary quartz.

REGAL GROUP.

The Regal claims are about a mile southeast of Ocotillo, and the workings are in a small hill on the south side of Red Raven Wash. Several brecciated zones and veins with east-west trend cross these claims and are developed by shallow shafts and tunnels. On the Regal No. 1 an inclined shaft about 35 feet deep is driven in iron-stained brecciated andesite porphyry. The zone is about 6 feet wide, trends N. 80° W., and dips 45° S. The zone is said to assay \$8 a

ton in gold. On the Regal claim a 70-foot tunnel driven N. 10° E. into the hill, a winze 35 feet deep, and two short drifts constitute the development work. The country rock is andesite porphyry and gray tuff, cut by numerous veins and stringers of quartz and calcite, most of which have vertical dips. The largest calcite veins are 6 to 8 inches wide, and the winze was sunk on one of these veins. A short drift from the bottom of the winze intersects and follows for 20 feet a quartz vein about 1 foot wide. The quartz is porous and in places shows distinctly a pseudomorphic replacement of calcite. It is coated with an abundant manganese oxide residue, probably originally contained in the calcite. This material is said to yield gold on panning.

C. O. D. GROUP.

The C. O. D. group consists of several claims on a zone of brecciated red andesite porphyry which trends about N. 70° W. and crops out in several places along the course of Red Raven Wash. The brecciated zone is from 10 to 40 feet wide, is partly silicified, and in one place contains a calcite vein 3 feet wide. A shaft on one of the claims is probably 100 feet deep. The material on the dump consists of silicified andesite fragments, calcite, and gouge, but the tenor of the ore was not learned. Development on other claims of this group consists merely of shallow discovery holes.

CLAIMS SOUTHEAST OF OCOTILLO.

On the south and west sides of Red Raven Wash, about 7 miles southeast of Ocotillo, are 20 or more claims covering low hills that lie between high mesas to the west and the broad desert plain to the east. These claims are on the outcrops of numerous small brecciated zones and calcite and quartz veins in andesite and associated tuffs. The development work on most of them consists simply of shallow discovery holes and short tunnels, so that little could be learned of the continuity or character of these mineralized zones. The veins trend from northwest to west, and all have southerly dips. Mr. A. R. Gibson has submitted a sketch map of many of the claims surrounding the Big Horn and has indicated localities from which free gold can be panned, but no assays are available.

BIG HORN PROSPECT.

The workings of the Big Horn prospect consist of a tunnel 120 feet long which connects with a shaft 35 feet below the collar. The tunnel is driven N. 25° E. and cuts several small shear zones in the andesite porphyry stained with iron and manganese oxides. A shear zone several feet wide, with 2 inches of slickensided gouge, is exposed in the shaft. The country rock of andesite porphyry is gray, brown, or purple and contains abundant altered calcic feldspars in a dense

groundmass. Fine flake gold is said to have been found in the gouge material from these fissures.

CEMITOSA PROSPECT.

The Cemitosa prospect is in Cemitosa Wash, a short distance west of the Cemitosa Tanks. The workings consist of small discovery holes in a brecciated zone of andesite porphyry 10 feet wide. This zone trends N. 50° W., has a vertical dip, and can be traced for 1,500 feet along the westerly slope of a basalt-capped mesa north of the Cemitosa Tanks. The country rock is a reddish to brown andesite porphyry which apparently grades into the basalt capping of the mesa. The andesite at this point is probably a thin flow overlying granite, which is exposed at about the same elevation a short distance west and southwest of the tanks. The brecciated zone is iron-stained and contains numerous stringers of calcite, some of which are 1 foot wide. Part of the calcite is dark colored and it probably contains manganese. Fine colors of gold may be obtained from parts of this lode by careful panning, but the highest assay in gold reported from this prospect is \$3 a ton.

COPPER DEPOSITS IN GRANITE.

GENERAL CHARACTER.

The copper deposits examined in this reconnaissance occur in the northern part of the Kofa Mountains along a shear zone in granite. The granite is exposed in an area of low relief in a zone over 1 mile wide west of the Cemitosa Tanks. Small knolls and mesas on the eroded surface of the granite are composed of quartzose breccias and tuffs and andesites. North of Cemitosa Wash the mesas are numerous and the area of granite is restricted to narrow belts in the arroyos, and to the south the granite is largely concealed by outwash deposits. The shear zone, which trends northwest, marks in a general way the western limit of the granite and probably represents a fault. Along this zone the granite is hydrothermally altered, and sericite, chlorite, epidote, and a greenish talcose mineral are prominently developed. A sheared basic dike consisting chiefly of altered pyroxene occurs in this zone and is associated with the copper mineralization of the Alamo group.

ALAMO GROUP.

The Alamo group consists of several claims along the western base of mesas north of a low divide at the head of Cemitosa Wash. The workings are all shallow holes or short drifts which explore the outcrop of the shear zone. Nearly all these workings show copper-stained rock and in some there are small irregular veins and seams of oxidized copper ores containing chrysocolla, malachite, and earthy oxides. The country rock of granite and basic dike rock is highly

altered and numerous slip planes are exposed in the workings. The development is insufficient to indicate fully the character of the deposit, and no ore body has yet been found.

ALONAH GROUP.

The Alonah group comprises several claims south of the road between the Cemitosa Tanks and Alamo Spring. The relief is low, and the outwash from the mesas to the west conceals much of the granite. The developments consist of shallow holes sunk in the sheared and altered granite, apparently along the same shear zone or fault on which the Alamo group is located. Along this zone the feldspar of the granite is in places completely sericitized and the ferromagnesian minerals are altered to chlorite and epidote. The mineralization has produced small seams and replacements of the sheared granite by oxidized copper minerals and disseminated magnetite, but the copper content is low. The development is entirely too superficial to show whether an ore body is present.

LEAD DEPOSITS IN MONZONITE PORPHYRY.

A dike of monzonite porphyry which cuts the pre-Cambrian metamorphic rocks crops out on a small ridge about a mile north of the King of Arizona mine. A short tunnel has been driven along a vein in the intrusive rock near the contact. No work was being done at the time of the writer's visit, and the tunnel could not be entered. The ore consists of a galena disseminated in a gangue of coarse fluorspar and calcite crystals. The tenor of the ore was not learned. This occurrence of galena is similar to deposits of economic importance in the Castle Dome Range, where the galena is separated from the gangue minerals fluorspar and calcite by dry concentration.

PLACER DEPOSITS.

The known placer deposits of the Kofa Mountains occur in a gulch draining westward north of the detached hills in which the King of Arizona mine is located. These placers have been worked for many years, and the total production is reported to be about \$40,000 in gold nuggets. At present these placers are being worked in a small way, and a yearly production of several hundred dollars is reported. The gold occurs in outwash deposits which consist of boulders and fragments from the metamorphic and volcanic rocks. The gold-bearing débris is said to be from a few feet to 70 feet deep over an area of approximately 60 acres. The gold is coarse and occurs near bedrock. It has evidently been derived from the disintegration of auriferous veins in the metamorphic rocks, as it is much coarser than that contained in the North Star and King of Arizona veins.