References: Goodyear, 1888, p. 527; 1890, p. 151; Storms, 1893, p. 106; Crawford, 1894, p. 221; 1896, p. 311; Merrill and Waring, 1919, p. 532-533; Tucker, 1925, p. 480; Sampson, 1935, p. 509-511, Engel, and others, 1959, p. 63-67.

R.B.S., from Engel and others.

Granite Mine

Location: NW¼ sec. 4 (proj.), T. 6 S., R. 15 E., S.B.M., ~~U. S. Army Corps of Engineers~~ Chuckwalla Mountains quadrangle, 15', ~~1945~~ 1963; about 3 miles southwest of Desert Center.

Ownership: Henry K. Hennigh, Box 468, Desert Center (1959).

History: According to the present owner, the Granite mine was first located in 1860, by two men, named Hurst and Smith, who started to work the deposit in 1894. A 10-stamp mill was built and operated for an undetermined period. In 1917, the mine was reported to have changed hands several times. It was held, at that time, by Silas Marsters, Riverside (Merrill and Waring, 1917, p. 540). In 1920, the Granite mine was owned and operated by Chuckawalla Mining and Milling Company. In 1929, (Tucker and Sampson, p. 480) it was still in the same hands but idle. A 10-ton ~~Harding~~ Hardinge ball mill was installed in 1930 when the mine was reopened with financial support from a Mr. Osborn, Pasadena, and the present owner. Capacity was increased, in 1932, by use of a 24-ton Denver ball mill. The gold was recovered by amalgamation, table, and cyanide. Operations were terminated in 1932 because of the low grade of the ore. H. K. Hennigh has retained ownership to the present time and is currently doing exploration. (Personal communication, H. K. Hennigh).

Photo 15

Geology: A mineralized fault strikes N. 10° - 20° W. along a low ridge of Mesozoic granite and dips 40° - 55° SW. It is exposed in the mine for a strike distance of about 350 feet and to a maximum depth of 100 feet. Quartz veins ranging from 0 to 3 feet thick lie in the fault plane. Through the northern half of this exposure the fault branches. The two principal breaks thus formed are roughly 55 feet apart where exposed in the north end of the workings. Here, in addition, the granite is cut by basic dikes as much as 3 feet in thickness. Both the dikes and the quartz veins along the faults have been fractured since their emplacement. The fault zone is cut off at the south end of the workings by another fault.

The ore consists of fractured vein quartz containing oxides of iron, manganese oxides, and minor copper minerals. Fine, free-milling gold occurs in the iron oxides. Silver is reported as a product of the mine, but its ore mineral was not identified. Some parts of the mine have yielded radioactivity measurements as high as ten times background and samples analyzed by the U.S. Geological Survey laboratories contained thorium and were graded (percent) at (0.45eU) 0.034 U (Walker and others, 1956, p. 12, 37).

Development: The old 1894 discovery shaft, at the south end of the workings was sunk 100 feet on and near the fault. At the 50-foot level a 130-foot drift was driven northwest and a 40-foot drift southeast to a short crosscut. There are several stopes near the shaft. Crosscuts extend 70 feet southwest and 70 feet northwest from the bottom of the shaft. The north workings comprise a 330-foot crosscut adit. A drift extends roughly 300 feet southwest on a level 30 feet down the dip of the fault from the 50-foot level of the south shaft with which level it is connected by two raises. An additional 100 feet of drifts explores a branch of the fault in the north workings. Ore bodies, as thick as ~~up to~~ a foot ~~thick~~ were stoped in a 10-foot-wide shear zone north and south of the junction of the faults.

When visited in March 1959, activity was centered in the exploration of a narrow northwest-trending vein exposed on the east slope of the ridge 200 to 300 feet southeast of the crosscut adit. A 30-foot shaft had been sunk on the vein. A gently inclined shaft, being driven west from a point 50 to 75 feet lower on the slope to crosscut the vein was about 40 feet long and had not reached the vein.

. Production: The yield of the Granite mine was not determined. The owner stated that the ore ~~runs~~ contains about $10 per ton in gold and $6 in silver.

References: Merrill and Waring, 1917, p. 540; Tucker and Sampson, 1929, p. 480; 1945, p. 133-134; Walker and Others, 1956, p. 12, 37.

R.B.S. 3/9/59.

Grandaddy Mine

Location: NE¼ sec. 5 (proj.), T. 8 S., R. 21 E., S.B.M., McCoy Spring quadrangle, 1952; about 1,000 feet northeast of peak 1195, in the Mule Mountains, and about 13 miles by road west of Ripley. The Grandaddy Mine is accessible by a quarter of a mile of narrow foot trail which extends southwest from the nearby Grubstake Mine.

Ownership: Carlo M. Micalizio, 529 N. Broadway, Blythe (1958).

History: Undetermined.

Geology: The country rock is gneissic granite. A fault, which strikes N. 40° W. and dips 85° NE. crosses the claim. A mafic dike as much as 3 feet wide, and a quartz vein, lie in the fault zone. The dike is the footwall of the vein and both the dike and the quartz vein are complexly fractured. The vein is exposed for about 100 feet and is as much as 3 feet in width. It resembles the vein at the Hodges Mine a quarter of a mile to the east and probably is a part of the same vein system.

Hematite and chlorite ~~were the principal minerals observed in~~ fill fissures and vugs in the vein.

Development: The vein has been explored by shallow trenches along the full length of its outcrop. ~~Idle.~~

Production: Undetermined.

References: None.

R.B.S. 4/8/58.

Grubstake Mine

Location: NE¼ sec. 5 (proj.), T. 8 S., R. 21 E., S.B.M., McCoy Spring quadrangle, 1952; in the Mule Mountains about 13 miles, by road, west or Ripley.

Ownership: Carlo M. Micalizio, 529 N. Broadway, Blythe (1958).

History: Undetermined.

Geology: The country rock is gneissic granite. In the mine area a fault is exposed for about 100 feet. It strikes N. 70° W. and dips 35° SW. The fault is marked by a zone of gouge 3 to 4 feet thick which includes a shattered and contorted quartz vein as much as 1 foot in thickness. The vein contains seams and pockets of hematite. According to the present owner this material yields $49.00 per ton in gold.

A zone of contorted gneissic rocks as much as 5 feet wide crops out about 500 feet northwest of the mine. This zone contains crushed lenses and thin veins of quartz associated with calcite, chrysocolla, chlorite, and hematite. It strikes N. 60° E., and dips 35° SE. This fault zone apparently is unrelated to the one at the mine.

Development: The main workings (on the N.70° W.-striking fault) consist of 2 inclined shafts about 100 feet apart and 40 feet deep driven on the dip of the fault. The ~~shear~~ fault zone to the northwest was opened by a trench and a 15-foot adit -- Mr. Micalizio states that this work was done at some unknown time before he acquired the property and shows little to warrant further work.

Production: Undetermined.

References: None.

R.B.S. 4/8/58.

Hansen (Hensen) mine (Hensen Well)

Location: NW¼ sec. 26, T. 3 S., R. 8 E., S.B.M., Lost Horse Mountain quadrangle, 1958; Joshua Tree National Monument, about 1½ miles southwest of Pinyon Well, north slope of the Little San Bernardino Mountains.

Ownership: William F. and Frances M. Keys, Box 114, Joshua Tree, hold the pinyon group of claims (White Hills, Mountain View, Pinyon, Grand View) in sec. 26. Mr. Keys reports (oral communication January 1960) that the "Hansen shaft" is on the Grand View claim.

History: The early history of the Hansen mine is unknown, but it may have been part of the Pinyon (Tingman-Holland) mine about half a mile to the southeast. The nearby Hensen Well was an important source of water to early-day miners. According to Brown (1923, p. 273) "The well is in a little flat in a very narrow canyon and is high up near the summit of the Little San Bernardino Mountains. Near it (in 1918) are the ruins of an old arrastre and the remains of one or two small stone buildings. ---the water was siphoned to the Eldorado mine with that of Pinyon Well." In 1960 the exact site of the well was not found, but a largely caved vertical shaft and foundations for several buildings, one of which apparently was once a mill, were noted in the NW¼ sec. 26.

Geology: The NW¼ of sec. 26 is underlain by light gray to buff coarse-grained quartz monzonite (Mesozoic White Tank ~~quartz~~ monzonite). The "Hansen shaft" explores thin quartz stringers in a shear zone which strikes N. 55° W., is vertical, and exposed at the surface for a strike length of about 1,000 feet. A second quartz vein crops out about 1,500 feet to the east. This vein strikes about N. 50° W., is vertical or dips steeply southwest, is 2 to 3 feet wide, and exposed at the surface for about 750 feet. Along the same strike, about 600 feet to the southeast, vein quartz again crops out. Here the vein area is as much as 16 feet wide, is exposed for about 600 feet, strikes N. 50° W., and dips steeply southwest.

Development: In the NW¼NW¼ sec. 26 a vertical shaft ("Hansen shaft") is sunk on quartz stringers in a shear zone. The workings are inaccessible but the size of the dump suggests at least 100 feet of workings. To the east in the NE¼NW¼ sec. 26 the second quartz vein is explored by several short adits.

Production: Undetermined.

Reference~~s~~: Brown, 1923, p. 273.

C.H.G. 1/26/60.

Happy Jack Group

Location: NE 1/4 sec. 30 (proj.), T. 6 S., R. 16, E., S.B.M., Chuckwalla Mountains quadrangle, 15', 1963; about 1 1/2 miles southwest of Corn Spring and 7 miles southeast of Desert Center.

Ownership: Not determined (1959).

History: These claims were operated in the years 1896 to 1898 by the Happy Jack and Chuckwalla mining companies (Merrill and Waring, 1919, p. 540).

Geology: A quartz vein as much as 3 feet wide is exposed for about 300 feet down the north side of a low ridge and for 200 feet on a rise to the north across a narrow ravine. The vein lies along a shear zone in Mesozoic granitic rock. It strikes N. 30° E. and dips 45° NW.

The vein quartz carries pockets and stains of iron oxides. Pyrite is present, but uncommon.

Development: On the ridge south of the wash the vein is explored by 2 inclined shafts, 50 and 100 feet deep, and a drift-adit driven southwest about 125 feet. The 50-foot shaft is about 20 feet northeast of the adit portal. The 100-foot shaft is 100 feet southwest of the adit portal and connects to the adit at the 30- to 40-foot level. Between the shaft and portal the vein is stoped through a distance of about 30 feet, ~~at a point~~ near the shaft, and up the vein about 20 feet. A 15-foot winze lies below the stope. The adit extends about 25 feet beyond the 100-foot shaft. Though partially caved, it probably connects with a raise to the surface. The workings below the adit level were not examined.

On the rise north of the ravine two inclined shafts, 80 feet apart, one 50 feet deep and the other of undetermined depth, are sunk on the vein and join with an undetermined amount of level workings. About 100 feet south of the shafts a 12-foot inclined shaft is sunk on a shear which strikes N. 10° E. and dips 40° NW. From the bottom of the shaft a drift extends 50 feet to the northeast on a vein 1 to 2 feet in thickness.

According to Merrill and Waring (1919, p. 540) development on these claims reached a depth of 300 feet.

Production: Undetermined.

References: Merrill and Waring, 1919, p. 540; Tucker and Sampson, 1929, p. 481.

R.B.S. 3/13/59.

Helicross Mine

Location: SE¼ sec. 3 (?), T. 2 S., R. 12 E., S.B.M. (proj.), Dale Lake quadrangle, 15' 1956; Pinto Mountains, Dale District, 8 miles south of Dale Lake, half a mile east of San Bernardino Wash (figure 31).

Ownership: Undetermined.

History: Undetermined, probably active during the 1930's. Idle.

Geology: Shear zones containing quartz stringers in massive Mesozoic quartz monzonite (fig. 28). Shears strike west to N. 20° W., dip 70° SW. to vertical. At the east working the vein quartz is stained yellow brown to red brown by iron oxide and contains a few fresh pyrite cubes and some pyrite cubes altered to iron oxide.

fig 28

Development: Two areas have been explored. The west group of workings lies adjacent to the valley in low hills and consists of a 30-foot shaft inclined 80° SW., a 25-foot vertical shaft at the end of a 20-foot open-cut which joins a 110-foot adit, and a 60-foot adit driven east from a 35-foot open cut ~~(fig. [illegible])~~. The second area lies half a mile to the northeast and 600 feet above. Here an adit of undetermined length is driven N. 20° W. The size of the dump suggests several hundred feet of workings. A truck-loading bunker remains below the adit.

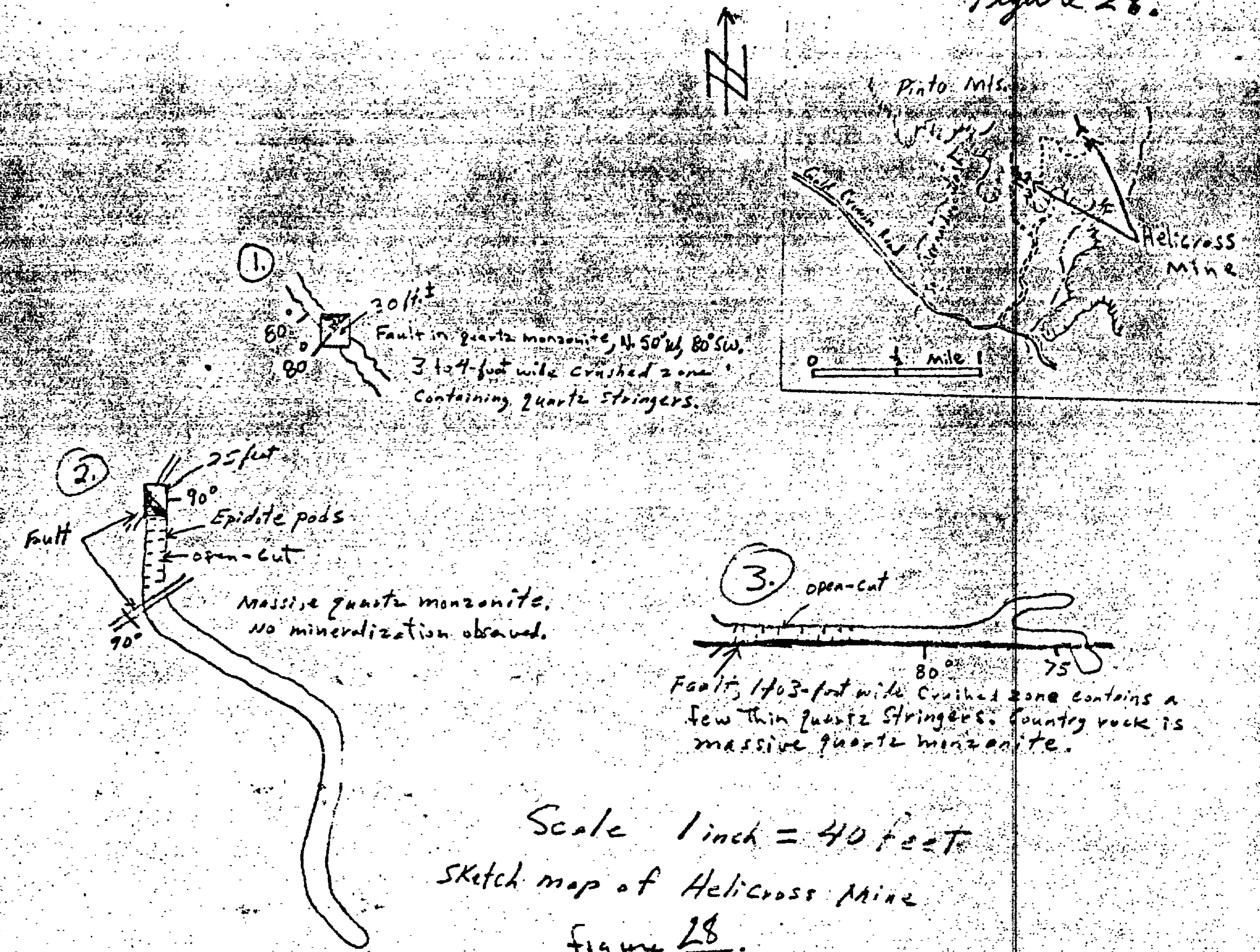
Production: Undetermined.

References: None.

C.H.G. 5/16/61.

Gold

figure 28.



Scale 1 inch = 40 feet

Sketch map of Helicross Mine

figure 28.

Hemet Belle Mine

Location: E 1/2 SE 1/4 sec. 29, T. 6 S., R. 4 E., S.B.M., Hemet Reservoir quadrangle, 15', 1940; 2 miles east of Kenworthy Guard Station, in the San Jacinto Mountains.

Ownership: D. C. Mayne, 159 South Columbia Street, Hemet (1958).

History: The Hemet Belle mine is one of the old mines of the area. In 1917, one E. E. Chilson of Kenworthy (a town which no longer exists) was reported to have been working this mine. It was equipped with a 5-stamp mill (Merrill and Waring, 1917, p. 535). In 1929, the Hemet Belle was reported idle and listed as a part of the Chilson Estate (Tucker and Sampson, 1929, p. 481). It was relocated and renamed by the present owner in 1951.

Geology: The ~~New~~ Hemet Belle mine explores a gold-bearing quartz vein in the plane of a fault which is traceable for about 500 feet up a ridge on the east side of Hemet Valley. The fault strikes N. 55° E. and is vertical. The quartz vein is as much as a foot wide. Iron oxides fill vugs and fractures in the quartz. According to Merrill and Waring (1917, p. 535) the ore yielded $15 to $20 per ton in gold with some pockets of richer ore.

Development: The workings consist of a 300-foot adit, a 100-foot vertical shaft and several prospect pits. The adit enters the ridge in barren rock on a bearing of N. 50° E. At 100 feet, it turns right, goes 20 feet to the vein, turns left, and follows the vein for 200 feet to the bottom of the shaft.

The present owner was building a new road to the mine in 1958. In 1961, Norman Sanders reported that the road had been completed, and that the adit had been extended to 400 feet.

Production: Undetermined.

References: Merrill and Waring, 1917, p. 535; Tucker and Sampson, 1929, p. 481.

R.B.S. 6/24/58

Hexahedron (Hexie) Mine

Location: SE¼NE¼ sec. 11, T. 3 S., R. 9 E., S.B.M., Lost Horse Mountain quadrangle, 15', 1958; Joshua Tree National Monument, at the south crest of the Hexie Mountains, 4 miles east of Squaw Tank.

Ownership: Undetermined (1960).

History: The Hexahedron Mine was under development as early as 1894 when Ed. Holland and A. G. Tingman, Indio, were the owners (Crawford, 1894, p. 223). Development work and prospecting in the area continued through 1896 (Crawford, 1896, p. 311). The mine was still active in 1914 (Merrill, 1917 (1919) p. 536) and was owned by the Indio Mining and Milling Company, but by 1918 was inactive and the mill had been dismantled (Tucker and Sampson, 1929, p. 481). No written description of the mill was found, but tailing debris and old foundations in the N½NE¼ sec. 14, T. 3 S., R. 9 E., S.B.M. mark a former mill site. The Hexie mill is said to have been a 5-stamp mill and the largest in the area. In 1960, the road to the mine from Pleasant Valley was impassable and the workings appeared long inactive.

Geology: Banded quartz-biotite gneiss (Pinto gneiss) underlies the mine area. The mine workings explore an altered felsite dike which strikes N. 35° W., dips 40° NE., and is 10 feet wide at the surface. The dike contains thin quartz stringers, local concentrations of pyrite cubes thoroughly altered to iron oxide, and much red to red-brown iron oxide. Dark green mafic dikes, thoroughly weathered, cut the felsite and gneiss irregularly. Crawford (1894, p. 223) described the ore shoot as 75 feet long, 15 to 20 feet in thickness, and dipping 45° N.

Development: The principal working is a 300-foot drift adit driven S. 35° E. with one 30-foot crosscut at 210 feet driven S. 40° W. Above the adit level are 3 open cuts, each about 50 feet long and 30 feet deep. Many shallow prospect pits have been opened in the area.

Production: U. S. Bureau of Mines records list placer production from the Hexahedron of 116.68 ounces of gold in 1893 by H. E. Fallant, Indio.

References: Crawford, 1894, p. 223; Crawford, 1896, p. 311; Merrill, 1917 (1919) p. 536; Tucker and Sampson, 1929, p. 481; ~~Tucker and Sampson,~~ 1945, p. 135.

C.H.G. 1/29/60.

Hidden (Ensperation, Lost Mine Parallel) Mine

Location: SW¼ sec. 7, T. 3 S., R. 8 E., S.B.M., SE¼ sec. 12(?), T. 3 S., R. 7 E., S.B.M., Lost Horse Mountain quadrangle, 15' 1958; Joshua Tree National Monument, on the south face of the Little San Bernardino Mountains, 3/4 mile southwest of Keys (Salton) View.

Ownership: John and Margaret Samuelson, 656 Staple Street, Compton (1936). Undetermined (1960).

History: This property is said to have been discovered by the Sellers brothers who used the name Lost Mine Parallel. During the 1930's, William F. Keys operated the mine. Ore was packed by mules up the steep face of the Little San Bernardino Mountains to Keys (Salton) View above. From there the ore was trucked to Keys Ranch, where it was milled in a 2-stamp mill (Oral communication W. F. Keys, 1960). Long idle.

Geology: The mine area is underlain by resistant, fine- to medium-grained, Mesozoic granite (assigned to the Fargo Granite* by Babcock, 1961, p. 37 and pl. 1). The irregularly shaped granite mass is surrounded by a halo of altered rock which Babcock (1961, p. 39 and pl. 1) mapped as granitized metadiorite. Both the granite and metadiorite are cut by mineralized faults which strike N. 15°-20° W., and dip steeply east. The mineralized areas are marked by iron gossan and the narrow veins contain pyrite, chalcopyrite, quartz, magnetite, and presumably gold. The mine workings chiefly explore two northwest-trending faults, about a quarter of a mile apart. The west fault, which dips about 80° E., has been prospected along its strike for about 500 feet, and the east fault for about 300 feet.

Development: Numerous prospect pits, shallow shafts, and short adits of undetermined extent.

Production: Undetermined.

References: Babcock, 1961, p. 37-40, 74, pl. 1.

C.H.G. 6/21/57.

* Unpublished, informal name.

Hidden Treasure (American Flag Mine) Claims

Location: E½ sec. 13 (proj.), T. 8 S., R. 20 E., W½ sec. 18, T. 8 S., R. 21 E.; Palo Verde Mountains quadrangle, 1953; on the east slope of the Mule Mountains, 13 miles west of Ripley.

Ownership: Ned Hyduke, Star Route, Palo Verde (1960).

History: This property was worked in 1910 under the ownership of Frank Steunchfield, Palo Verde. It was then named the American Flag mine. In 1917 a list of properties known to be located in the area included the name American Flag M. and M. Co., owned by C. A. Ludden, Pomona, but no details were given (Merrill and Waring, 1917, p. 541). The literature contains no subsequent report on this mine. An ~~mine called the~~ American Flag mine was shown by Tucker and Sampson (1945) on their plate 35, but it ~~appears to be mislocated~~ was in a different location.

Geology: These claims are in an area of low hills formed in foliated gneissic rock of northerly structural trend. A shear zone is exposed through a distance of about 1,000 feet on the east slope of a ridge. It strikes N. 10° W., dips 30° SW. and is as much as 3 feet wide. A fractured quartz vein ranging from 0 to 6 inches in thickness lies along the foot wall. The vein quartz contains seams and bunches of iron oxides with lesser proportions of calcite, specular hematite, chlorite, sericite, pyrite, and traces of secondary copper minerals. Free-milling gold is unevenly dispersed through the above gangue minerals with a probable concentration in the iron oxides.

Development: When visited (January 1960) activity centered at the old shaft which was about 100 feet deep on the dip of the vein. Debris had not been cleared from the bottom of the shaft but some ore had been removed from near the collar. A drift adit was being driven northwest from the end of the ridge about 100 feet south of the shaft. It had reached a length of about 60 feet along the shear zone and should reach the shaft in another 30 to 40 feet. This will afford access to the shaft at about the 50-foot level. Northwest of the shaft the vein is exposed in 5 shallow prospects through a horizontal distance of about 170 feet.

Similar veins in the immediate vicinity have been sampled but as yet have remained undeveloped.

Production: According to U. S. Bureau of Mines records, in 1910 the mine yielded 40 tons of ore from which 18 ounces of gold and 11 ounces of silver were recovered. ~~Though the current work is mainly developmental the owner hopes to install a small mill on his ranch near Palo Verde in anticipation of future production.~~

References: Merrill and Waring, 1917, p. 541; Tucker and Sampson, 1945, pl. 35 ~~(mislocated)~~.

R.B.S. 1/18/60.

Hoag Mine

Location: NE¼ NW¼ sec. 24 (proj.), T. 4 S., R. 5 W., S.B.M., Steele Peak quadrangle, 7.5', 1953; about 7 miles west of Perris and roughly 1,000 feet east of Hartford Springs.

Ownership: Undetermined (1959).

History: The first report on the Hoag Mine was by R. J. Sampson in 1935 (p. 512). According to Sampson this property was worked by an unnamed operator from 1884 to 1886, again starting in January 1932, by H. M. Harford, Perris, and that at the time of his report (1935), the mine was flooded and the dumps were being worked.

Geology: Like the neighboring Washington Mine, the Hoag Mine is in an area of low hills and ridges composed of deeply weathered diorite. The vein explored by the mine is poorly exposed. According to Tucker and Sampson, 1945 (p. 135) it strikes northwest and dips 40° SW. He states, in addition, that the ore occurs in lenses ranging from a few inches to 2½ feet in thickness and is of limited extent both on the strike and dip.

Development: The Hoag Mine was entered through three vertical shafts and one inclined shaft. When visited in 1959 all four openings were either caved or caving, ~~and were unsafe to enter~~. The maximum depth attained in the workings was 300 feet and roughly 400 feet of drifts were driven at various levels (Sampson, 1935, p. 512). The shafts are arranged in a rough diamond about 270 feet in its longest dimension. ~~This suggests that part of the subsurface work must consist of exploratory cross cuts.~~

Production: U. S. Bureau of Mines records show that from 1934 to 1937, 3,657 tons of ore yielded 231.79 ounces of gold and 110 ounces of silver.

References: Sampson 1935, p. 512; Tucker and Sampson, 1945, p. 135.

R.B.S. 6/16/59.

Hodges Mine

Location: W½ sec. 4 (proj.), T. 8 S., R. 21 E., S.B.M., McCoy Spring quadrangle, 1952; on the east slope of the Mule Mountains about 8 miles west of Ripley.

Ownership: Undetermined (1958).

History: This mine was formerly operated early in the present century by Hodge Bros., who had a 3-stamp mill at Palo Verde. It was taken over at an unreported date by Mr. Ludden of Pomona, who added 2 stamps and moved the mill to the mine. Water was pumped from a well in the valley 3½ miles away. Operations continued until 1913 (Tucker and Sampson, 1929, p. 481.) Idle.

Geology: The rocks at the Hodges mine are gneissic granite cut by quartz veins. The veins form a generally west-trending system but a few strike from N. 70° W. to N. 70° E. Dips range from 60° southward ~~through vertical~~ to 60° northward. Most of the veins have exposed lengths ranging from 50 to 100 feet and are of irregular thickness, rarely exceeding one foot. The veins are fractured and largely recemented with iron oxides which appear to have been derived from the alteration of sulfides. Free-milling gold occurs in fissures or is finely disseminated in limonite.

Development: The workings are in a narrow canyon and on a steep ridge immediately to the northwest of the old camp site. Development consists of 3 vertical shafts and 3 adits which are apparently joined by an undetermined amount of drifting and stoping. A depth of at least 100 feet was attained at the adit levels. Mining seems to have been systematic, as evidenced by a long haulage adit driven north from the floor of the canyon through barren rock, to facilitate drifting and stoping on the veins in the ridge. Little timber was used except a stulls in the stopes. No equipment remains on the property, but the walls of a 3-room stone house are still standing near the mouth of the canyon. When visited (Feb., 1958) the mine was open and dry. Access was good.

Production: Undetermined.

References: Tucker and Sampson, 1929, p. 481.

R.B.S. 2/21/58.

Hornet Group

Location: SW¼ sec. 1, T. 2 S., R. 9 E., S.B.M. (proj.), Valley Mountain 15' quadrangle, 1956; Pinto Mountains, Gold Park, about 8.5 miles S. 22 E. from Four Corners, Twentynine Palms (see pl. 1 /) figure 19.

Ownership: Undetermined.

History: I. N. Lish and B. E. Lish, 8465 Cottonwood, Fontana, located the Hornet Group in May 1956.

Geology: A low elongate south-trending ridge is carved in the Pinto gneiss. Along the crest of this ridge the gneiss is intruded by fine-to medium-grained hornblende granite, thin veins of gold (?)-bearing milky quartz, and narrow green basic dikes.

Development: Several pits, trenches and bulldozer scrapes have exposed the veins and dikes along the ridge crest over a distance of 0.2 of a mile (fig. 29). Near the Gold Park road there is a 20-foot trench dug to join a vertical shaft sunk 12 feet in a fault (fig. 1 /). At the bottom of the shaft a drift is driven 15 feet south. The claims are apparently not being worked.

Production: Undetermined.

References: None.

J.R.E. 2/12/59.

figure 29

Figure 29. Gold Hornet

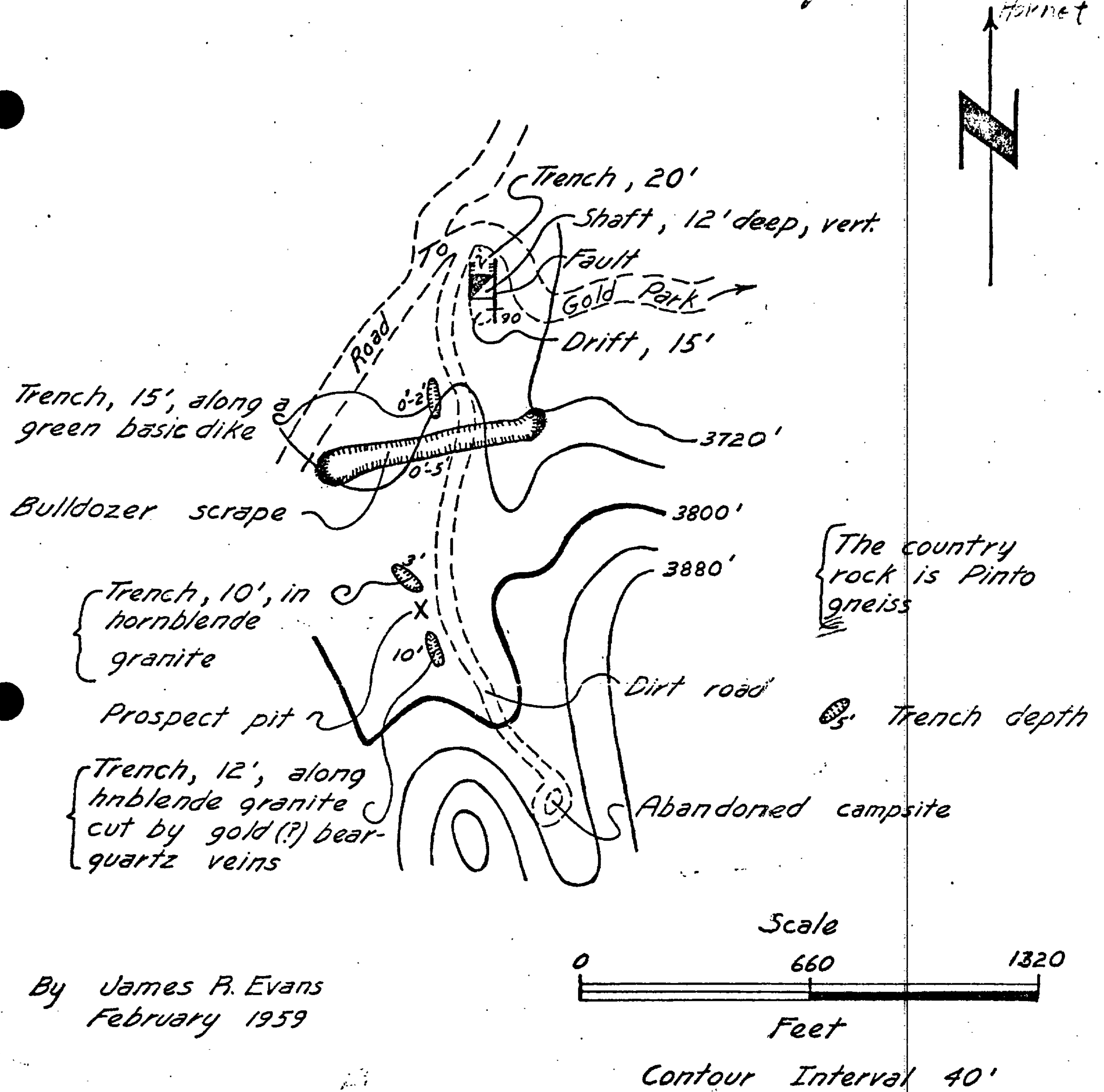


Figure 29 (1) Sketch map of the Hornet group (topography from U. S. G. S. 15' Valley Mountain quadrangle, 1956).

Ida-Leona Mine

Location: NE¼ sec. 30, T. 4 S., R. 4 W., S.B.M., Steele Peak quadrangle, 7.5', 1953; about 6 miles west of Perris.

Ownership: Mrs. Orva Nelson, Perris.

History: Formerly the Ida-Leona was described with the older Gavilan mine (Tucker and Sampson, 1945, p. 135-136) which is about 400 feet north of it. The Ida-Leona was most active during the thirties. It was closed in 1942 ~~because of the gold closing order L-208~~ and has since remained idle.

Geology: The country rock is quartz diorite. A quartz vein ranging from 1 to 4 feet in width strikes N. 65° W., and dips 60° SW. It is exposed for about 250 feet. Free-milling gold is associated with iron oxides, pyrite, and galena in small pockets and fissure fillings in the quartz.

Development: When visited in 1959 three inclined shafts were found. ~~They were caved and their extent was not deteremined.~~ ~~In 1945~~ the workings were reported (Tucker and Sampson, 1945, p. 135-136) to consist of a 2-compartment shaft 350 feet deep with drifts of unspecified extent at the 100, 150, 250, and 300 foot levels. This shaft was probably the most southeasterly ~~one observed by the writer.~~ The other two openings may have been raises, ventilation shafts, or exploratory shafts.

Production: A reported (Tucker and Sampson, 1945, p. 136) $50,000 in gold was won from an unstated tonnage of ore said to assay $25 to $50 per ton. Although some high-grade ore was reported, in 1945, to have been shipped to U. S. Smelting Company, Salt Lake City, Utah, the bulk of the ore was milled at the mine.

References: Sampson 1935, p. 508-509; Tucker and Sampson, 1945, p. 135-136; Larsen, 1948, p. 130.

R.B.S. 6/15/59.

Indian Rose Quartz Queen (Indian Queen) Mine

Location: NW¼ sec. 32, T. 4 S., R. 4 W., S.B.M., Steele Peak quadrangle, 7.5', 1953; about 6 miles west of Perris (figure 42).

Ownership: Frank Koehn, Rt. 2, Box 94, Perris (1959).

History: The old Indian Queen mine was reported as a new prospect in 1896. ~~Equipment consisted of a small steam hoist, a 5-stamp mill and a 4" cornish pump.~~ The owner was J. B. Dennis, Perris (Crawford, 1896, p. 311). By 1899 the mine appears to have changed hands, and was reported as "--developed into a promising property by Mr. Anderson." (Mining and Scientific Press, 1899, vol. 79, p. 750). U. S. Bureau of Mines records show that for the year 1899 the mine was operated by Indian Queen mining Co., Perris and for the years 1900 and 1901 production was credited to Anderson and Morris of Perris. In 1917, the property was held by a party named Morrison, Goldfield, Nev. (Merrill and Waring, 1917, p. 531). ~~Save for assessment work,~~ the mine appears to have been inactive since 1917.

Geology: The country rock is weathered diorite. ~~The mine is in poor repair (1959) and the features described in former reports could not be confirmed.~~ The vein was reported to strike northwest and dip 70° SW. (Merrill and Waring, 1917, p. 531). This vein is at the west end of the claim. A second vein is exposed in workings near the north side of the claim. It strikes west, dips 50° S. and consists of broken and pulverized quartz lying in the plane of a shear zone little more than an inch wide where exposed. The quartz is stained and pocketed with iron oxides.

Development: The old workings, which appear to have comprised three shafts, are now caved. They were reported to have been 65 feet deep (Merrill and Waring, 1917, p. 531). The west-trending vein is explored by a 6-foot shaft, now caved, ~~from which a 20-foot drift was driven east (personal communication, Frank Koehn).~~ In addition ~~this~~ the west-trending vein is exposed in an excavation near the junction of Santa Rosa Road and a dirt road which extends southward to Rancho El Nido.

Production: In the period 1896 to 1901, 850 ounces of gold and 806 ounces of silver were credited to this mine (U. S. Bureau of Mines records). ~~No figures were found for the tonnage of ore removed.~~

References: Crawford, 1896, p. 311; Mining and Scientific Press, 1899, vol. 79, p. 750; Merrill and Waring, 1917, p. 531; Tucker and Sampson, 1929, p. 482; Sampson, 1935, p. 512.

R.B.S. 9/24/59

Iron Chief Mine

Location: Sec. 35, T. 3 S., R. 13 E., S.B.M. (proj.), U. S. Army Corps of Engineers Eagle Tank quadrangle, 15', 1943; Eagle Mountains, about 1½ miles southeast of the Black Eagle mine and 11 miles northeast of the East Pinto Basin-West Pinto Basin-Cottonwood Pass and Black Eagle mine roads intersection.

Ownership: Kaiser Steel Corporation, P.O. Box 217, Fontana, own at least 6 patented claims - The Gray Eagle Group (March 1960).

History: Tucker (1924, p. 192) reports that the property was originally located by William Stevens and Thomas Dolfflemeyer of San Bernardino. In 1897 the mine was reportedly sold to Charles Lane of San Francisco, who installed a small mill and operated the mine for several years. Mr. Lane did not complete payments on the property and the original owners took over installing a 50-ton cyanide plant, operating the mine and mill until about 1902 (Tucker, 1924, p. 192). From 1902 to at least 1909 the Southern Pacific Railroad Company apparently owned and worked the mine (Tucker, 1924, p. 192). Production was recorded in 1900 and 1901. Apparently little if any work beyong assessment work has been done since 1909 and 6 claims (Gray Eagle Group) were patented in 1915.

Geology: The mine is in a contact area between Paleozoic(?) calcitic dolomite and Mesozoic quartz monzonite (see fig. 1/). An oxidized zone composed mainly of hematite and quartz, 12 feet in maximum width and 6 feet in average width, contained $10 per ton of gold to a depth of 100 feet, where a sulfide zone containing chalcopyrite and pyrite was encountered. The mine operated at a profit in the oxidized zone but closed down when the sulfide zone was reached. The oxidized zone trends N. 70° W. and dips 45° N. (Tucker and Sampson, 1929, p. 482).

Development: A vertical shaft is sunk 140 feet deep on the contact of between quartz monzonite and dolomite and is intersected at the 100-foot level by a crosscut adit driven 500 feet south to intersect the oxidized zone. At this level there is at least 500 feet of drifting in the oxidized zone which has been stoped to the surface over a length of 300 feet (Tucker and Sampson, 1929, p. 482). In 1924 about 20,000 tons of tailings assaying 90¢ per ton in gold were disposed in the gulch, immediately south of the mine (Tucker, 1924, unpublished Field Report No. 83). About 8000 tons of tailings were still on the property as late as 1945 (Tucker and Sampson, 1945, p. 136). The mine is now filled in, boarded over, and of course inaccessible. It is at an elevation of 2500 feet and adjacent to the Black Eagle mine dirt road.

figure 30

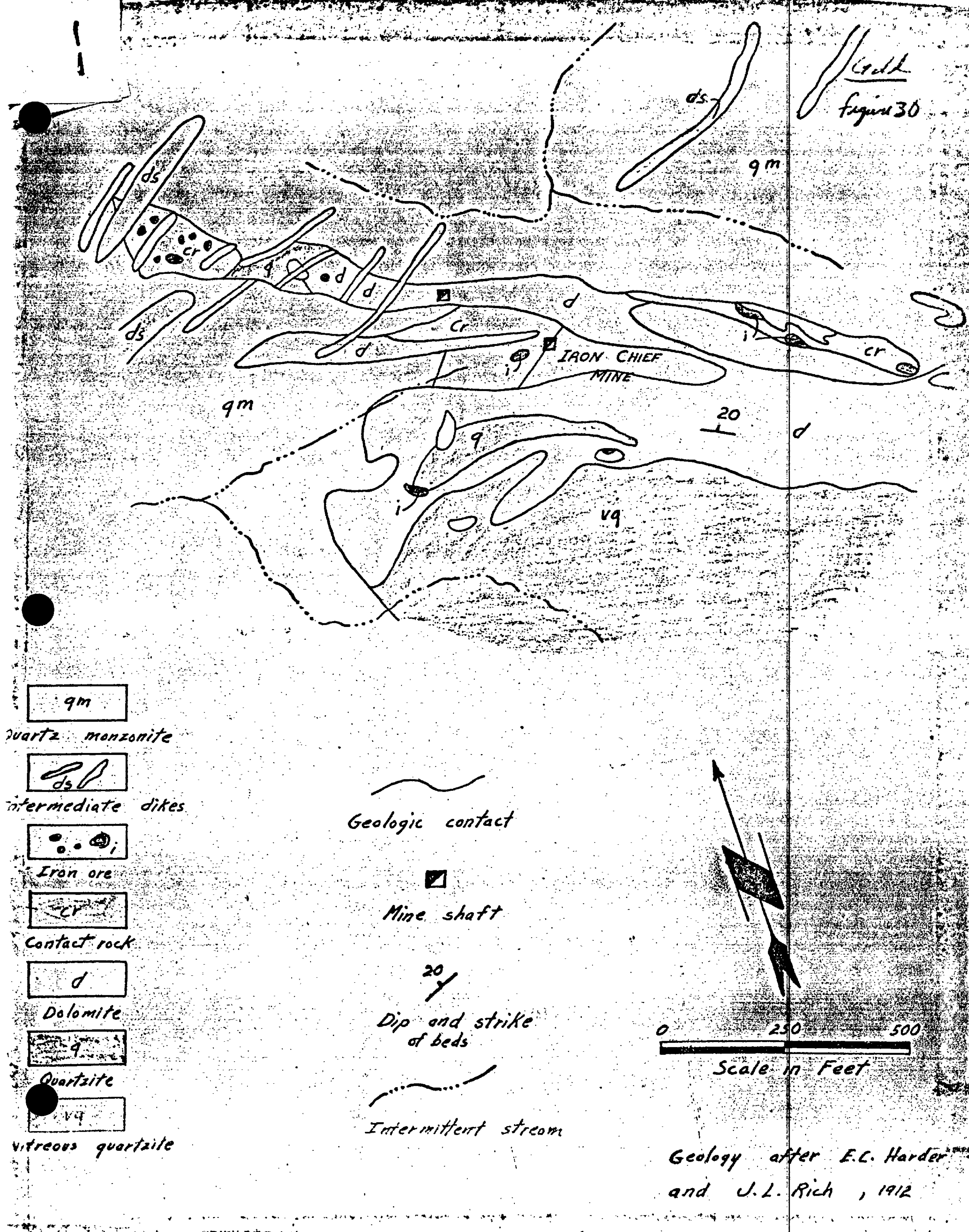
Production: The U. S. Bureau of Mines records show a production in 1900 of 142 ounces of gold extracted from 3,012 tons of crude ore, and in 1901 of 1,667 ounces of gold extracted from 2,515 tons of crude ore. Tucker and Sampson (1929, p. 482) report a value of $150,000 for total production.

References: Tucker, 1924, pp. 191-192; Tucker, 1924, unpublished Field Report No. 83; Tucker and Sampson, 1929, p. 482; Tucker and Sampson, 1945, p. 136.

J.R.E. 3/17/60

Figure 30. Geologic map of the Iron Chief gold mine and adjacent area. The quartzites and dolomite are part of a series of old metasedimentary rocks intruded by quartz monzonite, and dikes of intermediate composition. The contact rocks and replacement iron bodies are a result of the intrusion of quartz monzonite into calcitic dolomite.

Figure 30



Geology after E.C. Harder and J.L. Rich, 1912

Figure 30. Geologic map of the Iron Chief gold mine and adjacent area. The quartzites and dolomite are part of a series of old metasedimentary rocks intruded by quartz monzonite, and dikes of intermediate composition. The contact rocks and replacement iron bodies are a result of the intrusion of quartz monzonite into calcitic dolomite.

Jean (Postmaster) Mine

Location: N½ sec. 35 (proj.), T. 1 S., R. 23 E., S.B.M., Vidal quadrangle, 1950; on the northwest slope of the Riverside Mountains 5 miles south-southwest of Vidal.

Ownership: Undetermined (1958).

History: The Jean mine is so named on the Vidal quadrangle map but this name was not found in the literature. The mine was identified as the Postmaster mine by Danny G. Figueroa (personal communication), but this name has also escaped previous reports. It is probable that this is the property being worked by Bethel Mining and Lasing Company in 1929 (Tucker and Sampson, 1929, p. 473). In 1930 that company recorded gold production from a claim named Rattler (U.S. Bureau of Mines file) located in the same area and possibly the same mine.

Geology: The rocks in the mine area are contorted gneisses, quartzite, schist, and hornfels cut by quartz veins and mineralized faults. The veins and faults strike from N. 20° E. to N. 30° W. and dip about 40° NW. or SW. A barren vein of massive white quartz 2 to 4 feet wide crops out on these claims near the main camp site. However, few of the veins that have been mined are more than 2 feet wide. Most of the veins actually consist of numerous closely-spaced veinlets. Minerals noted associated with the quartz are chalcopyrite and hematite and less commonly, calcite and barite.

Development: Though the underground extent of the mine was not determined, at least 2 veins have been exploited from the surface.

Development consists of 1 inclined shaft, 1 vertical shaft, 2 adits and prospect pits. The principal shaft is inclined 45° NW. and extends to an undetermined depth on a shear zone mineralized with quartz stringers and veins. About 150 feet northeast of the inclined shaft is a vertical shaft of unknown depth. These 2 shafts are in the area of the main campsite. About 600 feet north of the campsite an inclined adit extends 20 feet southwest on a 12-18 inch-wide quartz vein striking N. 10° E. and dipping 40° SE. in platy schist. Up the slope to the east of the campsite about 1,000 feet is an adit driven southeast a reported distance of 1000 feet from which stoping extend 100 or more feet northeast to the surface (Danny G. Figueroa, personal communication). This adit explores a fault zone 12 to 18 inches wide striking N. 20° W. and dipping 35° SW. At the portal an 8 inch quartz vein is exposed from which veinlets branch over a width of about 2 feet. The vein narrows to a width of 2 to 6 inches where exposed in a stope, opening to the surface several hundred feet northeast of the adit portal.

Production: U. S. Bureau of Mines records show that in 1930, 12 tons of ore taken from the "Rattler" (probably the Jean mine) yielded 26.89 ounces of gold and 9 ounces of silver.

References: Tucker and Sampson, 1929, p. 473.

R.B.S. and C.H.G. 12/18/57

John's Camp

Location: SE¼SW¼ sec. 4 (proj.), T. 2 S., R. 9 E., S.B.M., Twentynine Palms quadrangle, 15' 1955; Joshua Tree National Monument, 8 miles south of Twentynine Palms.

Ownership: Undetermined.

History: Undetermined; old mill foundations at site are dated 1931. Apparently long idle.

Geology: Shear zones in coarse-grained Mesozoic quartz monzonite (Palms quartz monzonite of Rogers, 1954). The principal adit on the east side of a narrow canyon explores a shear and gouge zone 1 to 2 feet thick, which strikes north and is vertical to steeply east-dipping. Several hundred feet up the hill a second shear zone trends N. 45° E.

Development: A drift adit, of undetermined extent, is driven on the north-trending shear zone, and the zone has been opened by minor trenches above. The northeast-trending zones above have been explored by 4 short drift adits and shallow pits. To the west, across the canyon, is another adit, and there are several caved adits several hundred yards to the east.

Production: Undetermined.

References: Rogers, 1954, map sheet 24.

C.H.G. 5/19/61.

Jumbo Mine

Location: SE¼ sec. 30, NE¼ sec. 31, T. 4 S., R. 4 W., S.B.M., Steele Peak quadrangle, 7.5', 1953; about 6½ miles west of Perris. The claim lies athwart a low ridge just south of Santa Rosa Road (figure 7).

Ownership: Undetermined.

History: The Jumbo Mine was reported active as early as 1896 at which time it was owned by M. E. Bethrum, Perris (Crawford, 1896, p. 312). Although subsequent reports add nothing to the 1896 description, the present condition of the property suggests considerable activity since 1896. U. S. Bureau of Mines files show that the Jumbo mine was active as late as 1900 and that S. T. Crawford, and a party named Stanford, both of Perris, held the mine in the years 1899 and 1900 respectively.

Geology: A poorly exposed shear zone as much as one foot wide contains thin, discontinuous veins and pods of crushed quartz ranging from 0 to about 2 inches in thickness. The shear zone strikes N. 10° W. across a ridge of deeply weathered diorite and dips about 80° SW. The crushed vein quartz is stained and pocketed with iron oxides. It has yielded gold and silver but assay data are lacking.

Development: The earliest reported development consisted of a 50-foot shaft (Crawford, 1896, p. 312) but inspection of the property revealed that, in addition, at least one adit and several other shafts or deep prospect pits were opened. A foundation suggests that a mill had been installed. When visited (1959) the workings were caved and inaccessible.

Production: During the four reported years, 1896, 97, 99 and 1900, U. S. Bureau of Mines records show that a total of 1,382.10 ounces of gold and 477 ounces of silver were won from an unreported tonnage of ore. These figures seem high but they might constitute an unapportioned total resulting from the milling of ore from a number of small nearby mines.

References: Crawford, 1896, p. 312; Tucker and Sampson, 1929, p. 482; 1945, pl. 35; Sampson, 1935, p. 512.

R.B.S. 9/23/59

Lane Mine

Location: Sec. 10 (proj.), T. 6 S., R. 15 E., U. S. Army Corps of Engineers Chuckwalla Mountains quadrangle, 15', 1945; in the Chuckwalla Mountains, 3 3/4 miles south of Desert Center. This mine is accessible only by means of faint trails from the Aztec Well area and from the Granite mine.

Ownership: Undetermined (1959).

History: Early reports barely mention the Lane mine but their dates, 1896 (Crawford, p. 312) and 1919 (Merrill and Waring, p. 540) mark times during its early development, and, at the later date, after operations had ceased.

Geology: A shear zone with a maximum width of 5 feet is exposed for about 500 feet along the south slope of a granite ridge. It strikes N. 50° W. and dips 45° NE. Contained within the shear zone is a crushed quartz vein as much as 2 feet wide which is unevenly mineralized with oxides of iron and traces of secondary copper minerals.

Development: The vein has been explored ~~by means of~~ by a 50-foot shaft, 3 shallow shafts 10 to 20 feet deep, and an open cut. The shafts are inclined on the dip of the vein. In addition, there is a shallow pit which appears to be the collar of a caved shaft.

Production: Undetermined.

References: Crawford, 1896, p. 312; Merrill and Waring, 1919, p. 540.

R.B.S. 4/29/59.

Langdon Claim

Location: SW¼, sec. 10 (proj.), T. 4 S., R. 22 E., S.B.M., Big Maria Mountains quadrangle, 1951; about 6 miles by dirt road and trail east of Midland Road and 3 miles northeast of Black Hill.

Ownership: Undetermined (1958).

History: According to Mr. George Ringwald, Blythe, (personal communication 1/12/59) this property was worked from 1932 to 1934 by a man named Langdon.

Geology: The country rock, gneiss cut by quartz-feldspar pegmatite dikes, is faulted. The faults are poorly exposed. One, explored by the north workings, is vertical and strikes N. 45° E. Another, in the southern workings, strikes N. 85° W. and dips 80° NE. Gold-bearing quartz veins of undetermined extent lie in the fault planes. They range from a fraction of an inch to as much as a foot in thickness. Fractures and pockets in the veins are filled with iron oxides.

Development: The north workings comprise a 20-foot drift adit from the end of which a 17-foot raise was driven to the surface. The south working, in a narrow ravine about 1,000 feet to the southeast of the north adit, consists of a 50-foot inclined shaft.

Production: Not determined.

References: None.

R.B.S. 12/19/58.

Last Chance Mine

SE1/4, 23 (proj.)

Location: Sec. 2[illegible] ([illegible]), T. 6 S., R. 15 E., S.B.M., ~~U. S. Army Corps of Engineers~~ Chuckwalla Mountains quadrangle, 15', 19~~49~~ 63; in the Chuckwalla Mountains about one mile south of Aztec Well and 3 miles west of Corn Spring. This property is ~~about a quarter of a mile~~ a short distance southeast of the C.O.D. mine and probably lies along the same fault zone.

Ownership: Not determined (1959).

History: Last held, in 1948, by E. M. White.

Geology: A vertical fault zone as wide as 4 feet, which strikes N. 20° W., is poorly exposed for about 200 feet on a low granite ridge. Quartz veins and lenses as much as 5 inches wide are unevenly distributed in the fault plane. The veins are stained and pocketed with iron oxides. Calcite is present but not common.

Development: The fault zone on the nose of the ridge has been explored by means of a 20-foot adit. A 10-foot prospect pit in the fault zone lies about 75 feet up the slope from the adit.

Production: Not determined.

References: None.

R.B.S. 5/1/59.

Leon Mine

Location: NW¼ NW¼ sec. 18, T. 6 S., R. 2 W., S.B.M. Romoland quadrangle, 7½', 1953; about 6 miles south-southeast of Romoland.

Ownership: Hans Christensen, Romoland, one patented claim.

History: According to early reports the Leon Mine was opened in the late 1800's (Crawford, 1894, p. 223). By 1917 it was still being referred to as "a promising prospect" (Merrill and Waring, 1917, p. 534-535). The actual amount of gold taken from the property was not recorded. According to U. S. Bureau of Mines records, during the years 1950 to 1953 the property was worked by W. A., M. E., and R. H. Obarr, 1541 Freeman Ave., Long Beach.

Geology: A shear zone as much as 3 feet wide strikes N. 55° W. and dips 70° N.E. across the southwest slope of a hill underlain by Mesozoic metasedimentary and metavolcanic rocks. Quartz vein material of undetermined average thickness is distributed unevenly in the shear zone. The shear is exposed for about 1,500 feet.

Photo 16

Development: Two vertical shafts, a shallow pit, and a trench explore the vein. The collars of the shafts are on the vein and about 200 feet apart, the northwesterly one being higher than the other by about 50 vertical feet. The northwest shaft, now caved, was once reported to be 150 feet deep (Crawford, 1896, p. 312). ~~A small sheet-iron shack, which housed the hoisting machinery, still stands near it.~~ The southeast shaft is open but ~~and untimbered as far down as could be observed from the~~ at the partially caved collar. Its depth was not determined. The pit and trench lie on the shear zone between the two shafts~~, and are simply shallow prospects~~.

Production: In 1950, 3 tons of ore yielded 1 ounce of gold and 1 ounce of silver (U. S. Bureau of Mines records, published ~~with permission of the owner~~).

References: Crawford, 1894, 223; 1896, p. 312; Tucker and Sampson, 1929, p. 483.

R.B.S. 10/22/58.

Lost Angel (Laseter, Sippi?) Mine

Location: SW¼ sec. 35, T. 3 S., R.8 E., S.B.M., Lost Horse Mountain quadrangle, 15', 1958; Joshua Tree National Monument in a narrow canyon high on the southwest slope of the Little San Bernardino Mountains, 2 3/4 miles southwest of Pinyon Well. This mine previously, and apparently erroneously, was reported in sec. 22, T. 3 S., R. 8 E., S.B.M. (Tucker and Sampson, 1945, p. 137).

Ownership: Clyde Jones, P.O. Box 1678, Indio (1957).

History: The Sippi mine, which probably is the Lost Angel mine, is said to have been worked by a Mr. McFarland in the 1890's. The Lost Angel mine was owned many years ago by W. H. Laseter, Twentynine Palms. The property was leased to C. L. Woods, Indio, from 1937-1945 when the mine comprised 8 claims. A. F. Perry acquired the holdings in 1945 and subsequently sold them to Clyde Jones in 1956. Apparently the mine has not been worked since about 1937.

Geology: The mine workings explore a 5-foot wide shear zone in biotite-diorite gneiss and biotite schist (Precambrian Chuckwalla complex) on the west side of the canyon. The shear zone strikes N. 80° W., is vertical, and contains discontinuous quartz stringers as much as 1 foot wide.

Development: Tucker and Sampson (1945, p. 137) reported a 75-foot shaft and a 150-foot adit on the vein, and a 5-stamp mill on the property. In June 1957 the shaft was not found, the adit on the west side of the canyon was about 50 feet long, and no trace of the mill remained.

Production: U. S. Bureau of Mines records show 2 tons of crude ore produced in 1937 yielded 2 ounces of gold and 1 ounce of silver.

References: Tucker and Sampson, 1945, p. 137.

C.H.G. 6/29/57.

Lost Horse Mine

Location: SW¼NW¼ sec. 3, T. 3 S., R. 8 E., S.B.M., Lost Horse Mountain quadrangle, 1958; Joshua Tree National Monument, 3 miles southeast of Ryan Campground and Lost Horse Well, on the east side of a small valley high in the central part of Lost Horse Mountain.

Ownership: Leanta Stafford Ryan, 242 E. Center, Covina holds one patented claim of 13.5 acres.

History: The gold-bearing vein developed by the Lost Horse Mine, was worked as early as 1894 when ore was hauled to the Pinon Mountain mill (apparently located at the present El Dorado patented mill site at Pinyon Well). During this early development Lang, Holland, and Tingman, of Indio were the owners of 2 claims (Crawford, 1896, p. 223). The area was surveyed for patent in 1895 and a patent was issued in 1897 to Nathan Ryan and others. Apparently the mine was in almost continuous operation from 1895-1908, but under several operators: 1896-98, Thos. C. Ryan; 1899-1900, Lost Horse Mining and Milling Company; 1901, 1905, S. M. Kelsey; 1906, 1908, Lost Horse Mining and Milling Company.

By 1896 a 2-stamp mill had been built several miles north of the mine, probably at Lost Horse Well. Workings included a 80-foot drift adit, 50-foot winze, 50-foot drift from the bottom of the winze, and a 235-foot vertical shaft with a horse-whim (Crawford, 1896, p. 312). In 1929 Tucker and Sampson (p.483) reported the shaft was 500 feet deep and a 10-stamp mill was at the mine. Water was piped to the mine from Lost Horse well.

After being idle for about 20 years the mine was reopened in 1931 under lease by Gen'l Mining and Development Company who mined pillars of ore from the upper levels and milled in the 10-stamp mill. The last activity apparently was in 1936 when J. D. Ryan processed 600 tons of tailing. The operation during the 1930's yielded only a few hundred ounces of gold and local residents report the vein was faulted off at depth and drifting failed to find the vein. Apparently long idle.

Geology: The mine area is underlain by dark well-foliated thin banded quartz-biotite gneiss (Precambrian Pinto gneiss). The banding strikes north to N. 40° W. and is steeply dipping to vertical. According to Merrill (1917 p. 536) the principal workings explore a quartz vein which strikes east, dips 85° N., ranges from 6 inches to 5 feet in width, and is exposed on the surface at several points for about 800 feet. In June 1957, the vein could not be observed in the main shaft because of timbering, but the dump material contained iron-stained vein quartz, gneiss, and black mica schist. Twenty feet east of the shaft a 4-inch quartz vein strikes N. 20° E., and is vertical. Two shallow shafts, 300 and 500 feet to the east on the ridge explore east-striking vertical, thin, iron-stained quartz veins in shear zones in gneiss. Where best defined in the upper shaft the shears strike N. 15° W., and dip 70° SW.

Development: The Lost Horse mine workings consist chiefly of a 500-foot vertical shaft with a small amount of drifting on the vein on the 100, 200, 300, and 400-foot levels (Tucker and Sampson, 1945, p. 137). About 100 feet west of the main shaft an adit is driven N. 80° E. along a 5-foot wide shear zone. Apparently this is the adit described by Merrill (1917, p. 536) as being 80 feet long with a 50-foot winze and a 50-foot drift east driven from the bottom of the winze. The vein also has been explored by 2 shallow shafts, 300 and 500 feet east of the main shaft, and by several pits. In 1957, a vertical headframe, several partially collapsed wooden and stone buildings, and a largely dismantled 10-stamp mill remained on the property. delete

Production: This property has been credited (Chesterman, 1957, p. 79) with the only production of bismuth in California and the 20 tons of bismuth ore produced in 1904 are listed as being from the Lost Horse, formerly the Lang copper mine. It appears this report is erroneous as a long time local resident, Mr. William F. Keyes, states the bismuth ore came from the Sulphide Bismuth mine (see herein) in the early 1900's, when the property was known as the Lang Copper mine, but Mr. Lang also apparently was a partner in the Lost Horse mine. No evidence of copper or sulfide mineralization was observed at the Lost Horse mine.

Tucker and Sampson (1945, p. 137) report the total value of gold from the Lost Horse mine as $350,000. This is in rough agreement with the more than 10,000 ounces of gold and 16,000 ounces of silver reported (U.S. Bureau of Mines records) to have been recovered from an undetermined tonnage of ore and 600 tons of tailings (produced) yielded by the Lost Horse mine from 1895 to 1936.

References: Crawford, 1894, p. 223; Crawford, 1896, p. 312; Mining and Scientific Press, 1900 (May, vol. 80, no. 18) p. 494; Merrill, 1917 [1919] p. 536; Tucker and Sampson, 1929, p. 483; Tucker and Sampson, 1945, p. 137; Chesterman, 1957, p. 79.

C.H.G. 6/28/57.

Lost Pony Mine

Location: Sec. 24, T. 6 S., R. 14 E., S.B.M., U. S. Army Corps of Engineers 15', Chuckwalla Mtns. quadrangle, 1945; on the southwest slope of the Chuckwalla Mountains 6 3/4 miles southwest of Desert Center. The mine is marked on the quadrangle map.

Ownership: Undetermined.

History: The Lost Pony mine appears to be an old property, but its date of location was not determined. In the early 1940's the mine was owned by Dell Barnum, Desert Center. In 1940 Desert Center Mining Company leased and operated the property for an undetermined period (Tucker and Sampson, 1945, p. 137).

Geology: The country rock is gneissic granite cut by aplite and pegmatite dikes as much as 3 feet wide. The gneissic structure has a general strike about N. 10° W. A fault zone, traceable for about 1100 feet, strikes west nearly at right angles to the structure of country rock and dips 50° S. A fine-grained, basic dike ranging from 5 to 30 feet in thickness lies in the fault zone. Quartz veins ranging from 0 to 1 foot in thickness lie along the footwall of the fault zone.

The veins and the dike are fractured, probably by recurrent movement on the fault. The most pronounced shearing followed the footwall creating irregular masses of gouge as much as 3 feet wide in which a large proportion of the vein quartz was dragged and crushed. Minerals observed in the ore are calcite, siderite, chlorite, magnetite, hydrous iron oxides, and scattered stains and thin crusts of chrysocolla. No data on the gold content of the deposit were obtained.

Other quartz veins strike parallel to the fault and crop out 50 to 100 feet south of it. These veins appear to be barren. In addition a second basic dike, 40 feet wide, is exposed 75 feet north of and parallel to the fault but it does not appear to be associated with a fault or vein.

Development: Two shafts, 50 and 80 feet deep, were sunk in the hanging wall. These shafts probably connect with workings serviced by 6 inclined shafts driven on the vein but because of the poor condition of the mine no entry was made to check the extent of development. The mine was reported to be at least 200 feet deep with drifts on the 50, 100, and 200 foot levels (Tucker and Sampson, 1945, p. 137). In addition there is a trench and several prospect pits and, near the west end of the outcrop, ~~there is~~ a 50-foot crosscut adit in the hanging wall from which a drift runs 60 feet east on the vein. A 60-foot shaft explores the dike, exposed to the north of the fault, with apparently negative results.

Production: Desert Center Mining Company made a number of shipments of high-grade ore to American Smelting and Refining Company's smelter, Garfield, Utah but the tonnage and grade ~~was~~ were not reported (Tucker and Sampson, 1945, p. 137). Idle (1959).

References: Tucker and Sampson, 1945, p. 137, pl. 35.

R.B.S. 11/16/59

Louise Mine

Location: Sec. 17, T. 2 S., R. 12 E., S.B.M. (proj.), ~~U. S. Army Corps of Engineers~~ ~~Pinkham Well~~ [Hexie Mountains] quadrangle, 15', 19~~48~~ [63]; Pinto Mountains, about 1½ miles west of the Gold Crown mine and 4 miles southwest of New Dale (Site) [figure 31]. ~~(See pl. 3/)~~.

Ownership: Emmett Bethurum, Box 111, Amboy, owns 2 unpatented lode claims (March 1958).

History: The mine was originally located in the late 1920's by Jack Meek and E. V. Evans, and was active in 1929 (Tucker and Sampson, 1929, p. 483). Emmett Bethurum owned and operated the mine from 1937 to 1939.

Geology: Quartz monzonite is cut by a north trending and nearly vertical fault containing a quartz vein 2 feet in average thickness. Tucker and Sampson (1929, p. 483) report that the vein is mineralized with galena, chalcopyrite, and shows free gold.

Development: The main shaft is sunk vertically on the vein to an undetermined depth. Probably drifts extend from the shaft at one or more levels. Other workings of minor extent consist~~ing~~ mainly of shallow shafts and surface trenches [and] are randomly distributed about 350 feet south along the fault trace from the main shaft.

Figure 31
482

Production: Compiled by the U. S. Bureau of Mines and published with permission of the owner.

Year	Crude Ore (tons)	Gold (oz.)	Silver (oz.)	Copper (lbs.)	Lead (lbs.)
1937	38	13	27		
1938	67	19	24	209	1,292
1939	3	3			

References: Tucker and Sampson, 1929, pp. 483-484.

J.R.E. 3/30/60

Lucky Boy (Walker Claim) Mine

Location: SE¼ sec. 9, T. 6 S., R. 3 W., S.B.M., Romoland quadrangle, 7½', 1953; about 9 miles south of Perris, in a cultivated area between two low, rounded hills.

Ownership: Undetermined.

History: This deposit was discovered in 1892. Development proceeded slowly under the ownership of Sam Walker, Menifee (Storms, 1893, p. 385; Crawford, 1894, p. 223-224; personal communication, John D. Walker). In 1917 the owner was reported dead (Merrill and Waring, 1917, p. 534) and, since that date, the mine has remained idle.

Geology: The country rock at the mine is deeply weathered Mesozoic diorite. The whole outcrop is barely 100 feet long and brush, soil, and the caved state of the mine obscure the deposit. The vein appears to strike about N. 55° W. and, according to John Walker, son of the original owner, it is vertical. It was reported to range from 4 inches to one foot in thickness and to be faulted in two places (Storms, 1893, p. 385). The vein is fractured and the quartz is recemented and pocketed with iron oxides. There appears to be no report on the gold content except some high grade estimated by Storms to run about $65 per ton. Pyrite is present in the ore below the water table (personal communication, J. D. Walker).

Development: The workings are filled or caved but formerly two shafts, 50 and 60 feet deep respectively, were sunk on the vein. Water was reported to be the principal problem (Crawford, 1896, p. 312).

Production: Undetermined. ~~Idle (1959)~~.

References: Storms, 1893, p. 385; Crawford, 1894, p. 223-224; 1896, p. 312; Merrill and Waring, 1917, p. 534; Tucker and Sampson, 1929, p. 484; 1945, pl. 35; Sampson, 1935, p. 513.

R.B.S. 10/20/59.

Lucky Dollar Mine

Location: Sec. 24 (proj.), T. 5 S., R. 13 E., S.B.M., U. S. Army Corp of Engineers, 15', Canyon Spring quadrangle, 1944; about 3 miles east-northest of Hayfield Pumping Station and a little more than half a mile east-southeast of the Golden Eagle Mine, at the south edge of the Eagle Mountains.

Ownership: Undetermined.

History: Papers found at the mine show that it was claimed in 1940 by C. H. Kelly. No records for other years were found.

Geology: A quartz vein, ranging from 0 to 3 inches thickness, lies along the hanging wall of a fault zone, as much as 4 feet wide, which is poorly exposed on the crest of a narrow granite ridge. The fault strikes N. 45° E. and dips 45° SE. Voids and fractures in the vein carry oxides of iron which has probably formed from the weathering of sulfides. Gold, where present, is a free-milling residue as with other ores in the area.

Development: The outcrop is penetrated by a 12-foot inclined shaft. A crosscut adit was driven southeast from a point about 100 feet down the slope to the west. It appears to be at least 100 feet long but whether or not it reaches the vein was not determined due to the unsafe condition of the back.

The tonnage yield reported for the year 1940 suggests that the vein was reached and worked, but little vein material was found on the dump.

Production: U. S. Bureau of Mines records show that in 1940 the Lucky Dollar mine yielded 9 tons of ore from which 10 ounces of gold and 4 ounces of silver were recovered.

References: None.

R.B.S. 11/20/59

Lucky Lady Claim

Location: SE¼ sec. 19 (proj.), T. 7 S., R. 17 E., S.B.M., Sidewinder Well quadrangle, 15', 1952; southwest of the Aztec and Rainbow Claims. It is at the northeast base of a ridge and is reached by a side road off Dupont Road.

Ownership: Undetermined.

History: This property was developed during the 1930's and worked for a period of short but unrecorded duration (J. Dupont, personal communication).

Geology: Undetermined. ~~The property was not visited but probably resembles the nearby Aztec and Rainbow Claims, which are on northwest-trending, gold-bearing quartz veins in gneissic country rock.~~

Development: The deposit was explored by a single shaft, 75 feet deep.

Production: Undetermined. Mr. J. Dupont stated that some ore of good grade was taken from the claim.

References: None.

R.B.S. 4/28/59.

Lucky Strike (Ophir) Mine

This report is based largely on information contained in a recently published description by Engel, Gay and Rogers (1959, p. 67-68).

Location: Sec. 21, T. 5 S., R. 4 W., S.B.M., U.S. Army Corps of Engineers Lake Elsinore quadrangle, 15', 1942; at the northeast base of a low hill just southeast of Highway 74, about 3 miles northeast of Elsinore.

Ownership: R. S. Fisher and R. L. Read, Elsinore (1945) own an undetermined area of patented land (formerly railroad land) including the mine.

History: The Lucky Strike was reported active in 1919 (Merrill and Waring, p. 529).

Geology: The country rock is deeply-weathered, Mesozoic quartz diorite. A quartz vein, about 15 inches wide at the surface, strikes N. 80° E., and dips 45° S. in the collar of the main shaft, but apparently turns to strike N. 55° E. and dip 55° SE. where exposed 100 feet to the east. The vein is discontinuously exposed for several hundred feet across the hill. At the surface, the vein quartz is strongly stained with iron oxides and has a well-defined clay selvage. A second, more northerly vein, not exposed on the surface, is reported also to strike east, but to dip 35° and intersect the main vein at the 50-foot level. The veins contain free gold, silver, marcasite, pyrite, arsenopyrite, and copper oxide stains; the north vein has the higher silver content. On the 50-foot level the vein is reported to range from 2 to 24 inches in thickness with an average thickness of about 10 inches. On this level the oreshoot is reported to be about 85 feet long. Some of the ore was reported to bear 25 ounces of silver and $8 in gold per ton (Sampson, 1935, p. 513).

Development: Mine openings include the main shaft, inclined 45° along the main vein and 150 feet deep, and a second inclined shaft of undetermined depth about 100 feet to the east. In 1955, both shafts were caved at a depth of about 30 feet and inaccessible. Past reports indicate the existence of a 100-foot drift to the north (presumably east) of the main shaft on the 50-foot level, and a 150-foot drift in the same direction on the 150-foot level. In 1935, the lower level, though under water, was reported to have exposed a 30-inch-width of sulphide ore.

Production: Undetermined.

References: Crawford, 1896, p. 313; Merrill and Waring, 1917, p. 529; Tucker and Sampson, 1929, p. 486; 1945, p. 137-138; Sampson 1935, p. 513; Engel and others, 1959, p. 67-68.

R.B.S., from Engel and others.

Lum Gray (Arica, Gray, Long Shot, Priest) Mine

Location: NE¼ NE¼ sec. 12, T. 2 S., R. 19 E., S.B.M., Rice quadrangle, 15' 1954; west of the main ridge of the Arica Mountains in a shallow valley 6½ miles southwest of Rice.

Ownership: Undetermined (1958).

History: According to Tucker and Sampson (1929, p. 481), this mine was worked by Assets Realizing Company from 1909 to December 1912, at which time operations were suspended. These authors state that the property was subsequently relocated by one E. E. Schellenger as the Arica claim. Merrill and Waring (1917, p. 541-542) reported that, when visited in November of 1914 the Gray Mine was leased (owner not specified) to "Assets Realizing Mines Company".

Edward W. Rowe, Rice, the last reported owner, operated this property under the name Long Shot #1 during the years 1950, 51, and 53 (U. S. Bureau of Mines records).

Geology: The country rock consists of contorted and sheared metasedimentary rocks of Paleozoic(?) age comprising schist and limestone. They strike N. 70° W. and dip 70° SW. in the mine area. Ore minerals form deposits along a shear zone which roughly parallels the structure of the rocks. The shear zone is exposed unevenly for about 1,000 feet along the strike. It contains quartz veins as much as one foot in thickness. Much of the wall rock near the veins contains chrysocolla and iron oxides in fissures and shears. Much of the quartz vein material is brecciated. The ore minerals in the vein and enclosing rock are hematite, limonite (in part as pseudomorphs after pyrite), chrysocolla, malachite, pyrite and manganese oxide.

The vein is reported to carry approximately 0.75 ounces per ton in gold and to be free milling down to 150 feet. Below that depth pyrite becomes abundant (Tucker and Sampson, 1945, p. 138).

Development: The shear zone is explored by one vertical shaft, 700 to 800 feet to the northwest of which is a shaft inclined 60° SW., and an undetermined amount of sub-surface work. According to Tucker and Sampson (1945, p. 138) the vertical shaft was said to be 990 feet deep. In an earlier report (Tucker and Sampson, 1929, p. 481) it is stated that there are 700 feet of drifts and crosscuts at the 300-foot level and that a winze descends from that level to a depth of 229 feet from which there are 300 feet of drifts and crosscuts at various levels. A stope reaches the surface 40 to 50 feet south of the inclined shaft. This may be the work referred to by Tucker and Sampson (1945, p. 138) as having been done from a drift off a 175-foot shaft, possibly the inclined shaft noted above.

When visited in April, 1958, the shafts were open and dry and well timbered. ~~The stope was still open and the stulls sound.~~ ~~Nothing remains of former mine buildings but the foundations. The shafts have no head frames but access is good and portable frames could easily be installed.~~

Production: During its intermittent development in the years between 1912 and 1950 the Lum Gray mine yielded as much as 1,200 tons of ore from which 1,100 ounces of gold, 534 ounces of silver, 6,911 pounds of copper and 920 pounds of lead were recovered.

References: Merrill and Waring, 1917, p. 541-542; Tucker and Sampson, 1929, p. 481; 1945, p. 138, pl. 35; Goodwin, 1957, p. 604.

R.B.S. 4/11/58.

Maggie (Little Maggie) Mine

Location: NW¼ sec. 32, T. 4 S., R. 4 W., S.B.M., Steele Peak quadrangle 7.5', 1953; about 6 miles west of Perris (see figure 42).

Ownership: Charles Hess, 4427 Larchwood Place, Riverside (1958).

History: This mine was located prior to 1894. By that year an arrastra had been built and development was proceeding under the ownership of J. M. Hasson, Perris (Crawford, 1894, p. 223). The mine was idle in 1896 (Crawford, 1896, p. 312). Activity was next reported in 1935 at which time a Chilean mill was being used. The owner was Chas. Lanhorn, Box 152, Perris (Sampson, 1935, p. 512). The mine was worked in 1940 by Charles Hess, Riverside, probably under lease (U. S. Bureau of Mines records). In 1945, it was reported idle (Tucker and Sampson, 1945, p. 136-137, pl. 35).

Geology: The mine area is underlain by deeply weathered Mesozoic diorite. A narrow shear, rarely exceeding 4 inches in width, strikes N. 85° W. and dips 50° SW. The shear contains crushed and pulverized vein quartz material reported to be as much as 8 inches wide (Tucker and Sampson, 1945, p. 136). It has an indistinct surface exposure of about 100 feet.

Development: The vein is explored by 4 inclined shafts, now in poor repair. One is flooded below the 50-foot level. Two others are partially filled with debris and are about 30 feet deep. The fourth shaft is about 40 feet deep. At these depths only a small amount of drifting and stoping was done. Three of these shafts were reported to be 175 feet, 75 feet and 75 feet deep respectively (Tucker and Sampson, 1945, p. 136), but were not identified because of the flooded or filled condition of the mine. An old ball mill was still on the property when it was visited (1959).

Production: The only recorded production from the Maggie mine was two tons of ore for the year 1940, which yielded 1 ounce of gold (U. S. Bureau of Mines records).

References: Crawford, 1894, p. 223; 1896, p. 312; Mining and Scientific Press, 1895, vol. 70, p. 106; Merrill and Waring, 1917, p. 531; Tucker and Sampson, 1929, p. 483; 1943, p. 136-137, pl. 35; Sampson, 1935, p. 512.

R.B.S. 9/24/59

Mammoth Group

Location: NW¼ SW¼ sec. 8, T. 6 S., R. 3 W., S.B.M., Romoland quadrangle, 7.5, 1953; about 10 miles south of Perris.

Ownership: John Rostas, Route 1, Romoland.

History: According to U. S. Bureau of Land Management records, this group, comprising the 2 claims, Edith and Mammoth, was patented by F. A. Stephens, et al., in 1896. At that time development of the mine was already well advanced (Crawford, 1896, p. 312). The claims were owned by A. A. Adair, Riverside, in 1917, (Merrill and Waring, 1917, p. 534) but there was no report of activity then or since.

Geology: A lenticular body of quartz is well exposed on the southeast slope of a low granodiorite ridge through a horizontal distance of about 250 feet (fig. 32). The vein strikes northeast, dips about 15° northwest and is as much as 7 feet thick. Fractures and fissures in the quartz are filled or lined with iron oxides. In addition, the vein contains free-milling gold and pyrite. No assay data were found.

Photo 17

Figure 32

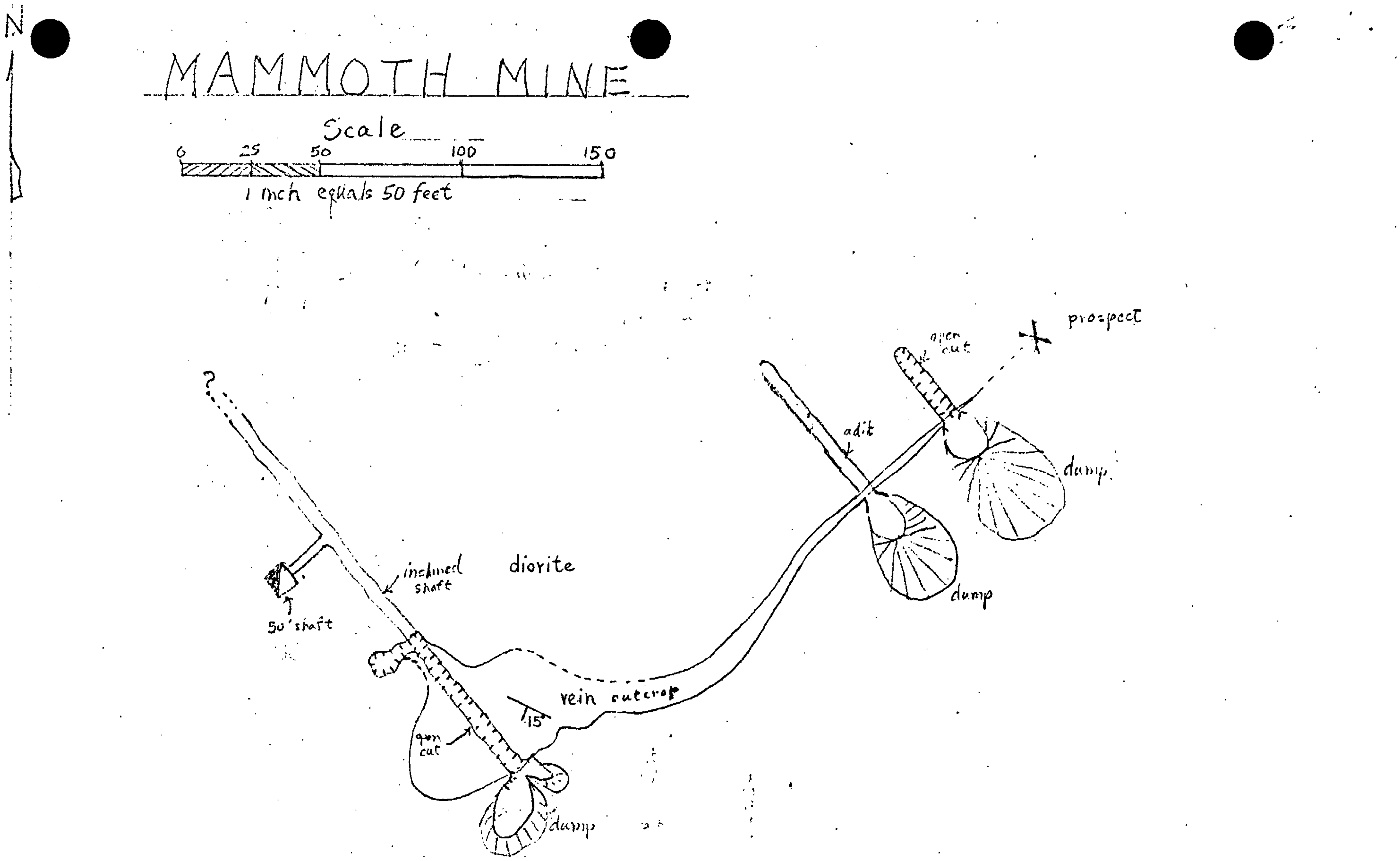
Development: The deposit has been explored by means of a 50-foot shaft, an inclined shaft, an adit, and two open-cuts, ~~arranged as shown in figure~~. In addition there are several shallow prospects.

The inclined shaft is reported to be 200 feet deep and to join with the vertical shaft through a crosscut drift (Crawford, 1896, p. 312). The portal of the inclined shaft is at the face of an open-cut as much as 8 feet deep and 60 feet long, cut in the broad, west lobe of the vein outcrop. The cut and shaft bear N. 40° W. The tapering, east end of the outcrop is explored by the adit and second open-cut. The adit extends N. 40° W. for 60 feet. The open-cut, 40 feet farther east, is parallel to the adit and is 30 feet long. At the adit portal the vein appears to have divided into three roughly parallel veins as much as 6 inches thick separated by tabular bodies of country rock 1 to 2 feet in thickness.

Production: Undetermined. Idle (1959).

References: Crawford, 1896, p. 312; Mining and Scientific Press, 1899, vol. 78, no. 10, p. 267; Merrill and Waring, 1917, p. 534; Tucker and Sampson, 1929, p. 484; 1945, pl. 35; Sampson, 1935, p. 513.

R.B.S. 9/21/59.



Caption?

Gold
[illegible]
figure 32.

Gold

Mastodon Mine

Location: SE¼ sec. 14, SW¼ sec. 13, T. 5 S., R. 11 E., S.B.M., Cottonwood Spring 15' quadrangle, 1958; Cottonwood Mountains, Joshua Tree National Monument, about 0.8 miles southeast of Cottonwood Spring.

Ownership: Harold E. Haulsey, P.O. Box 1124, Cortez, Colorado owns 1 lode claim (March 1958).

History: In 1945, the mine was owned by George W. Hulsey (Haulsey?), Indio (Tucker and Sampson, 1945, p. 138).

Geology: At the main workings a northwest-trending and 40° NE. dipping fault cuts White Tank quartz monzonite (fig. 33). The fault zone contains thin iron stained gold quartz veins. About 400 feet to the west is a northwest-trending and 60° NE.-dipping quartz vein as much as one foot wide.

Development: The main shaft is sunk 75 feet in a fault plane. About 400 feet west, another shaft is sunk to an unknown depth on the 1-foot wide quartz vein. It is caved at the 10-foot level. Material was hauled from the mine along a narrow dirt road to the Winona Spring (Cottonwood Spring Custom) mill. The mill had a capacity of 40 tons a day and processed material from other mines in the Pinto Basin area (Tucker and Sampson, 1945, p. 129). The mill is in ruins and the mine is idle.

Figure 33
500

Production: Undetermined.

References: Tucker and Sampson, 1945, p. 129, (and p.) 138.

J.R.E. 12/11/59.

Figure 33. Sketch map showing the location (A), and a geologic sketch map (B), of the Mastodon mine (topography from U.S.G.S. 15' Cottonwood Spring quadrangle, 1958).

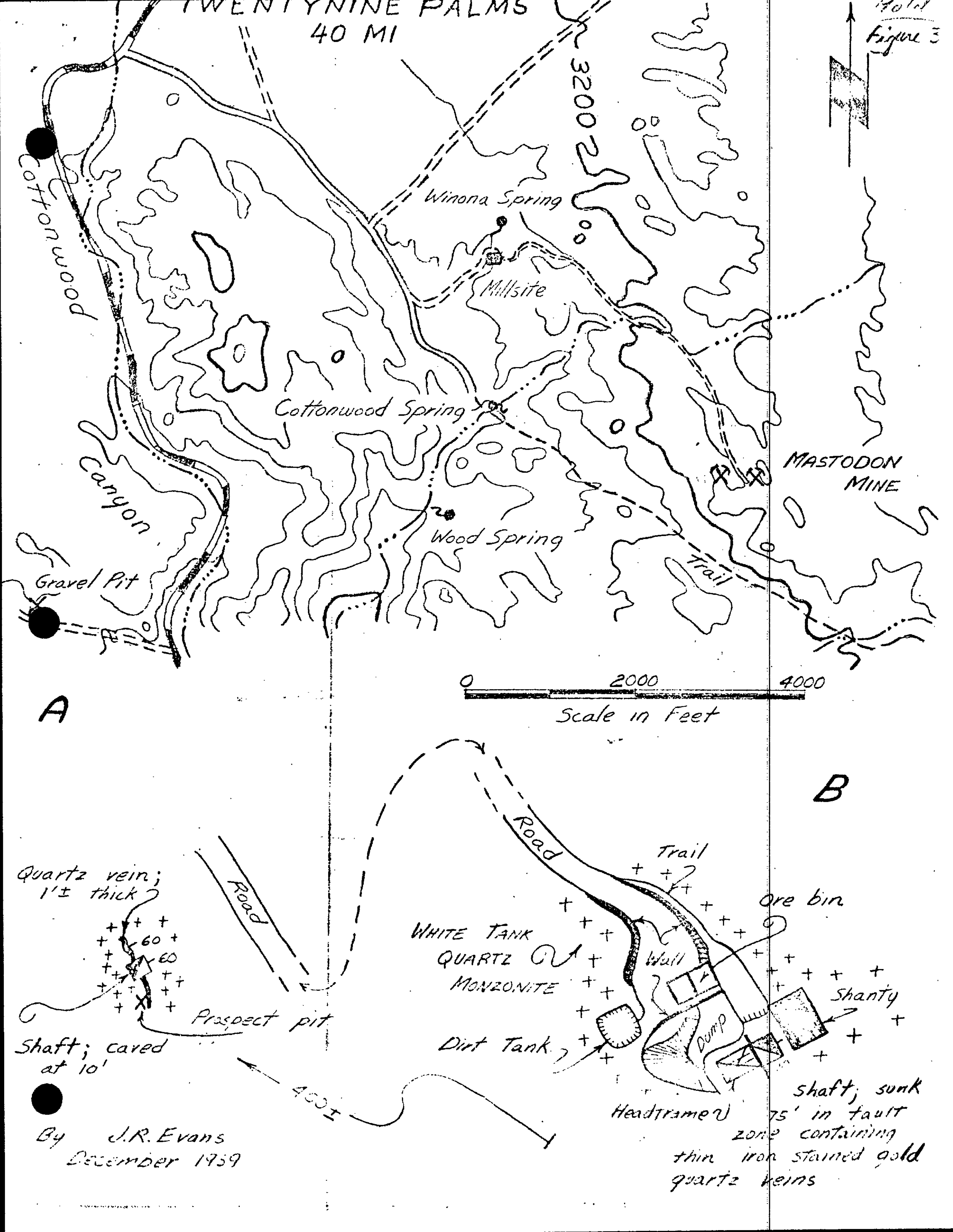


Figure 3
TWENTYNINE PALMS
40 MI
3200
Winona Spring
Millsite
Cottonwood Canyon
Cottonwood Spring
MASTODON MINE
Wood Spring
Trail
Gravel Pit
0
2000
4000
Scale in Feet
A
B
Road
Trail
Ore bin
WHITE TANK QUARTZ MONZONITE
Wall
Shanty
Dump
Dirt Tank
Headframe
Shaft; sunk 75' in fault zone containing thin iron stained gold quartz veins
Quartz vein; 1'± thick
60
60
Road
Prospect pit
Shaft; caved at 10'
By J.R. Evans
December 1959

Meek (Thelma and Desert Gold Group) Mine

Location: Sec. 14 (proj.), T. 2 S., R. 12 E., S.B.M., Pinto Basin quadrangle, 15', 1963; Pinto Mountains, about 4 miles south-southeast of New Dale (site) and 1 mile southeast of the Gold Crown mine (Figure 31).

Ownership: H. G. Frydenlund, Box 704, Twentynine Palms, owns at least 2 unpatented lode claims (March, 1958).

History: Jack Meek owned the property in 1929, and at this time had performed only exploration work consisting of a few shallow shafts sunk on different veins (Tucker and Sampson, 1929, p. 488). Jack Meek owned and intermittently operated the mine on a small scale until his death in the early 1950's.

Geology: The Thelma group is located on a series of generally west-striking quartz veins, ranging in thickness from 1 to 2 feet. The Desert Gold group is located on north-trending and steeply-dipping quartz veins ranging in thickness from 1/2 to 2 feet. The veins cut Mesozoic quartz monzonite and locally are heavily mineralized with hematite showing free gold.

Development: Tucker and Sampson (1945, p. 144) reported that several shafts ranging from 20 to 70 feet in depth were sunk on veins.

Two shafts, which now constitute the main workings are sunk on steeply-dipping and generally north-striking faults. The shaft nearest the house ~~(pl.)~~ is at least 100 feet deep and drifts ~~join~~ connect to it at one or more levels. There is an estimated total of about 400 feet of work. The other shaft, about 500 feet east and higher on the hillslope, is at least 120 feet deep and drifts join ~~to~~ it at one or more levels. Total work here is estimated to be about 700 feet.

Production: Undetermined.

References: Tucker and Sampson, 1929, p. 488; Tucker and Sampson, 1945, p. 144.

J.R.E. 3/11/60

Menifee Mine

Location: SE¼SE¼ sec. 5, T. 6 S., R. 3 W., S.B.M., Romoland quadrangle, 7½', 1953; about 8 miles south of Perris.

Ownership: Ora Rhodes, P.O. Box 915, Perris.

History: Though its date of discovery was not determined, by 1885 the Menifee Mine was well developed and a five-stamp mill was being constructed on the property ~~to avoid the continued shipment of concentrates to San Francisco via San Diego~~ (Mining and Scientific Press, 1885, vol. 51, p. 120). The mine appears to have been operated continuously through 1896 at which time it was owned by H. N. McGready et al., Menifee (Crawford, 1896, p. 312). In 1899, the mine was idle and had passed into the hands of a Chicago interest (Mining and Scientific Press, 1899, vol. 79, p. 750). U. S. Bureau of Mines records show that in 1900 G. S. Allen, Perris, operated the mine, followed in 1901 by W. F. Bray, Perris and in 1903 by Morrison and Anderson, Perris. These men may have been lessees. Tom Chaffin owned the Menifee Mine in 1917 (Merrill and Waring, 1917, p. 533) and as late as 1935 (Sampson, 1935, p. 513). The claim is now part of Rhodes Ranch.

Geology: The vein is no longer exposed but according to an old report it appears to lie along a diorite-schist contact. It strikes northeast and dips 80° NW. to a depth of 40 feet below which it flattens to 65° NW. The vein was reported to range in thickness from one foot to 30 inches ~~in thickness~~ and to yield about $24 per ton in gold. Traces of pyrite were reported present (Storms, 1893, p. 385). Fragments of ore on the old dump resemble the ore from nearby mines in that the fragments are fractured vein quartz with coatings and pockets of iron oxides.

Development: The vein was explored through 4 shafts 30, 55, 100, and 125 feet deep from which drifting and stoping had been accomplished (Mining and Scientific Press, 1899, vol. 79, p. 750; Sampson, 1935, p. 513). ~~At present~~ In 1959, the shafts ~~are~~ were filled and the mine long abandoned.

Production: Compiled by the U. S. Bureau of Mines and published with permission of the owner.

Year	Crude ore (tons)	Recoverable metals Gold (ounces)	Silver (ounces)
1900	-	29.02	282
1901	-	41.12	
1903	45	21.77	

References: Mining and Scientific Press, 1885, vol. 51 no. 7, p. 120; 1899 vol. 79, no. 27, p. 750; Storms, 1893, p. 385; Crawford, 1896, p. 312; Merrill and Waring, 1917, p. 533; Tucker and Sampson, 1929, p. 484; 1945, pl. 35, no. 86; Sampson, 1935, p. 513.

R.B.S. 9/22/59.

Mission Sweet Mine

Location: Sec. 34 (proj.), T. 3 S., R. 13 E., S.B.M., Pinto Basin quadrangle, 15', 1963; Eagle Mountains, about 3 miles southwest of the Black Eagle mine and 9 1/2 miles northeast of the East Pinto Basin-West Pinto Basin-Cottonwood Pass and Black Eagle mine roads intersection (Figure 56).

Ownership: Undetermined.

History: Undetermined.

Geology: Mesozoic hornblende granite is cut by several minor north-trending and steeply-dipping faults that contain gold-bearing quartz veins and stringers. The veins are thin and discontinuous; the thickest one observed was about 8 inches. The hornblende granite is intrusive into old sedimentary rocks, and near the top of a hill about 1,000 feet northeast of the printipal development work it is intrusive into calcitic dolomite. No mineralization was observed in the short adit driven into the contact zone.

Development: The principal workings consist of a few shallow shafts with short drifts. The deepest shaft observed was 18 feet, with 20-foot drifts driven north and south at the bottom in a fault plane. The mine is at an elevation of about 2,200 feet and is idle.

Production: Undetermined.

References: None.

J.R.E. 3/17/60

Mission (Huff-Lane) Mine

Location: Secs. 14 and 21 (proj.), T. 2 S., R. 12 E., S.B.M., Pinto Basin quadrangle, 15 ', 1963; Pinto Mountains, about 2 miles north-northeast of Mission and Sunrise Wells (Figure 31).

Ownership: L. P. Clause, Box 85, Indio, owns 7 unpatented claims and 2 mill sites (March 1958).

History: The mine was discovered by George Lane, Mecca, in 1887, and was owned by him and E. C. Huff in 1929 (Tucker and Sampson, 1929, p. 481). Apparently little work was done until the 1930's. From 1933 to 1936, the mine was owned and operated intermittently by E. C. Huff, 823 South Bonnie Brae Street, Los Angeles. The Mission Gold Mines Company, Mecca, owned and intermittently operated the mine from 1939 to 1942. The present owner, representing the Mission Mining Company, operated the mine in 1951 and 1955.

Geology: Massive, Mesozoic quartz monzonite is cut by a series of semi-parallel quartz veins containing pyrite, chalcopyrite, hematite, gold, and secondary copper and iron minerals. The three principal veins are known as the Water Well Verde, and Lone Star. The Water Well vein has been the most extensively worked.

It strikes N. 20° W., dips 75° - 80° E., is 2 feet in average width, and has a proven surface length of 3000 feet (Tucker 1934, unpublished Field Report No. 124). The Lone Star and Verde Veins are of undetermined extent.

Development: Work began on the Water Well Vein in 1931 and by 1946 a 600-foot shaft had been sunk. On the 125-foot level a drift is driven 533 feet north and 191 feet south. At a point 388 feet from the shaft along the north drift, there is a 120-foot raise on the vein to the surface. These workings developed an ore shoot 2 feet wide and 60 feet long, and ore milled from a stope in this shoot was reported by Tucker and Sampson (1945, p. 139) to have had an average value of $25 per ton in gold. Other work consists of drifts driven north 100 feet, south 120 feet on the 400-foot level; north 325 feet, south 100 feet, on the 600-foot level. The 325-foot north drift was driven to develop an ore shoot 2 feet wide and 200 feet long. Four shipments of ore from this shoot to the Gold Crown Mining Company mill are reported to have averaged $43 per ton in gold (Tucker and Sampson, 1945, p. 139).

In 1934, the Verde shaft was reported to be 350 feet deep, and the Lone Star shaft 50 to 70 feet deep (Tucker 1934, unpublished Field Report No. 124). During certain periods of time in the 1930's and early 1940's it is probable that ore was milled at the Sunrise Mine (Mission) mill about 2 miles south of the mine ~~(pl. 37)~~. Certainly ore was milled there in 1951 and 1955. ~~Neither the mine or the mill was in operation on the day of the property visit.~~

Production: Compiled by the U. S. Bureau of Mines and published with permission of the owner.

Year	Crude Ore (tons)	Gold (oz.)	Silver (oz.)	Copper (lbs.)
1933	20	11	7	
1934	132	33	6	
1936	100	36	7	
1939	189	187		
1941	632	568		
1942	213	277	158	589
1951	122	26	16	
1955 ~~1952~~	10	3		

References: Tucker and Sampson, 1929, pp. 481-482; Tucker, 1934, unpublished Field Report No. 124; Tucker and Sampson, 1945, p. 139.

J.R.E. 3/8/60.

Model (Chuckwalla and Model) Mine

Location: Sec. 2, T. 7 S., R. 14 E., (proj.), S.B.M., Chuckwalla Mountains quadrangle, 15', 1945. The Model mine is reached by about 7½ miles of dirt road extending south of U.S. Highways 60 and 70 from a point 9 miles west of Desert Center.

Ownership: William R. McGowen, Box 461, Desert Center (1959).

History: This property was described as the Chuckwalla and Model group of mines by Tucker and Sampson (1945, p. 129). Fifteen claims were then held by Mrs. A. R. Enloe, Los Angeles, and Leslie Waldrip, Indio. U.S. Bureau of Mines records show that this mine's best years were in 1902 and during the thirties. The most recent activity was in 1947 to 1949 (Personal communication, Wm. R. McGowen, March 30, 1959) but no record of production was found for that period.

Geology: A fault zone as much as 3 feet wide is exposed for about 200 feet along the north slope of a low granite ridge. It strikes N. 40° E. and dips 70° NW. Irregular bodies of crushed vein quartz lie along the fault zone and reach a maximum thickness of one foot. Both the vein matter and the enclosing gouge and wall rock are stained and veined with iron oxides. The fault appears to split, forming two distinct zones through the southwestern half of its exposed length.

Development: The fault is explored by a 50-foot inclined shaft and several trenches 20 to 50 feet long and as much as 10 feet deep. Because no copper or lead minerals were noted in these developments, and those metals are reported from this mine, it is probable that undescribed mine openings are present on other claims of this group.

Production: Compiled by the U.S. Bureau of Mines and published by permission of the owner.

Recoverable Metals

Year	Crude ore	Gold (ounces)	Silver (ounces)	Copper (pounds)	Lead (pounds)
1902	150	72.57			
1934	64	56.40	208	311	1,270
1935	46	25.82	85	179	1,465
1936	10	2.57	1		
1940	75	21	14		
1941	20	25			
1946	3	3	3		

References: Tucker and Sampson, 1945, p. 129; Goodwin 1957, p. 601.

R.B.S. 4/30/59

Moose Mine

Location: Secs. 11 and 12 (proj.), T. 2 S., R. 12 E., S.B.M., Dale Lake quadrangle, 15', 1956; Pinto Mountains, about 4 miles north of Mission and Sunrise Wells and 2 miles east of the Gold Crown mine (figure 31).

Ownership: Walt Rose, General Delivery, Twentynine Palms, owns at least 1 unpatented claim (March 1960).

History: The Moose mine is one of the 3 mines owned and operated by Sunrise Mines Incorporated, San Diego, in the 1930's. In 1933, the property consisted of the Moose group of 3 claims (Tucker, 1933, unpublished field report No. 121). Willard H. Allen owned and operated the mine in 1939. Earl Geiger owned and operated the mine in 1941 and 1942 (see Sunrise mine description).

Geology: A north-trending and 68° W.-dipping fault cuts Mesozoic quartz monzonite, and contains a gold-quartz vein 6 feet in average width (Tucker, 1933, unpublished field report No. 121).

220

Development: The main workings consist of an inclined shaft sunk 203 feet in the fault plane. There is a 50-foot drift driven north, and a 90-foot drift driven south, on the 70-foot level to develop the 70-foot ore shoot. At the shaft collar level a drift adit is driven south on the vein about 90 feet. A lower adit is driven south 200 feet on the vein. The mine is worked intermittently by the present owner.

Production: Compiled by the U. S. Bureau of Mines and published with permission of the owner.

Year	Crude ore (tons)	Gold (oz.)	Silver (oz.)
1932	100	58	23
1939	3	1	1
1941	75	32	7
1942	75	35	15

References: Tucker, 1933, unpublished Field Report No. 121.

J.R.E.

Morning Star Mine

Location: Sec. 30 (proj.), T. 6 S., R. 16 E., S.B.M., Chuckwalla Mountains quadrangle, 15', 1963; about 1 1/2 miles southwest of Corn Spring and 7 miles southeast of Desert Center.

Ownership: Undetermined (1959).

History: This mine was worked in the late 1920's by the Morning Star Mining Company (Tucker and Sampson, 1929, p. 485).

Geology: The Morning Star mine explores a mineralized aplite dike which strikes N. 35° E., along the east slope of a ridge cut in Mesozoic granite. The dike is about 6 feet wide and vertical. It is one of a system of brown-weathering, generally porphyritic dikes of granitic composition in the north-central part of the Chuckwalla Mountains. These dikes are usually barren. They have been identified as quartz latite porphyry (Miller, 1944, p. 20, 65).

The dike on the Morning Star claims appears to have been shattered, and the resulting boxwork of fissures filled by quartz and pyrite. The pyrite has altered to oxides of iron. Free-milling gold was observed in a specimen of the dike. No published assay data were found.

Development: A 50-foot shaft was sunk on the dike. About 500 feet down the slope to the northeast a 160-foot adit was driven northwest to cross-cut the dike, but work was suspended before the dike was reached.

Production: Undetermined.

References: Tucker and Sampson, 1929, p. 485; Miller, 1944, p. 20.65.

R.B.S. 3/13/59.

Morning Star (Jackknife, Morgan) Mine

Location: ~~This group of seven claims is in the~~ NW¼ NW¼ sec. 6, T. 2 S., R. 24 E., and SW¼SW¼ sec. 31, T. 1 S., R. 24 E., S.B.M., Vidal quadrangle, 15' 1950; 6 miles south of Vidal in a high valley about half a mile southwest of the Mountaineer Mine and accessible by trail from that property (fig. 34/).

Ownership: Benjamin M. Stansbury, P.O. Box 315, La Canada (1960) owns seven claims.

History: According to Jack Stewart, a resident of Parker, Arizona, the Morning Star mine used to be known as the Morgan claims. Though no record of activity was found under that name, a report on the old Jackknife claims was included in the Fifteenth Report of the State Mineralogist in which Cal Morgan and H. D. Bradley are given as owners (Merrill and Waring, 1917, p. 83). In 1929 ~~it was reported~~ Tucker and Sampson (1929, p. 482) reported that C. W. Mitchell, Parker House, Boston, Massachusetts had acquired the Jackknife along with the Calzona and Steece properties. The name Morning Star was used by the Morning Star Mining Co. which held the property in 1945 (Tucker and Sampson, p. 139). There appears to have been little activity since that date.

Photo 18

519

Geology: The rocks of the area are limestone, dolomite and gypsum interbedded with schists. They strike N. 50° -60° E., dip 45° - 50° NW. and are cut by a system of northeast-trending, low-angle faults and shear zones and northwest-trending high-angle faults. The valley trends northeastward along the strike of the rocks. A contorted gypsum unit as much as 100 feet in thickness crops out along the valley floor and the base of the northwest slope. Faulting and shearing appear to have occurred roughly parallel to, and in part within, this unit. At the northeast end of the valley this shear zone is crossed by a northwest-trending fault. Mineralization is extensive in and about the junction of the fault and the shearing forming an ore shoot which plunges 30° to the northwest ~~(Fig. [illegible])~~. Gold occurs in a gangue composed of iron and manganese oxides, limestone, schist, barite, chalcopyrite, secondary copper minerals, and quartz. The copper minerals are chrysocolla and malachite. The ore is in pockets, veins, and zones of fault breccia.

Development: A 100-foot vertical shaft was sunk on the northwest-trending fault. At the 60-foot level a raise was driven S. 80° E. at about 30°. The raise explores a tabular ore body, reported to have been as much as 6 feet in thickness (Tucker and Sampson, 1945, p. 139). The ore body strikes N. 80° E. and dips 35° NW. It appears to lie parallel to the bedding of the country rock. The raise is about 100 feet long and was broadened, by irregular stoping, to a maximum width of about 30 feet. At its upper limit the raise opens to the foot of a 30-foot shaft from the surface. At the foot of the raise a 15-foot drift was driven N. 50° W. and a 40-foot drift S. 50° E., on the fault, from a chambered area adjoining the 100-foot shaft. The upper limit of the ore body is exposed in shallow working on the southeast side of the valley about 100 feet northeast of the main shaft. Here it occupies a 3 to 4 feet-thick breccia zone. As exposed in the workings the lower terminus of the ore body is at the vertical fault although thin stringers lie in the fault zone. It is possible that the mineralized zone extends southwest of the fault at a lower level but the lower 40 feet of the main shaft shows no evidence of this.

When visited in 1957, all former buildings and the head frame of the vertical shaft had been destroyed by fire. The mine was revisited in April, 1961, by which date a new head frame, collar and ladder had been installed on the main shaft. Remains of a tramway still stand on saddles to the northeast along the trail to the Mountaineer mine.

Production: By 1932, an estimated $100,000 in ore averaging $60 per ton in gold and copper had been taken from these claims.

References: Merrill and Waring, 1917, p. 543; Tucker and Sampson, 1929, p. 482; 1945, p. 139; Mitchell, 1932.

R.B.S. and C.H.G. 12/19/57

R.B.S. 4/20/61

Morris Washington Deposit

Location: S 1/2 sec. 22, T. 4 S., R. 4 W., S.B.M., Steele Peak quadrangle, 7 1/2', 1953. The deposit is on the Morris Washington Ranch, about 3 miles northwest of Perris.

Ownership: Undetermined.

History: Undetermined.

Geology: A pegmatite dike as much as 3 feet wide is exposed on the southeast slope of the hill. It strikes north and dips 30° W. Milky- to vitreous quartz is the chief constituent of the dike; the other components, feldspar and biotite mica, are localized in pockets and along the margins of the body. The dike is fractured and in an irregular central zone of the fissures and cavities are filled with oxides of iron. Some of the stains resemble altered, lath-shaped biotite crystals.

A post-dike system of fractures and faults strikes N. 20° - 30° W., and dips 70° - 75° SW., cutting the country rock and the dike. These breaks range from a fraction of an inch wide to shear zones 20 feet in width; they are filled with granular carbonate.

The presence or percentage of gold, or other precious metals in the deposit, was not determined.

Development: The principal workings are a 30-foot shaft inclined 30° W. and a partially caved drift adit about ten feet long which terminates at the collar of a second shaft of undetermined but probably shallow depth. These two openings are about 10 feet apart in the face of a cut on the east slope of the hill. They explore the pegmatite dike.

Two open cuts, one on the northwest slope and one on the south slope, explore northwest-striking faults. The one on the northwest slope follows a shear zone 20 feet wide which contains veins and lenses of calcium carbonate as much as 3 feet wide. The south cut explores a shear zone about 6 feet wide. Pegmatite dikes with a maximum width of 2 inches are exposed in the cut. Here carbonate veins a fraction of an inch wide form a coarse boxwork in the deeply weathered country rock. A 10-foot drift extends beyond the face of the cut and terminates at a 5-foot winze.

Production: Undetermined.

References: None.

R.B.S. 6/16/59.

Moser (Gold Flake (?), Patches (?)) Claims

Location: Secs. 17 and 20 (proj.), and SW 1/4 sec. 21, T. 2 S., R. 16 E., S.B.M., Coxcomb Mountains quadrangle, 15', 1963; on the east slope of the Coxcomb Mountains.

Ownership: Five unpatented claims, Leo, Maxie, Jenny, Moser, and Bamby are held by Carl Moser, 1732 West Rosecrans, Gardena, and Edward-Severson, 2302 West 154 Street, Gardena.

Mr. Moser holds the Leo, Maxie, and Bamby claims and a half interest in the Jenny and Moser claims. In 1959, the Leo claim was under lease to Wright Randall. Mr. Severson holds half interest in the Jenny and Moser claims and leases Moser's half interest.

History: This deposit is probably the site of the old Gold Flake and Patches claims which were shown by Tucker and Sampson (1945, pl. 35). The history of those claims is unknown. Mr. Moser first held the property in 1944.

Geology: The Moser claims are in an area underlain by Mesozoic granodiorite and complexly intruded pendants of metamorphic rocks of probable early Mesozoic age. A quartz vein ranging in thickness from several inches to as much as 5 feet is unevenly exposed for about 7,000 feet. The vein strikes N. 40° W., dips 65° SW, and lies in the plane of a fault. The vein quartz is strongly fractured and the contained metal-bearing minerals are largely altered by meteoric water. The vein contains irregular masses of pyrite, iron oxides, and, locally, stains and thin crusts of copper carbonates. Galena is present but is largely altered to earthy cerrusite and anglesite. The gold is free milling and is most abundant in concentrations of lead minerals. Silver is present in the galena and possibly in unidentified secondary minerals.

Photo 19

Development: When visited in 1959 development was proceeding on the Jenny and Moser claims. On the Jenny claim an inclined shaft had been sunk about 130 feet on the vein. About 110 vertical feet down the slope a crosscut adit extends 200 feet southwest to the vein. From the face a drift was run 50 feet northwest on the vein and joins with the inclined shaft about 20 feet northwest of the adit. Another drift, being driven southeast on the vein, has been carried a distance of 450 feet, well on to the Moser claim. In this southeast drift it is hoped to cross a downward extension of reportedly rich ore found in the outcrop.

The former owners worked the deposit through several shallow prospects and short adits to the southeast of the present (1960) development and probably were responsible for much of the work on the aforementioned inclined shaft, ~~(fig.)~~.

On the Leo claim there is an old shaft 20 feet deep at the bottom of which is a 12-foot crosscut, and an open cut just southeast of the shaft. An ore shoot is exposed in a prospect near the end of the road and close to the boundary between sections 17 and 20.

Production: No sustained production has been reported from these claims. In 1947 and 1948, a total of 18 tons of select(?) ore was shipped for smelting. According to the owner, this ore yielded $125 per ton in gold and silver.

References: Tucker and Sampson, 1945, pl. 35.

R.B.S. 11/17/59

Mountain Queen Mine

Location: NW 1/4 NW 1/4 sec. 7, T. 2 S., R. 20 E., S.B.M., Rice quadrangle, 15', 1954; on the east slope of the Arica Mountains.

Ownership: Undetermined (1958).

History: This property was located (date unknown) as the Juanita No. 5 claim, however, U.S. Bureau of Mines records show that in 1938 it was called the Mountain Queen. The owner at that time was H. C. Wiley, Rice. By 1945, it had become one of the Lum Gray claims (Tucker and Sampson, 1945, p. 139-140).

Geology: The Mountain Queen mine explores two gold-bearing shear zones in a homoclinal section of schist and carbonate rocks exposed on the east slope of the Arica Mountains. In the mine area, the bedding and schistocity of the rocks strike N. 60° W. and dip 50° SW. One shear zone is exposed high on the slope for a distance of about 500 feet. It dips and strikes about the same as the country rocks. This zone is roughly 3 feet wide and is mineralized with lenses, pods, and veins of iron-stained quartz as much as one foot thick. The other shear zone is about 1,000 feet to the northeast and roughly 100 feet lower on the slope. It strikes N. 20° E., dips 55° NW., and contains a fractured quartz vein as much as 6 feet wide.

The quartz of both shear zones is stained and pocketed with oxides of iron and manganese and traces of malachite.

Development: The upper shear zone was developed from 2 drift adits entering opposite sides of the ridge. One adit was driven S. 50° E. for an undetermined distance. The other adit enters the south slope of the ridge and trends N. 65° W. In 1945, this adit was reported to be 100 feet long and from it a winze descends at an inclination of 50° to 200 feet (Tucker and Sampson, 1945, p. 139-140). It might connect with the other adit through underground workings, ~~but this was not proven~~. Within the first hundred feet of the portal the vein was stoped to the surface. ~~The stope was timbered with stulls but the adits are untimbered.~~

Development on the lower shear zone consists of a 30-foot vertical shaft and 2 shafts, about 200 feet apart, inclined on the dip of the vein. One of the inclined shafts is 25 feet deep--the other of undetermined depth.

Production: According to U. S. Bureau of Mines records, (published with permission of the owner) in 1938 this mine yielded 187 tons of ore from which 74 ounces of gold and one ounce of silver were recovered.

References: Tucker and Sampson, 1945, p. 139-140.

R.B.S. 4/11/58.

Mountaineer (Calzona) Mine

Location: S½ sec. 31, T. 1 S., R. 24 E., S.B.M., Parker Quadrangle, 15' 1950; on the east slope of the Riverside Mountains, 36 miles north of Blythe.

Ownership: Hugh Gordon, 727 West 7th Street, Suite 7, Los Angeles.

History: This group of claims was owned and worked by Calzona Mines Company from 1898 to 1920 (Merrill and Waring, 1917, p. 542-543). In 1920, the property was acquired by Mountaineer Mining Company who held it until October 1935. In 1935, a 50-ton flotation plant was installed on the property. Water for operating the mine and mill was pumped 1½ miles from the Colorado River (Tucker and Sampson, 1945, p. 140). Early in 1960, the property was leased and worked briefly by Figueroa Mines, P.O. Box 453, Blythe, who shipped a 21-ton lot of select ore to American Smelting and Refining Co., Hayden, Arizona.

Geology: The country rock is sheared and contorted limestone, dolomite, and schist which strike northeast and dip 40°-50° NW. The mine explores a mineralized zone at and near the junction of two faults (fig. 34). One fault is parallel to the bedding of the country rock and is exposed on the southeast side of a narrow, northeast-trending canyon. The other fault strikes N. 25° W., dips from vertical to steeply northeast and is exposed on both sides of the canyon.

Figure 34.

Gold occurs in a gangue of quartz, barite, chalcopyrite, malachite, chrysocolla, and oxides of iron and manganese. The ore forms irregular lenticular bodies ranging from 0 to 10 feet in thickness and a few tens of feet in lateral and vertical extent. The ore bodies appear to have formed both by fissure filling and replacement. One of the two principal ore bodies was encountered at the 150-foot level. It is a mass of altered and mineralized country rock, as much as 10 feet in thickness and of undetermined lateral extent, lying on the fault parallel to the bedding of the country rock and extending northeastward from the junction of the two faults. The other ore body was discovered on the northwest-trending fault between the 150-foot level and the northwest adit. (fig. 4). The thickness and extent of this body was not determined, the workings being inaccessible.

The Mountaineer mine has been examined as a prospective source of manganese but no manganese production has been reported (Wilson, 1943, p. 184). Samples of Mn oxides, taken from the Mountaineer and the neighboring Morning Star mines, are reported (personal communication, Danny G. Figueroa) to contain as much as $19 per ton in gold.

Development: The mine has been worked from a west drift adit ~~(the west adit)~~ driven 150 feet northwest into the northwest side of the canyon on the northwest-trending fault and a 150-foot shaft inclined 50° northwest on the fault junction, driven from low on the southeast side of the canyon. A manway was sunk from the collar of the shaft to a point 30 feet southwest of the shaft at the 80-foot level and the ~~two~~ manway and shaft were connected by a drift. The manway appears to follow a barren shear zone which might be the same fault as that extending northeast of the junction. At about the 115-foot level on the shaft a short drift was driven northeast from which a winze was sunk, at about 40°, which crosses above the shaft to a gallery just above its base. From the base of the shaft a gallery was driven northeast into ore which was stoped from the gallery and explored through a 65-foot winze. A 190-foot drift extends northwest from the base of the shaft. A raise connects the drift to the northwest adit and an additional raise extends from the adit to the surface. An undetermined amount of stoping was done adjacent to the raises. Figure 34 shows the principal features of the mine and orientation of the workings on the faults.

Production: Compiled by the U.S. Bureau of mines and published with permission of the owner.

Year	Crude ore (tons)	Gold (ounces)	Silver (ounces)	Copper (pounds)
1915	50	92.01	10	7,656
1916	46	28.69		4,050
1934	1,495	81.35	12	
1935	(45 (12 concentrates)	80.48		1,273

The 21-tons of ore shipped in 1960 yielded $62.70 in gold (@ $32.3185 per ounce) and $32.34 in copper (@ $0.30725 per pound) per ton.

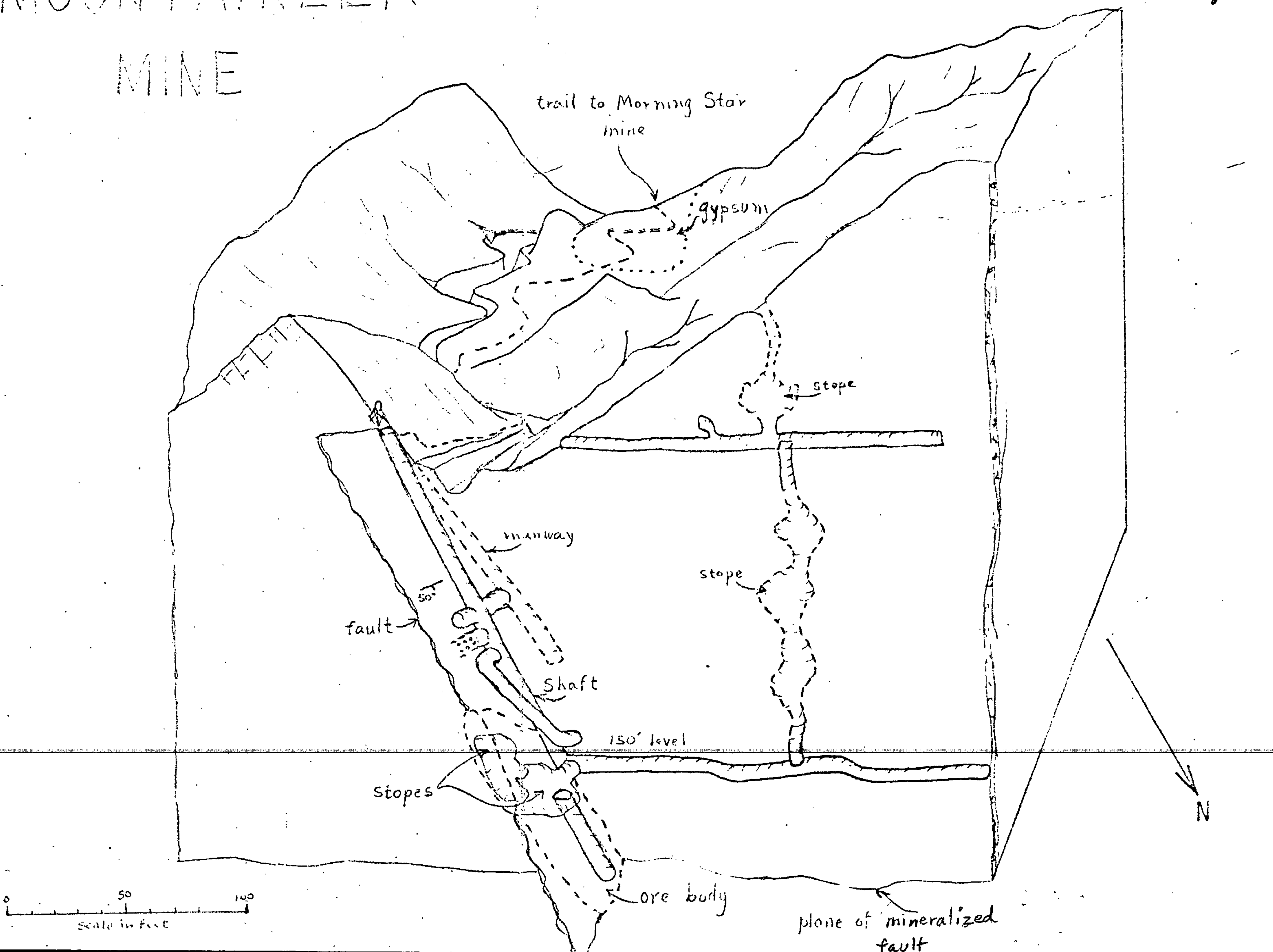
References: Merrill and Waring, 1917, p. 542-543; Tucker and Sampson, 1929, p. 477; Wilson, 1943, p. 184; Tucker and Sampson, 1945, p. 140, pl. 35).

R.B.S. 4/20/61.

MOUNTAINEER MINE

Riverside County

Figure



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G-k

Mystery (Mirtry) Mine

Location: Sec. 15?, T. 2 S., R. 13 E., S.B.M. (proj.), ~~U. S. Army Corps of Engineers (Eagle Tank)~~ Pinto Basin quadrangle, 15', 1963), at the base of the north slope of the Eagle Mountains, Joshua Tree National Monument, about 6 miles southeast of Mission Well (figure 31). Not confirmed, January 1960.

Ownership: Undetermined, 1960.

History: A small scale gold placer operation carried on from 1933 to 1936 when L. L. Benthall, Indio owned the ~~project~~ property.

Geology: Alluvium was processed by placer methods for gold.

Development: Undetermined, but was reported to be a small scale hand operation (U. S. Bureau of Mines records).

Production: Compiled by the U. S. Bureau of Mines.

Year	Yardage handled	Gold ounces
1933	185	9
1934	250	6
1935	500	13
1936	100	4

References: None.

J.R.E.

New El Dorado (El Dorado) Mine

Location: Secs. 16 and 17, T. 3 S., R. 10 E., S.B.M. (proj.), U. S. Army Corps of Engineers (Pinkham Well) Hexie Mountains quadrangle, 15', 1943; Hexie Mountains, Joshua Tree National Monument, about 5 miles southeast of White Tank, and about 1 mile southwest of the West Pinto Basin Road (see pl. 2 A). Figure 35

Ownership: The New El Dorado Mining Company, 308 Orange Grove Ave., Alhambra, owns a patented millsite in sec. 24, T. 3 S., R. 8 E., S.B.M. (Pinyon Well site) located August 31, 1921, and 3 patented lode claims in secs. 16 and 17, T. 3 S., R. 10 E., S.B.M. (proj.) located April 5, 1906.

History: Originally located by Fred Vaile, Indio, in 1911 as the El Dorado Mine. The first record of production of gold-silver ore was in 1911, and the last in 1938. In 1929, the mine was operated by John White, San Bernardino, who leased from Fred Vaile, Los Angeles. Workings consisted of a 500-foot shaft connected by north drifts on the 100, 200, 300, 450, and 500-foot levels (Tucker and Sampson, 1929, p. 485).

Figure 35

Geology: A major fault striking N. 20° W. and dipping 76° E. cuts the Precambrian Pinto Gneiss which here has been carved into an elongate east-trending ridge (figure 36). Oxidized milky quartz in a vein as much as 4 feet thick, mineralized with gold, silver, and galena occurs along the fault.

Development: At least 2,000 feet of drifts, shafts and minor crosscuts have been worked in and adjacent to the plane of the fault. The main shaft is inaccessible below the 90-foot level which contains about 800 feet of drifts and minor crosscuts (figure 36). An indistinct jeep road leads west about 5 miles from the mine, into the Pleasant Valley, and then southeast about 4 miles to the Pinyon Well millsite. The mine is idle.

Figure 36

Production: Compiled by the U. S. Bureau of Mines and published with permission of the owners.

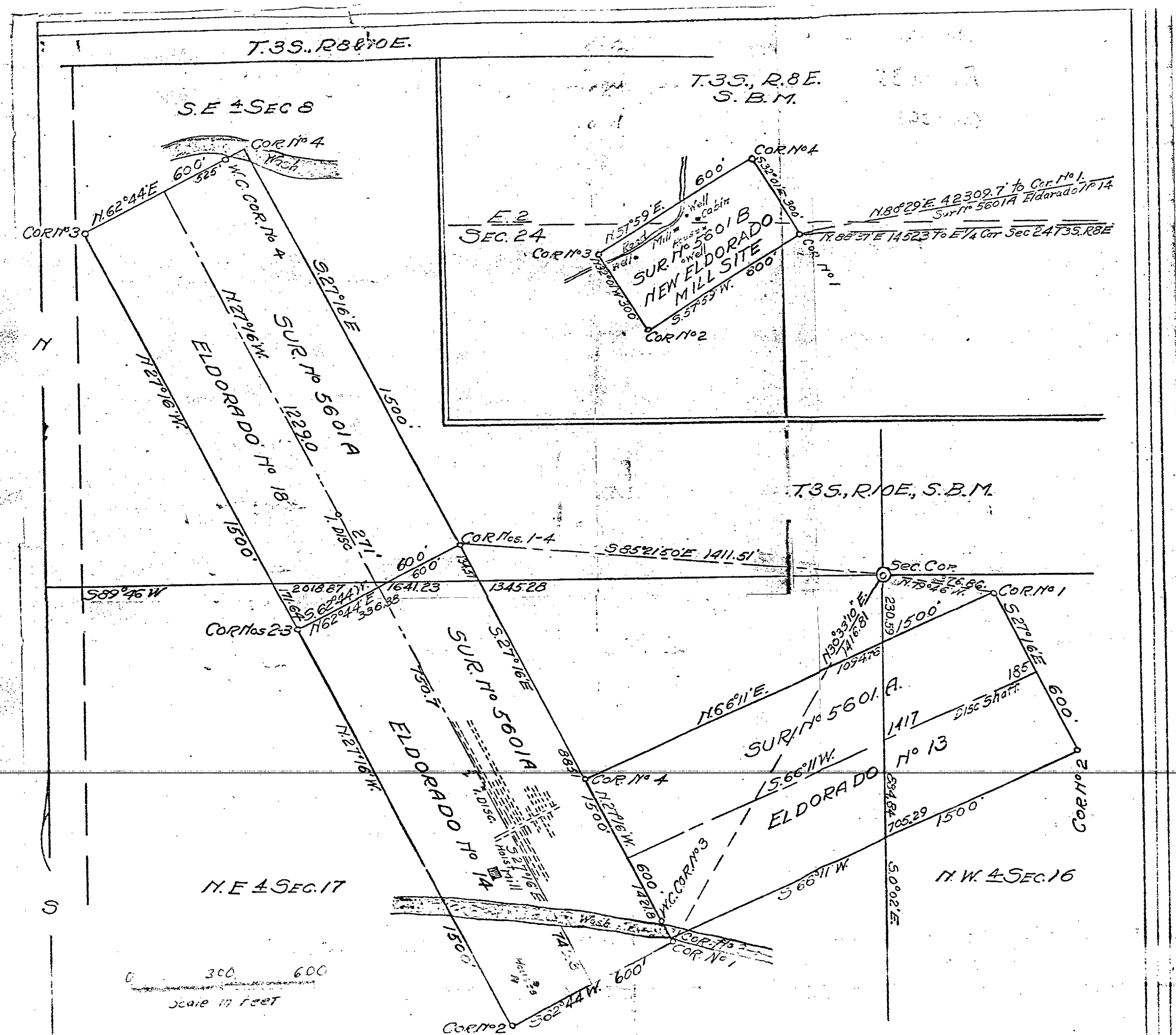
Year	Crude ore (tons)	Recoverable Metals Gold (ounces)	Silver (ounces)	Lead (pounds)
1911	18	9	4	
1912	53	22	7	
1913	739	564	147	
1914	1,033	464	119	
1915	1,072	331	73	
1916	549	172	29	
1930	260	83	18	
1931	3	4	10	2,041
1935	200	30	9	
1936	400	108	23	
1937	1,000	190	121	
1938	75	30	31	

The "Eldorado (New Eldorado) mine" has been described (Brown, 1923, p. 266) as a source of vanadium, the ore mineral being vanadinite, but no formal report of vanadium production appears to have been made.

References: Brown, 1923, p. 266; Tucker and Sampson, 1929, p. 485.

J.R.E. 12/9/59

Figure 35. Plat of the lode claims and mill-site of the New Eldorado Mining Company (Survey No. 5601- A-B; surveyed October 25-30, 1921; patent no. 919797 issued October 10, 1923).


T.3S., R8&10E.
T.3S., R.8E.
S.B.M.
S.E ¼ SEC 8
E/2
SEC. 24
SUR. No 5601 B
NEW ELDORADO
MILL SITE
N.88°29'E. 42309.7' to Cor. No 1, Sur No 5601A Eldorado No 14
N.88°37'E 14523.7 to E¼ Cor Sec 24 T3S. R8E
T.3S., R.10E., S.B.M.
SUR. No 5601A
ELDORADO No 18
ELDORADO No 14
SUR. No 5601. A.
ELDORADO
No 13
S.85°21'50"E. 1411.51'
Sec. Cor.
S.89°46'W
N.E ¼ SEC. 17
N.W. ¼ SEC. 16
S.0°02'E.
Wash
0 300 600
Scale in Feet
N
S

New Eldorado (Pinyon Well) Millsite

Location: $N\frac{1}{2}SE\frac{1}{4}$ sec. 24, T. 3 S., R. 8 E., S.B.M., Lost Horse Mountain quadrangle, 1958; Joshua Tree National Monument, on the south side of Pushawalla Canyon trail at the east margin of the Little San Bernardino Mountains.

Ownership: Fred Vaile, Los Angeles (1929). Undetermined (1960).

History: Pinyon Well was the only water supply for mines operated at different times in this region in the 1890's. In 1895, ore from the Desert Queen mine is reported to have been milled here in a 2-stamp mill (W. F. Keys, oral communication January 1960). In 1918, the wreck of a 2-stamp mill, 2 deserted cabins, several abandoned shafts, and 2 wells marked the spot (Brown, 1923, p. 267). In 1921, the New Eldorado millsite of 4.13 acres was located at Pinyon Wells. Patent was issued in 1923 and the wells supplied water through a pipe line to the El Dorado Mine, about 9 miles east, in the 1920's. The wells have not been used for many years, probably not since the Eldorado mine closed in the late 1930's.

Geology: The Pinyon well site is underlain by coarse-grained White Tank ~~quartz~~ monzonite of Mesozoic age. A shear zone strikes N. 70° W., dips 70°-75° NE., and has been explored, apparently for water, by 3 shafts over a distance of about 400 feet.

Development: In 1923, patent plats indicated 3 wells, 2 cabins, and a mill building on the property.

References: Brown, 1923, p. 267.

C.H.G. 4/7/58.

Figure 36. Sketch map showing the location (A), and a geology on the 90-foot level (B), of the New El Dorado mine (Topography from U.S.A.C.E. 15' Pinkham Well quadrangle, 1943).

North Star Mine

Location: NW 1/4 sec. 6 (proj.), T. 2 S., R. 10 E., S.B.M., Valley Mountain quadrangle, 15', 1956; Pinto Mountains, Gold Park, about 8.3 miles S. 30° E. from Four Corners, Twentynine Palms.

Ownership: Undetermined.

History: The North Star mine was originally located as the Atlanta, and in 1920 was owned by the Gold Park Consolidated Mines Company, with offices at 1021 Black Building, Los Angeles. By 1929, J. Klugh of Pasadena owned the mine and it was known as the North Star group (Tucker and Sampson, 1929, p. 472). By 1945, the property was owned by Floyd Mining and Milling Company, Earl F. Skadan, president; G. C. Zimmerman, secretary, Norco (Tucker and Sampson, 1945, p. 140).

Geology: Mine workings are in quartz veins in a north-trending, nearly vertical fault zone which cuts the Precambrian Pinto Gneiss. The mineralized fault zone is exposed through a distance of 660 feet by the mine workings (fig. 37). Veins are post-faulting and are strongest where fluids have crossed zones of weakness. Accordingly, the quartz veins are as much as 2 feet thick in the fault zone. The quartz veins contain disseminated grains of pyrite, altering to limonite, and possibly contain gold.

Development: All mine workings are in the fault zone and have exposed it nearly continuously along a north-south line for a distance of 660 feet (fig. 37). The uppermost shaft is sunk 20 feet vertically on a gouge zone 1-foot thick. About 140 feet south another shaft is sunk 25 feet (vertically). A trench, from 0-6 feet deep, extends north about 80 feet from this shaft. Approximately 80 feet further south is a 7-foot deep trench, 55 feet long ending in a burrow-like adit that opens south and extends inward 15 feet. About 165 feet south of the mouth of the burrow an adit is driven north at least 140 feet. A raise is driven to the surface 135 feet from the portal. It opens a few tens of feet downslope from the burrow. Next in sequence, 110 feet south, is an adit driven 250 feet N. 5° W. (fig. 1/). About 110 feet south of lower adit, is what appears to be the discovery shaft. It is the most ancient of all workings and is sunk vertically at least 50 feet. The mine is idle.

Production: Undetermined.

References: Tucker and Sampson, 1929, p. 472; Tucker and Sampson, 1945, p. 140.

J.R.E. 2/10/59.

Figure 37

North Star (Sunset) Mine

Location: Sec. 14, T. 2 S., R. 12 E., S.B.M. (proj.), ~~U. S. Army Corps of Engineers~~ (~~Eagle Tank~~ Pinto Basin) quadrangle, 15', 1943; Pinto Mountains, about 2½ miles north of Mission and Sunrise Wells (~~pl. 3~~ figure 31).

Ownership: Mr. Ross and Mr. Carpenter, 4401 Keystone Ave., Culver City, own at least one unpatented claim (March 1960).

History: Undetermined.

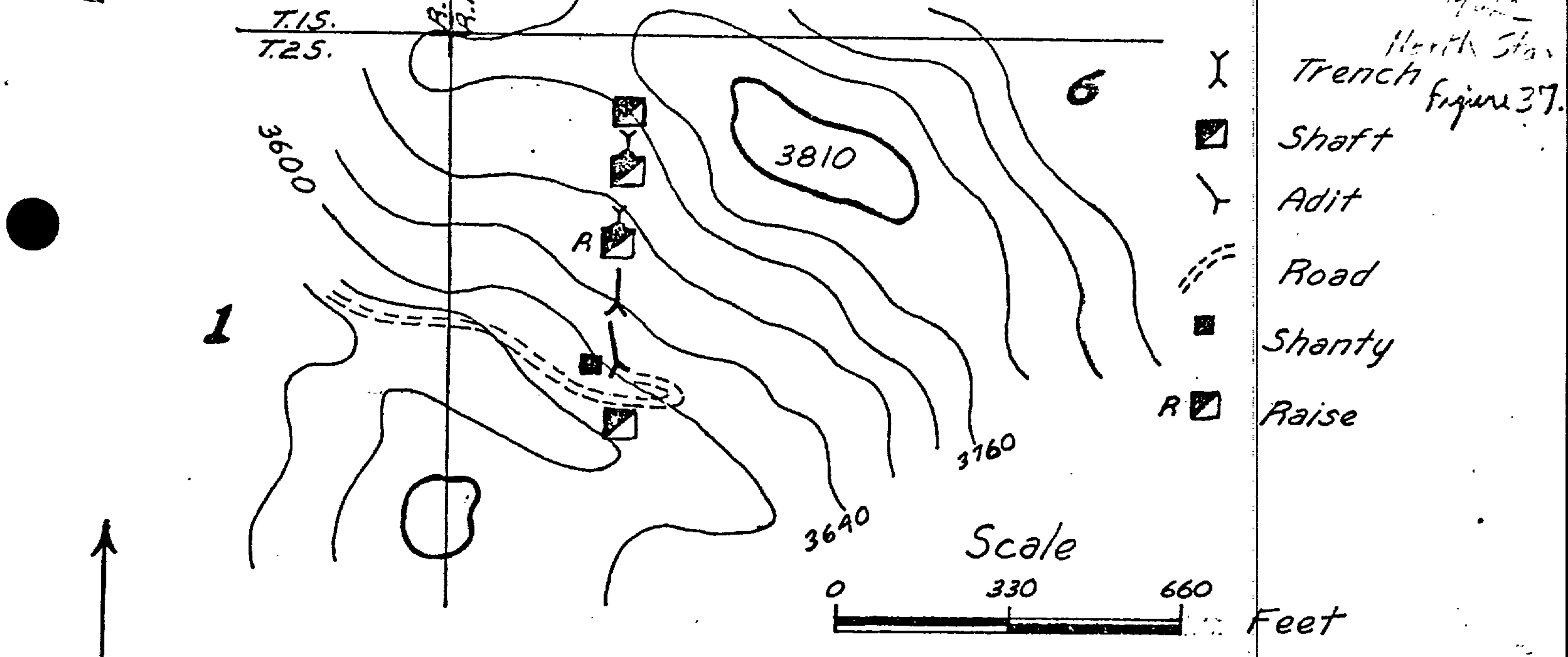
Geology: Massive quartz monzonite is cut by a north-trending vertical fault containing quartz veins as much as 6 inches wide.

Development: A vertical shaft is sunk 100 feet in the plane of the fault. The mine is worked intermittently by the owners.

Production: Undetermined.

References: None.

J.R.E. 3/9/60.


T.1S.
T.2S.
6
1
3810
3600
3760
3640
R
Trench
Shaft
Adit
Road
Shanty
Raise
Scale
0
330
660
Feet
figure 37.

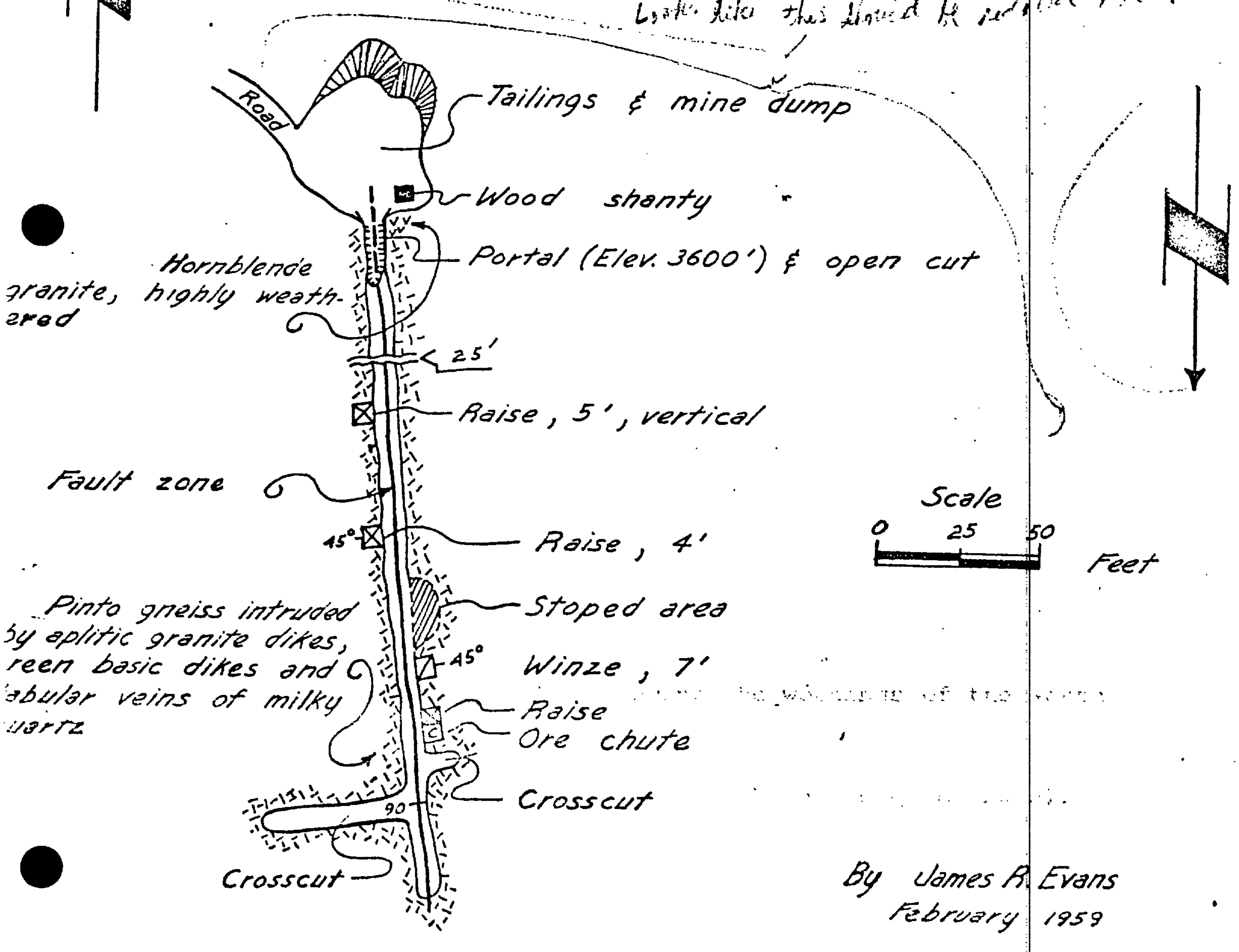

Tailings & mine dump
Road
Wood shanty
Portal (Elev. 3600') & open cut
Hornblende granite, highly weathered
25'
Raise, 5', vertical
Fault zone
Raise, 4'
45°
Stoped area
Winze, 7'
45°
Raise
Ore chute
Crosscut
90
Crosscut
Pinto gneiss intruded by aplitic granite dikes, green basic dikes and tabular veins of milky quartz
Scale
0
25
50
Feet
By James R. Evans
February 1959

Figure 31. Map showing the workings of the North Star mine and a geologic sketch map of the lower adit level (topography from U.S.G.S. 15' Valley Mountain quadrangle).

Nuisance Group

Location: NE 1/4 sec. 12 (proj.), T. 2 S., R. 9 E., S.B.M., Valley Mountain quadrangle, 15', 1956; Pinto Mountains, Gold Park area, 9 1/4 miles S. 25° E. of Four Corners, Twentynine Palms.

Ownership: Undetermined.

History: Virginia Downs filed on the property November 1, 1955.

Geology: Thin veins of gold (?)-bearing quartz occur in Pinto Gneiss. They are strongest along and in the plane of a fault which trends north, and dips 20° west.

Development: An inclined, but partly-caved shaft has been sunk to an undetermined depth in the plane of the fault. The shaft is in the central part of a shallow open cut, which is in the north part of a larger roughly circular open cut that leads into the portal of an adit. The adit has been driven south about 40 feet in the fault plane.

Production: Undetermined.

References: None.

J.R.E. 3/20/59

Oehl Placer Claim

Location: Sec. 1, T. 2 S., R. 12 E., S.B.M. (proj.), Dale Lake quadrangle, 1956; Pinto Mountains, about 3/10 mile south of the Rose of Peru mine and 4½ miles northeast of Mission and Sunrise Wells ~~(see pl. 31)~~ figure 31.

Ownership: Bonnie H. and Dean H. Oehl, 77 E. 9th Ave., San Bernardino own 1 unpatented claim.

History: The mine was discovered and worked in the 1930's. No work has been done in recent years.

Geology: The mine is in a low mound of older Quaternary alluvium composed of clasts ranging in size from boulder to silt. A few tens of yards to the north the alluvium thins and feathers out on quartz monzonite. Because of the subordinate amount of fine-grained matrix the deposit would appear to be a poor source of gold.

Development: The principal work consists of a 70-foot burrow-like adit driven north and west into the small hill of fairly well indurated older alluvium. Several tens of yards to the southeast a shaft is sunk vertically about 20 feet in a relatively flat surface of the alluvium.

Production: Undetermined.

References: None.

J.R.E. 3/8/60

Oro Copio Mine

Location: Reported to be in sec. 6, T. 2 S., R. 10 E., and sec. 12, T. 2 S., R. 9 E., S.B.M. (proj.); about 9½ miles southeast of Twentynine Palms in the Pinto Mountains, Gold Park area, by Tucker and Sampson, 1929, p. 486. Not confirmed in 1959. This mine may include part or all of the mine workings ascribed herein to the Gold Park Consolidated (?) gold mine #5.

Ownership: Undetermined.

History: The mine was apparently active in 1921 and was owned by the Gold Park Consolidated Mines Company (Tucker, 1921, p. 348). By 1929, the mine was idle (owner, Ellsworth Nichols, Santa Ana) but between 1921 and 1929 additional work was done (Tucker and Sampson, 1929, p. 486).

Geology: Narrow quartz veins, striking N. 10° E., follow a shear zone in granite~~, which is here altered to~~ gneiss (Tucker, 1921, p. 348).

Development: Three shafts, 50, 75, and 100 feet deep ~~respectively~~ are sunk on the quartz veins (Tucker and Sampson, 1929, p. 486).

Production: Undetermined.

References: Tucker, 1921, p. 348; Tucker and Sampson, 1929, p. 486.

Outlaw Mine

Location: Sec. 1 (?), T. 2 S., R. 13 E., S.B.M. (proj.), Dale Lake 15' quadrangle, 1956; Pinto Mountains, Joshua Tree National Monument, about 9 miles northeast of Sunrise ~~Well~~ and Mission Wells, and 2½ miles northeast of the Zulu Queen mine (Figure 31).

Ownership: Undetermined.

History: The Outlaw mine may have been part of the holdings of the Sunrise Mines Inc., San Diego, which included several mines in the eastern and northern part of the Pinto Basin ~~were~~ that were operated by this company in the 1930's (see the Sunrise mine description).

Geology: The mine is on ~~top of~~ a small outlying hill which is on the northeast side of a southeast-trending wash that drains the south slope of the Pinto Mountains~~, from the north~~. The hill is carved in quartz monzonite cut by a major N. 50° W.-trending and 70° NE.-dipping fault. A zone of crumbled and red-stained altered rock about 20 feet in average thickness marks the fault trace and is well exposed on the surface over several tens of feet. Locally the fault zone contains thin, discontinuous, and highly oxidized quartz veins.

Development: A shaft is sunk at least 100 feet in the altered zone. The upper 35-foot segment of the shaft is at an inclination of 70° westward, but below this it begins to flatten. Water was obtained at Sunrise Well about 9 miles southwest.

Production: Undetermined.

References: None.

J.R.E. 3/10/60

Pinto (Calidonia) Mine

Location: NE 1/4 sec. 1 (proj.), T. 2 S., R. 9 E., S.B.M., Valley Mountain quadrangle, 15', 1956; Pinto Mountains, Gold Park, 8.4 miles S. 27° E. of Four Corners, Twentynine Palms.

Ownership: Undetermined.

History: In 1918, the mine was owned and operated by the Gold Park Consolidated Mines Company, W. C. Winnie, president, J. E. Schweng, secretary, C. W. Roach, manager; offices 1021 Black Building, Los Angeles (Tucker and Huguenin, 1918, p. 1).

Geology: Mesozoic hornblende granite, locally crosscut with thin stringers of epidote, intrudes the (Precambrian) Pinto Gneiss. The area is cut by many faults and most of the workings are in a north-trending and steeply west-dipping fault zone. Both the gneiss and the granite are cut by veins of gold (?)-bearing milky quartz as much as 3 feet wide.

Development: Five shafts, one 45 feet deep, have been sunk (fig. 38). Four of these are in a north-trending and steeply west-dipping fault zone which is trenched out to a shallow depth along the strike for a distance of 145 feet. Two adits have been driven; one southeast 120 feet to intersect the northermost shaft in the fault zone; the other southwest 45 feet. The latter mentioned adit has a total of 55 feet of drifts; the north drift probably intersects the southernmost shaft in the fault zone. The mine is idle.

Production: Undetermined.

References: Tucker and Huguenin, 1918, p. 1.

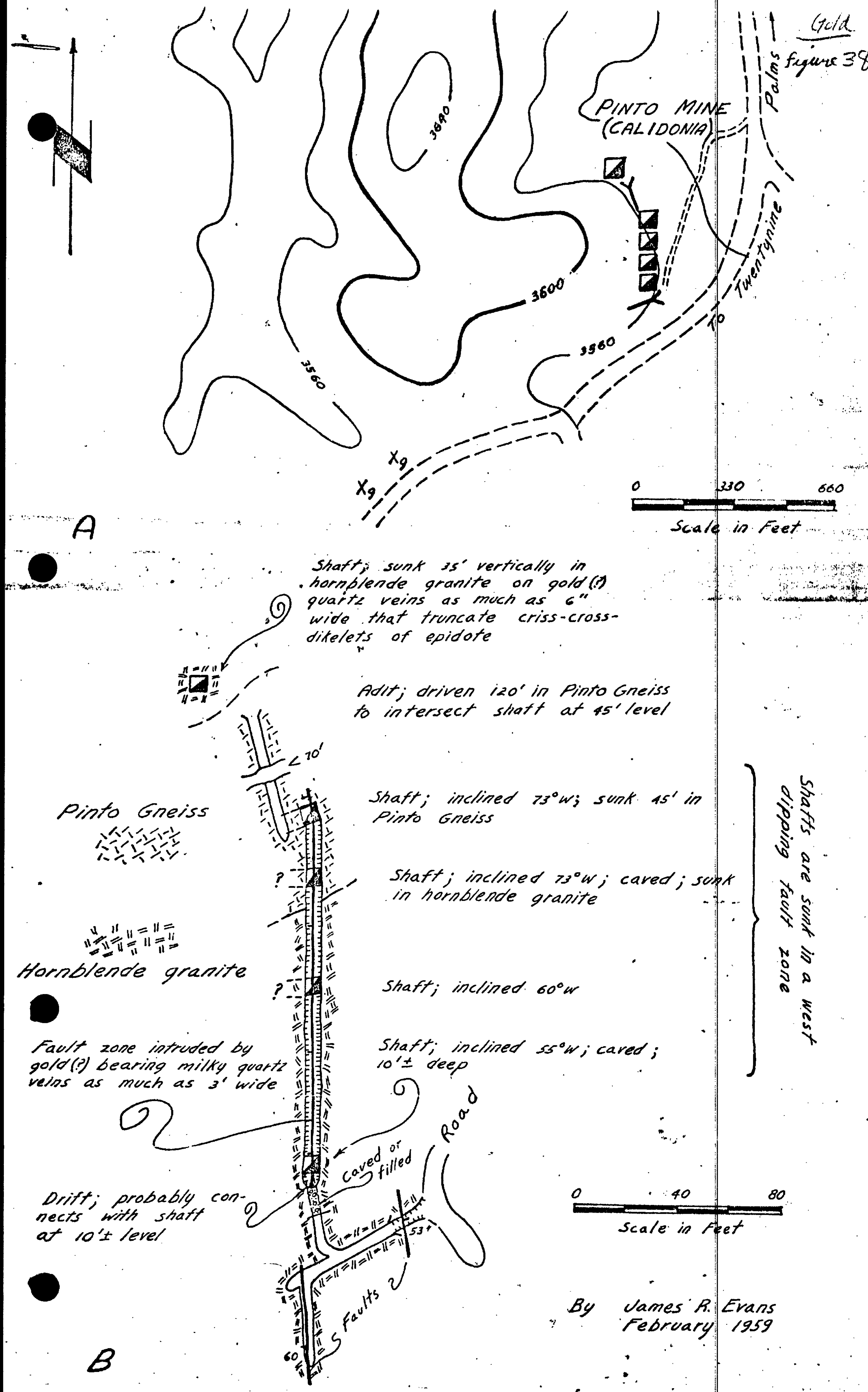
J.R.E. 2/11/59

Figure 38

38

Figure (1)/. Sketch map showing the areal distribution (A); and a geologic sketch map (B) of the Pinto (Calidonia) mine (topography from U.S.G.S. 15' Valley Mountain quadrangle, 1956).

Gold
figure 38



Pinto Chief Mine

Location: Sec. 1 (proj.), T. 2 S., R. 12 E., S.B.M., Dale Lake quadrangle, 15', 1956; Pinto Mountains, 1 mile south of the Brooklyn mine and 3 1/2 miles southeast of New Dale (site). See figure 31.

Ownership: Undetermined

History: An old property, dating at least from the 1930's.

Geology: A northeast-trending and nearly vertical fault cuts quartz monzonite of Mesozoic age. The fault contains quartz veins of undetermined thickness and extent (Karl Schapel, oral communication, 1960).

Development: A shaft is sunk 300 feet in the fault plane, and is joined to 150 feet of drifts on the 300-foot level (Karl Schapel, oral communication, 1960). The mine is idle.

Production: Undetermined.

References: None.

J.R.E. 3/8/60

Pinto Mine

Location: Sec. 14 (proj.), T. 2 S., R. 12 E., S.B.M., Pinto Basin quadrangle, 15', 1963; Pinto Mountains, about 3 miles north-northeast of Mission and Sunrise Wells (figure 31).

Ownership: Undetermined.

History: Mr. Olsen and Mr. Jenson, Hollywood, owned and operated the mine in 1932.

Geology: Massive, Mesozoic quartz monzonite is cut by a southwest-trending and steeply-dipping fault which contains quartz veins of undetermined length and width (Karl Schapel, oral communication, 1960).

Development: The main shaft is sunk at least 200 feet in the fault. There are southwest and northeast drifts of undetermined extent on at least two levels (Karl Schapel, oral communication, 1960). The mine is idle.

Production: Compiled by the U. S. Bureau of Mines.

Year	Crude Ore (tons)	Gold (oz.)	Silver (oz.)
1932	14	6	3

References: None.

J.R.E.

Pinyon (Tingman-Holland) Mine

Location: S½ sec. 26, T. 3 S., R. 8 E., S.B.M., Lost Horse Mountain quadrangle, 15' 1958; Joshua Tree National Monument, 1½ miles southwest of Pinyon Well along the crest of the Little San Bernardino Mountains.

Ownership: William F. and Frances M. Keys, P.O. Box 114, Joshua Tree hold the Pinyon group of claims (White Hills, Mountain View, Pinyon, Grand View) in sec. 26.

History: The Pinyon mine was worked as early as the 1890's by A. G. Tingman and Ed Holland, Indio, who by 1891 are said to have been operating two mills in The Blue Cut, several miles north of the mine. The mine was active as late as 1907 when it was operated by W. F. Wilkinson, Indio. Subsequently the property was inactive for many years and was relocated by Mr. Keys in the 1920's. Apparently the mine has remained inactive since the 1920's.

Geology: The mine area is underlain by light gray to buff, deeply weathered, coarse-grained quartz monzonite (White Tank ~~quartz~~ monzonite of Mesozoic age). The principal workings explore a quartz vein in a shear zone. The quartz vein is 2 to 4 feet wide at the surface, strikes N. 55° W., dips steeply southwest or is vertical, and is exposed on the surface, at several points in bold outcrops, for about 2,200 feet. About 1,000 feet to the west a parallel quartz vein crops out for about 700 feet.

Development: A drift adit has been driven southeast on the principal vein and may have connected with 2 two vertical shafts above on the vein. These workings are largely caved and inaccessible, but the amount of dump material suggests extensive underground workings. Crawford (1894, p. 224) reports the deepest work on the veins was 70 feet from the surface. In addition the vein has been explored by numerous short adits and prospect pits, also caved. The vein to the west has only been explored by shallow pits.

Production: U. S. Bureau of Mines records credit the "Pinon" mine, Tingman and Holland, Indio, with 483.75 ounces of gold in 1896 and, in 1907, 20 tons of ore yielding 7.74 ounces of gold.

References: Crawford, 1894, p. 224; Crawford, 1896, p. 313; Merrill, 1917 [1919], pp. 535-536.

C.H.G. 1/27/60.

Poulson Claim

Location: NW¼ sec. 29, T. 6 S., R. 4 E., S.B.M., Hemet Reservoir quadrangle, 15 1940; 1½ miles northeast of Kenworthy Guard Station.

Ownership: Undetermined.

History: Undetermined.

Geology: The geology of this deposit was not determined owing to the inaccessible state of the mine and lack of exposure of the vein. The country rock is granitic. ~~The orientation of the mine buildings and site suggest that the vein strikes northeast.~~

Development: The mine, now boarded over, appears to have been entered through a shaft. Judging from the size of the mine dump, the number of structures and apparently large investment in equipment, considerable effort was expended. If ore was mined it appears to have been taken elsewhere for milling ~~(figure).~~

Production: Undetermined. Idle (1959).

References: None.

R.B.S. 10/23/59.

Prospector Claims

Location: $SE\frac{1}{4}$ sec. 18, T. 2 S., R. 24 E., S.B.M., Poston quadrangle, 7.5', 1955; on the southeast slope of the Riverside Mountains, about a quarter of a mile west of U.S. Highway 95 and 10 miles, by road, south of Vidal.

Ownership: Trust lands of the Colorado River Indian Reservation, administered by U. S. Bureau of Indian Affairs.

History: A notice found on the property indicates that in 1925 it was held by Arthur W. Williams and H. F. Wilson of Vidal. An unrepaired, bulldozed road suggests more recent activity but no record of such was found. The mine appears long unworked.

Geology: The mine workings explore mineralized zones in faulted and fractured limestone of Paleozoic(?) age which appears to trend northeast and has an irregular but generally shallow dip. At the mine, the limestone caps two north-trending ridges about 600 feet apart, upon which it appears to be as much as 50 feet thick. The limestone is underlain by fractured Precambrian granitic rocks. The more easterly ridge is cut by a vertical fault zone striking N.65°E. which contains pods and thin veins of hydrous iron oxides, specular hematite, chrysocolla, calcite, and quartz. The western ridge contains a body of contorted and sheared limestone of undetermined extent. It appears to be an essentially horizontal, tabular mass, at least 6 feet thick where exposed, which is complexly divided by shears and fractures. The shears and fractures are mineralized as are those in the eastern deposit except that secondary copper minerals appear to be more abundant.

Development: A 50-foot, vertical shaft penetrates the eastern ridge; collar surrounded by rotten timber and caving dump material. Several shallow prospect pits lie to the northeast, and within 50 feet of the shaft. In the west ridge an adit driven 20 feet N.60°E. to the base of a 20-foot shaft which opens to the surface. At the base of the shaft is a winze, filled to within 10 feet of its collar by debris caved from the shaft above, and a 20-foot drift driven N.30°W.

Production: Undetermined.

References: None.

R.B.S. 3/16/62

Ragsdale Claim

Location: NE¼ sec. 19 (proj.), T. 7 S., R. 17 E., S.B.M., Sidewinder Well quadrangle, 15' 1952; on the east slope of the Chuckwalla Mountains. The property is a quarter of a mile north of the Aztec and Rainbow claims and accessible by a short side road from Dupont Road.

Ownership: Undetermined.

History: Undetermined.

Geology: The country rock is Precambrian gneiss cut by dioritic porphyry dikes. A shear zone, which strikes S. 65° W. and dips 75° NW., is poorly exposed for about 100 feet on the east slope of a low ridge. The zone contains a quartz vein ranging from 0 to 6 inches in thickness. Pyrite and galena appear once to have been abundant in the vein but are now largely altered, the pyrite to iron oxides and traces of secondary copper minerals, and the galena to cerussite and wulfenite. Fractures in the vein are partially filled with crystalline quartz and chalcedony.

Development: The deposit has been developed by means of a single 35-foot drift adit and two prospect pits.

Production: Undetermined. Idle (1960).

References: None.

R.B.S. 2/24/60.

Rainbow Mine

Location: NW 1/4 sec. 7 (proj.), T. 8 S., R. 21 E., S.B.M., McCoy Spring quadrangle, 15', 1952; on the western ridge of the Mule Mountains approximately 4 miles northeast of Wiley Well, and about 1,000 feet northeast of the Roosevelt mine.

Ownership: O. F. Wright, P. O. Box 1062, Blythe (1958).

History: The Rainbow mine was formerly described with the Roosevelt mine in a common group of 8 claims which had once been called the Santa Fe mine (Tucker and Sampson, 1945, p. 142-143).

Geology: The Rainbow mine is in an area underlain by sheared Precambrian granite. A vein, which pinches and swells from 0 to 2 feet in thickness, is exposed for about 500 feet on a west-to-northwest-trending ridge. The vein strikes west, dips 60° N., and is thoroughly shattered. Fissures and vugs contain iron oxides, malachite, and chalcopyrite. Tucker and Sampson (1945, p. 143) state that the ore averages $12 per ton in gold.

Development: A drift adit was driven about 130 feet westward on the vein from a point low on the ridge. The vein quartz has been stoped above the most westerly 100 feet of the adit and has been stoped to the surface at several points.

Production: Undetermined.

References: Tucker and Sampson, 1945, p. 142-143.

R.B.S. 2/19/58

Red Cloud Group (Red Head Group)

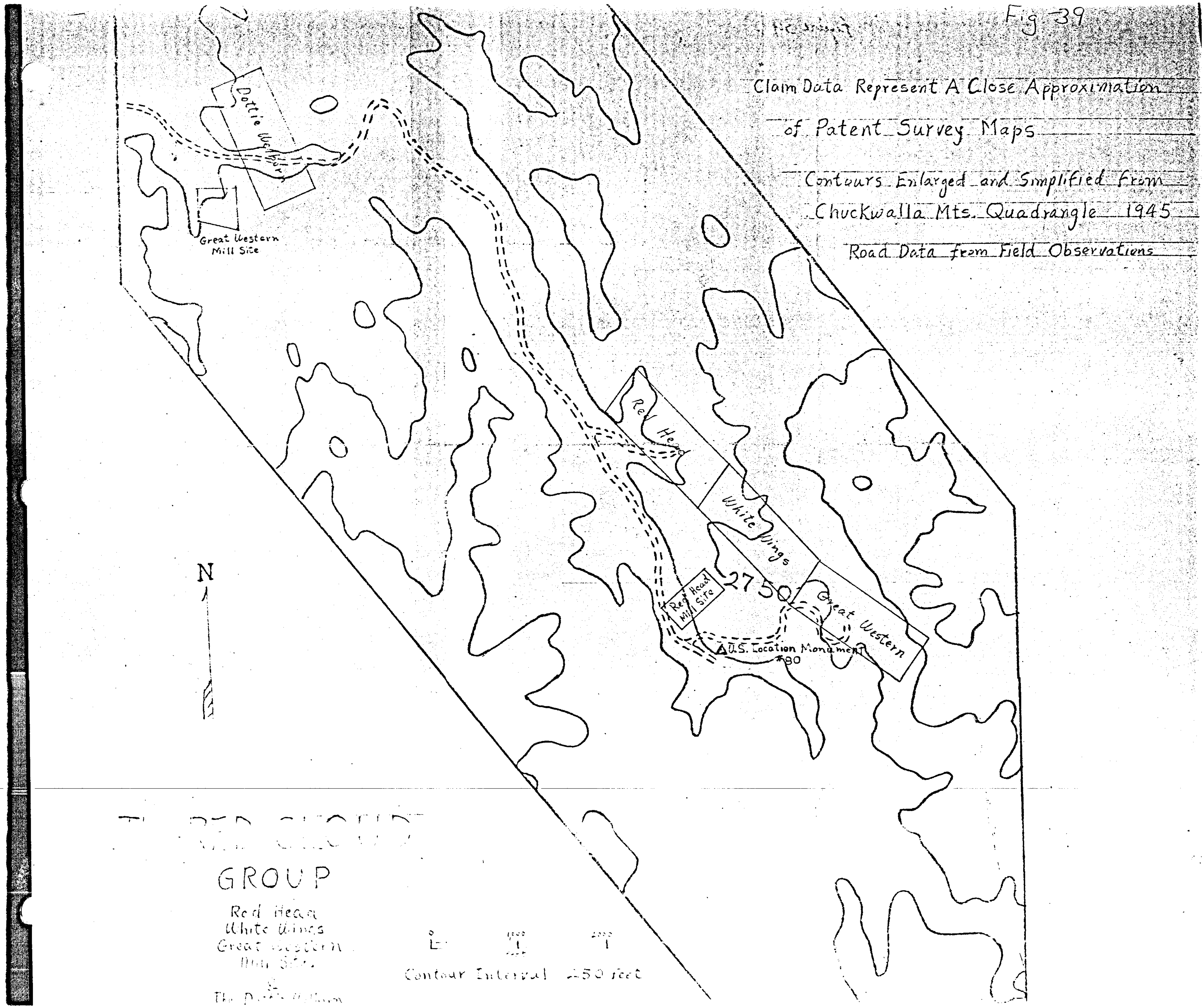
Location: Secs. 32 and 33 (proj.), T. 6 S., R. 15 E., S.B.M., Chuckwalla Mountains quadrangle, 15', 1963; on the northeast side of a northwest-trending canyon, 9 miles by dirt road southeast from U.S. Highways 60 and 70, and 8 miles south-southwest of Desert Center.

Ownership: J. D. Huston, Indio.

History: The Red Head, White Wings, Great Western, and Dottie Welborn, patented claims (see herein), (fig. 39/), were located prior to 1886. Possibly the earliest report of the property was published in 1886, but no details were given (Mining and Sci. Press, 1886, vol. 52, p. 100). The claims were worked by the Red Cloud Mining Company, Salton, from 1899 to 1901. The Red Cloud group appears to have been idle from 1901 to 1932. In 1932, it was worked by Red Cloud Mines, Los Angeles, and from 1935 to 1940 by S. and W. Mine Development Company, 2250 Crenshaw, Los Angeles (U. S. Bureau of Mines records).

Figure 39

Photo 20



Claim Data Represent A Close Approximation
of Patent Survey Maps
Contours Enlarged and Simplified from
Chuckwalla Mts. Quadrangle 1945
Road Data from Field Observations
Dottie Washburn
Great Western
Mill Site
Red Head
White Wings
Red Head
Mill Site
2750
Great Western
U.S. Location Monument
#90
N
GROUP
Red Head
White Wings
Contour Interval 250 feet

Fig. 39

Geology: The Red Cloud group is in an area underlain by Precambrian gneissic rocks, the foliation of which have a northwesterly trend. A quartz vein as much as 15 feet thick is well exposed in an outcrop about 4,500 feet long. It strikes N. 20° to 40° W. and dips 60° NE. The vein appears to lie in the plane of a fault on which subsequent movement has sheared both the vein and the surrounding country rock. The resulting zone of broken and mixed material reaches a maximum width of 10 feet on the Red Head claim. The hanging wall has been altered through a zone as much as 200 feet wide. It forms a bold outcrop of buff-colored, iron-stained rock in which the gneissic banding is still evident. As with the fault zone, this alteration is most extensive on the Red Head claim. The shearing and alteration of the country rock yields an uneven mixture of gangue material, but the vein appears to consist primarily of quartz-containing pockets and veinlets of iron oxides and pyrite. Fluorite is common in the dump on the Red Head claim, but its distribution throughout the body of the deposit was not determined. Small proportions of secondary copper minerals form crusts and stains in the vein matter. Scheelite has been reported present in the deposit (Elmer E. Tubbs, personal communication). The ore contains free gold, but both amalgamation and cyanide were used to achieve maximum returns.

Photo 21

Development: The workings on the Red Cloud Group comprise three inclined shafts (~~one on each of the claims,~~) from which considerable drifting and stoping was accomplished (fig. 40/). The crosscut adit, shown below the White Wings Adit was intended to ~~run~~ extend northeastward some 600 feet from the Red Head Mill Site ~~(fig.)~~ to serve in part as a drainage channel but it was only extended about 200 feet. ~~long when operations ceased.~~

Production: Compiled by the U. S. Bureau of Mines and published with permission of the owner.

Year	Crude ore (tons)	Gold (ounces)	Silver (ounces)	Copper (lbs.)	Lead (lbs.)
		Recoverable Metals			
1899		43.54			
1901		96.75			
1932	212	17.33	6		
1935	788	430.76	142	984	
1936	1,033	403.16	93		
1937	1	2	1		
1938	2,064	386	166	306	300
1939	185	71	17		
1940	57	19			

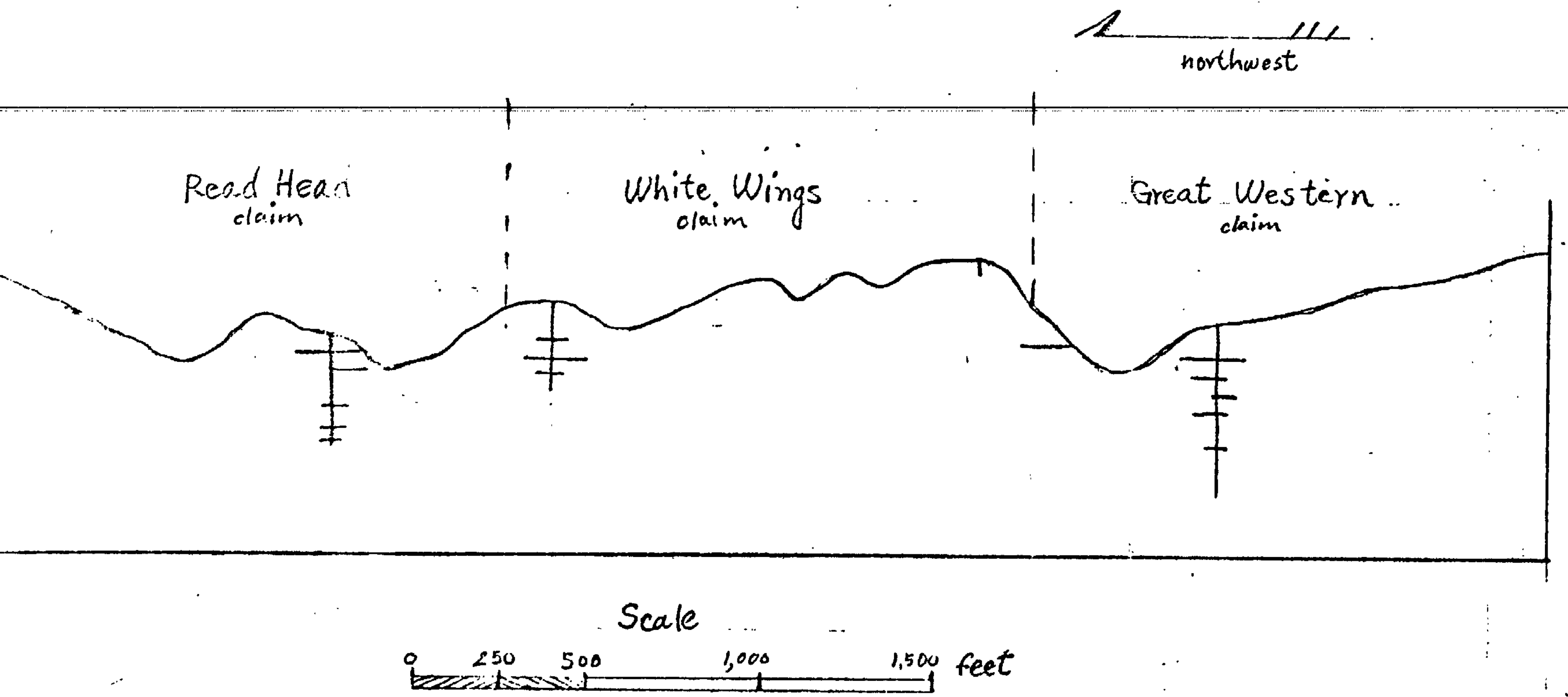
References: Mining and Sci. Press, 1886, vol. 52, p. 100; Orcutt, 1890, p. 900-901; Merrill and Waring, 1917, p. 539; Tucker and Sampson, 1929, p. 486-487; 1940, p. 51-52; 1945, p. 141-142.

R.B.S. 1/21/60.

figure 40

Figure 40.

RED CLOUD GROUP



A sketch of the underground development on the claims of the Red Cloud Group in the plane of the vein. Adopted from an unpublished sketch by W. B. Tucker.

Red Streak Mine

Location: Sec. 22 (proj.), T. 6 S., R. 15 E., S.B.M., Chuckwalla Mountains quadrangle, 15', 1963; 5 3/4 miles south of Desert Center and 2 miles west of Aztec Well.

Ownership: Undetermined.

History: Undetermined.

Geology: The Red Streak mine is high on the north slope of a peak underlain by a complex of Precambrian metamorphic rocks cut by dikes of granitic and basic igneous rock. A shear zone is exposed in an outcrop about 130 feet long on a slope at the head of a narrow ravine. It strikes N. to N. 10° E. and dips 35° west-northwest. A quartz vein, 0 to 1 foot thick lies in the shear zone. The vein is fractured and contains iron oxides as discreet masses of limonite pseudmorphs after pyrite and as fracture fillings. The gold content of this material was not determined.

Development: Near the southern extreme of the outcrop the shear zone is opened by a forked, open-cut one arm of which lies on the vein, the other on a barren zone along the footwall of a basic dike striking southwest. The arms of the cut are 10 to 15 feet long and short 10 to 12-foot adits extend beyond their faces. About 30 feet downslope to the north an adit cuts S. 10° W. through sheared granite on the footwall of another basic dike but the vein was not encountered. The remaining development comprises 4 shallow prospects downslope to the north.

Production: Undetermined. Idle, 1960.

References: None.

R.B.S. 2/24/60.

Red Top Mine

Location: Sec. ~~(34)~~ 15 (proj.), T. 6 S., R. 15 E., S.B.M., ~~(U. S. Army Corps of Engineers)~~ Chuckwalla Mountains quadrangle, 15', 19~~45~~63; about 5 miles south of Desert Center and 2 miles west of Aztec Well.

Ownership: J. M. De La Garza, P.O. Box 453, Desert Center (1959).

History: U. S. Bureau of Mines files show activity on a claim of this name during 1940 and 1941 under the ownership of Wiley Brothers, Blythe.

Geology: A quartz vein as much as one foot ~~in width~~ wide is poorly exposed for about 500 feet along the west side of a low granite ridge. It strikes N. 45° W. and dips 25° NE. Free-milling gold occurs in the vein. Oxides of iron, small pockets and stains of chrysocolla, and scattered ~~bunches~~ small masses of galena are present.

Development: Three shafts have been driven down the dip of the vein. They are nearly equally spaced near the northwest end of the outcrop. The deepest, a 30-foot shaft, is on the east side of a shallow ravine, a 10-foot shaft lies about 65 feet to the southeast of it and a 20-foot shaft 100 feet farther southeast on the outcrop.

Production: According to U. S. Bureau of Mines records (published with permission of the owner) the Red Top yielded 64 tons of ore, during the period 1940-42, from which 33 ounces of gold and 7 ounces of silver were obtained.

References: None.

R.B.S. 4/28/59.

Renrut-Neerg (Alveston) Claim

Location: SW¼ sec. 29, T. 6 S., R. 4 E., S.B.M., Idyllwild ~~(Hemet Reservoir)~~ quadrangle, 15' 1959 ~~1940~~; about 2 miles east of Kenworthy Guard Station.

Ownership: E. K. Turner, Route 1, Box 32, Mountain Center.

History: California Division of Mines files indicate that this property was patented in 1896 by Rueben B. Alves as two ~~(2)~~ claims, one placer and one lode, under the name Alveston.

Geology: This property includes the sandy floor of a shallow canyon and an adjoining ridge of jointed and weathered granitic rocks to the northwest. Fine gold is disseminated in what appears to be a shallow alluvial deposit in the canyon and in a vein cutting the ridge. The vein is as much as 4 inches wide. It lies in the plane of a shear zone about 4 feet wide which strikes N. 35° E. The dip is vertical at the surface but flattens to about 75° NW. at a depth of 20 feet. This deposit is poorly exposed for about 100 feet on the crest of the ridge. The gold is contained in oxides of iron which pocket and stain the vein quartz. The owner stated that the vein averages $17 per ton in gold and that samples taken from thin veins in the walls of the shear zone, assayed $5 to $8 per ton.

Development: The owner has won small quantities of gold from the placer deposit in the canyon by means of a sluice box, however, the water supply is seasonal, and difficult to regulate or conserve.

The vein is explored by a shaft about 60 feet deep. At the bottom drifts extend 20 feet southwest and 50 feet northeast. The backs of the drifts have been overhand stoped as much as 12 feet up dip.

Production: Undetermined. ~~Idle (1959)~~.

Reference: Tucker and Sampson, 1945, pl. 35.

R.B.S. 10/23/59.

Rice Claims

Location: S 1/2 sec. 31, T. 7 S., R. 1 E., S.B.M., Sage quadrangle, 7 1/2', 1954; 4 1/2 miles south of Sage, in the mountains.

Ownership: Undetermined (1958).

History: No work appears to have been done on this property for many years. According to Harry Bergman, a long-time resident in the area, this mine was operated in the early 1900's by two men named William Rice and Manny Ridge. Bergman (personal communication, 1958) said that these men made meager wages in gold.

Geology: The workings of this mine are spaced irregularly along a poorly exposed contact between mica schist and Mesozoic diorite. The contact strikes approximately N. 45° W. along the southwest side of a low ridge. It is traceable for about three quarters of a mile. The planes of schistosity are vertical and roughly parallel to the contact. Pods, stringers, and veins of quartz as much as 2 feet wide parallel the schistosity.

Development: Development comprises 5 vertical shafts and one drift adit. A sixth shaft, indicated on the Sage quadrangle, at the northwest end of the property, was not examined.

The drift adit is at the southeast end of the property. It is about 50 feet long and bears N. 45° W. on a quartz vein which ranges in width from 0 to 2 feet. The portal is partly caved. One of the vertical shafts, of undetermined depth, is situated immediately in front of the adit portal. This shaft appears to explore the junction of the northwest-trending vein and a vertical shear zone bearing N. 20° E. The shear zone is filled in part by a quartz vein with a maximum width of one foot. The dump material and workings were examined briefly, but no recognizable ore minerals were found.

Two shafts, about 50 feet apart, are situated approximately 1,000 feet northwest of the adit. These shafts are on a shear trending N. 40° E. The northeast shaft is vertical to a depth of about 40 feet, below which point it slopes steeply to the northeast to an undetermined depth. No vein is exposed near the collar. The southwest shaft is vertical for an estimated depth of about 100 feet, below which point it is flooded to an undetermined depth. A quartz vein as much as four inches wide follows the plane of a shear where it is exposed at the collar.

The remaining 2 shafts are about 800 feet farther northwest and are about 200 feet apart along a line drawn northeast between them. The northeasternmost shaft is about 75 vertical feet higher than the southwest shaft. It is about 100 feet deep to water. the collar is in barren schist, however, the dump material ~~indicates the presence of~~ contains vein quartz probably obtained at depth. ~~Though some timber remains at the collar, entry was not possible.~~ The southwest shaft is also about 100 feet deep to water. There is no vein exposed at the collar. The dump consists largely of dioritic material with minor amounts of vein quartz. One small crystal of molybdenite was found in a fragment of quartz. The shaft is untimbered and the collar is surrounded by a light wire fence (July, 1958).

Production: Undetermined.

References: None.

R.B.S. 7/25/58.

Rich Gold (Gold Crown #2) Mine

Location: Sec. 8 (proj.), T. 3 S., R. 10 E., S.B.M., Hexie Mountains quadrangle, 15', 1943; Hexie Mountains, Joshua Tree National Monument, about 4 miles southeast of White Tank, and about 1/4 mile south of the West Pinto Basin Road.

Ownership: Undetermined.

History: Originally located as the Gold Crown No. 2. Relocated as the Rich Gold mine July 1, 1931, by S.B. Trujillo and Loyd E. Kinder, 1223 West Fifth Street, San Bernardino.

Geology: Pinto Gneiss is cut by west-trending minor faults and a northwest-trending pegmatite dike. The faults contain thin specularite-hematite-chalcopyrite (?)-bearing quartz veins.

Development: Two shafts, one 25 feet and the other possibly 100 feet deep, are sunk in the plane of a west-northwest-trending fault (fig. 41 /, locs. 3 and 4). At locality 2, a ~~15-foot~~ shaft is sunk 15 feet in a west-trending fault. The pegmatite dike is exposed in a shallow 20-foot long northwest-trending open cut. The mine is idle.

Production: Undetermined.

References: None.

J.R.E. 1/25/60

Figure 41

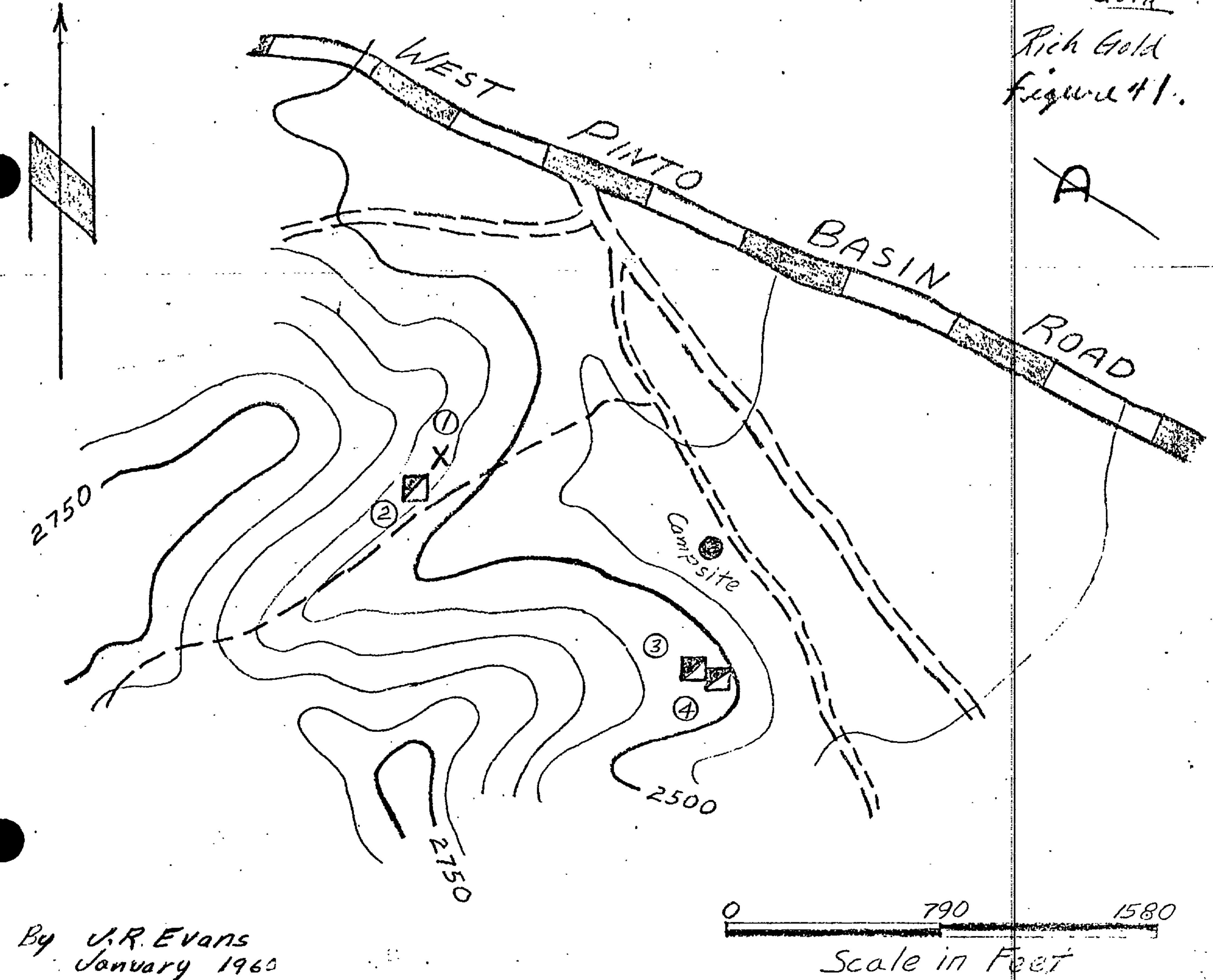
Figure 41. Sketch map showing the areal distribution of the workings (A), and a schematic geologic sketch map (B) of the Rich Gold (Gold Crown #2) mine (topography from U.S.A.C.E. 15' Pinkham Well quadrangle, 1943).

Gold

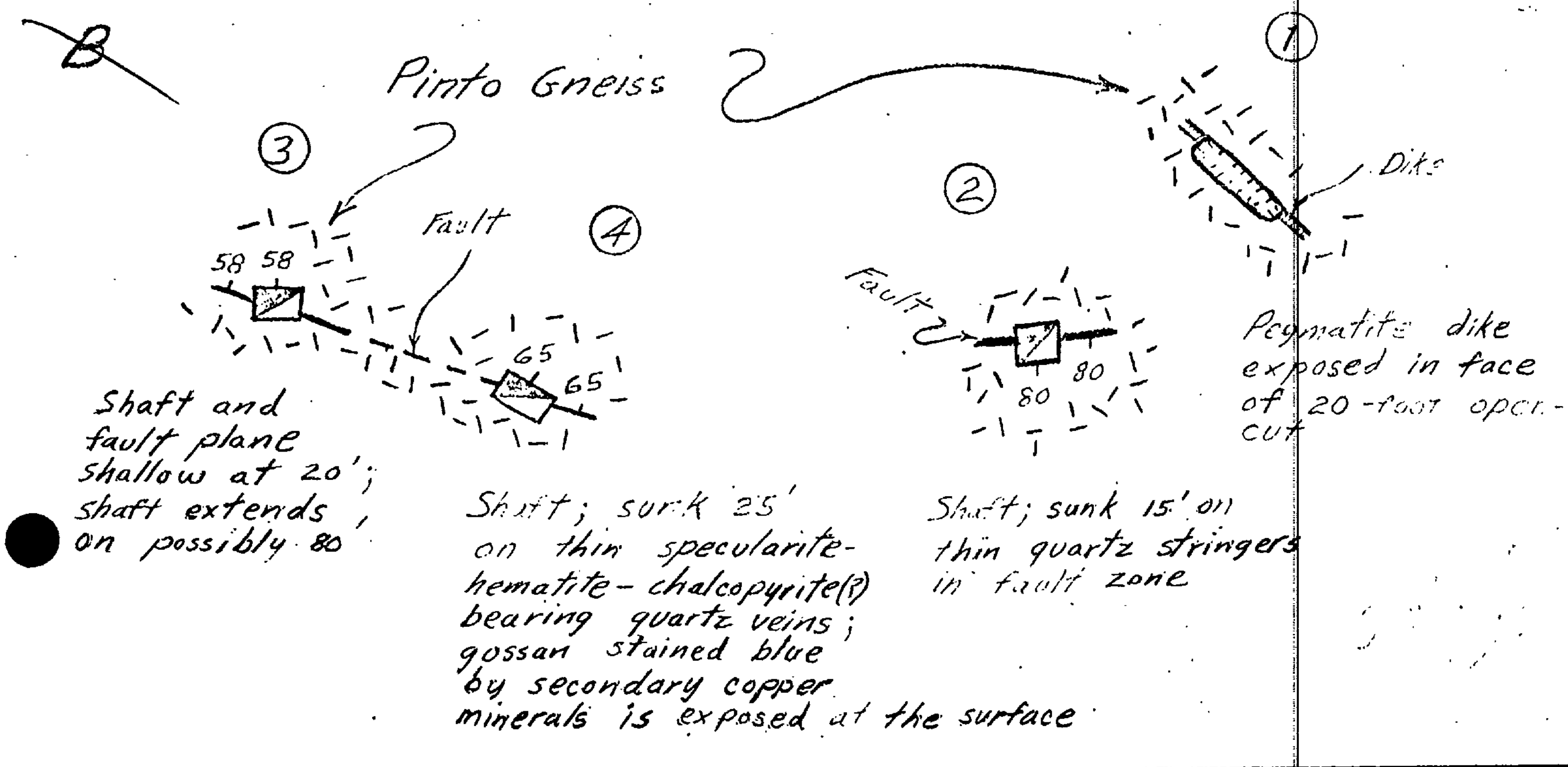
Rich Gold

figure 41.

A



B



Romoland Group

Location: SW¼ sec. 23, NW¼ sec. 26, T. 5 S., R. 3 W., S. B.M., Romoland quadrangle, 7.5', 1953; 2 miles south of Romoland.

Ownership: Undetermined.

History: Undetermined.

Geology: The Romoland Group is on a short, north-trending ridge of dioritic rocks of Mesozoic age on the north side of an unnamed group of hills. Narrow, poorly exposed quartz veins lie on shear planes which strike N. 25° E. to N. 25° W. and dip 50° SE. to 70° NE. as exposed in the workings. The quartz is unevenly mineralized with clots and fissure fillings of iron oxides a sample of which, when panned, showed traces of gold. Where observed, the veins range from a fraction of an inch to 2 inches in thickness.

Development: ~~The fault~~ A shear was explored on the north slope of the ridge by a partly caved, 15-foot shaft inclined S. 20° E. at about 45°. On the east slope a second shaft was sunk about 50 feet on the 70° dip of a vein. In a shallow ravine on the west side of the ridge an adit was driven S. 85° E. in apparently-barren diorite. The portal is partially caved but the adit appears to be at least 100 feet long.

Production: Undetermined.

References: None.

R.B.S 6/18/59

576

294

Roosevelt (Roosevelt and Rainbow, Sante Fe) Mine

Location: NW¼ sec. 7 (proj.), T. 8 S., R. 21 E., S.B.M., McCoy Spring quadrangle, 15' 1952; on the western ridge of the Mule Mountains about 4 miles northeast of Wiley Well.

Ownership: Undetermined (1958).

History: In 1945, Tucker and Sampson (p. 142-143) reported that the Roosevelt mine was part of a group of 8 claims which included the nearby Rainbow mine. The Roosevelt and Rainbow mines were formerly known as the Santa Fe mine.

Geology: The country rock is ~~highly~~ sheared granite. A fault trace is poorly exposed along the floor of a narrow canyon where it strikes N. 50° - 60° E. and dips about 50° SE. The fault zone contains irregular bodies of sheared vein quartz material which, according to Tucker and Sampson (1945, p. 143), forms a talcose gouge, mineralized with free gold, which assays from $8 to $100 per ton.

Development: The mine comprises 2 inclined shafts about 100 feet apart. The western shaft slopes about 60° near the collar, flattening to approximately 45° at a depth of about 50 feet. The eastern shaft appears to slope similarly. The depth of these shafts was not determined. According to Tucker and Sampson, in 1945 the western shaft was about 135 feet deep. At 60 feet below the collar of the shaft a 50-foot drift extended westward and a 20-foot drift eastward. No reference is made to any drifting from the eastern shaft.

When visited (1958) the timbering in the collars of the shafts was in fair condition. An ore bin, in good repair, still stood near the west shaft. The road to the mine was passable.

Production: Undetermined.

References: Tucker and Sampson, 1945, p. 142-143.

R.B.S. 2/19/58.

Rose of Peru

Location: Sec. 1, T. 2 S., R. 12 E., S.B.M. (proj.), Dale Lake quadrangle, 1956; Pinto Mountains, about 3 miles southeast of New Dale (Site) and about 1 mile south of the Brooklyn mine (pl. 3).

Ownership: Bonnie H. Oehl, 777 East 9th Ave., San Bernardino owns 2 unpatented lode claims (March 1960).

History: Originally owned and operated by Karl Schapel, Box 113, Twentynine Palms, from 1939 to 1941.

Geology: Generally north-trending and steeply-dipping quartz veins of undetermined extent occur in massive quartz monzonite.

Development: The main shaft, adjacent to the road, is 300 feet deep and sunk 70° E. on a vein. There are 600 feet of north-south drifts on the 200-foot level (Karl Schapel, oral communication, 3/8/60). About a quarter of a mile northeast of the main shaft another shaft is sunk 100 feet on a north-trending and steeply-dipping vein. This shaft is joined to 125 feet of drifts on the 100-foot level (Karl Schapel, oral communication, 3/8/60). Other workings are of minor extent and consist of shallow shafts, short adits and prospects. The mine is worked intermittently by the owner.

Production: Compiled by the U. S. Bureau of Mines and published with permission of the owner.

Year	Crude Ore (tons)	Gold (oz.)	Sixxxx
1939	33	33	
1940	10	6	
1941	12	17	

References: None.

J.R.E. 3/8/60.

Ruby Lee Claim and Millsite

Location: The mill site is in sec. 10, T. 4 S., R. 11 E., S.B.M. (proj.), ~~U. S. Army Corps of Engineers~~ Pinkham Well quadrangle, 15', 1943; Hexie Mountains, Joshua Tree National Monument, bordering the Pinto Basin, about 4 miles northwest of the West Pinto Basin - Cottonwood Pass - East Pinto Basin road intersection. The claim was not found but ~~there are~~ several small prospect pits exist in section 9 about 1 mile west of the millsite. A Jeep road leads west from the millsite to the prospects.

Ownership: A. A. Dietemann, 874 North Beverly Glen, Los Angeles 24, owns 1 unpatented claim and 1 millsite (March 1958).

Geology: The mill site and prospects are underlain by massive but strongly jointed hornblende granite.

Development: At the millsite a cabin and a few sheds house miscellaneous equipment (elevation 3,000 feet). A jeep road leads east from the millsite to a junction with the West Pinto Basin Road about 3 miles northwest of its junction with the east Pinto Basin Road and Black Eagle mine road.

Production: Undetermined.

References: None.

J.R.E. 10/14/59

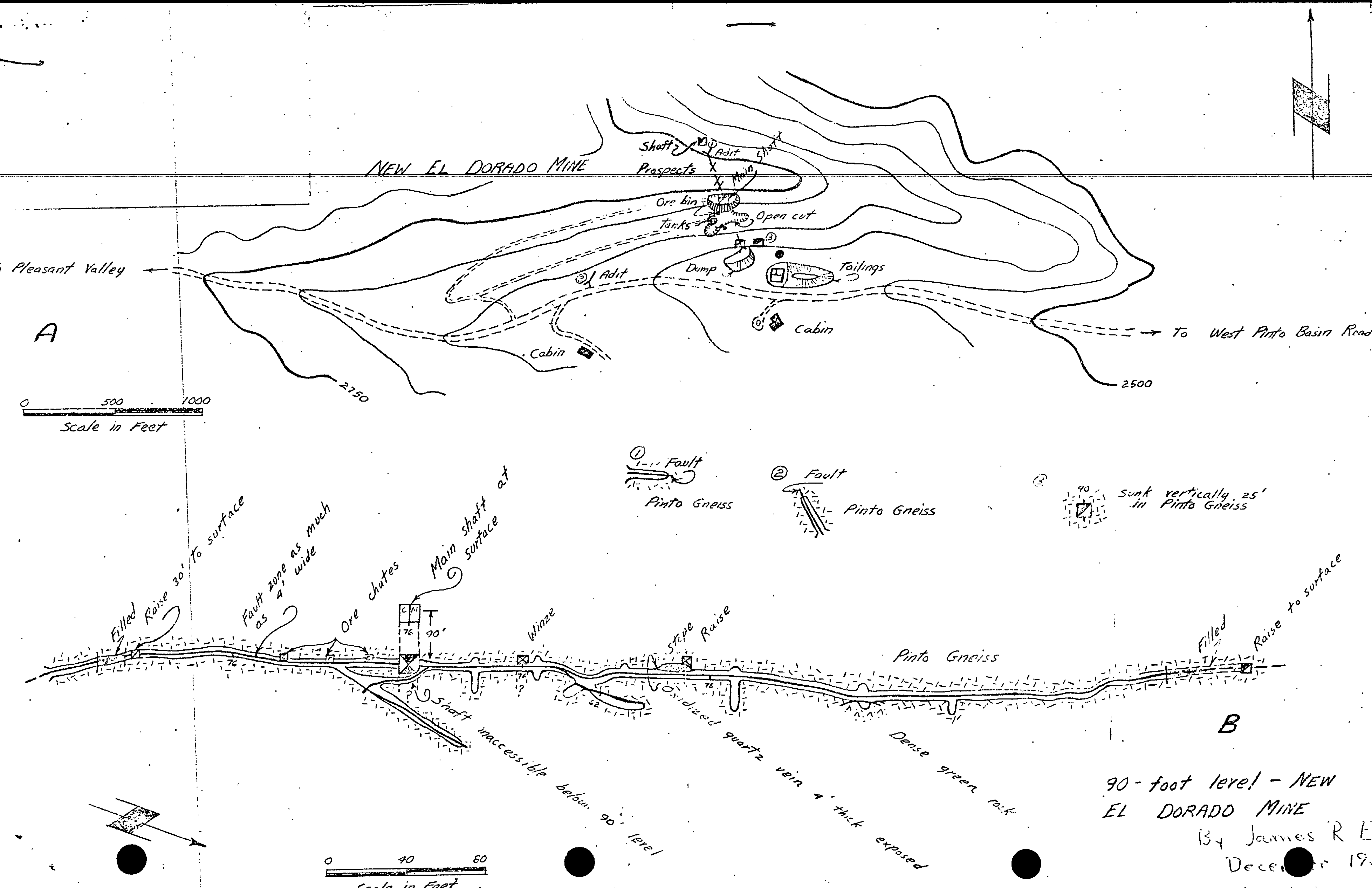
Rusty Gold (Summit or Sunset Group) Mine

Location: Sec. 16 (proj.), T. 2 S., R. 12 E., S.B.M., Pinto Basin quadrangle, 15', 1963; Pinto Mountains, about 1 mile southwest of the Gold Crown mine and close to 3 1/2 miles south of New Dale (site). See figure 31.

Ownership: Undetermined.

History: Originally located as the Sunset group of 7 claims in the 1920's by Jack Meek, Twentynine Palms. By 1929, only exploration work had been done and the property was idle (Tucker and Sampson, 1929, p. 488). From 1929 to 1944, several shafts ranging in depth from 10 to 20 feet had been sunk and in 1945 the property was again reported idle. Jack Meek, however, was still the owner (Tucker and Sampson, 1945, p. 144) but had apparently relocated the claims as the Summit group. A. T. Roy, Twentynine Palms, worked the claims in 1956 and recorded a small production of copper. The mine was not being worked on the day of the property visit.

Geology: A series of west-trending vertical quartz veins as much as 2 feet thick occur along minor faults in Mesozoic quartz monzonite.



90-foot level - NEW EL DORADO MINE

By James R Evans December 1959

Development: The main shaft is sunk vertically 35 feet in a fault containing a hematite-gold quartz vein, one foot in average thickness. There appears to be short drifts in the fault plane at the 15-foot level. There are several other shallow prospects from 10 to 20 feet deep, sunk on quartz outcrops and veins; all near the main shaft.

Production: Compiled by the U.S. Bureau of Mines and published with permission of the owner.

Year	Crude Ore (tons)	Gold (oz.)	Copper (lbs.)
1940	5	5	
1956	15		237

References: Tucker and Sampson, 1929, p. 488; Tucker and Sampson, 1945, p. 144.

J.R.E. 3/30/60

San Antonio Mine

Location: SE 1/4 sec. 32, T. 4 S., R. 4 W., S.B.M., Steele Peak quadrangle, 7 1/2', 1953; about 4 miles west of Perris (fig. 42/).

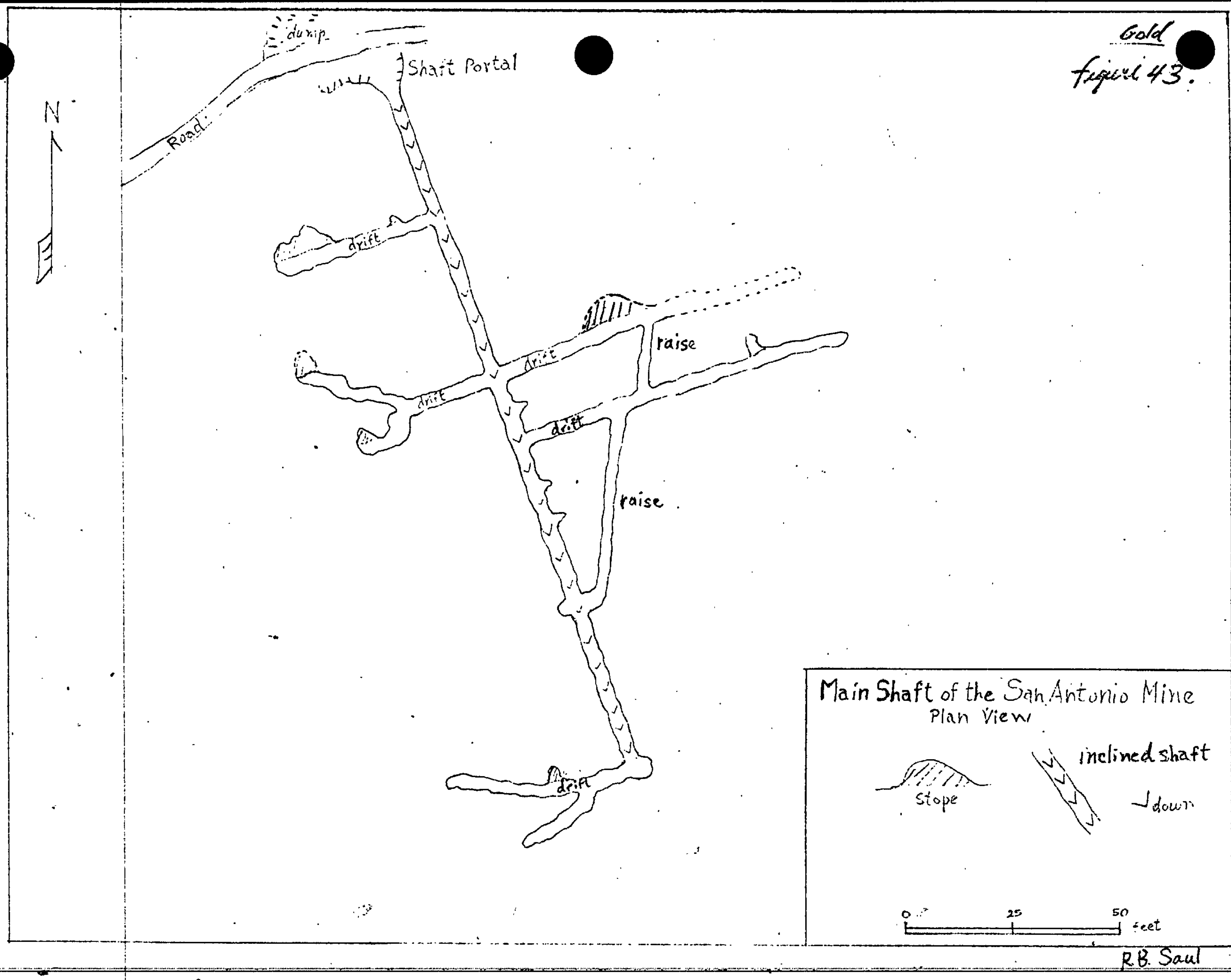
Ownership: Lillian P. Enloe, 3120 East 2nd Street, Long Beach, and Ricardo Montijo hold this patented claim and several surrounding unpatented claims.

History: U.S. Bureau of Mines files show that this claim was worked in 1935 by Ralph Mellor, Perris, and by Dick Montijo from 1938 through 1940.

Geology: The San Antonio claim lies high on the northwest slope of a ridge composed of deeply weathered dioritic rock of Mesozoic age. The claim includes the outcrop of a poorly exposed quartz vein as much as one foot wide which strikes N. 70° E. and dips about 25° SE. The lateral extent of the vein appears to be about 1,000 feet. The vein quartz contains veinlets and pockets of iron oxides which carry free-milling gold.

Development: The vein has been explored through six inclined shafts, five adits, and an open cut. The most extensive of these workings, inclined shaft No. 6, is shown in greater detail in Figure 43/.

Figure 42


Gold
figure 43.
Main Shaft of the San Antonio Mine
Plan View
inclined shaft
stope
down
0
25
50
feet
N
dump
Shaft Portal
Road
drift
drift
drift
drift
drift
raise
raise
R.B. Saul

In addition to gold ore, residual boulders of the dark, blue-gray country rock have been quarried on this claim. These dense, homogenous masses yield an attractive product called "black granite" (see section on ~~decorative stone~~ dimension stone).

Production: Published by permission of the U. S. Bureau of Mines.

Year	Crude ore tons	Recoverable Metals Gold (ounces)
1935	14	2.97
1938	2	1.00
1939	4	1.00
1940	3	1.00

References: None.

R.B.S. 6/17/~~6~~59

Figure 43

Santa Fe Group

Location: NW 1/4 sec. 31, T. 4 S., R. 4 W., S.B.M., Steele Peak quadrangle, 7 1/2', 1953; about 6 miles west of Perris.

Ownership: Undetermined (1959). Three patented claims, the Adyar, Florence, Goldbug, and Adyar Millsite.

History: The Santa Fe group was first worked prior to 1881 (Goodyear, 1888, p. 527), but was idle in that year. Activity was renewed briefly in 1893 under the ownership of Phelps, Judson, and others, Pasadena, (Storms, 1894, p. 224). F. M. Woods and others, having brought in a 5-stamp mill from the Temescal tin mine, worked the Santa Fe group from 1894 to 1896 (Mining and Scientific Press, 1894, vol. 69, p. 394; Crawford, 1896, p. 314). There is no subsequent report of activity on these claims.

Geology: The Santa Fe group is on the north slope of a low ridge composed of deeply weathered Mesozoic diorite. The poorly exposed vein strikes N. 70° W. and dips about 45° SW. The vein is probably less than a foot wide. The vein material on the surface consists of two types; quartz-tourmaline material, and quartz-containing pockets and fractures filled with oxides of iron. The ore, presumably the latter of the above, was reported in 1895 to be on a par with that found elsewhere in the district (Mining and Scientific Press, 1895, vol. 70, p. 106); about $30 per ton in gold.

Development: The indistinct outcrop of the vein was explored by an inclined shaft and closely-spaced pits and shallow shafts along a strike distance of about 300 feet. An adit was driven into the ridge about 100 vertical feet below the outcrop. It was reported to have extended 700 feet southwest and to have cut the vein 500 feet from the portal (Crawford, 1896, p. 314). ~~The adit and the inclined shaft were boarded up when the property was visited and the upper workings were in bad repair.~~

Production: Undetermined, (1959).

References: Crawford, 1894, p. 224; Mining and Scientific Press, 1894, vol. 69, p. 394; 1895, vol. 70, p. 106, 382; Crawford, 1896, p. 314; Merrill and Waring, 1917, p. 530; Tucker and Sampson, 1929, p. 487; Sampson, 1935, p. 514.

R.B.S. 9/23/59.

Santa Rosa (Rosario, Northern Belle) Mine

Location: SE 1/4 sec. 30 and NE 1/4 sec. 31, T. 4 S., R. 4 W., S.B.M., Steele Peak quadrangle, 7 1/2', 1953; about 6 miles west of Perris.

Ownership: Undetermined (1959).

History: The Santa Rosa mine was located about 1879 by Mexicans who recovered the gold in arrastres (Mining and Scientific Press, 1894, vol. 69, p. 394). W. A. Goodyear (1888, p. 527) referred to the property as the Rosario or Northern Belle mine and gave its location and a brief description of the vein and the rocks in the area. In 1893 (Storms, p. 384), the name Santa Rosa had been adopted and the mine was reported active. By 1893, a mill building had been erected on the property, and a 20-stamp mill was installed (Crawford, 1894, p. 224-224; Sampson, 1935, p. 514).

In 1959, the Santa Rosa was idle and all structures and machinery were gone.

Geology: The vein explored by the Santa Rosa mine, was reported to be as much as 3 feet wide (Sampson, 1935, p. 514), but is poorly exposed on the surface. It strikes N. 10° W. and dips 45° SW. (Crawford, 1896, p. 314). The country rock is Mesozoic diorite.

Development: The vein was explored to a depth of 200 feet by inclined shafts and trenched along its strike for about 1,000 feet (Crawford, 1894, p. 224-225; Sampson, 1935, p. 514). The workings are now caved.

Production: During the years 1895-1901, the Santa Rosa mine yielded 6,745.40 ounces of gold in an unreported tonnage of ore (U.S. Bureau of Mines records).

References: Goodyear, 1888, p. 527; Storms, 1893, p. 376; Crawford, 1894, p. 224-225; Crawford, 1896, p. 314; Merrill and Waring, 1917, p. 592; Tucker and Sampson, 1929, p. 487; 1945, pl. 35; Sampson, 1935, p. 514.

R.B.S. 6/15/59.

Schellenger Mine

Location: Sec. 18 (proj.) T. 4 S., R. 22 E., S.B.M., Big Maria Mountains quadrangle, 15', 1951; on the west slope of a hill, about 1 1/2 miles north of Black Hill in the Big Maria Mountains.

Ownership: Undetermined (1958).

History: In 1929, Tucker and Sampson (p. 487) reported that 6 claims were held by E. E. Schellenger, Blythe, but only assessment work had been done on them. By 1945, (Tucker and Sampson, p. 143) development had progressed to essentially the present state, and the mine was idle. T. A. Ashby, Rice, and M. A. Anderson, Pasadena, owned the claims in 1945. When visited in December, 1958, the Schellenger mine appeared long idle.

Geology: Gneissic, Precambrian country rock is cut by granitic pegmatite dikes as much as 6 feet wide which strike northwest. A fault trends east and dips 85° N. The fault fissure is filled by a quartz vein as much as 18 inches wide. Layers of chlorite 1-2 inches thick lie along both the foot and hanging walls. The vein is fractured and the chlorite is slickensided, suggesting post-mineralization movement. The ore minerals in the quartz vein, pyrite and oxides of iron, are reported to carry $15 per ton in gold (Tucker and Sampson, 1945, p. 143).

Development: A lower and an upper adit are driven east on the vein. The lower adit is about 70 feet long, and contains a narrow raise extended a few feet up the vein from the face. The upper adit is roughly 30 feet higher on the vein, about 50 feet farther east, and is 30 feet long.

Production: Undetermined.

References: Tucker and Sampson, 1929, p. 487; 1945, p. 143.

R.B.S. 12/19/58

Shannon Mine

Location: NW 1/4 sec. 1 (proj.), T. 2 S., R. 9 E., S.B.M., Valley Mountain quadrangle, 15', 1956; Pinto Mountains, Gold Park area, 8.1 miles S. 23° E. from Four Corners, Twentynine Palms.

Ownership: Undetermined.

History: Undetermined.

Geology: Mesozoic hornblende granite is cut by thin aplite and pegmatite dikes and contains gold (?)-bearing milky quartz veins as much as 1 1/2 feet thick. Minor, nearly vertical faults occur locally. A fissure filling of vein quartz is exposed in the adit nearest the road.

Development: The workings consist of an adit driven northeast 38 feet, an adit driven southwest 25 feet, a 100-foot shallow trench, a prospect pit, and a 30-foot shaft inclined 60° E. The mine is idle.

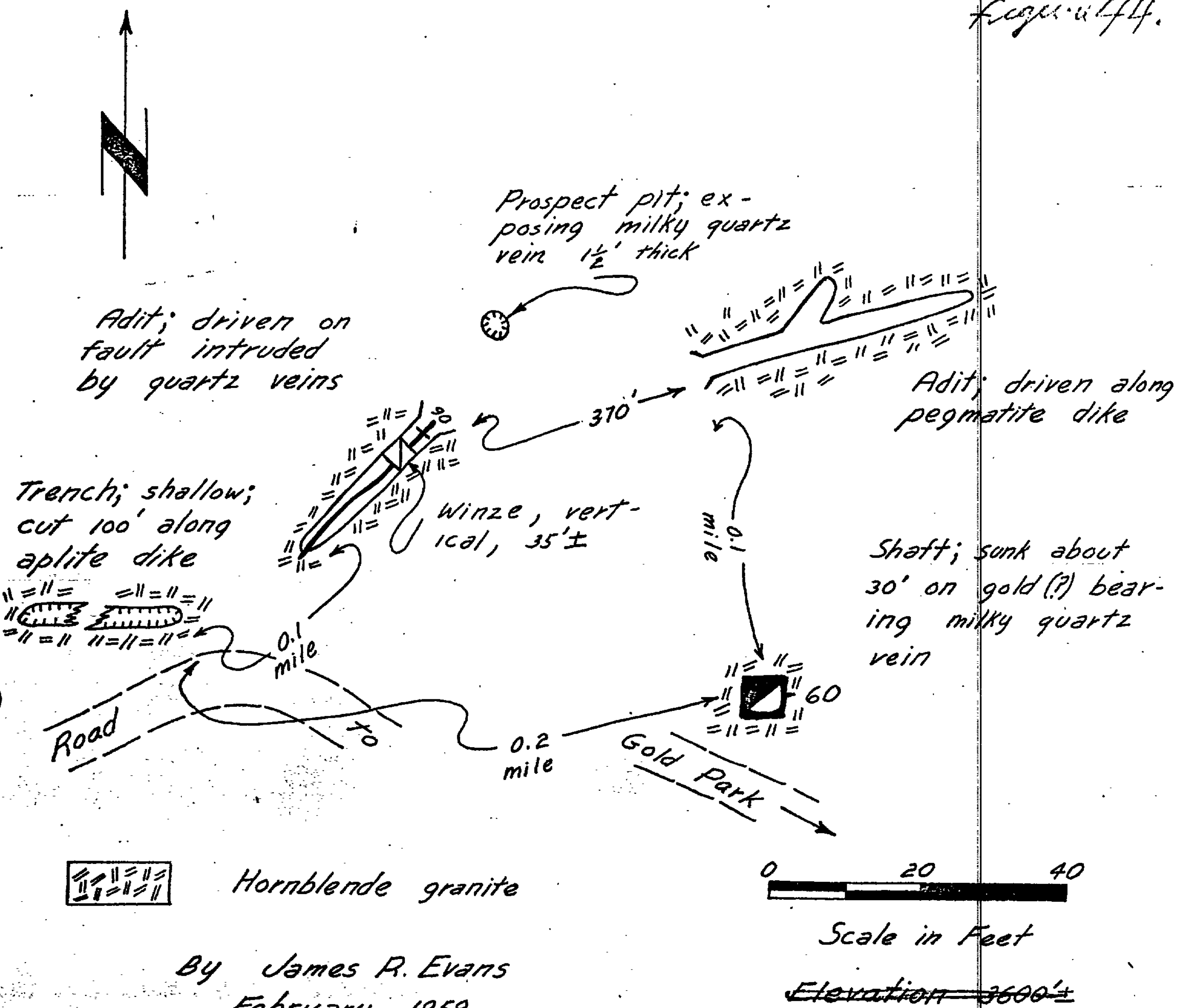
Production: Undetermined.

References: None.

J.R.E. 2/12/59

Figure 44

Shannon figure 44.



By James R. Evans
February 1959

Figure 44. Geologic sketch map of the Shannon mine.

Silver Bell Mine

Location: Sec. 8 (proj.), T. 3 S., R. 10 E., S.B.M., Hexie Mountains quadrangle, 15', 1963; Hexie Mountains, Joshua Tree National Monument, about 4 miles southeast of White Tank, and about 1/2 mile southwest of the West Pinto Basin road.

Ownership: Undetermined (December 1959).

History: Originally owned by W. F. Keys, P. O. Box 114, Joshua Tree. Prospected for gold during the 1930's, then idle for many years. Latest exploration was for copper in the mid-1950's. In 1956, the property was sold to Farrington Mann, 9207 South Lakewood Boulevard, Rivera.

Geology: Pinto Gneiss is cut by two major faults, several minor faults, and is intruded locally by thin, highly altered, basic dikes. A zone of crushed material containing highly oxidized chalcopyrite, and pyrite with specularite and gold in quartz is well exposed in the open cut along a north-trending and steeply east-dipping fault. The wall rock is highly stained and altered, and contains secondary copper (chrysocolla, azurite, and malachite) and iron (limonite, hematite) minerals.

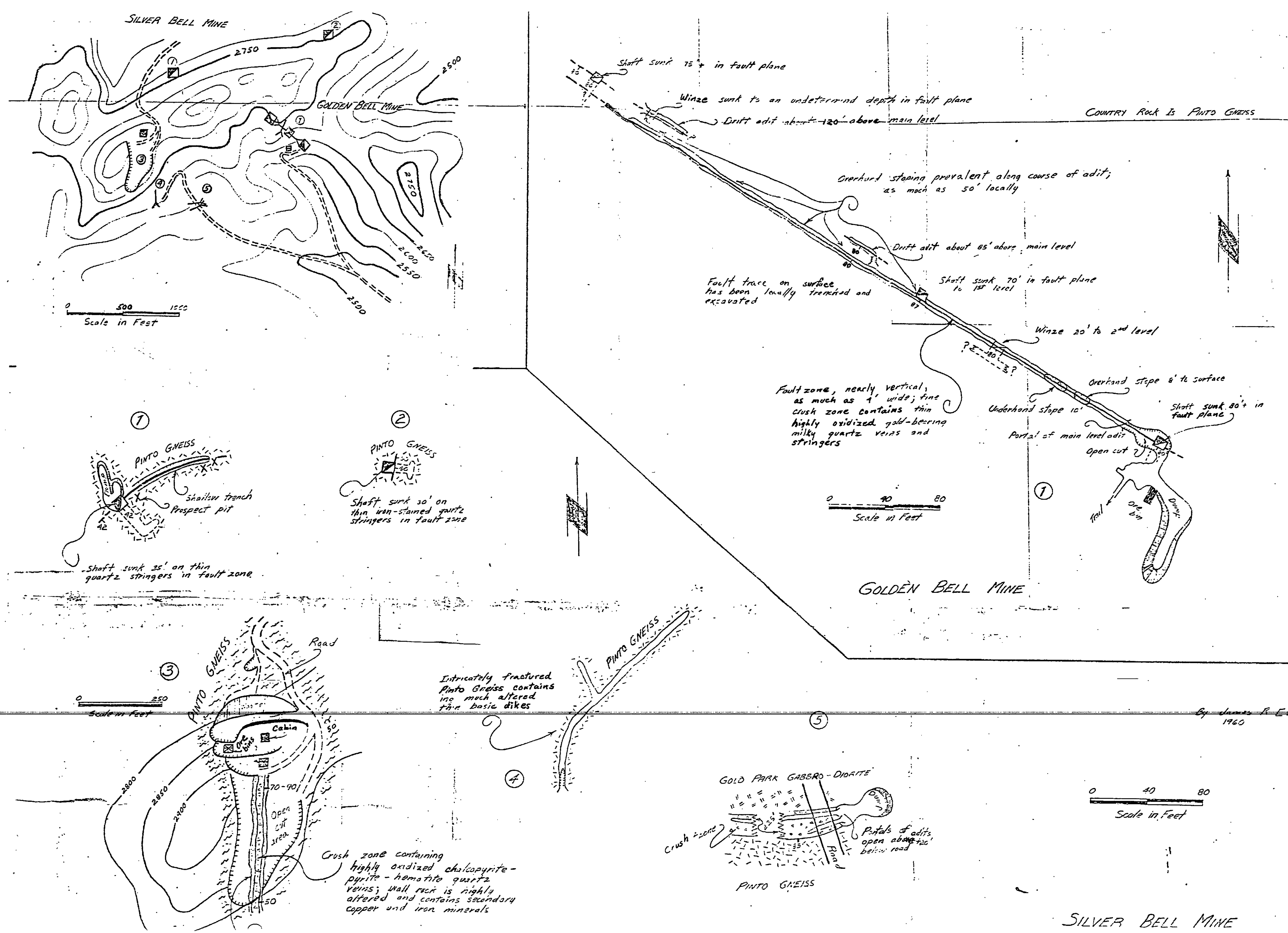
Nearly 500 feet southeast of the open cut a west-trending and steeply-south-dipping fault zone, as much as 20 feet wide and at least 200 feet long, separates (Mesozoic) Gold Park gabro-diorite from (Precambrian) Pinto gneiss. No mineralization was observed in this gouge zone. The minor faults contain thin quartz stringers and veins (see fig. 1).

Development: Older work along the northwest slope of a northeast-trending ridge consists of 2 shallow shafts sunk on quartz veins contained in minor faults. Mining of the copper-bearing crushed and altered zone has involved the shaving off of the east slope of a small knob-like hill. About 500 feet southeast of the cut, 2 narrow and relatively old burrows have been driven into a west-trending gouge zone; one about 280 feet, the other 25 feet. About 400 feet west of the burrows an adit is driven about 160 feet in fractured Pinto Gneiss.

Production: Several tons of material was processed for copper in the mid-1950's at a mill in sec. 16, T. 1 N., R. 9 E., S.B.M., San Bernardino County, about 2 1/2 miles north of Twentynine Palms on Utah Trail. Concentrates produced were not marketed.

References: None.

J.R.E. 12/11/59



SILVER BELL MINE
GOLDEN BELL MINE
2750
2500
2650
2600
2550
2500
0 500 1000
Scale in Feet
Shaft sunk 75'± in fault plane
Winze sunk to an undetermined depth in fault plane
Drift adit 120' above main level
COUNTRY ROCK IS PINTO GNEISS
Overhand stoping prevalent along course of adit; as much as 50' locally
Drift adit about 85' above main level
Fault trace on surface has been locally trenched and excavated
Shaft sunk 70' in fault plane to 1st level
Winze 20' to 2nd level
Fault zone, nearly vertical, as much as 4' wide; fine crush zone contains thin highly oxidized gold-bearing milky quartz veins and stringers
Overhand stope 8' to surface
Underhand stope 10'
Shaft sunk 80'± in fault plane
Portal of main level adit
Open cut
Ore bin
Dump
Trail
0 40 80
Scale in Feet
GOLDEN BELL MINE
PINTO GNEISS
Shallow trench
Prospect pit
Shaft sunk 35' on thin quartz stringers in fault zone
Shaft sunk 30' on thin iron-stained quartz stringers in fault zone
Road
0 250
Scale in Feet
Cabin
Ore bins
70-90
Open cut area
2800
2850
2900
Crush zone containing highly oxidized chalcopyrite-pyrite-hematite quartz veins; wall rock is highly altered and contains secondary copper and iron minerals
Intricately fractured Pinto Gneiss contains much altered thin basic dikes
GOLD PARK GABBRO-DIORITE
Dump
Portals of adits open above road
Road
Crush zone
PINTO GNEISS
By James R. Evans 1960
0 40 80
Scale in Feet
SILVER BELL MINE

Silver Scorpion Mine

Location: SE 1/4 sec. 1 (proj.), T. 2 S., R. 9 E., S.B.M., Valley Mountain quadrangle, 15', 1956; Pinto Mountains, Gold Park, 8.7 miles S. 28° E. of Four Corners, Twentynine Palms.

Ownership: Undetermined.

History: Carlos J. Bassler, Jr., and Francis E. Bassler located the property October 16, 1953.

Geology: Epidote-rich Gold Park gabbro-diorite has been injected by hornblende granite which is cut by a northwest-trending fault. Thin stringers of aplite, and tabular gold (?)-bearing milky quartz veins occur in the immediate area, but are strongest in the fault zone.

Development: A 20-foot shaft is sunk on a 56° SW. inclination in the plane of a northwest-trending fault. The shaft is near the center of a trench that has exposed the fault nearly continuously along a 50-foot line. At 20 feet, a drift extends southeast for an unknown distance paralleling the fault line exposed on the surface. It is idle.

Production: Undetermined.

References: None.

Sinock Mine

Location: Sec. 17 (proj.), T. 2 S., R. 12 E., S.B.M., Pinto Basin quadrangle, 15', 1963; Pinto Mountains, about 3 1/4 miles northwest of Mission and Sunrise Wells (figure 31).

Ownership: Undetermined.

History: Probably a mine active in the 1930's. It does not appear to have been worked in recent years.

Geology: The mine is in massive quartz monzonite of Mesozoic age cut by steeply-dipping faults of random orientation. One shaft is sunk on a north-trending and 70° E.-dipping fault; the other is sunk on a N. 70° E.-trending and 80° W.-dipping fault. Both faults undoubtedly contain quartz veins, but the quartz does not crop out.

Development: The main shaft, sunk in the north-trending fault, is at least 80 feet deep and probably is joined to drifts at several levels. Total workings here are estimated to be 400 to 500 feet. Several tens of yards southwest of the main shaft another shaft is sunk at least 100 feet in the plane of the N. 70° E.-trending fault. Work done here totals perhaps 200 to 300 feet.

Production: Undetermined.

References: None.

J.R.E. 3/30/60

Smith Brothers Claims

Location: Smith Brothers No. 1 claim is in the SW 1/4 sec. 8, Smith Brothers No. 4 claim is in the NE 1/4 sec. 7 (proj.), T. 2 S., R. 10 E., S.B.M., Valley Mountain quadrangle, 15', 1956; Pinto Mountains, about 10 miles S. 30° E. of Four Corners, Twentynine Palms. Smith Brothers claim No. 8 is in the NE 1/4 sec. 19 (proj.), T. 2 S., R. 10 E., S.B.M., Pinkham Well quadrangle, 15', 1943; Pinto Mountains, 11.2 miles S. 25° E. of Four Corners, Twentynine Palms.

Ownership: Undetermined.

History: John Uland, Milton B., and Albert H. Smith located the claims in 1955.

Geology: The country rock at claim No. 1 is Precambrian Pinto Gneiss and at claim No. 4, (Mesozoic) Palms granite. Country rock is cut by minor faults, and intruded by fine-grained green basic dikes as much as 2 feet thick. Secondary copper mineralization is in evidence at one prospect ~~(fig. [illegible])~~. At No. 8 claim, hornblende granite is cut by a steeply-south dipping fault in which occur hematite-chalcopyrite-gold (?)-bearing milky quartz veins.

Development: A shallow prospect characterizes No. 1 claim, while 4 prospects and a shaft sunk 35 feet vertically comprise the workings at No. 4 claim (fig. 45/). At No. 8 claim, a shaft has been sunk vertically 14 feet on a fault trending N. 75° E. Short drifts extend out from the foot of the shaft in nearly east and west directions.

Production: Undetermined.

References: None.

J.R.E. 3/17/59

Figure 45

Figure 45 Gold
Smith Brothers claim

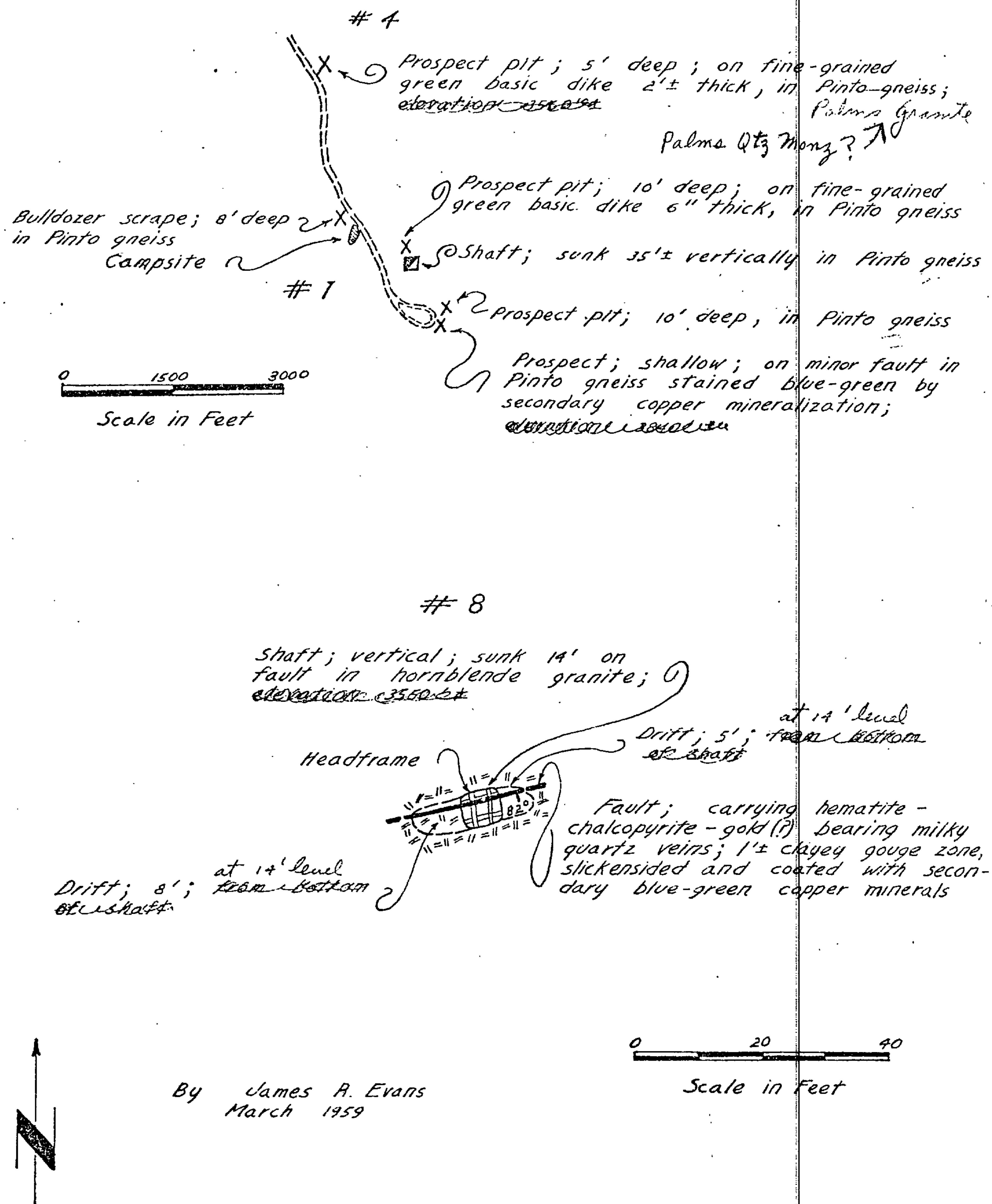


Figure 45. Sketch maps of the Smith Brothers claims.

Location: Sec. 6, T. 5 S., R. 10 E., S.B.M., Hexie Mountains quadrangle, 15', 1963; Cottonwood Mountains, about 6 miles northwest of Cactus City in Pinkham Canyon.

Ownership: Clifford S. Coy, 2032 Genevieve Street, San Bernardino, owns 3 unpatented lode claims (January 1960).

History: In 1935, the mine was active and J. P. Coy, W. L. Secomb, and C. S. Coy, Highland, were the owners.

Geology: (Precambrian) Pinto Gneiss underlies the southwest slope of a northwest-trending ridge. The gneiss is cut by a fault which trends north and dips 80° E. A well-developed gouge zone 1 to 3 feet thick contains an oxidized milky quartz vein.

Development: A tunnel is driven 90 feet south in the fault plane, through a small projecting ridge, to intersect a 40-foot shaft. The shaft is sunk 80° E. in the fault plane; from which point it flattens and extends possibly another 100 feet. The vein has been overhand stoped ~~at several places~~ to the surface from the floor of the tunnel at several places along its course to the shaft intersection.

Production: Compiled by the U. S. Bureau of Mines and published with permission of the owner.

Year	Crude ore (tons)	Recoverable metals Gold (ounces)	Silver (ounces)
1935	35	47	8

References: None.

J.R.E. 1/28/60.

Standard Mine

Location: Sec. 13, T. 2 S., R. 12 E., S.B.M., (proj.), Pinto Basin quadrangle, 15', 1963; Pinto Mountains, Joshua Tree National Monument, about 3 miles north-northeast of Mission and Sunrise Wells (fig. 31).

Ownership: Undetermined.

History: See Duplex mine. The mine was owned and operated by Willard Allen and Joe Geiger, Twentynine Palms, from 1938 to 1941.

Geology: Massive Mesozoic quartz monzonite is cut by a southwest-trending fault which contains gold-quartz veins of undetermined length and width (Karl Schapel, oral communication, 3/8/60).

Development: A drift adit comprises the main workings and is driven at least 300 feet southwest in the plane of the fault. Other work is of relatively minor extent and consists mainly of shallow shafts and prospects, although one shaft is at least 50 feet deep (Karl Schapel, oral communication, 3/60). The mine is idle.

Production: Compiled by the U. S. Bureau of Mines and published with permission of the owner.

Year	Crude Ore (tons)	Gold (oz.)	Silver (oz.)
1938	104	60	13
1939	89	47	9
1940	238	494	4
1941	287	30	20

References: Tucker, 1933, unpublished field report No. 122.

J.R.E.

Stanford Mine

Location: NE¼ sec. 9, T. 5 S., R. 4 W., S.B.M., Steele Peak quadrangle, 7½', 1953; on the west slope of a narrow north-trending ridge 1 mile southeast of Steele Valley.

Ownership: Undetermined.

History: By 1894, the Stanford Mine had been developed to essentially its full extent and a small, 5-stamp mill installed under the ownership of Hearn Bros. of Perris (Crawford, 1894, p. 225). In 1896, the mine was idle (Crawford, 1896, p. 314) and no report of subsequent activity was found.

Geology: The Stanford Mine penetrates a dip slope underlain by fractured, phyllitic rocks which strike north and dip 35° W. These rocks are cut by a poorly-exposed fault which strikes N. 25° W. and dips 45° - 75° SW. The sheared zone comprises an irregular body of sheared rock as much as 3 feet wide containing crushed, iron-stained quartz veins as much as 1 foot in thickness and what appears to be a thin porphyry dike.

Development: The fault is explored by an inclined shaft, reported by Crawford (1894, p. 225) to be 125 feet deep, a 50-foot crosscut and a drift of undetermined length. The crosscut cuts the fault 35 feet from the portal and 15 feet north of the shaft. The drift extends south from the crosscut to and beyond the shaft a distance of at least 50 feet, it being impossible to cross the shaft to determine its southern extent. The drift crosses the shaft about 40 feet below the collar. ~~When visited (October, 1960) the mine was untimbered, open and dry.~~

Production: Undetermined.

References: Crawford, 1894, p. 225; 1896, p. 314; Merrill and Waring, 1917, p. 532; Tucker and Sampson, 1929, p. 487.

R.B.S. 10/21/60.

Stanford Mine, Small Prospects Near

Location: SW¼SE¼ sec. 5, T. 5 S., R. 4 W., S.B.M., Steele Peak quadrangle, 7½', 1953; at the southwest edge of Steele Valley about 5½ miles southwest of Perris. Some prospects probably are in the SW¼ of the section.

Ownership: Undetermined.

History: This area was being prospected and mined in a small way in 1893 and 1894 (Crawford, 1894, p. 225) but the lack of any other reference makes the duration of these operations uncertain.

Geology: The country rock, granodiorite, has been eroded to an irregular pattern of low knolls and swales. A shear zone as much as 10 feet wide is exposed for about 300 feet. It strikes N. 15° W. and dips 85° NE. Quartz ~~both massive and finely crystalline,~~ forms stringers and veins ranging in width from 0 to 4 inches ~~wide~~ in the sheared country rock. The quartz is pocketed and stained with iron oxides and was reported (Crawford, 1894, p. 225) to be rich in gold in some spots.

Development: The main development is a caved shaft of unknown original depth but now about 30 feet deep. A short crosscut appears to have been driven east at the 15-foot level but this, too, is now caved. The shaft is at the southeast end of the outcrop. To the northwest the trend of the shear zone is pock marked by numerous shallow prospect pits, now largely filled and grown over by brush. Just south of the shaft, and near the dirt road which traverses Steele Valley, is an old arrastra pit. ~~is still discernable~~.

Production: Undetermined.

References: Crawford; 1894, p. 225.

R.B.S. 9/25/59.

Steece (Black Canyon) Group

Location: Sec. 1, T. 2 S., R. 23 E., and sec. 6, T. 2 S., R. 24 E., S.B.M., Parker quadrangle, 15' 1950; on the eastern slope of the Riverside Mountains 6 miles south of Vidal.

Ownership: Desert View Mines Inc., c/o Grace M. Tucker, Shattock Hotel, Berkeley 4. This owner holds the unpatented Silver Dome, Fraction, Gossen, Jackknife, Ernie, and Melvill lode claims and the adjacent, patented Black Canyon, Barnes, Buena Vista, Triangle, Emerald Copper, Green Gobbler Copper, Ruby Copper, Soda Basin Copper, and Washington lode claims (1957).

History: The Steece Group was first ~~reported on~~ described in 1917 (Merrill and Waring, p. 543) at which time it was owned by Richard Silliland and Ed Arnold of Calzona. At that time the main shaft was 500 feet deep. In a 1929 report the mine was said to be idle but soon to be reopened under the ownership of C. W. Mitchell, Parker House, Boston, Massachusetts (Tucker and Sampson, 1929, p. 487-488). Subsequently, according to the old Glendale Land Office records (1938), these claims had passed into the ownership of the Vidal Mining Co. and were reported as the "Black Canyon Group."

Geology: The Steece mine is in a geologically complex area. A folded and contorted ~~section~~ succession of Paleozoic(?) limestone and cherty dolomite about 700 feet thick is separated from underlying Precambrian schists along a shear zone which strikes roughly east-west, dips 10° N. and is exposed along the base of the mountains for about half a mile. The shear zone is mineralized with gold-bearing veins as much as 20 feet ~~in~~ thickness composed of quartz, hematite, barite, malachite, and chrysocolla.

Development: The extent of underground development was not determined but it appears to have explored downward along the shear zone. The mine is entered through several inclined shafts and adits. Ore appears to have been trammed down the several hundred feet of steep slope to stock-piling and loading points in a canyon which cuts west through the foothills and up which a road leads to the mine.

The ~~final~~ depth of the mine is reported to be 900 feet (Jack Stewart, Parker, Arizona, personal communication, ~~Feb. 18,~~ 1958).

Production: Undetermined.

References: Merrill and Waring, 1917, p. 543; Tucker and Sampson, 1929, p. 487-488; 1945, pl. 35.

R.B.S. and C.H.G. 12/19/57.

Stella Mine

Location: Sec. 10, T. 2 S., R. 12 E., S.B.M. (proj.), Dale Lake quadrangle, 15' 1956; Pinto Mountains, about 3 miles south of New Dale (Site) and approximately 1/10 mile north of the Gold Crown mine (see ~~pl. 3~~ figure 31).

Ownership: Ivan C. Winter, Box 1271, Twentynine Palms, owns 4 unpatented lode claims and a millsite.

History: The property was discovered in the late 1950's and has been worked intermittently since that time. A gold quartz mill was in a nearly complete stage of assembly on the day of the property visit.

Geology: Thin and discontinuous quartz veins intrude massive quartz monzonite and are strongest along preexisting minor faults. The largest vein observed was about 6 inches in average thickness.

Development: Four shallow vertical shafts are sunk in minor faults. The deepest shaft is 15 feet.

Production: None as of March 1960.

References: None.

J.R.E. 3/10/60

Sterling Mine

Location: SW 1/4 sec. 20 (proj.), T. 6 S., R. 14 E. S.B.M., Hayfield quadrangle, 15', 1963; on the northeast slope of the Orocopia Mountains, 3 1/2 miles south of U. S. Highways 60 and 70 and 1 1/2 miles southeast of the Gold Cup group, in a southwest-trending canyon.

Ownership: Undetermined.

History: This group of claims was located prior to 1896. During 1896, the property was being worked and a 10-stamp mill under construction by the Sterling Mining Company, Los Angeles (Crawford, 1896, p.314). The Sterling mine was once reported to have been a part of the Red Cloud group (Merrill and Waring, 1919, p. 539) but its distance from that group makes this seem unlikely. The same report states that the mill had been moved to the Lost Horse mine in the Pinon District, so presumably, the mine was idle. The appearance of the mine and camp sites suggests subsequent operation but no record of this was found.

Geology: The Sterling mine workings explore two faults which lie athwart a quartz monzonite-gneiss contact (fig.). One fault strikes east across a low ridge. On the ridge crest it dips vertically but flattens to about 80° N. where exposed in the workings. The other fault converges from the southwest. It strikes N. 80° E. across a ravine just west of the ridge and dips vertical, to steeply southeast (fig.).

Discontinuous quartz veins, ranging from 0 to 5 inches in thickness, lie in the planes of the faults. In addition, the fault in the ravine has been intruded by a basic dike. Locally the veins contain heavy concentrations of porous iron oxides in an irregular central zone. Voids in the oxides commonly contain yellow, tabular crystals of wulfenite as much as half an inch across. No information was obtained on the gold and molybdenum content of the veins.

Development: The vein in the ridge is explored by an adit, a 10-foot shaft and several shallow prospects. The adit was driven S. 70° E., 50 feet on a barren shear zone. A crosscut was then ~~run~~ extended 33 feet N. 35° E. to the vein on which a drift was driven 40 feet east. The shaft was sunk where the vein crosses the ridge, about 100 feet up the slope from the adit portal.

The vein in the ravine has been prospected by at least 12 shallow pits. ~~but no deeper work was done~~.

Production: Undetermined. Idle (1960).

References: Crawford, 1896, p. 314; Merrill and Waring, 1919, p. 539.

R.B.S. 2/11/60.

Stone House (La Rica) Mine

Location: NE 1/4 NW 1/4 sec. 4 (proj.), T. 8 S., R. 21 E., S.B.M., McCoy Spring quadrangle, 15', 1952; on the crest of the Mule Mountains and half a mile northeast of the Hodges mine. Access is by trail.

Ownership: Joe Hannah, Jr., et al., c/o Melvin Wehe, 121 West Charter Way, Stockton (1955), were the last known owners.

History: The Stone House mine is one of an undetermined number of old lode claims. Papers in the area indicate at least eleven claims were held in 1955 under this name, by the above noted owners. Judging from an old description, it is possible that this is the old La Rica mine (Tucker and Sampson, 1929, p. 483).

Geology: This mine apparently was opened in the search for gold in a fault zone that cuts gneissic granite. The fault zone is about 10 feet in average width and can be traced for about 200 feet up the slope at the head of a steep canyon. It strikes N. 45° W., and dips 45° SW. The mineralization appears to be confined to the quartz veins which are as much as one foot thick and thoroughly fractured. Hematite is common in fissures and vugs along with small amounts of chrysocolla, present as stains and coatings. Calcite and chlorite occur as scattered masses about an inch in average size.

Development: Two short adits and ~~2~~ two shallow prospect pits explore the fault. The adits are driven northwest just below a saddle at the head of the canyon and the ~~2~~ two prospects are a few tens of feet above them near the saddle. The lower adit is about 40 feet deep. The upper adit, 50 feet higher on the same vein, is 15 feet deep. ~~Both adits are untimbered, and were open and dry in February, 1958.~~

Production: Undetermined.

References: Tucker and Sampson, 1929, p. 483.

R.B.S. 2/21/58.

Sunrise Mine

Location: Sec. 26, T. 2 S., R. 12 E., S.B.M. ~~(proj.);~~ ~~U. S. Army Corps of Engineers~~ ~~(Eagle Tank)~~ Pinto Basin quadrangle, 15', ~~1943~~ 1963; southeastern tip of the Pinto Mountains, one mile north of Mission Well figure 31.

Ownership: Howard M. Fox, 810 N. Whittier Drive, Beverly Hills.

History: The Sunrise mine is said to have been discovered about 1900 and apparently was intermittently active until the mid-1930's. In 1929, it was acquired by Sunrise Mines, Incorporated, 416 Electric Building, San Diego. In 1933, the Sunrise group consisted of 15 claims and was operated by Sunrise Mines Incorporated along with the Zulu and Moose groups (see herein) and the Cortez group of 3 claims whose location is undetermined. Sixty five gallons of water per minute were pumped from Sunrise Well, one mile to the south. In 1939, the Sunrise mine was under lease to Pinto Basin Mining and Milling Company which was remodeling the mill to do custom work (Tucker and Sampson, 1940, p. 52-53). This lessee treated custom ore until closed by War Production Board order L-208 in 1942 (Tucker and Sampson, 1945, p. 143-144). The mine was idle in 1945 and by 1958, all buildings and equipment had been removed from the vicinity of the Sunrise shaft.

Geology: Quartz veins in sheared Mesozoic quartz monzonite. Just south of the shaft a well defined fault strikes north to N. 20° W., is steeply dipping, and is exposed for a strike length of several hundred feet. At the shaft no vein material was observed, but in 1940 Tucker and Sampson (p. 52, 53) reported "A series of parallel quartz veins in granite; strike N. 20° W., dip 70° SW.; width 2 to 4 feet."

Development: By 1933 the Sunrise Shaft had been sunk to a depth of 300 feet on an inclination of 79°, with levels at 100, 200, and 300 feet. In 1940, (p. 52-53) and again in 1945 (p. 143-144) Tucker and Sampson reported these workings with no additions. The shaft is boarded over (1961) and timbered so the vein is not visible; but the inclination is due west. All surface equipment has been removed.

Production: U. S. Bureau of Mines records credit Sunrise Mines, Inc. with 67.51 ounces of gold and 28 ounces of silver from 218 tons of ore in 1933 and 71 tons of ore in 1941 yielding 15 ounces of gold. Whether this production was from the Sunrise shaft, or from other operations of the Sunrise Mines Inc. is not known.

References: Tucker and Sampson, 1940, p. 52, 53; Tucker and Sampson, 1945, p. 143-144.

C.H.G. 5/16/61.

Top of the World (Victor, La Plomo, Steele) Mine

Location: SE¼ sec. 32, T. 4 S., R. 4 W. and NE¼ sec. 5, T. 5 S., R. 4 W., S.B.M., Steele Peak quadrangle, 7½', 1953; on the north edge of Steele Valley about 5 miles west of Perris (figure 42).

Ownership: Nolan F. Fultz, P.O. Box 175, Perris.

History: The Top of the World Mine was first developed prior to 1888 but the date of location was not determined. By 1888, much of the present development had been accomplished under the ownership of H. C. Steele (Goodyear, 1888, p. 527). The mine was idle when reported on in 1894 (Crawford, 1894, p. 225) ~~Still owned by H. C. Steele, the "Victor Mine" was again reported idle~~ and in 1896 (Crawford, 1896, p. 314). The Top of the World Mine was reported active in 1935 when Calbert and Fultz were the owners (Sampson, 1935, p. 514-515). Apparently the mine was worked on a small scale from 1933-1938 but by 1945 the mine was again idle (Tucker and Sampson, 1945, p. 144, pl. 35). ~~At present~~ In 1959, only assessment work is being done.

Geology: The workings of the Top of the World mine lie athwart a low ridge ~~(fig.)~~ underlain by Mesozoic diorite and a small pendant of quartz-mica schist which strikes N. 10° W. and has a generally vertical dip. At least 2 aplite dikes cut both the diorite and schist.

Judging from the arrangement of the workings and some of the older reports, it appears that the vein lies at or near the diorite-schist contact for at least part of its explored extent. It is poorly exposed at the surface, but appears to strike about N. 20° E. and dips about 45° NW. The vein is reported to range in thickness from 9 to 3 feet and is composed of quartz containing unvenly distributed gold and silver-bearing galena. Ore from one shoot ~~(fig.)~~ has assayed as high as $1,000 in gold and twenty-five ounces of silver per ton (Goodyear, 1888, p. 527; Storms, 1893, p. 384), however, an average based on 1933-1938 production figures, would be roughly $48 in gold and 2.4 ounces of silver per ton (U.S. Bureau of Mines files).

Development: The mine (plate 1) was developed through a main inclined shaft 175 feet deep and three shallower inclined shafts, two of which are now (1959) largely filled. Lateral development was accomplished on the 60, 120, and 175-foot levels. The lowest level opens to an adit driven north from the south slope of the ridge to ventilate and drain the mine. An ore shoot was stoped between three raises at the southwest end of the 60-foot level. An inclined shaft in the hanging wall was sunk by the present owner to avoid the caved upper part of the old main shaft.

Production:

During the years 1933 to 1938 the top of the World mine yielded about 46 tons of ore from which about 24 ounces of gold and 12 ounces of silver were recovered.

References: Goodyear, 1888, p. 527; Storms, 1893, p. 384; Crawford, 1894, p. 225; 1896, p. 314; Merrill and Waring, 1917, p. 531-532; Tucker and Sampson, 1929, p. 489; 1945, p. 144, pl. 35; Sampson, 1935, p. 514-515; Goodwin, 1957, p. 607-608.

R.B.S. 9/24/59.

Triangle (Pilot) Mine

Location: Sec. 6, T. 7 S., R. 16 E., S.B.M., Chuckwalla Mountains quadrangle, 15', 1963; in the Chuckwalla Mountains at the mouth of a canyon which drains the north slope of Pilot Mountain, about 2 1/2 miles south and east of Aztec Well.

Ownership: Not determined (1959).

History: The Triangle mine was reported in 1929 to be owned by William B. Krosse, J. M. Halloway, and C. A. McGraw, who lived at Aztec Well (Tucker and Sampson, 1929, p. 489).

Geology: A fault in gneissic granite is exposed for about 200 feet along the east flank of a ridge. The fault zone is as much as 3 feet wide and is mineralized by a quartz vein as much as 2 feet wide. Fractures and pockets in the vein are filled with oxides of iron and traces of secondary copper minerals. The fault strikes N. 45° E., and dips 40° NW.

Development: The Triangle mine consists of 3 inclined shafts, 2 open-cuts, and an adit. The shafts are about 70 feet apart along the exposed extent of the vein. The northwest shaft is roughly 100 feet deep, the middle shaft is 35 feet deep, and the southeast shaft is blocked by caving at a depth of 20 feet. The two open-cuts adjoin the portals of the northwest and central shafts. In addition, drifting extends 30 - 40 feet southeast from the central shaft. Two short raises connect this drift with the surface. The adit was driven to crosscut the vein from a point about 40 feet down slope and northeast of the middle shaft.

Production: The total yield of the Triangle was not determined. Tucker and Sampson (1929, p. 489) stated that one ton of sorted ore was treated in an arrastra at Aztec Well and that $125 in gold was recovered.

References: Tucker and Sampson, 1929, p. 489; Tucker and Sampson, 1945, pl. 35 (mislocated).

R.B.S. 5/1/59.

No.

Twin Buttes #1 Mine

Location: SE¼ sec. 18, T. 5 S., R. 2 W., S.B.M., Winchester quadrangle, 7.5', 1953; about one mile southwest of Homeland at the northwest end of a shallow, southeast-draining canyon.

Ownership: Undetermined.

History: This was one of seven unpatented claims located in 1935 by Don F. Hays. Previously this claim had been held by Menifee Wilson who did most of the development.

Geology: Two en echelon shear zones, which strike east and dip 80° N., are exposed through a distance of about 200 feet on a knoll underlain by diorite. The planes of these shears contain lenticular bodies of milky vein quartz ranging from 0 to 4 feet in thickness. The quartz is highly fractured and sheared and resulting fissures and cavities are filled with oxides of iron.

Development: The west vein is explored by a 6-foot pit, a 60-foot shaft, is crossed by a trench 60 feet long, and, at its eastern extreme, by a prospect pit and a second shallow trench. The east vein is explored by a 60-foot shaft joined at the 15-foot level by a 30-foot adit driven west on the shear.

Production: Undetermined. Idle (1959).

References: None.

R.B.S. 9/22/59

Twin Buttes #2

Location: SE¼ sec. 18, T. 5 S., R. 2 W., S.B.M., Winchester quadrangle, 7½', 1953; one mile southwest of Homeland. This unpatented claim lies in a saddle where a trail (see quadrangle map) crosses a northeast-trending ridge.

Ownership: Mrs. Mayme J. Hays, Route 1, Box 193, Romoland.

History: This is one of seven claims located by Don F. Hays in 1935. The date of its development was not determined.

Geology: A vertical shear zone as much as 4 inches wide strikes N. 40° W. across the diorite ridge. Though poorly exposed, the shear zone appears to converge with an aplite dike about 15 feet wide which strikes N. 70° W. and which is well exposed on the ridge. A thin vein of iron-stained quartz lies in the shear zone. It carries free-milling gold. As presently exposed the vein exceeds an inch in thickness in only a few places.

Development: A 50-foot drift adit follows the shear zone to within an estimated 30 feet of its junction with the dike.

Production: None.

References: None.

R.B.S. 9/22/59.

Prospect (Name Undetermined)

Location: Sec. 16 (proj.), T. 2 S., R. 12 E., S.B.M., Pinto Basin quadrangle, 15', 1963; Pinto Mountains, about 3 miles northwest of Mission and Sunrise Wells.

Ownership: Undetermined.

History: Possibly part of the work was done by the Sunrise Mines Inc., San Diego, during the 1930's (see Sunrise Mine description).

Geology: Several steeply-dipping quartz veins, as much as a foot thick, cut massive quartz monzonite. In the prospect area the veins are semi-parallel and trend generally west.

Development: A few shallow shafts, one about 20 feet deep, are sunk on the veins. The mined quartz has been piled near the pits and apparently contained no values.

Production: None.

References: None.

J.R.E. 3/30/60

Mine (Name Undetermined)

Location: Sec. 8 (?), T. 3 S., R. 10 E., S. B. M., Hexie Mountains quadrangle, 15', 1963; Hexie Mountains, Joshua Tree National Monument, about 4 1/2 miles southeast of White Tank, and about 1/2 mile south of the West Pinto Basin Road.

Ownership: Undetermined.

History: Undetermined.

Geology: Blue-gray quartzite and quartz-muscovite schist of the Pinto Gneiss are cut by a northwest-trending and 65° southwest-dipping fault. The fault is marked by a 2- to 5-foot wide breccia-gouge zone which contains thin quartz stringers.

Development: A drift adit is driven 100 feet northwest in the fault plane. Forty feet from the portal, a winze is sunk to the 30-foot level in the plane of the fault. From this point, a drift extends northwest 18 feet. A few tens of feet west of the adit portal a pegmatite body and thin quartz stringers have been explored by means of a 20-foot vertical shaft. The mine is idle.

Production: Undetermined.

References: None.

J.R.E. 1/25/60

Mine (Name Undetermined)

Location: NW cor. sec. 34, T. 2 S., R. 8 E., S.B.M., Lost Horse Mountain quadrangle, 15', 1958; Joshua Tree National Monument, 1 3/4 miles southeast of Ryan Campground in a valley between Lost Horse Mountain and Ryan Mountain.

Ownership: Undetermined (1960).

History: Undetermined, but apparently a very old working and long idle.

Geology: Aplite dikes in thin banded, Precambrian quartz-biotite gneiss (Pinto Gneiss). Where exposed in the shaft, the dikes strike N. 10° E. and are vertical. The largest dike is 10 inches wide at the surface but is 6 inches wide at a depth of 20 feet; a second dike is 4 inches wide at the surface, and there are several thinner dikes. The dikes are not exposed at the surface beyond the shaft.

Development: One vertical shaft of unknown depth.

Production: Undetermined.

References: None.

C.H.G. 1/28/60

Mine (Name Undetermined)

Location: NE 1/4 NE 1/4 sec. 4, T. 3 S., R. 8 E., S.B.M., Lost Horse Mountain quadrangle, 15', 1958; Joshua Tree National Monument, in the central part of the Lost Horse Mountains on a ridge half a mile northwest of the Lost Horse mine.

Ownership: Undetermined.

History: Undetermined. Probably the exploratory work was in connection with the Lost Horse mine (see herein) in the 1890's.

Geology: Quartz veins occur in shear zones in banded, Precambrian quartz-biotite gneiss (Pinto Gneiss). Two principal quartz veins have been explored: one strikes N. 20° W., dips 70° NE., is solid, and one foot thick; 50 feet to the northeast is a 5- to 6-foot wide sheared vertical quartz vein which strikes north. The vein quartz shows very little iron oxide stain and no sulfides.

Development: The vertical vein is explored by an adit, now caved, and an inclined shaft is sunk on the inclined vein. The shaft apparently is shallow, but the adit, as indicated from the size of the dump, may have at least 100 feet of workings.

Production: Undetermined.

References: None.

C.H.G. 6/20/57

Mine (name undetermined)

Location: NE¼NE¼ sec. 33, T. 2 S., R. 8 E., S.B.M., Lost Horse Mountain quadrangle, 15' 1958; Joshua Tree National Monument, 1½ miles south of Ryan Campground and Lost Horse Well, on the northeast slope of the Lost Horse Mountains.

Ownership: Undetermined.

History: Undetermined, apparently long idle.

Geology: Quartz veins in gneissic quartz monzonite (Pinto gneiss). One vein, exposed in an open trench near the crest of the hill, strikes N. 60° E., dips 65° NW., and has been trenched laterally for about 50 feet. A second vein, exposed at the portal of the adit below, strikes N. 45° W., dips 70° SW., and is as much as 3 feet wide. Other thin quartz stringers intersect the trend of this vein at right angles. The dumps contain small amounts of yellow-brown iron oxide stained vein quartz.

Development: The quartz vein near the hilltop has been explored by a narrow trench about 50 feet long and 10 to 15 feet deep, and a shaft inclined 65° NW. is sunk from the bottom of the trench. About 300 feet to the southeast and 175 feet below the trench and shaft an adit is driven N. 45° W. The size of the dumps suggests several hundred feet of underground workings, and the shaft and adit may join. The workings are reached by ~~means of a quarter of a mile of foot trail, from the end of the Jeep road in the valley to the east.~~

Production: Undetermined.

References: None.

C.H.G. 5/19/61.

Vidal Lime Claim

Location: NW¼ SW¼ sec. 19, T. 1 S., R. 24 E., S.B.M., Vidal quadrangle, 1950; at the north end of the Riverside Mountains, 2 3/4 miles south of Vidal.

Ownership: Jack Stewart, General Delivery, Parker, Arizona; 8 claims, leased to Jack Gordon, Wendon, Arizona (1957).

History: This ~~mine~~ claim was operated for a short time during 1957 by H. G. Smith, Box 416 Buckeye, Arizona; possibly under lease from the present owner.

Geology: The rocks in the area of the Lime ~~mine~~ claim are platy Precambrian gneiss. The slopes near the mine are partially covered by thin deposits of travertine. A mineralized fault, bearing gold and rich in copper minerals, strikes N. 60° - 80° W. across the claims and dips 65° NE. Because of the travertine deposits and the irregular distribution of the ore, the fault is not traceable for more than a few tens of feet in any exposure. Minerals identified are chrysocolla, malachite, quartz, and hematite. They occur in pods and lenses as much as 6 feet wide. ~~in width.~~

Development: This deposit is explored by 2 shafts of undetermined depth. One is inclined steeply along the fault and the other, a few feet away, is vertical, apparently affording access to the inclined shaft. An adit of unknown length has been driven northwest into the side of a shallow canyon just south of the main site, and a shallow prospect trench is cut in the north-facing slope at the main site.

Production: During 1957, this mine was reported to have yielded 116 tons of ore from which 4 ounces of gold, 5 ounces of silver, and 1,479 pounds of copper were recovered.

References: None.

R.B.S. and C.H.G. 12/20/57

Virginia (Missing Link, Virginia Shay) Mine

Location: NE¼ sec. 32, NW¼ sec. 33, T. 4 S., R. 4 W., S.B.M., Steele Peak quadrangle, 7.5', 1953; at the junction of Santa Rosa Road and an unimproved dirt road which extends southward to Steele Valley. This point is about 5½ miles, by road, west of Perris (see figure 42).

Ownership: Undetermined.

History: The Virginia mine was first reported under development in 1893 (Storms, p. 385). Active mining was first noted by Crawford (1894, p. 225), a shaft 200 feet deep having been sunk by the owner Jerry Shey, ~~a resident of~~ Perris. The mine was idle in 1895 and 96 at which time it was owned by J. B. Dennis, Perris (Crawford, 1896, p. 313), and appears to have remained inoperative through 1929 (Merrill, 1917, p. 532; Tucker, 1929, p. 485) having then passed into the ownership of Hugh Duff, 626 Wesley Roberts Building, Los Angeles. From 1930-1931 the property was leased to H. L. Musick, 2336 Whittier Boulevard, who sunk a shaft on a new vein (Tucker, 1945, p. 138-139). Frank W. Kitchen, 230 E. 3rd Street, Perris, who worked in the mine during that period, states that this shaft was sunk to explore a vein which had been discovered by core drilling. The drill had cut the vein at a low angle giving a false measure of its thickness.

Geology: Deeply-weathered Mesozoic diorite is cut by two quartz veins, each as much as 3 feet wide. The spatial relationship of the veins is not evident on the surface, but judging from the position of the shafts they are as much as 200 feet apart and roughly parallel. Attitudes given by Tucker (1945, p. 138-139) are N. 75° E., 56° SE. for the north vein, and N. 50° E., 60° SE. for the south vein. They average from $8 to $10 per ton in gold.

Development: The old shaft is on the south vein. It is low on a slope on the south edge of the property and is reported to be 200 feet deep. According to Mr. Kitchen, the shaft which was sunk to explore the north vein is 240 feet, and there is a 75-foot drift northeast at the 50-foot level, and a 150-foot drift at the 175-foot level. Operations were terminated owing to an excess of water.

Production: Undetermined.

References: Storms, 1893, p. 385; Crawford, 1894, p. 225; Merrill, 1917, p. 532; Tucker, 1929, p. 485; Sampson, 1935, p. 513; Tucker, 1945, p. 138-139.

R.B.S. 6/18/59

Washington Mine

Location: NE¼ sec. 24 (proj.), T. 4 S., R. 5 W., S.B.M., Steele Peak quadrangle, 7.5', 1953; 7 miles west of Perris and a quarter of a mile southeast of Hartford Springs.

Ownership: Undetermined.

History: Last reported activity was in 1940 and 1941 by Vern W. Decker, Perris (U. S. Bureau of Mines files).

Geology: Deeply-weathered Mesozoic diorite is cut by a fault which strikes N. 10° W., and dips 40° SW. The fault plane comprises a shear zone as wide as one foot sparsely mineralized with quartz veins ranging from a fraction of an inch up to 3 to 4 inches in thickness. Fractures and small cavities in the quartz contain iron oxides and free-milling gold. The vein is poorly exposed on the surface.

Development: The fault is explored by two inclined shafts approximately 70 feet apart. The more northerly shaft is timbered and open to 50 feet, below which it is flooded. Its total depth or lateral development was not determinable. The other shaft is caved.

Production: According to U. S. Bureau of Mines records, during 1940 and 1941 this mine yielded 31 tons of ore from which 2 ounces of gold and one ounce of silver were obtained.

References: None.

R.B.S. 6/16/59.

Zulu Queen Mine

Location: Sec. 15 (proj.), T. 2 S., R. 13 E., S.B.M., Dale Lake quadrangle, 15', 1956; Pinto Mountains, Joshua Tree National Monument, about 6 miles northeast of Mission and Sunrise Wells (Figure 31).

Ownership: Undetermined.

History: The Zulu Queen mine is one of 3 mines owned by the Sunrise Mines Inc., 726 Electric Building, San Diego, in the 1930's. In 1933, the property consisted of the Zulu group of 11 unpatented claims (Tucker and Sampson, 1945, p. 143). The mine was worked intermittently from 1933 to 1938 (see Sunrise mine description).

Geology: A major shear zone as much as 12 feet wide cuts Mesozoic quartz monzonite. The shear zone trends north, is vertical, and contains gold-bearing quartz veins and lenses that range in thickness from a few inches to 18 inches.

Development: A vertical, 2-compartment shaft is sunk 100 feet in the shear zone. On the 50-foot level, there is a drift 175 feet south, and on the 100-foot level there is a drift 75 feet south (Tucker, 1933, unpublished field report No. 121). Directly south of the headframe of the shaft, and at the same elevation, an adit is driven 110 feet southward in the shear zone. A vertical winze connects to the 50-foot level about 85 feet from the portal. At 110 feet, another nearly vertical winze extends to the 50-foot level. Water was obtained from Sunrise Well, about 6 miles southwest.

Production: Compiled by the U. S. Bureau of Mines and published with permission of the owners.

Year	Crude ore (ton)	Gold (oz.)	Silver (oz.)
1934	19	24	5
1935	18	3	1
1936	28	4	1
1938	47	7	

References: Tucker, 1933, Unpublished Field Report No. 121; Tucker and Sampson, 1945, pp. 143-144, pl. 35.

J.R.E. 3/10/60.

Gypsum

The principal source of gypsum ($CaSO_4 \cdot 2H_2O$) in Riverside County has been the upper (Paleozoic (?)) Maria formation, exposed in the Riverside Mountains, Big Maria Mountains, Little Maria Mountains, and the north end of the Palen Mountains in the eastern part of the County. In all the above areas except the Little Maria Mountains, there has been essentially no gypsum mining, although each area contains deposits of potential commercial grade.

From 1925 to 1940, the United States Gypsum Company plant in the Little Maria Mountains was the largest single source of gypsum products in California. Production ~~has since~~ remained about the same to 1966 when work at that site was stopped. ~~but the~~ That operation had been overshadowed by the exploitation of deposits in other parts of California (Ver Planck, 1952, p. 13).

Gypsiferous material for use as a soil conditioner has been taken from the deposit in the Little Maria Mountains (Ver Planck, 1952, p. 105) in Riverside County, but most of such gypsum (gypsite) has been mined in the western part of the county.

~~Gypsum (Gypsite).~~ in the form of

Gypsite, an earthy mixture of very small gypsum crystals with clay and sand or other impurities, has been mined in an area that lies along the northeast flank of the Santa Ana Mountains about 4 miles south and southwest of Corona. There a narrow, irregular belt, averaging about 500 feet in width but as much as 3,000 feet wide containing rather low-grade gypsite extends for about 3½ miles in a northwesterly direction between Joseph and Tin Mine canyons. The gypsite comprises a mixture of altered volcanic rock (hornblende andesite of the Jurassic (?) Santiago Peak volcanics) and gypsum. Although the gypsum content is only between 20 and 30 percent, the material ~~carries~~ contains enough iron and lime to make it of value as a soil conditioner (Ver Planck, 1952, p. 58). Exploitation of the Corona deposits has been sporadic and most of the mining took place from 1909-1934, with most of the material used in local~~ly by~~ orchard~~ists~~s. Production of gypsite from the Corona area for agricultural use is hindered because agricultural gypsite must generally contain more than 50 percent gypsum.

Small quantities of gypsite ~~are said to~~ may have been taken from fluvial deposits at the south end of the Palen Mountains for use in the Blythe area (see herein under Iron Cap and Iron King claims).

Barth (Prizer) Deposit

Location: Undetermined (1961). Ver Planck (1952, p. 124) lists the property in sec. 2, T. 4 S., R. 7 W., S.B.M., ~~This is a doubtful location because section~~ 2 which is wholly covered with older alluvium. This location may have been ~~for~~ a grinding or storage site ~~area~~; the gypsum probably was obtained from the Eagle Canyon-Tin Mine Canyon gypsite belt in the nearby Santa Ana Mountains.

Ownership: Undetermined (1961).

History: Operation was by H. A. Prizer in 1909 and W. C. Barth in 1914.

Geology: Undetermined.

Development: Undetermined.

Production: Small production of gypsite for agricultural use was reported in 1909, 1914, and 1917.

References: Merrill, 1917 [1919], p. 579; Ver Planck, 1952, p. 124-125; Gray, 1961, p. 115.

C.H.G. 3/2/61.

Big Chief (Freeman-Nonhof, White Gypsum Group, Ware) Deposit

Location: SE¼ sec. 9, SW¼ sec. 10, T. 4 S., R. 7 W., S.B.M., Corona South quadrangle, 7½', 1954; northeastern flank of the Santa Ana Mountains, 3½ miles southwest of Corona, on the south side of Tin Mine Canyon.

Ownership: P. E. Coleman, 301 Fruit Street, Santa Ana, owns the Big Chief placer claim of 20 acres (1957).

History: In 1923 G. R. Freeman and E. R. E. Nonhof, Corona, did some development work. The property was leased in 1943 to Dr. Leon N. Katz, 9837 Foothill Blvd., San Fernando when bulldozer cuts were made and some sampling was done. In 1947, the property was held by Howard S. and Irene J. Ware, 219 East Olive Street, Corona. Mr. Coleman located the property in 1954 and in 1956 limited trenching and sampling were done. This area was formerly part of the White Gypsum Group (see herein).

Geology: See White Gypsum Group herein.

Development: Several short adits 10 to 30 feet long and shallow open cuts.

Production: See White Gypsum Group herein.

References: Gray, 1961, p. 115.

C.H.G. 3/3/61.

Eagle Canyon (Frazer) Gypsum Deposit

Location: Lots 1 and 2, SW¼ sec. 13; N½NW¼ sec. 24, T. 4 S., R. 7 W., S.B.M., Corona South quadrangle, 7½', 1954; about 4 miles south of Corona along both sides and west of the mouth of Eagle Canyon.

Ownership: T. A. and F. M. Frazer, 718 Howard Street, Corona, own three unpatented placer claims: Eagle Group, Eagle Group No. 2, and Eagle Group No. 3, totaling about 150 acres (1957).

History: The Eagle Canyon deposit was mined for agricultural gypsum from 1913 to 1917. Other than assessment work the property has apparently since been idle except during 1943-44 when Dr. Leon Katz mined about 1,000 tons of gypsite. This material was used only for testing and experimental purposes. A small crushing plant was also installed in 1943-44 but proved unsatisfactory and was removed in the early 1950's.

Geology: Gypsite occurs as a network of narrow, closely spaced, satin spar veinlets in zones of hydrothermally altered dacites and andesites of the Jurassic(?) Santiago Peak Volcanics. The gypsiferous zones strike about N. 70° W. and lie along or near the Elsinore fault zone. The gypsite belt, which is as much as 500 feet wide, occurs on both sides of Eagle Canyon and crops out sporadically for a lateral distance of nearly 1,500 feet across the ridge to the next small canyon to the west (Manning Canyon). Tucker and Sampson (1945, p. 168) report the gypsum content ranges from 15 to 25 percent. However, Dr. Katz reports that most of the material has a gypsum content of only about 15 percent (Gray, 1961, p. 83).

Development: Short adits, shallow open cuts, and prospect pits. On the west side of Eagle Canyon an adit is driven west 80 feet; about 200 feet south of this adit there is an open cut 70 feet in length; on the west side of Manning Canyon an adit has been driven west 100 feet (Tucker and Sampson, 1945, p. 168). The most recent development was done in 1943-44 along the east side of Eagle Canyon and consisted of an adit driven southeast 20 feet and an open cut 60 feet in length and 15 feet in depth.

Production: Small recorded production of gypsite, 1913-1917.

References: Merrill, 1917 [1919], p. 579; Tucker and Sampson, 1945, p. 168; Ver Planck, 1952, p. 58, 125, 132; Gray, 1961, p. 83-84, 115.

C.H.G. 8/17/62.

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El Cerrito Ranch

Location: Undetermined.

Ownership: Undetermined.

History: A small tonnage of gypsite is reported to have been produced in the period 1915-1917 for private agricultural use. This gypsite probably was mined from the Eagle Canyon - Tin Mine Canyon gypsite belt about 3 miles south and southwest of Corona in the Santa Ana Mountains.

References: Merrill, 1917 [1919], p. 579; Ver Planck, 1952, p. 135; Gray, 1961, p. 115.

C.H.G. 3/3/61.

Elki Claims

Location: SW$\frac{1}{4}$ sec. 10, T. 4 S., R. 7 W., S.B.M., Corona South quadrangle, 7$\frac{1}{2}$', 1954; northeastern flank of the Santa Ana Mountains, 3$\frac{1}{2}$ miles southwest of Corona, on the south side of Tin Mine Canyon.

Ownership: George S. Jones, 3262 Santa Ana Street, South Gate (1957).

History: Mr. Jones located three claims (Elki 1-3) in 1956. Formerly part of White Gypsum Group (see herein).

Geology: See White Gypsum Group herein.

Development: Open trenches and one 30-foot adit.

Production: See White Gypsum Group herein.

References: Gray, 1961, p. 115.

C.H.G. 3/3/61.

Hagador Canyon Gypsum Deposit

Location: NW¼ sec. 15, S½SW¼ sec. 10; NE¼ sec. 16, T. 4 S., R. 7 W., S.B.M., Corona South quadrangle, 7½', 1954; about 4 miles southwest of Corona, along Hagador Canyon and the ridges on both sides of the canyon.

Ownership: W. R. and Virginia Adams, 301 Fruit Street, Santa Ana, own two unpatented placer claims located in 1952: Farmer's Friend Nos. 1 and 2 (1957). In 1956, Orrin M. Pierce, 1607 North Flower Street, Santa Ana located two placer claims, Alpha and Omega in secs. 9, 10, 15, 16; and A. F. Bullard and William Redding, 1008 South Pacific Avenue, San Pedro also located two placer claims, Red Bull No. 2 (S½SW¼ sec. 10) and Red Bull No. 3 (N½NW¼ sec. 15).

History: The earliest recorded operation was in 1910 and the deposit was later mined in 1915, 1916, 1924, and 1926-34. During the 1926-34 operation by E. R. E. Nonhof a crushing and screening plant with a reported capacity of 40 tons per day was erected in upper Hagador Canyon. Collapsed remains of this plant remained on the property in 1956, but there is no known production since 1934.

Geology: The gypsum occurs in hydrothermally altered metavolcanic rocks of the (Jurassic(?)) Santiago Peak Volcanics, and is similar to the Eagle Canyon deposit (described herein). The gypsum-bearing zone strikes northwestward and lies along the southwest side of the Elsinore fault in rugged, brush-covered foothills of the Santa Ana Mountains. Along Hagador Canyon the gypsum-bearing zone is about 3,000 feet wide, but to the northwest narrows to about 1,500 feet on the south side of Tin Mine Canyon, where it apparently terminates. Tucker and Sampson (1945, p. 169) report that the gypsite beds are about 200 to 300 feet in width and about 750 feet in length in secs. 10 and 16 astride Hagador Canyon, with the principal exposure on the west side of the canyon. To the southeast, along the east side of Hagador Canyon, Tucker and Sampson (1945, p. 166) report an exposure of clay (probably altered volcanic rock along a shear zone) that contains 25 to 37 percent gypsum. This gypsum-bearing zone is about 600 feet wide and 1,500 feet long. To the southwest, along the west branch of Hagador Canyon in the NE¼ sec. 16, is exposed a gypsite body several hundred feet thick.

Development: Several large adits and open cuts and trenches, together with a number of shallow open cuts and short adits. In 1956, the open cuts and trenches were caved and the principal adits were inaccessible because of standing water and caving. The area is overgrown with brush so that the gypsite-bearing zones are very poorly exposed.

Production: Undetermined, but this property probably has been the principal source of agricultural gypsite in the Corona area. The output was sold as a soil conditioner to growers in southwestern Riverside County.

References: Merrill, 1917 [1919], p. 579; Symons, 1928, p. 269; Symons, 1935, p. 279; Tucker and Sampson, 1945, p. 168-169; Ver Planck, 1952, p. 57-58, 126, 132, 142, 149; Gray, 1961, p. 84-85, 115.

C.H.G. 8/17/62.

Jameson Deposit

Location: Sec. 3(?), T. 4 S., R. 7 W., S.B.M., Corona South quadrangle, 7½', 1954. Location of deposit, given by Ver Planck (1952, p. 126) as sec. 3, is doubtful because the only gypsum found there today is a very minor amount associated with clay shales of the Paleocene Silverado Formation.

Ownership: Undetermined.

History: W. H. Jameson Company, Corona, is reported to have produced a small amount of gypsite in 1915 for private use on orchards. Probably the gypsum was mined from the Eagle Canyon-Tin Mine Canyon gypsite belt, about 3 miles south and southwest of Corona in the Santa Ana Mountains.

Geology: Undetermined.

Development: Undetermined.

References: Merrill, 1917, [1919], p. 579; Ver Planck, 1952, p. 126, 138; Gray, 1961, p. 115.

C.H.G. 3/3/61.

Main Street (Gypsum) Canyon Gypsum Deposit

Location: S½NE¼ sec. 15; N½S½ sec. 14, T. 4 S., R. 7 W., S.B.M., Corona South quadrangle, 7½', 1954; about 4 miles south of Corona along Main Street (Gypsum) Canyon and adjoining ridges.

Ownership: Mrs. Josephine Middlesworth, 847 W. 9th Street, Corona, owns one unpatented placer claim (Morning Star) in the S½NE¼ sec. 15 (1957). Floyd N. Champion, et al., 3316 E. Anaheim Street, Long Beach, owns five unpatented placer claims (Capitol Dome 1-5) covering about 75 acres in the NW¼SE¼ sec. 14, T. 4 S., R. 7 W., S.B.M. (1957).

History: This deposit was first worked about 1900 and was intermittently active on a small scale until 1937. It was further explored by several lessees during 1944-45 and apparently has since been idle.

Geology: The gypsum occurrence is similar to that of the Eagle Canyon deposit (described herein). Satin spar veinlets occur in metamorphosed Jurassic(?) Santiago Peak volcanic rocks along the Elsinore fault zone and in brown shales of the adjacent Silverado Formation. The main body of the deposit occurs along the west side of Main Street (Gypsum) Canyon and on the brush-covered ridge northwest toward Hagador Canyon. The gypsite-bearing zone is about 600 feet wide on the west margin of Main Street Canyon, but widens to nearly 1,500 feet on the ridge to the northwest. Tucker and Sampson (1945, p. 168) report that the exposed gypsite-bearing zone on the Morning Star claim was 700 feet in width. Several smaller exposures of gypsite lie on the east side of Main Street Canyon.

Development: Short adits, and shallow trenches, open cuts, and prospect pits.

Production: Undetermined intermittent production of gypsite for agricultural use by citrus growers in the vicinity of Corona ~~during a period~~ dating from before 1901 until 1935.

References: Aubury, 1906, p. 286; Merrill, 1917 [1919], p. 579; Tucker and Sampson, 1945, p. 168; Ver Planck, 1952, p. 57-58, 126, 136, 140; Gray, 1961, p. 85-86, 115.

C.H.G. 8/17/62.

Maria Mountains Deposits

Location: Secs. 1, 2, 3, 4 (proj.) T. 4 S., R. 20 E.; secs. 30, 31, 34, 35 (proj.) T. 3 S., R. 21 E.; and secs. 5, 6, and 7 (proj.), T. 4 S., R. 21 E., S.B.M., Midland and Big Maria Mountains quadrangles, 1952, 1951; on the west slope of the Big Maria Mountains and in the southeast one-third of the Little Maria Mountains near the town of Midland, 22 miles north-northwest of Blythe.

Ownership: United States Gypsum Company, 300 W. Adams St., Chicago 6, Ill.

History: When the Maria Mountains gypsum deposits were described by Merrill and Waring (1917, p. 577-579) they were claimed by a number of interests. Subsequent changes are here outlined.

U. S. Bureau of Mines [Land Management] records show that the United States Gypsum Company patented twenty-two 20-acre placer claims in the Little Maria Mountains and three 20-acre placer claims in the Big Maria Mountains in 1916. In the same year P.A. English, et. al. patented five groups comprising forty, 20-acre claims, some in the Big Maria Mountains but principally in the Little Maria Mountains. About 1915, W. W. Orcutt, et. al., patented five placer claims in the northwest corner of the Little Maria Mountains gypsum bearing area comprising a total of 620 acres (Tucker and Sampson, 1929, p. 510; U. S. Bureau of ~~Mines~~ Land Management records).

In 1920, the U. S. Gypsum Company was reported to have completed extensive exploratory work in the Little Maria Mountains area (Tucker, 1920, p. 327), and by 1929 a plant had been built and extensive development accomplished. In 1937 underground mining was started on property shown as the "Brown Mine" on the Midland quadrangle. This operation was discontinued in 1949 because of more economical open pits which had been started in 1946 in the area marked "Victor Mine" on the map (personal communication, E. E. Sturrock, U. S. Gypsum Mine Superintendent).

In 1929 Messrs. Garland, C. M. Langdon and Ray T. Savage, of Los Angeles, held an unspecified number of claims on the west slope of the Big Maria Mountains. A small crushing plant was employed on the Savage property (Tucker and Sampson, 1921, p. 513) and evidence was found that a small plant had once been used on the White Elephant claim, held in 1932 by Langdon, in sec. 35, T. 3, S., R. 21E., S.B.M.

In the mid-30's, U. S. Gypsum, through the patent of 19 more claims in the Little Maria and 8 more claims in the Big Maria areas and other transactions, acquired the Garland, Garbutt and Orcutt, Langdon, and Savage deposits (U. S. Bureau of ~~Mines~~ Land Management records; Tucker and Sampson, 1945, p. 170).

In 1945 U. S. Gypsum Co. engaged Utah Construction Company to explore the Garbutt and Orcutt property and, in 1947, mining was begun. In 1948, Utah Construction Company acquired an interest in the property. It was closed in June, 1950 (Ver Planck, 1952, p. 13-14).

As reported by Ver Planck (1952, p. 104), "The United States Gypsum Company's plant at Midland, Riverside County, began producing uncalcined gypsum products in 1928 in a plant that has since been enlarged." In September, 1958 the facility was improved by the completion of a natural gas line, north from the Blythe area. This will facilitate the continued manufacture of calcined gypsum products which has been roughly doubled since its inception August 15, 1928 (Tucker and Sampson, 1929, p. 515). The products are wallboard, plaster lath and interior plasters. In 1945 the wallboard plant was reported (Tucker and Sampson, 1945, p. 172) to have a capacity of 100,000 square feet of 3/8-inch wallboard and lath; at that time claimed to be the largest such plant in the United States. Products manufactured in lesser quantities were wall plaster, and finishing and casing plaster. Agricultural gypsum and cement retarder were to have been added to the plants list of products but these are not now (1960) being produced.

U.S. Gypsum's Midland Plant ceased operations in November, 1966 (Smith, 1969, p. 203). Most of the facility has since been removed.

Geology: In the Little Maria Mountains the area underlain by gypsiferous rocks is wedge-shaped, being about 2½ miles long, 2 3/4 miles wide at the east end and 1 mile wide at the west end. The rocks strike east and northeast and dip steeply north and northwest. The only published geologic map of the deposit covers ~~just~~ its western half (Ver Planck, 1952, pls. 2 and 3). Here, four, generally traceable gypsum zones as much as 150 feet thick containing beds of gypsum ranging from 0 to 10 feet in thickness, are included in altered limestone ~~formations~~ about 1,000-feet thick exposed roughly parallel to the north and south margins of the area. Between the two belts of limestone the central or axial part of the area consists of an indefinite thickness of gypsiferous greenschist.

A quartzite unit about 550 feet thick and a limestone unit 800 feet thick are exposed between the north margin of the gypsum-limestone formation and an upfaulted granitic body. The gypsum-bearing rocks lie on undifferentiated metamorphic and granitic rocks along the south margin of the deposit. The gypsum bodies commonly are mixed with the associated rock types in a manner described in detail by Ver Planck (1952, p. 17) who states that anhydrite was found in the Utah Construction Company Quarry, is common in the U. S. Gypsum Company quarries to the east, and is thought to be the immediate source of the gypsum.

The structure of the deposit has been suggested to be an anticline (Merrill and Waring, 1917, p. 578-579), an overturned anticline or possibly an unfolded, homoclinal sequence (Ver Planck, 1952, p. 18), or an overturned syncline (Shklanka, personal communication, 1958). The structural interpretation is important in regard to determining the best method to obtain reserves at depth. As with the Palen Mountains deposit (see herein), the disturbed condition of these rocks makes estimation of reserves uncertain.

The gypsum-bearing rocks exposed on the west flank of the Big Maria Mountains appear to be the same as those described above. They strike generally eastward and dip north in what appears to be a homoclinal structure, but Hamilton (1960, p. 277-278) has found this area to be complexly faulted.

Development: Prior to the mid-1930's the deposits in the Big Maria Mountains had been developed on a small scale and have since been held as reserves by U. S. Gypsum Company. The Savage deposit was explored by a 40-foot adit (Tucker and Sampson, 1929, p. 513) and the White Elephant claim by three short, chambered adits.

By 1945 development at the Brown mine in the Little Maria Mountains comprised an open pit 500 feet long, 50 feet wide and 50 feet deep from the bottom of which 2 tunnels about 200 feet long had been driven southwest. Nearby, to the southwest, two adits had been driven on gypsiferous units 20 to 60 feet in thickness. The lower adit was 1 mile long. Stopes were run to the surface at 25-foot centers, the distance to the surface being about 400 feet. The upper adit appears to have been less extensive and to have been driven in a parallel bed of gypsum overlying and a short distance to the north of the lower adit (Tucker and Sampson, 1945, p. 171).

The present quarry, at the site of the former Victor Mine, includes an area of about 1 square mile and comprises several intercommunicating pits as much as 100 feet deep on some faces. Gypsum ~~is~~ was drilled and blasted down from the quarry faces, loaded into trucks with power shovels and trucked to the nearby plant. Most of the impurities ~~are~~ were eliminated by selective procedures in the quarry.

The Utah Construction Company quarry is in sec. 11, T. 4 S., R. 20 E., S.B.M. Here three beds of gypsum as much as 60 feet in thickness striking N. 25° E. and dipping 60° NW. are exposed in benches on a low hill. The quarry is an irregular area about 700 feet long and 500 feet wide (Ver Planck, 1952, p. 18-20).

Production: U. S. Gypsum data not available; Utah Construction Company is credited with about 60,000 tons of agricultural gypsum (Ver Planck, 1952, p. 105).

References: Spurr, 1911, p. 787-790; Merrill and Waring, 1917, p. 577-579; Stone and others, 1920, p. 78-79; Tucker, 1920, p. 327; Tucker and Sampson, 1929, p. 510-515; 1945, p. 170-172, pl. 35; Ver Planck, 1950, p. 227; 1952, p. 13-20; 1957, p. 234; Hamilton, 1960, p. 277-278.

R.B.S.

Morning Star Deposit

Location: NE 1/4 NE 1/4 sec. 1 (proj.), T. 2 S., R. 23 E., SW 1/4 SW 1/4 sec. 31, T. 1 S., R. 24 E., and NW 1/4 NW 1/4 sec. 6, T. 2 S., R. 24 E., S.B.M., Vidal quadrangle, 15', 1950; on the northwest side of a narrow, northeast-trending canyon in the Riverside Mountains. The name Morning Star is used for convenience because part of this deposit is overlapped by a lode claim of that name (see herein under gold).

Ownership: Undetermined.

Geology: A gypsum unit of undetermined purity is exposed through a horizontal distance of about 3,500 feet and appears to be as much as 100 feet thick. It strikes northeast and dips about 40° NW. The gypsum weathers to a porous, tan surface but fresh material is white and fine-grained. The rocks in the area are strongly sheared and locally contorted. This deposit is probably similar to others in the region in which gypsum is interbedded with gypsiferous schist and quartzite. The overlying and underlying rocks are impure limestone and dolomite of possible Paleozoic age, which form bold ridges and cliffs (fig. 341).

Development, Production, References: None

R.B.S. 4/20/61

Omei Claim

Location: S½ sec. 9, T. 4 S., R. 7 W., S.B.M., Corona South quadrangle, 7½', 1954; northeastern flank of the Santa Ana Mountains, 3½ miles southwest of Corona, on the south side of Tin Mine Canyon.

Ownership: Mrs. B. I. Markwell, 1001 N. Lowell Street, Santa Ana (1957).

History: See White gypsum group.

Geology: See White gypsum group.

Development: See White gypsum group.

Production: See White gypsum group.

References: Gray, 1961, p. 116.

C.H.G. 3/3/61.

Palen Mountains Gypsum Deposit

Location: NE¼ T. 3 S., R. 18 E., S.B.M., Palen Mountains quadrangle, 15' 1952; in Palen Pass between the north end of the Palen Mountains and the southeast end of the Granite Mountains, about 25 miles northeast of Desert Center.

Ownership: Undetermined.

History: The gypsum deposits in the Palen Pass area were first described by Harder (1910, p. 407-416). In 1920, Joe Montgomery, and associates were planning to develop the property as the Standard Gypsum Company (Tucker, 1920, p. 326-327) but appear to have dropped the project. About 1930 extensive holdings are reported to have been patented by John Webb and George Pepperdine and additional development done in 1949 by Webb and Fleetwood Lawton (Ver Planck, 1952, p. 21). No record that patents were granted was found however, and subsequent litigation suggests that they were denied. The remoteness of the deposit and legal difficulties appear to have discouraged exploitation.

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Geology: The Palen Mountains Gypsum deposit includes several sequences of gypsiferous beds in a north-dipping, faulted homoclinal section of metamorphosed Precambrian igneous and Paleozoic (?) sedimentary rocks that are exposed in an area 3 miles long and 1 1/2 miles wide in Palen Pass. The gypsum occurs as irregular, massive beds of white, finely crystalline rock of reportedly good grade, ranging in thickness from 0 to 150 feet, interbedded with marble and quartzite or in thinly laminated, gypsiferous, epidote-rich schist. Anhydrite is not common, but its possible increase at depth has not been determined (Hoppin, 1954, p. 12-13). The gypsum beds pinch and swell, and contain fragments and small blocks of limestone. Thus, the estimation of gypsum reserves and the mining of a pure product would be complicated.

Development: The deposit has been explored by means of several shallow adits and pits, and extensive bulldozer cuts, but apparently there has been no systematic development.

Production: Undetermined.

References: Harder, (E. C.), 1909, p. 407-416; Stone and others, 1920, p. 78; Tucker, 1920, p. 326-327; Tucker and Sampson, 1929, p. 510-514; 1945, p. 167, pl. 35; Miller, 1944, p. 28; Jenkins, (O. P.), and others, 1950, p. 227; Ver Planck, (W. E.), 1952, p. 21-24; 1957, p. 234; Hoppin, (R. A.), 1954, 25 pp.

R.B.S. 3/11/59.

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Riverside Mountains-Parkford Deposits

Location: Secs. 6 and 7, T. 2 S., R. 24 E., S.B.M., Parker quadrangle, 15', 1950 and Vidal quadrangle, 15', 1950; on the east slope of the Riverside Mountains, 6 miles south of Vidal.

Ownership: U. S. Government in part (Colorado River Indian Reservation), in part undetermined.

History: E. A. Parkford, Pacific Mutual Building, Los Angeles, and J. M. Wilson, Vidal, acquired an undetermined number of claims in sec. 7 prior to 1929 (Tucker and Sampson, 1929, p. 511). Subsequent reports mention or briefly describe these deposits, but give no ownership data. Apparently this material has not yet been mined.

Geology: The schistose, quartzitic, gypsiferous and carbonate rocks of Paleozoic (?) age underlying the east slope of the Riverside Mountains have been contorted, sheared and faulted, but the full extent to which these features have complicated the gypsum deposits has yet to be determined. The following data is from a report on the Parkford deposit (Tucker and Sampson, 1929, p.511) by Smith Emery and Company, Los Angeles.

The Parkford deposit underlies a hill 250 feet high, 400 feet wide and 700 feet long and is exposed on three adjoining hogbacks through an additional distance of about 600 feet. Gypsum beds of high purity as much as 50 feet in thickness interbedded with limestone strike north and dip 30° to 60° west. The proportion of limestone increases in the south end of the outcrop (Tucker and Sampson, 1929, p. 511).

The Riverside Mountains deposit has been described (Ver Planck, 1952, p. 24) as comprising a 100-foot zone of coarsely crystalline white gypsum, interbedded with brown-weathering crystalline limestone and red quartzite, exposed through a distance of about half a mile. This deposit is in the west half of sec. 6.

Development: In 1929, the Parkford property had been developed by means of five adits 20 to 198 ~~198, 40, 27, 26, and 20~~ feet long, and open cuts but activity was confined to assessment work (Tucker and Sampson, 1929, p. 511). The Riverside Mountains deposit development consists of short adits and shallow pits (Ver Planck, 1952, p. 24).

Production: Undetermined.

References: Tucker and Sampson, 1929, p. 511; 1945, p. 167, pl. 35; Ver Planck, 1950, p. 227; 1952, p. 24; 1957, p. 234.

R.B.S. (not visited)

Tecumseh Group

Location: SW¼ sec. 10, SE¼ sec. 9, NW¼ sec. 15, NE¼ sec. 16, T. 4 S., R. 7 W., S.B.M., Corona South quadrangle, 7½', 1954; northeastern flank of the Santa Ana Mountains, 3½ miles southwest of Corona, between Tin Mine and Hagador Canyons.

Ownership: Orrin M. Pierce, 1607 N. Flower Street, Apt. G, Santa Ana (1957).

History: Parts of former White Gypsum and Hagador Canyon deposits (see herein) were relocated about 1954 as 5 claims (Tecumseh, Minot, Why Not, Alpha, Omega). Idle.

Geology: See White gypsum and Hagador Canyon deposits.

Development: See White gypsum and Hagador Canyon deposits.

Production: See White gypsum and Hagador Canyon deposits.

References: Gray, 1961, p. 116.

C.H.G. 3/3/61.

White Gypsum Group (Freeman-Nonhof, Big Chief, Ware)

Location: SE¼ sec. 9, SW¼ sec. 10, NE¼ sec. 16, T. 4 S., R. 7 W., S.B.M., Corona South quadrangle, 7½', 1954; northeastern flank of the Santa Ana Mountains 3½ miles southwest of Corona, on the south side of Tin Mine Canyon.

Ownership: P. E. Coleman, 301 Fruit Street, Santa Ana (1957).

History: Formerly a group of 8 unpatented claims (White Gypsum 1-8). The property was owned by G. R. Freeman and E. R. E. Nonof, Corona, in 1923 and a small production of gypsite was reported. About 1940 Howard S. Ware, Corona, acquired the property and it was leased in 1943 to Dr. Leon N. Katz, 9837 Foothill Blvd., San Fernando, who made some exploratory bulldozer cuts. In 1947, bulk sampling was done on the White Gypsum group, then known as Ware gypsum. The property was later abandoned and partly relocated in 1954-56 as Big Chief, Omei, Tecumseh, and Elki (see herein).

Geology: Veinlets of satin spar and gypsite in hydrothermally altered volcanic rock (Santiago Peak Volcanics, largely hornblende andesite).

Development: Several small cuts, shallow pits, and short adits.

Production: Small production of gypsite reported in 1923. Most of the material was used locally as a soil conditioner, small amounts may have been shipped for agricultural use.

References: Ver Planck, 1952, p. 127, 142, 146; Gray, 1961, p. 116.

C.H.G. 3/3/61.

Iron

The large bodies of metamorphic rock exposed in the eastern half of Riverside County contain scattered masses of massive magnetite. The largest of these magnetite bodies is in the Eagle Mountains. Indeed, the Eagle Mountains deposit is the largest known deposit of iron ore in the western United States (see Eagle Mountain mine herein). In 1956 this ore body contained estimated reserves of 43,000,000 long tons (Gay, 1957, p. 247), a figure which must since have been revised upward on the basis of subsequent exploration.

In 1948 Kaiser Steel Corporation started utilizing ore from the Eagle Mountain mine as a source of blast furnace feed. By 1956 the mine had yielded 9,800,000 tons of blast furnace ore. Since 1956 mining and beneficiating efficiency and capacity have steadily increased at the mine in response to demands of the expanding and increasingly modern furnaces, mill, and fabricating plant at Fontana, and fabricating plants at Napa and Montebello. The productive capacity of the Kaiser Eagle Mountain mine ~~will find~~ has found further outlet in export shipping capacity ~~to be made available with~~ through the completion of a ~~new~~ bulk loading facility for ships at the Port of Long Beach (Davis and others, 1962, p. 3,4). This ~~new~~ facility ~~will have~~ has a capacity of 2,800 tons per hour.

The ore body at the Eagle Mountain mine was the only one being actively mined in Riverside County in 196~~2~~6. Small deposits in the Palen and Maria mountains have been examined and one, the Iron King and Queen (see herein), has been extensively prospected. ~~and may soon be developed.~~

Black Giant Deposit

Location: Secs. 34 and 35 (proj.), T. 3 S., R. 13 E., S.B.M., Pinto Basin quadrangle, 15', 1963; Eagle Mountains, about 1 mile west of the Iron Chief mine, and 10 miles northeast of the East Pinto Basin-West Pinto Basin-Cottonwood Pass and Black Eagle mine roads intersection.

Ownership: Carl Saure and A. Vrbanac, 8312 California Avenue, Whittier, own 11 unpatented claims (March 1958).

History: Undetermined.

Geology: Thin, irregular and discontinuous pods and lenses of replacement magnetite occur in calcitic dolomite of Paleozoic (?) age.

Development: The property is developed only by shallow open cuts.

Production: Undetermined.

References: None.

J.R.E. 3/17/60

Eagle Mountain Mine

Location: The main iron deposits are in secs. 36, 35, and 34, T. 3 S., R. 14 E., S.B.M. (proj.), Coxcomb Mountains quadrangle, 1963; Eagle Mountains, about 12 miles north-northwest of Desert Center on U.S. Highway 60-70. The steel plant is at Fontana, San Bernardino County, about 114 airline miles to the northwest.

Ownership: Kaiser Steel Corporation, P.O. Box 217, Fontana, San Bernardino County, owns at least 130 patented claims and about 40 unpatented claims (1960).

History: The following notes of historical interest concerning the Eagle Mountain iron district are taken from U.S. Bureau of Mines Information Circular 7735, 1956.

> "The importance of the Eagle Mountain district as a potential source of iron ore on the Pacific coast was recognized early in the century by E.H. Harriman of the Southern Pacific Railroad. Over 100 claims were acquired and patented in 1908; but until the late 1930's this area had no usable roads, water, or power. During this period far western iron-ore deposits held little commercial interest."

In 1909, E.C. Harder of the U.S. Geological Survey examined and prepared maps of the Eagle Mountain area. This study was the first detailed investigation of the iron ores of California.

Photo 23

"The Riverside Iron and Steel Co. of Pasadena, California, was organized in 1940 and obtained control of the Southern Pacific Land Co. claims. The company intended to erect several electric furnaces on the property to make higher grade iron by the Knowles process, as developed by the Corby Iron & Steel Co. in England, using petroleum coke as a reducing agent. These plans had to be abandoned because of the war, and the only production during World War II was approximately 60,000 tons of crude iron ore for ship ballast and shipment to the cement industry.

"Under the Strategic Minerals Program, the Bureau of Mines, in conjunction with the Federal Geological Survey, started an exploration program September 8, 1941. This was completed May 16, 1942. Project work indicated the existence of a large tonnage of direct-shipping ore and a greater potential reserve of lower grade ore amenable to low-cost beneficiation.

"In 1946 Kaiser Steel Corp., which was operating 1 blast furnace and 7 open hearths using 50- to 55-percent iron ore from Cedar City, Utah, and high-sulfur ore from the Vulcan mine, California, acquired the property. During 1947-48, a railroad was built from the property to the Southern Pacific Railroad at Ferrum, California; a crushing plant and stockpiling and loading facilities were constructed. In the latter part of 1948 opencut mining was begun on the Bald Eagle deposit, and regular shipments of iron ore were made to the Fontana steel mills 164 miles away. In 1949 a second blast furnace of 1,200 tons daily capacity was added at Fontana, and a third blast furnace of 1,200 tons daily capacity was added in 1953."

During 1957 a fourth blast furnace was added as well as other facilities which increased the steel-producing capacity by 40 percent. Also during 1957 a new ore beneficiation plant was completed and placed on stream at the Eagle Mountain mine.

Geology: A metamorphic sedimentary rock sequence of Paleozoic or older age is intimately intruded by quartz monzonite. As a result of intrusion two calcitic dolomite units at different stratigraphic horizons are irregularly replaced by magnetite.

Following intrusion and accompanying mineralization, the metamorphic rocks were warped into a broad northwest-trending anticline. Folding was accompanied by much high angle faulting. ~~(fig. 17).~~ After deformation of the rock complex, granite bodies and dikes of syenite, diorite, and diabase were intruded. Several dikes cut the ore bodies as well as other units.

The metamorphic rocks consist of an undetermined thickness of vitreous quartzite at the base, overlain by 20-200 feet of rusty-colored schistose meta-arkose. Above the meta-arkose bed is 20-120 feet of white but tan weathering calcitic dolomite containing replacement bodies of magnetite (South-Bald Eagle or lower ore body), overlain by diopside rich quartzite ranging in thickness from 150-380 feet. Overlying the quartzite is another calcitic dolomite bed, ranging in thickness from 50-200 feet, also containing replacement bodies of magnetite (North or upper ore body). This unit is capped by a lime silicate rich quartzite, locally banded, and of undetermined thickness.

At present the principal ore bodies are the North and South deposits; the Bald Eagle deposit is nearly depleted of ore that can be mined by present open pit methods. The size and shape of the North and South ore bodies are given below.

Size and shape of the North Ore Body and South Ore Body

	North Ore Body, feet	South Ore Body, feet
Strike length	5,200	2,600
Length explored	1,400	2,200
Maximum width across outcrop	450	300
Maximum thickness normal to dip	325	80
Average thickness normal to dip	250	60
Average dip	45	30
Depth, Bureau of Mines exploration on dip	500	1,200
Probable depth on dip	850	1,800

Taken from U. S. Bureau of Mines Information Circular 7735, p. 7.

Subsequent geophysical and drilling programs have explored the extent of ore beneath the alluvium to the east of the present operation. It is common knowledge that additional reserves were found but no report on quantity or quality was obtained.

Commercial material is composed of black, granular magnetite; red, dense hematite; and minor amounts of pyrite. In the ore in the weathered zone which extends about 100 feet below the surface, hematite is in excess of magnetite by about 5:1, but at depth magnetite is predominant, although generally associated with pyrite (Trengove, 1956, p. 7). The highest grade ore is that material composed mostly of magnetite. The Lower grade ore contains greater amounts of hematite, and a mixed gangue material composed of pyrite, and/or the contact metamorphic minerals diopside, actinolite, tremolite, wollastonite, quartz, labradorite, and scaptolite. Serpentine, chlorite, and sepiolite occur as alteration products of the magnesium bearing contact metamorphic minerals, and are also gangue minerals. Locally, and especially near the surface, veinlets and coatings of gypsum fill crevasses and fissures. Gypsum and pyrite are particularly significant as they both contain sulfur which does not enhance the steel making process. Iron contained in material in the North-South pits ranges in grade from about 30 percent to 65 percent before beneficiation. Before shipping to the Fontana Steel plant ore is upgraded to at least 60 percent iron.

Development: Recent operations begun in 1952 are restricted to the North-South ore bodies and both are mined from 1 large pit (~~[illegible]~~). Plans are such that when open pit mining methods are complete the pit will be 4,600 feet long, 2,000 feet wide at the widest point, and 660 feet from the highest elevation to the pit floor (Photo 23). It will have 22 benches, each 30 feet high, to provide for mining and stripping the two ore bodies (Trengove, 1956, p. 11).

Primary drilling is done with crawler mounted churn drills. Jackhammers and wagon drills are used only for roadwork and when new benches are begun (Trengove, 1956, p. 11). After blasting, broken ore is loaded by power shovels on trucks which transfer it to a jaw crusher set to 7½ inches. Crushed material is then moved by belt conveyor to the surge pile. Ore from the surge pile goes through a 3-inch and minus-1-inch crushing stage after which it is transferred to the beneficiation plant. This plant, (Photo 24) completed in 1957, utilizes magnetic and heavy media separation methods to upgrade the ore to at least 60% (shipping grade). From the plant ore is moved by belt conveyor to the stockpile from whence it goes to the loading tower in order to fill gondola cars for rail transport to Fontana. A detailed description of the mining

Pl. To 24
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techniques and milling operations is given by Trengove (1956).

Drilling (1960) revealed the presence of ore beneath the benefici-ation plant, and it was planned to combine the Bald Eagle and North-South pit into one large East-West pit.

Development at the Eagle Mountain mine has continued. The following information was contained in a Kaiser Steel Corporation news release dated November 3, 1965 (for details see Drossel, 1967).

"A major producing unit in Kaiser Steel's current $119 million ex-pansion program went 'on stream' this month as marble-sized pellets of concentrated iron ore formed a new kind of stockpile at the Company's Eagle Mountain, California iron ore mine. Trial shipments have already begun.

The new facility is an iron ore pelletizing plant with an annual cap-acity of two million long tons of pellets. Operation of the plant, and expanded mining facilities to feed it has increased employment at the mine to more than 1,050.

The pellet plant produces almost perfectly round spheres of hardened ore of 65 percent iron content. Ore as it comes out of the ground at Eagle Mountain averages 40 to 45 percent iron. The concentrated pellets provide a highly efficient material for the production of iron or 'hot metal', the basic material from which steel is made".

East Wide Canyon Iron-titanium deposit*

Location: NE¼ sec. 17, T. 2 S., R. 6 E., S.B.M., Thousand Palms quadrangle, 15' 1958, and Joshua Tree quadrangle, 1955; in Joshua Tree National Monument, 5 miles north of Fun Valley, on the southeast side of a steep hill on the east side of upper East Wide Canyon. Reached by about 5 miles of foot trail from the end of the road in East Wide Canyon.

Ownership: Southern Pacific Land Company, 65 Market Street, San Francisco 5.

History: The deposit has not been mined but was examined by Southern Pacific Company geologists in 1957 (Papke, K. G. and others, 1957). ~~The company study included geologic mapping and sampling.~~ Tests on separation of iron and titanium were made by the U. S. Bureau of Mines, Reno, Nevada.

*Adapted from an unpublished report by Keith G. Papke and others, courtesy of Southern Pacific Company.

Geology: The region is underlain by the (Precambrian) Chuckwalla complex of Miller (1944, p. 16-21). In sec. 17 and vicinity these rocks include medium- to coarse-grained, slightly foliated quartz monzonite and diorite gneiss. (Figure 46) In most exposures, foliation in the gneiss strikes northeast and dips northwest. Most of the granitic bodies appear to be crudely aligned with the northeast-trending gneissic foliation. Northwest-trending faults cut the area into blocks.

In the NE¼ sec. 17 iron-and titanium-rich gneiss occurs in several layers conformable with the gneiss and quartz monzonite. The iron-titanium layers strike northeast with an average dip of 45° NW. The exposed strike length of the mineralized gneiss is about 1,800 feet, with average total thickness of the two principal layers of iron-titanium about 55 feet. The southwest end of the mineralized zone apparently is terminated by a fault intruded by an acidic dike. On the northeast the mineralized zone appears to pinch out, but mica-rich gneiss with some iron-titanium lenses crops out farther northeast. ~~beyond the mapped area.~~

Figure 46

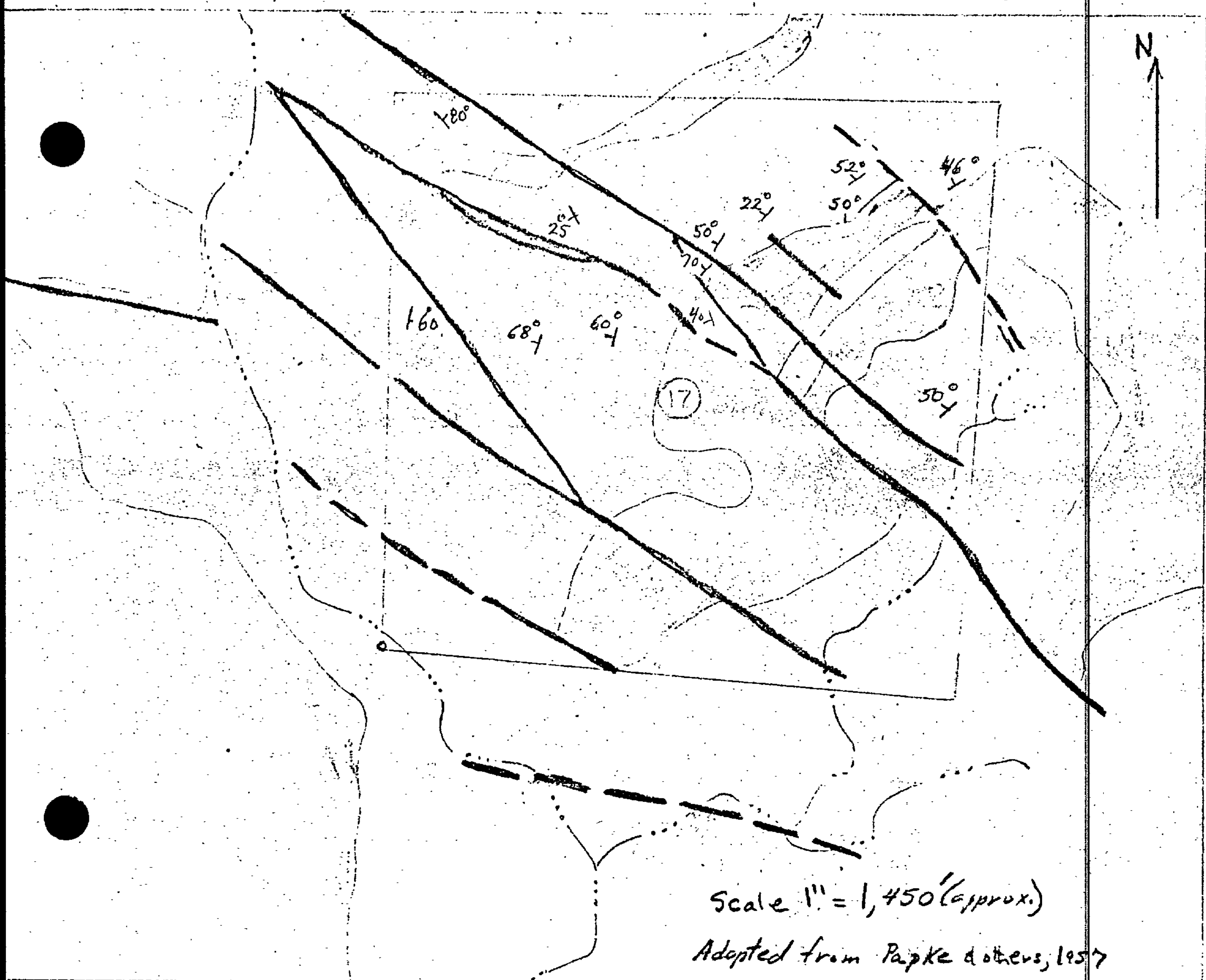
The principal minerals present are magnetite, ilmenite, and goethite. ~~Although most of the titanium is in the form of ilmenite some may occur as small grains of rutile.~~ Assays and magnetic-separation tests suggest the material may have the following approximate composition: magnetite 60 percent; ilmenite 20 percent; goethite, silicates, and other minerals 20 percent. Six samples taken across the southwest end of the main mass averaged 45.9 percent Fe, 19.5 percent TiO_2, 10.8 percent Si, trace P, and 0.07 percent S, (Papke, et. al. 1957).

Development: None, other than geologic mapping and sampling. Papke and others (1957, p. 4) estimate a total of about 1,500,000 long tons of material averaging more than 43 percent iron and 17 percent titanium oxide would be available per 100 feet of slope depth.

Production: None.

References: Miller, 1944, p. 16-21; Papke, 1957, 7 p.

C.H.G. 8/8/61.



Geology of Section 17, T. 2 S., R. 6 E., S.B.M. & vicinity
East Wide Canyon Iron-Titanium Deposit

EXPLANATION

Precambrian?: Chuckwalla Complex

- Iron-Titanium mineralization
- Quartz Monzonite
- Diorite Gneiss

Contact, with dip 50

Fault

Dip of foliation 40

Figure 46.

Iron Cap (Maria Mountains Iron Deposit) Claims

Location: NW¼ sec. 14, NE¼ sec. 15 (proj.), T. 4 S., R. 22 E., S.B.M., Big Maria Mountains, quadrangle, 1954; on a narrow ridge in the center of the Big Maria Mountains, 24 miles, by road and foot trail, north of Blythe.

Ownership: Not determined (1959).

History: Tucker and Sampson (1945, p. 146) briefly noted these claims as the "Maria Mountains Iron Deposit." J. O'Connell, Blythe, was the owner but no mention was made of development or activity.

Geology: Several elongate bodies of magnetite, containing some hematite, cap the crest of a narrow northwest-trending limestone ridge of Paleozoic(?) limestone and Precambrian schist. The outcrop area of the magnetite body is about 1500 feet long and as much as 200 feet wide. The maximum thickness was not determined but it is probably less than 100 feet. The regional trend of the limestone and schist country rock is about N. 60° W. with dips of 20° to 30° southwest. Where the limestone contacts and intergrades with the iron ore it is sheared and contorted. The magnetite appears to have replaced the limestone. In some exposures near the margin of the ore body it is apparent that mineralization advanced more rapidly along some beds than others.

Where the host rock is contorted, interposed ore is also contorted. Along the base of the ore bodies the host rock is strongly sheared and altered to epidote and tourmaline-actinolite schist. This shear zone contains sparse copper mineralization as fissure fillings and coatings of chrysocolla and malachite.

The volume of iron ore float in the alluvium and stream channels to the east and west of the deposit ~~probably~~ may exceed~~s~~ that of the ore remaining in place.

Development: Four shallow prospects and one 30-foot adit explore the shear zone underlying the magnetite ore bodies in an apparent quest for copper ore. No evidence was found indicating removal or exploration of the magnetite.

Production: Undetermined.

References: Tucker and Sampson, 1945, p. 146.

R.B.S. 1/13/59.

Iron Cap and Iron King Claims

Location: SE¼ sec. 19 (proj.), T. 5 S., R. 18 E., S.B.M., Sidewinder Well quadrangle, 15' 1952; on the southwest flank of the Palen Mountains, 16 miles east-northeast of Desert Center.

Ownership: John J. O'Connell, 437 N. Oakhurst Drive, Beverly Hills.

History: When first reported (Tucker and Sampson, 1945, p. 146, pl. 35) this property was held by Jack O'Connell and C. J. Hill, Beverly Hills.

Geology: This deposit is exposed on the sides of a shallow ravine cut in the south flank of a ridge of altered metavolcanic and metasedimentary rocks of probable Mesozoic age. The head of the ravine lies athwart a vertical-to-steeply-north-dipping shear zone which strikes east-west and appears to be as much as 300 feet wide. Within the shear zone the country rock is altered to a mixture of quartz, epidote, and calcite, and in part replaced by irregular, lenticular masses of magnetite.

Individual bodies of magnetite as much as 15 feet ~~in~~ thick~~ness~~ and 50 feet in lateral extent are exposed but the bulk of the iron deposit appears to comprise swarms or zones of small bodies averaging perhaps 3 feet ~~in~~ thick~~ness~~ and 15 feet in exposed length. The magnetite is fractured and as the host rock has weathered the iron oxide bodies have crumbled to a litter of float. Thus the full extent or number of magnetite bodies is difficult to estimate. The ore bodies appear to be unevenly distributed across the full width of the shear zone and to have a lateral extent of about 400 feet. Surface indications of iron mineralization extend only 30 to 40 feet up the east slope of the ravine. The western limit of the deposit is concealed beneath a wash.

The chief impurities in the magnetite appear to be unreplaced bodies of altered country rock the most common constituent of which (~~appears to be~~) is epidote. One specimen of magnetite float contained perhaps as much as 20 percent by volume of slender, prismatic apatite crystals. The ubiquity of this undesirable impurity was not determined.

Several hundred feet south of the head of the ravine, the ridge along its west side is crossed by several crushed and sheared quartz veins. They strike approximately N. 10° E., dip steeply northwest, and range from 0 to about 1 foot in thickness. They contain chrysocolla and malachite as crusts and veinlets associated with scattered, small pockets of iron oxides. One vein has been prospected for gold.

Development: The magnetite deposit has been opened through an open trench about 15 feet long and 6 feet deep at the face, and several shallow prospect pits.

A single 15-foot vertical shaft has been sunk in one of the narrow quartz veins. ~~The collar is timbered and set with concrete.~~

Production: Undetermined.

References: Tucker and Sampson, 1945, p. 146, pl. 35.

R.B.S. 3/16/62

Iron King and Iron Queen Claims

Location: S½SW¼SW¼ sec. 21 (proj.) and N½NW¼ sec. 28 (proj.), T. 5 S., R. 18 E., S.B.M., Sidewinder Well quadrangle, 15' 1952; on an isolated foothill at the south end of the Palen Mountains. These claims are at the end of an unimproved, sandy road which extends north 7½ miles from U.S. Highways 60 and 70 at a point 19½ miles east (by road) of Desert Center.

Ownership: S. E. Chiapella, 14208 Chandler Blvd., Van Nuys and John J. O'Connell, 437 No. Oakhurst Dr., Beverly Hills (1962).

History: This property has been extensively prospected but by 1962 had not ~~yet (1962)~~ been systematically mined.

Photo 25

Geology: The area of the Iron King and Queen Claims is underlain by greenstone. The claims lie on a fault and sheared zone as much as 100 feet wide which strikes about N. 75° W., dips 75° SW. The lateral extent of the fault was not determined. Lenses of massive magnetite lie in the fault where it is exposed on the east flank of a ridge zone. The largest magnetite body exposed is about 60 feet thick near the base of the ridge and narrows to a termination just below the ridge crest; a surface distance of about 300 feet. The main ore body appears to be flanked by at least two smaller lenses a few tens of feet in exposed length. One of the smaller bodies is a porous mass near the hanging wall just below the ridge crest, the other is an apatite rich lense near the footwall at about the same level. The ore bodies have gradational contacts with, and contain isolated horses of the country rock. They appear to be replacement deposits. In addition to contamination by included country rock the magnetite contains an undetermined but apparently high proportion of unevenly distributed apatite crystals.

No magnetite bodies were noted northwest of the ridge crest. Southeast of the ridge the main ore body is concealed by alluvium, but it appears to thicken both in that direction, and down the dip of the fault.

Development: This deposit has been exposed in an open cut at the base of the ridge and four evenly spaced bull-dozer cuts on its east slope (Photo 25/).

Production: Undetermined.

References: Tucker and Sampson, 1945, p. 146, pl. 35.

R.B.S. 11/28/62.

Lindy Loop #1 Deposit

Location: NE 1/4 sec. 36 (proj.), T. 4 S., R. 22 E., S.B.M., Big Maria Mountains quadrangle, 15', 1951; Big Maria Mountains, about 12 miles north of Blythe.

Ownership: Alfred E. Lindburgh, P. O. Box 517, LaHabra, owns at least one unpatented claim (1958).

History: Undetermined.

Geology: A northwest-trending fault that dips 51° SW. separates coarse-grained limestone in the hanging wall from wollastonite-bearing carbonate rock in the footwall. Both of these rock units are members of Paleozoic (?) Maria Formation (Miller, 1944, p. 25-28). A gouge zone as much as 15 feet thick contains mineralized veins composed principally of spongy hematite, altering to limonite, with stringers of dirty-green epidote. Portions of the wall rock along the fault are stained blue by a secondary copper mineral, probably chrysocolla. The hematite veins are elongate, semi-tabular, and tend to pinch and swell. A kidney 2 feet in maximum width was observed. Locally the wollastonite-bearing rock has been replaced by magnetite. An irregular replacement body a few tens of feet wide occurs low on the west slope of the hill between a prospect pit and the dirt road leading from the workings.

Development: Several open cuts and prospects pits expose the veins along the fault zone.

Production: Undetermined.

References: Miller, 1944, p. 32.

J.R.E. 12/17/58

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Sulphide Bismuth (Lang) Mine

Location: NE¼ sec. 11, T. 2 S., R. 7 E., S.B.M., Twentynine Palms quadrangle, 15' 1955; Joshua Tree National Monument, on the north slope of the Little San Bernardino Mountains on a ridge 2 3/4 miles west of Hidden Valley on the west side of Johnny Lang Canyon.

Ownership: William F. and Frances M. Keys, P.O. Box 114, Joshua Tree hold at least one claim (Sulphide bismuth iron).

History: This claim is reported to have been first located by Johnny Lang, about 1900, and was then known as the Lang Copper Mine. (Oral Communication W. F. Keys, 1960). Apparently the development work was done mostly by Mr. Lang in the early 1900's. In 1925, the claim was relocated by Mr. Keys.

Geology: The mine workings explore an iron-rich body in biotite-quartz gneiss. The iron-rich body strikes north to N. 20° W. and is vertical as indicated by well defined bands of red-brown iron gossan-like material and black magnetite-rich material. This body is 50 feet wide at the shaft and is at least 350 feet long. One sample which appeared typical of the magnetite-rich material was found to contain magnetite, laumontite, limonite, enstatite, and tremolite. The magnetite appeared to be the most abundant constituent and the tremolite is altered from the enstatite. Bismuth and titanium were not detected.

Development: In a ravine at the north end and at the east side of the iron-rich body a 200-foot crosscut adit is driven along a shear zone in gneiss which strikes N. 40° to 60° E., and dips 50° W. to vertical. A second adit, 50 feet above, is driven 75 feet on a parallel shear. About 300 feet to the south, the south end of the iron-rich body is explored by means of a 100-foot vertical shaft, equipped with an old windlass and wood ladder.

Production: Undetermined. William F. Keys (oral communication, 1960) reports that the 20 tons of bismuth reportedly produced in 1904 from the Lost Horse Mine (see herein) actually was from the Sulphide bismuth mine.

References: None.

C.H.G. 1/28/60.

Unidentified Iron Prospect

Location: SW¼ sec. 1 (proj.), T. 2 S., R. 23 E., S.B.M., Vidal quadrangle, 1950; on the west flank of the Riverside Mountains about a quarter of a mile northeast of the Gold Rice Mine.

Ownership: Undetermined.

History: Undetermined.

Geology: This deposit lies in a narrow valley along a contact between Paleozoic(?) limestone on the southeast and Precambrian schist on the northwest. The general strike of the rocks is N. 60° E. and the dip about 25° NW. The sheared condition of the schist and the contorted structure of the limestone underlying it suggest that the limestone and schist are in fault contact and that the valley is cut along the trace of a fault of considerable displacement. This might be the same fault that controlled mineralization at the Morning Star mine in the floor of a neighboring valley about one mile to the northeast (see herein). Hematite and barite occur in veins as much as 4 feet wide irregularly exposed through a distance of about 100 feet along the base of a limestone ridge on the southeast side of the valley. The barite appears to comprise less than 50 percent of the vein material but, locally, is intimately mixed with the iron oxides. Part of the deposit is covered by alluvium.

Development: Several shallow open cuts.

Production: Undetermined.

References: None.

R.B.S. 4/21/61

Lead, Silver and Zinc

Lead, silver and zinc, are here grouped under one heading because their ore minerals commonly are found together and, in Riverside County, these metals generally have been marketed as byproducts. Lead and silver have been mined for their own value in only three or four mines and even in such deposits these metals generally are accompanied by some other more valuable metal such as copper or gold. Ore containing appreicable quantities of zinc has been encountered in only the Bald Eagle mine, although it has been reported from the Balck Eagle mine and perhaps one or two other localities, where it is of minor significance.

From 1891 to 1961, a total of 2,228,~~062~~ 662 pounds of lead valued at ~~$341,975~~ $137,035 was reported from Riverside County. The total value is based on a price per pound which has fluctuated from a low of three cents in 1932 to a high of 18 cents in 1948. In 1961, the price ranged between 10 and 11 cents.

The principal ore of lead is galena, but many of the deeply weathered veins, exposed in the mines of Riverside County, contain appreciable proportions of secondary lead minerals of which cerussite is the most common. Wulfenite is farily abundant in many mines, especially those in the Chuckwalla Mountains, but generally as disseminated, small crystals. Pyromorphite is present in a prospect near the Red Cloud mine, but it might be more common as it is easily confused with copper carbonate.

Silver valued at $~~127,248~~ 126,657 was reported from mines in Riverside County between 1891 and 196~~1~~9. Most of the silver came from gold mines where it was found mixed in the gold or disseminated in sulfides. The lead sulfide, galena, is a particularly common host to silver. The mineral argentite has been reported from the Homestake group (see under copper) and might be present in the Bald Eagle mine (personal communication, Danny G. Figureoa) but such ore minerals of silver appear to be uncommon in the metal-bearing veins of the county.

Except for 1,901 pounds of zinc reported in the 1951 yield of the Bald Eagle mine, zinc production in Riverside County has never been large enough to achieve the notice of market statisticians. The 1951 yield was from the mineral sphalerite.

Bald Eagle (Neal Group) Mine

Location: SE¼ sec. 27 and NE¼ sec. 34, T. 3 S., R. 21 E., S.B.M. (proj.), Midland quadrangle, 15' 1952; Mig Maria Mountains, about 3 miles northeast of Midland, figure 47.

Ownership: Undetermined.

History: In 1929, the property consisted of 2 claims and was owned by Mr. Neal, Kingman, Arizona (Tucker and Sampson, 1945 p. 491). Lead-silver-copper mineralization, accompanying a felsite dike intrusion into limestone, was reported. Development consisted of a 60-foot shaft and 100 feet of tunnel work. No shipments of ore were made previous to 1929. The property was idle in 1929, and 1945 (Tucker and Sampson, 1945, p. 148), but was relocated in 1950 by Dan Figuerca, P.O. Box 453, Blythe. In 1950 and 1951 the mine was active and production was recorded.

Figure 47

Geology: The mine area is along the contact between an intrusive body of fine-grained Mesozoic granodiorite (?) and northeast-trending, tan-colored dolomitic limestone of Paleozoic(?) age (fig. 47). The dolomitic limestone is blocky and jointed, very coarse grained in large part, and dips gently northwestward. Most of the workings are in a pre-mineral fault zone which served as a channel-way for veins containing hematite, chalcopyrite, galena, sphalerite, epidote, chert, quartz and silver. Subsequent oxidation of vein material has resulted in the formation of azurite, limonite, plumbojarosite and jarosite. Seams of drusy, white gypsum occur locally, coating both vein material and country rock. Locally, veins of quartz and epidote, as much as 5 feet wide, intrude the dolomitic limestone. About half a mile north of the adits a well developed tactite zone occurs. Thin intercalated layers of brown garnet, white quartz, white and blue calcite, black tourmaline and green epidote are present in this zone. A mass of Precambrian augen gneiss rests upon the dolomitic limestone, and forms the backbone of the ridge above and northwest of the workings.

Photo 26

Development: Of a total of 9 adits, 5 have been driven northwest, 2 north, 1 northeast and 1 south. They are all in dolomitic limestone above the intrusive contact (fig. 1/). About half a mile northeast and about 200 feet higher on the same slope are 3 shafts of varying depth but no more than 50 feet. They are inclined about 45° northwest and in a tactite zone (fig. 3/). Workings, including adits, winzes, raises and stopes aggregate over 1300 feet and are accessible by jeep road, and foot travel on a good trail. The dirt road joins the Midland road about 2½ miles southeast of Midland (fig. 1/). Elevation of the workings is approximately 2000 feet. The mine is idle.

Production: Compiled by the U. S. Bureau of Mines and published with permission of the owner.

Year	Crude ore (tons)	Recoverable Metals				
		Gold (ounces)	Silver (ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
1950	56	1	390	108	15,922	------
1951*	181	---	1186	---	52,415	1,901

* The 1951 yield comprised both mined ore and dump material. The mined ore was found near the surface in the form of a kidney of sulfides. The site of this operation is marked by an open gallery near the point where the road turns west at the head of the canyon (Photo, 26) (personal communication, Danny G. Figueroa).

References: Tucker & Sampson, 1945, p. 148; Tucker, 1929, p. 491.

J.R.E. 12/18/58.

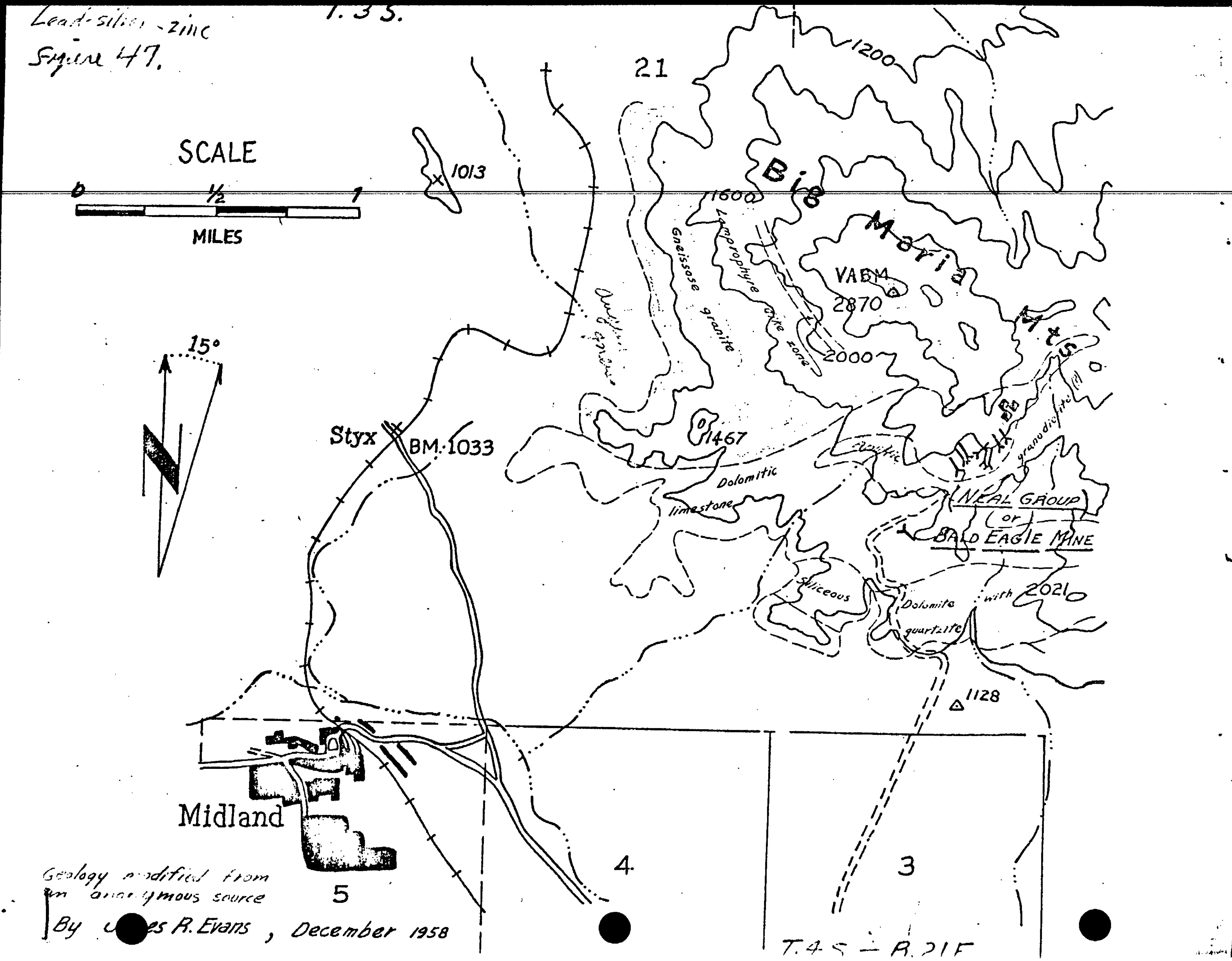

Lead-silver-zinc
Figure 47.
T. 3 S.
SCALE
0
½
1
MILES
15°
1013
21
1200
Big Maria Mts
1600
Gneissose granite
Lamprophyre dike zone
VABM
2870
2000
Styx
BM. 1033
1467
Dolomitic
limestone
granodiorite
NEAL GROUP
or
BALD EAGLE MINE
Siliceous
Dolomite with quartzite
2021
1128
Midland
4
3
5
Geology modified from an anonymous source
By James R. Evans, December 1958
T. 4 S. - R. 21 E.

Figure 47. Index and geologic map showing the location and areal distribution of the workings of the Bald Eagle (Neal Group) (topography from U.S.G.S. 15' Midland quadrangle, 1952).

Black Eagle Mine

Location: Sec. 30, T. 3 S., R. 14 E., S.B.M. (proj.), U. S. Army Corps of Engineers Eagle Tank quadrangle, 15', 1943; Eagle Mountains, about 12½ miles northeast of the East Pinto Basin-West Pinto Basin - Cottonwood Pass and Black Eagle mine roads intersection and adjacent to the Black Eagle mine road.

Ownership: Kaiser Steel Corporation, P.O. Box 217, Fontana, owns at least 3 patented claims; Mileta Nos. 1, 2, and 3 (March 1960).

History: The mine was originally located by M. Rust in 1898, and relocated by Edward Harmon in 1921 (Tucker, 1924, unpublished field report No. 84). In 1924 the property comprised 3 unpatented claims (Mileta Nos. 1, 2, and 3) and was still owned by Edward Harmon of San Bernardino, but under option to A. W. Scott and George Hayden of Los Angeles. Water was hauled 20 miles north from Cottonwood Springs in a 45 gallon tank. The mine was active and 6 men were employed (Tucker, 1924, p. 193). Tucker and Sampson (1929, pp. 474-475) report the mine was in operation from 1923 until the latter part of 1938.

By 1929, the mine was owned by the Black Eagle Mines Incorporated, L. M. Clancy, president, 505 Roosevelt Boulevard, Los Angeles, and was reported idle. The mine was apparently operated intermittently from about 1930 until the latter part of 1940. California Division of Mines records show a nearly continuous record of production from 1935 to 1940. In the early part of 1939, a 100-ton concentration and flotation plant was installed on the property. The plant was operated from July 1939 to January 1940, and treated ore at the rate of 75 tons per 24 hours. During this period the value of concentrates shipped was $53,706 ± (Tucker and Sampson, 1945, p. 147). Concentrates were shipped to Midvale, Utah, and 20 men were employed (Tucker and Sampson 1940, p. 47). All mine and mill equipment were removed from the property in December 1940. In 1945, the mine was owned by Imperial Metals Incorporated, S. B. Mosher, president, 811 W. 7th Street, Los Angeles (Tucker and Sampson, 1945, p. 146).

Geology: A fault zone separating diorite from quartzite contains a major N. 70° W.-trending and 85° N.-dipping quartz vein (Black Eagle Vein) filled with galena, malachite, azurite, cuprite, anglesite, cerrusite, lead-vanadinite, gold and silver. The vein ranges in thickness from 4 to 10 feet, has an average thickness of 6 feet, and a proven surface length of about 3000 feet. About 1400 feet west of the main shaft another vein (South Vein) striking N. 40° W. and dipping steeply northeast, intersects the Bald Eagle Vein at an oblique angle (see fig. 48). It is of minor importance and nearly all the work has been confined to the Bald Eagle Vein (Tucker and Sampson, 1945, p. 146).

figure 48

713

Development: A two-compartment shaft is sunk in the Black Eagle vein to a depth of 650 feet, with levels at 60, 100, 150, 200, 300, and 500 feet. On the 60-foot (adit level), a drift extends 600 feet west and 160 feet east from the shaft. On the 150-foot level, a drift runs 500 feet west and 180 feet east from the shaft. A drift 200 feet west and a drift 180 feet east are found on the 200-foot level. On the 300-foot level, a 485-foot drift extends west from whence a crosscut extends south 550 feet to the South vein. The vein has been drifted 170 feet from the crosscut. At present (1960), the mine is in large part caved, filled, and boarded over.

Production: The total production of the mine is estimated by Tucker and Sampson (1945, p. 147) to be valued at $200,000. They list the following data for concentrates and ore shipped from the property from 1935 to 1940.

Year	Copper		Lead		Silver
	Pounds	Value	Pounds	Value	Value
1935	2,073	$ 172	15,303	$ 616	$ 1,953
1936	6,355	525	53,983	2,483	4,269
1938	15,044	1,479	241,510	11,109	3,387
1939	68,683	7,143	634,071	29,801	11,604
1940	22,269	2,516	536,047	26,823	22,510

References: Tucker, 1924, unpublished Field Report No. 84; Tucker 1924, pp. 193-196; Tucker and Sampson, 1929, pp. 474-476; Tucker and Sampson, 1940, p. 47; Tucker and Sampson, 1945, pp. 146-147; Newman, 1924, unpublished report on the Black Eagle mine, 6 pp.

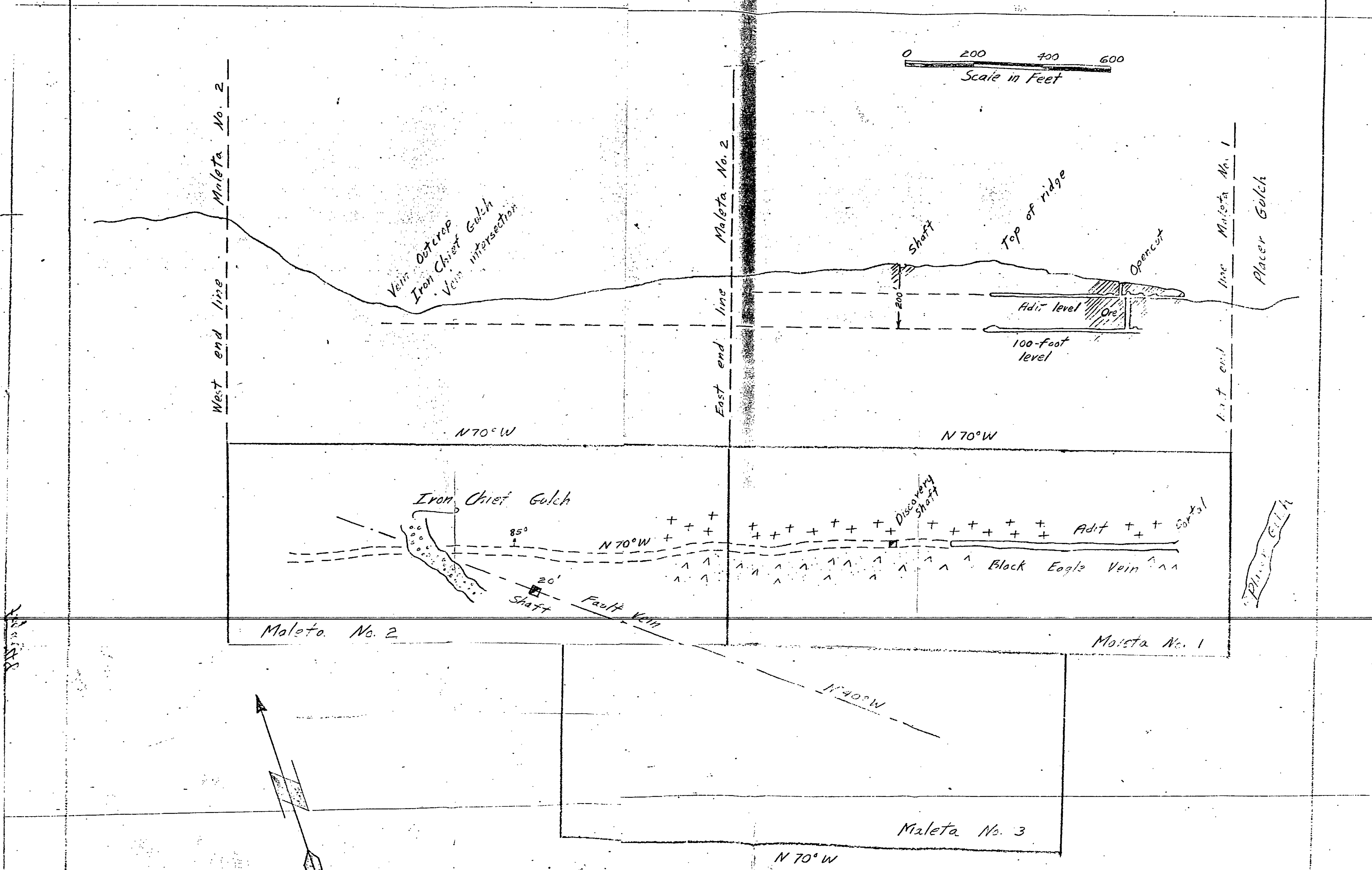
J.R.E. 3/17/60

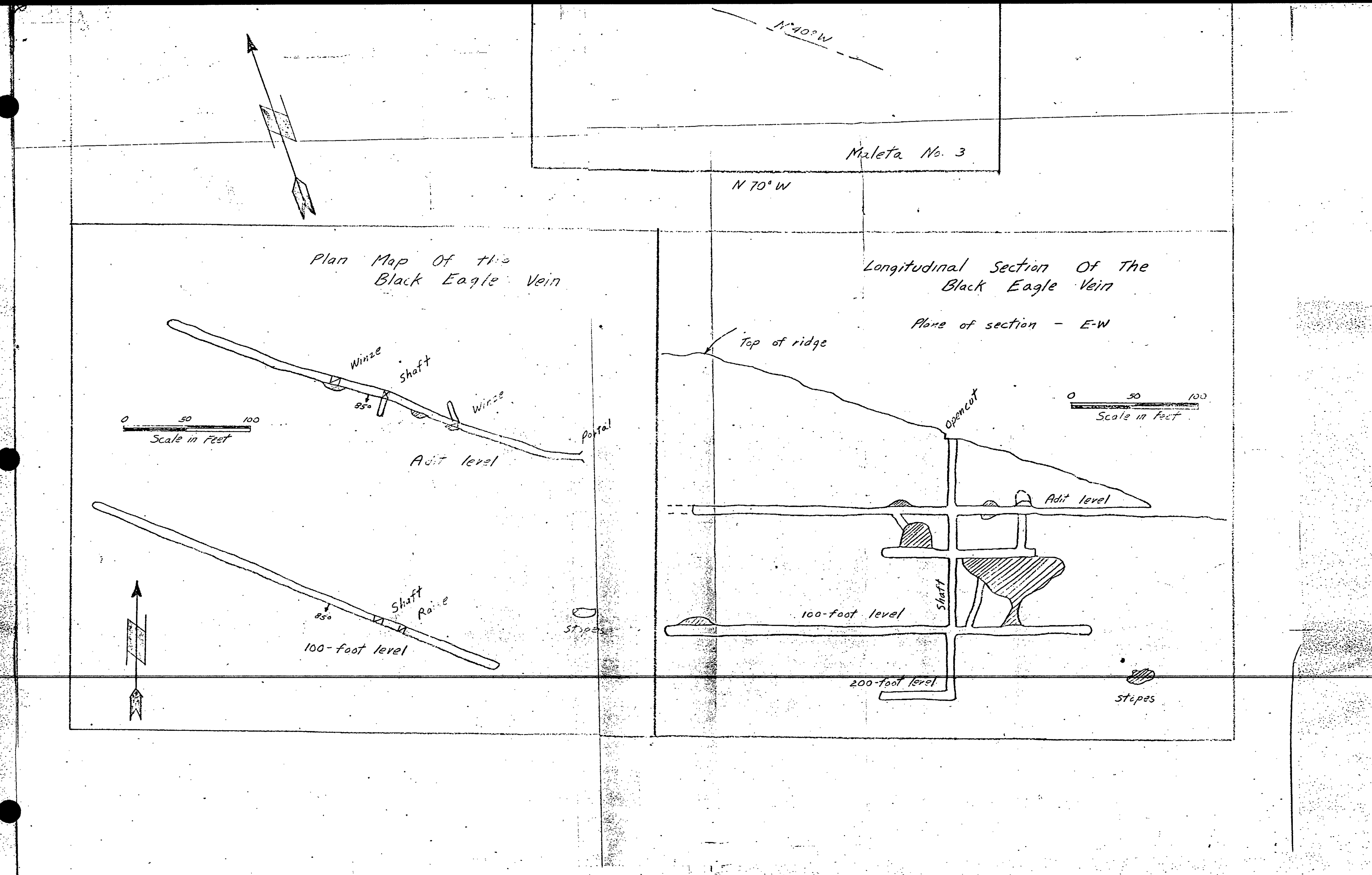
Lead-silver-zinc

Figure 48. Plan map and longitudinal sections of the Black Eagle Vein in 1924 (adapted from an unpublished report by M. A. Newman.)

BLACK EAGLE VEIN

East - West Longitudinal Section





N 40° W
Maleta No. 3
N 70° W
Plan Map Of the Black Eagle Vein
Winze
Shaft
85°
Winze
Portal
0 50 100
Scale in Feet
Adit level
Shaft
Raise
85°
100-foot level
Stopes
Longitudinal Section Of The Black Eagle Vein
Plane of section - E-W
Top of ridge
Opencut
0 50 100
Scale in feet
Adit level
Shaft
100-foot level
200-foot level
Stopes

Cap Hunter (Poor Boy) Mine

Location: Sec. 34 (proj.), T. 7 S., R. 16 E., S.B.M., Chuckwalla Mountains quadrangle, 15', 1963; on the south side of a west-trending valley near the south margin of the Chuckwalla Mountains. The mine is at the end of Dupont Road, which extends southwest from U.S. 60-70.

Ownership: Undetermined.

History: The Cap Hunter mine appears to be an old claim, but no records were found dated earlier than 1952. From 1952 to 1954, the mine was held by Roy M. Berg, Box 456, Desert Center. In 1957, it was held by Jack Stewart, William Sandoval and Bert L. George, who called it the Poor Boy mine.

Geology: The low ridges in the mine area are underlain by Pre-cambrian gneiss. A fault zone 1 to 2 feet wide is poorly exposed through a horizontal distance of about 400 feet. It strikes N. 75° W., and dips 45° SW. The fault contains a quartz vein, a foot or less in thickness, which carries iron oxides, galena, secondary copper minerals, and small proportions of cerussite. The vein quartz has been fractured, and the resulting spaces filled by the iron and copper minerals.

Development: The workings, now inaccessible, comprise 3 inclined shafts on the fault and an undetermined ~~amount~~ number of ~~drifting~~ drifts and ~~stoping~~ stopes. The southeast shaft is about 50 feet deep, ~~(and collared by collapsing timber)~~. The middle shaft, about 125 feet to the northwest, is caved and flooded to within about 20 feet of the collar. The northwest shaft, about 280 feet farther to the northwest, is 25 feet deep and has no vein exposed in it.

Production: Compiled by the U. S. Bureau of Mines and published with permission of the owners.

Year	Crude ore (tons)	Recoverable Metals			
		Gold ~~(ounces)~~ oz.	Silver ~~(ounces)~~ oz.	Copper ~~(pounds)~~ lbs.	Lead ~~(pounds)~~ lbs.
1952	1		5		316
1953	3	1	25		1,098
1954	40	1	15	54	850

References: None.

R.B.S. 1/22/60.

Corona Lead-Zinc Mine

Location: . SE¼ sec. 14, T. 4 S., R. 7 W., S.B.M., Corona South quadrangle, 7½', 1954; about 4 miles south of Corona on a steep ridge along the west side of Manning Canyon, midway between Eagle and Main Street (Gypsum) Canyons.

Ownership: Robert a Mattey, Jr., 11359 Biona Drive, Los Angeles 66, formerly held five lode claims by location—Wild Oak Nos. 1-5.

History: Located by Joe Smith, Temecula, and Fred Spiess, Corona, probably in the early 1940's. In 1943-45, it was under lease and option to Victor Mishelle, Corona Lead-Zinc Company, Malibu Beach, but was idle in 1945 (Tucker and Sampson, 1945, p. 147). About 1948, the property was acquired by Mr. Mattey, who did some development work for several years. In 1953, the principal adit was locked, the open cuts slumped, and the entire area covered with dense brush. The property has remained idle.

Geology: According to Tucker and Sampson (1945, p. 147) the mine explores a vein that contains oxidized lead-zinc and occurs in marine metasedimentary rocks. The mineralized areas occur along fracture zones in a small pod of quartzite, gray hornfels, and metagraywacke of the (Triassic(?) Bedford Canyon Formation. The metamorphic rocks are engulfed in hornblende andesite of the (Jurassic(?)) Santiago Peak Volcanics. Most of the lead-zinc is in a single discontinuous calcite-quartz vein exposed high on the steep west side of Manning Canyon. The vein material is mostly limonite-stained white to brown calcite with minor amounts of vein quartz ~~showing~~ marked with sparse black manganese dendrites. The vein fills a fracture zone which strikes northeast and dips 45° northwest. The vein ranges from 2 to 6 feet in width but the mineralized zone extends over as much as 15 feet and the metasedimentary country rock carries pyrite and pyrite altered to limonite. When visited in 1953 little vein material was encountered and no ore minerals were observed.

Development: Open cuts and adits. Tucker and Sampson (1945, p. 147) described the development thus: main workings were an open cut driven northeast for 360 feet and which explored the principal fracture zone high on the ridge west of Manning Canyon. Three hundred feet below the open cut and at the floor of Manning Canyon on its west side a crosscut adit, 92 feet long in 1945, was being driven N. 15° W. to intersect the vein exposed by the open cut above. This crosscut apparently did not cut the vein, although the rock in the face carried pyrite. Farther up Manning Canyon, about 300 feet west of the crosscut adit, there is a small open cut and two short adits are driven on a vein parallel to the principal mineralized zone exposed on the ridge above.

Production: A small mill was built in Manning Canyon in the early 1940's and although it is said to have been in operation about 1943 no record of production was found.

References: Tucker and Sampson, 1945, p. 147-148; Goodwin, 1957, p. 601-602; Gray, 1961, p. 61-62, 116.

C.H.G. 8/17/62.

Desert Center Mine

Location: SW¼ sec. 18, NW¼ sec. 19, T. 7 S., R. 17 E., (proj.) S.B.M., ~~U.S. Army Corps of Engineers,~~ Chuckwalla Mountains quadrangle, 15', 1963; and Sidewinder Well quadrangle, 1952; on the east slope of the Chuckwalla Mountains about 2 miles south of Ship Creek. In March, of 1962, a crude road had been bulldozed northwestward to the property from the Aztec Mines area on Dupont Road (shown on the Sidewinder Well quadrangle).

Ownership: C. H. McDonell and Gilbert Martin, c/o Vaux, 817 Balboa Blvd., Balboa, or Box 523, Desert Center.

History: The Desert Center mine was first described in 1929 (Tucker and Sampson, p. 491), at which time the property was held by S. A. Ragsdale, Desert Center and only assessment work was being done. U. S. Bureau of Mines records show that, in 1940, this property was held by Desert Center Mining Company, Los Angeles. In 1945, the mine was idle (Tucker and Sampson, 1945, p. 148, pl. 35). The present owners have held claims in the area since the mid-1950's.

Geology: The mine area is underlain by gneissic granitic rock cut by northeast and northwest-trending faults which contain metaliferous vein deposits. The best-exposed deposit cuts across a saddle in a narrow ridge west of the wash parallel to which the road to the mine ascends. In the saddle, a fault zone 6 feet wide strikes N. 60° E. and dips 85° SE. Within the fault zone are a basic dike about 2 feet thick and pods and stringers of quartz as much as 10 inches thick. The quartz is fractured and contains local concentrations of iron oxides, cerussite, and partially altered galena. In addition to lead, this deposit is reported (U.S. Bureau of Mines records) to contain small proportions of gold and silver. The deposit is exposed through a horizontal distance of about 100 feet on the northeast slope of the saddle, some 50 feet on the southwest slope, and an additional 150 to 200 feet southwestward across an adjoining spur.

A second fault is poorly exposed along the crest of a low, narrow ridge at the end of the road, parallel to the east bank of the wash and about 1,000 feet northeast of the above deposit. This fault zone appears to be about 18 inches wide. It strikes N. 50° W. and is vertical. Although vein material is not common in the outcrop, the mine dump shows vein quartz fragments as much as 6 inches thick containing bunches of galena, cerussite, iron oxides, and sparse crusts and bunches of secondary copper minerals. The lateral exposed extent of this fault may comprise the full length of the ridge, a distance of 1,000 or more feet, but it appears to be sparsely mineralized. At the southeast end of this ridge a 4-foot-wide fault zone strikes N. 85° E. and is vertical where exposed at the collar of a shaft. Here a 4-inch quartz vein contains small crystals of pyrite.

Development: The southwest saddle is explored by a 12-foot drift adit and six prospect pits on its northeast slope and a 25-foot shaft and several prospect pits on the southwest slope. The northeast ridge is explored by two shafts, both sealed against entry. One of these shafts appears to explore the junction of the N. 85° E. fault and the ridge fault. The other is about 400 feet to the northwest and appears to explore an ore shoot. The present owner is building a ~~cable conveyor system~~ aerial tram from the southwest-saddle development to a site near the end of the road at the toe of the northeast ridge.

Production: U. S. Bureau of Mines records show that in 1940, 4 tons of ore yielded 2 ounces of gold and 3 ounces of silver. Though not reported for that shipment, lead is the most abundant metal in this deposit.

References: Tucker and Sampson: 1929, p. 491; 1945, p. 148, pl. 35.

R.B.S. 3/15/62.

Groover (Carbonate Lead) Mine

Location: Sec. 4 (proj.), T. 2 S., R. 11 E., S.B.M., Valley Mountain quadrangle, 15', 1956; Pinto Mountains, 6 miles south-southwest of Old Dale (Figure 49).

Ownership: F. E. Groover, 12691 Trask Avenue, Garden Grove, owns 1 unpatented claim (1958).

History: Undetermined.

Geology: An intrusive mass of porphyritic quartz monzonite intrusive into white, tan weathering medium-grained dolomitic limestone, has produced a tactite zone as much as 7 feet thick. The intrusion has been along a fault. The tactite zone contains galena, azurite, malachite, and minor amounts of gold and silver. Several thin diorite dikes cut the quartz monzonite, and one near the portal of the main adit is about 7 feet thick and bounded by faults. The dolomitic limestone is a part of a sequence of northerly-dipping metasedimentary rocks of Paleozoic (?) age composed principally of varicolored quartzites. Normal faults, trending northwest and dipping southwest, cut both the quartz monzonite and the metasedimentary rocks.

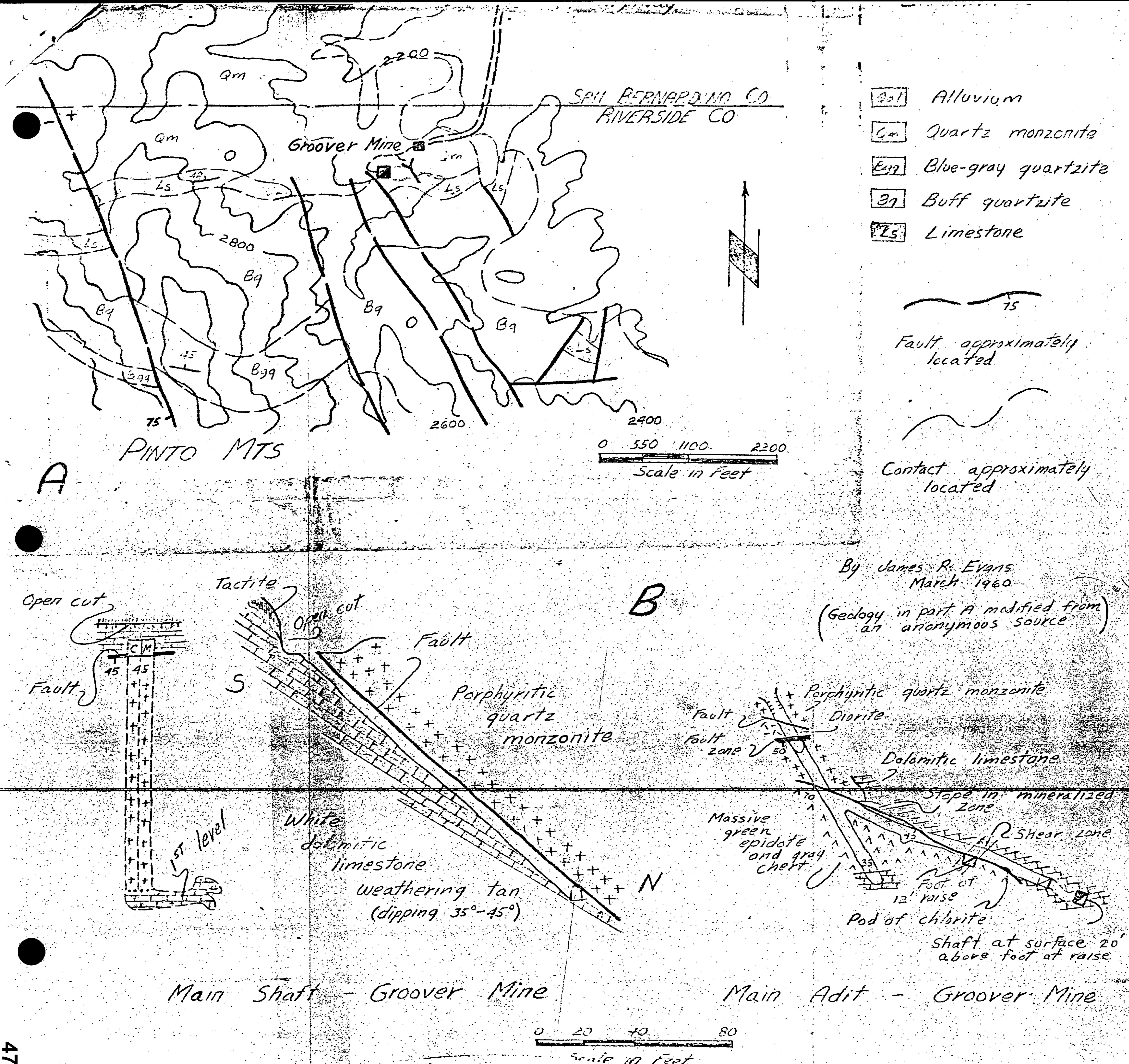
Figure 49

Development: A 2-compartment main shaft is sunk 150 feet north at 45° in a northeast-trending fault plane. The fault is exposed southwest and northeast a total of 215 feet from the shaft along the strike by surface trenching and open cuts. At the bottom of the shaft, a drift extends west about 30 feet. The main adit, 300 feet east of the main shaft, is driven south about 90 feet. At 50 feet a crosscut extends 95 feet southeast. At the end of the crosscut a raise connects to the ground surface 20 feet above. The mine is idle.

Production: Undetermined.

References: None.

J.R.E. 3/29/60



A
PINTO MTS
SAN BERNARDINO CO
RIVERSIDE CO
Groover Mine
Qm
Ls
Bq
Bgq
2200
2400
2600
2800
45
75
0 550 1100 2200
Scale in Feet
Alluvium
Quartz monzonite
Blue-gray quartzite
Buff quartzite
Limestone
Fault approximately located
Contact approximately located
B
By James R. Evans
March 1960
(Geology in part A modified from an anonymous source)
Open cut
Fault
1st level
Tactite
Open cut
Fault
S
N
Porphyritic quartz monzonite
White dolomitic limestone weathering tan (dipping 35°-45°)
Main Shaft - Groover Mine
0 20 40 80
Scale in feet
Porphyritic quartz monzonite
Diorite
Fault
Fault zone
Dolomitic limestone
Stope in mineralized zone
Shear zone
Massive green epidote and gray chert
Foot of 12' raise
Pod of chlorite
Shaft at surface 20' above foot at raise
Main Adit - Groover Mine

Figure to be

Figure 49. A. Geologic map of the Groover mine and adjacent area (topography from U.S.G.S. 15' Valley Mountain quadrangle, 1956). B. Geologic sketch maps of the main shaft and main adit of the Groover mine.

Jacklin Mine

Location: NE 1/4 NW 1/4 sec. 24, T. 1 S., R. 22 E., S.B.M., Vidal quadrangle, 15', 1950; on the northeast slope of the West Riverside Mountains, 7 1/4 miles southwest of Vidal.

Ownership: Undetermined.

History: Undetermined.

Geology: The country rock is slightly gneissic Mesozoic granodiorite. Irregular, tabular, and lenticular quartz bodies generally less than one foot in thickness and a few tens of feet in strike length, are exposed in the mine area. One such vein has been explored. It is vertical, strikes N. 55° E., is 4 to 6 inches wide in the mine workings, and is traceable for about 60 feet on the surface. The quartz contains small proportions of galena, chrysocolla, and iron oxides.

Development: A 75-foot drift has been driven southwest along the quartz vein described above.

Production: Undetermined.

References: None.

R.B.S. and C.H.G. 12/17/57

Part 3

Limestone, Dolomite, and Cement

Limestone production in Riverside County, a major mineral industry of the county, is estimated to be about one million tons each year. In 1963, most of this limestone was consumed in one portland cement plant, but limestone is also produced for roofing granules, white aggregate, asphalt tile filler, and other industrial purposes. Before the mid-1920's limestone was mined from deposits in the county for use in lime production, and at times limestone from the county has been utilized for poultry grit, beet-sugar manufacture, broken and crushed stone, building and ornamental stone, and flux in iron foundries. In addition to these deposits and the deposits being currently quarried, the county contains substantial, but largely undeveloped, reserves of carbonate rocks. Apparently some of these carbonate bodies are composed of industrial grade limestone, but in other bodies limestone and dolomite are too complexly intermixed to permit exploitation of either limestone or dolomite. Large masses of high-grade dolomite have not been reported.

In 1963 some of the deposits suitable for industrial use still were too remote or inaccessible to be of immediate commercial interest but some probably will be placed in production within a few years. Because limestone and cement producers in Riverside County number fewer than three in each reportable category, production figures ~~in 1961 were included with barite, gypsum, iron ore, peat, petroleum, and wollastonite, which had a combined value of $33,769,768.~~

have been concealed under unapportioned since 1912.

Commercial limestone production in Riverside County probably began about 1890 with the inception of a small lime industry. By 1895 several small kilns were operating in the northwestern San Jacinto Mountains in the vicinity of Lamb Canyon. At Crestmore, in 1905, two kilns were operating and the lime, about 75,000 barrels of which had been produced at that quarry, was known as "Lily White" lime. Stone from the Crestmore deposits also had been utilized for sugar-beet refining as well as for building and ornamental stone. Nearby deposits in the Jurupa Mountains have also been utilized for cement manufacture at Crestmore, and in recent years have been a source of roofing granules and white aggregate.

The portland cement industry in Riverside County began in 1909 when the Riverside Cement Company completed a dry-process plant at Crestmore. In 1958 an extensive modernization and expansion program was started at Crestmore and was nearing completion by the end of 1963. In mid-1961 a new white cement plant, built adjacent to the existing gray cement plant, went on stream. This plant is one of only 5 white cement plants in the United States and was the first new white cement plant built in this country in many years.

Figure 50

For many years before 1942 the City of Riverside mined limestone from The New City quarry on Central Avenue for use in oil and macadam construction of city streets. Poultry grit was mined from a nearby deposit during 1933-1945. One deposit in the Jurupa Mountains west of Riverside was also mined for poultry grit in the late 1920's as were two deposits in Bautista Canyon southeast of Hemet. In the mid 1940's the Jurupa Mountain deposit was a source of foundry stone.

Since the 1950's limestone deposits near Nightingale at the north margin of the Santa Rosa Mountains have been under development as a source of roofing granules, ornamental stone, and other limestone products. Similar developments are under way in the Big Maria Mountains, a few miles northwest of Blythe at the east end of the county.

Limestone and dolomite bodies in Riverside County are parts of roof pendants of metamorphosed sedimentary rocks which have been intruded by granitic rocks. The metamorphic rock masses include quartzite, schist, hornfels, and contact-rocks, as well as the carbonate rocks, which are minor in most pendants. Few of the metamorphic bodies have been mapped in detail and little direct evidence of the age of the original strata has been found, but all apparently are pre-Cretaceous in age.

Most of the carbonate rock deposits in Riverside County occur in three areas, the northwestern tip, the west-central part, and the northeastern part of the county. In the northwestern tip of the county isolated roof pendants containing limestone-bearing metamorphic rocks of Mesozoic or Paleozoic age occur at Crestmore and in the Jurupa Mountains. To date these deposits provide the principal source of commercial limestone in the County. Several large undeveloped deposits exist in the northern and southern parts of the San Jacinto Mountains in the west-central part of the county. Among the more promising of these are the Guiberson and Sims deposits at the low north edge of the San Jacinto Mountains, and the Whitlock deposit high in the southern part of the mountains. These deposits apparently contain high-calcium, low-iron limestone, but also contain intermixed dolomite and dolomitic limestone. In the northern Santa Rosa Mountains limestone deposits near Nightingale have been mined intermittently on a small scale in recent years and significant reserves of high-quality limestone apparently remain. These carbonate bodies, as well as numerous smaller bodies in the Santa Rosa and San Jacinto Mountains, are part of a thick and widely exposed sequence of pre-Cretaceous metamorphic rocks that is composed of mica schist and quartzite. Extensive deposits of limestone, dolomite, and dolomitic limestone occur in the Big and Little Maria Mountains in the northeastern part of Riverside County, about 15 miles northwest of Blythe. These deposits, of the Paleozoic(?) Maria Formation, are included in a thick sequence of quartzite, wollastonite-bearing rock, and schist. During the past several years efforts have been made to develop these deposits as a source of roofing granules and other limestone products. In the north-central part of the county carbonate rocks occur in the Eagle and Little San Bernardino Mountains, but large masses of pure limestone or dolomite are not presently known. These deposits, except for one or two small roofing granule operations during the 1950's, are undeveloped.

Best Ranch Deposit

This report is based largely on information contained in a recently published description by Engel, Gay, and Rogers (1959, p. 97-99).

Location: Sec. 28, T. 5 S., R. 4 W., S.B.M., ~~U.S. Army Corps of Engineers Lake~~ 7.5' Elsinore quadrangle, 19~~42~~53; about 2½ miles northeast of Elsinore, and one mile southeast of Highway 74.

Ownership: John A. Snyder, Route 2, Box 220, Perris, holds (1959) patent to 160 acres including the old quarry site and kilns.

History: Two stone kilns, each about 25 feet tall, stand about 150 feet northwest of the deposit. Made of country rock, the kilns were built sometime prior to 1890, and reportedly produced a good quality of lime (Goodyear, 1890, p. 151). A plan to manufacture hydraulic cement was unsuccessful and the property has been idle since 1890.

Geology: A discontinuous line of elongate limestone bodies strikes N. 75° W. parallel to the bedding of surrounding slate. The deposit dips about 50° N.E. Though limestone is exposed through a strike distance of half a mile or more, only the largest body, measuring about 75 feet in maximum width and 100 yards or more in exposed length, was developed. The adjacent outcrop, about 200 yards to the northwest, is approximately 50 feet wide and at least 100 feet long. Outcrops are partially obscured by soil.

The limestone is massive, light- to dark-gray and characteristically mottled. It is pre-Cretaceous in age. An undetermined but apparently small proportion of dolomitic material is present locally. Silica is present in the form of cherty and jaspery streaks and small pods as much as several inches wide and several feet long. Silica increases in abundance towards the east end of the main outcrop. Abundant unoriented silky sheafs of tremolite blades occur in at least one zone that covers an area of about 75 square feet near the southern edge of the main outcrop. The limestone is silicified adjacent to a steeply dipping aplite dike which strikes N. 80° W. across the southern margin of the main body.

Development: A five-foot pit and a bench 20 feet long and as deep as 8 feet are cut in the west end of the main outcrop. A 60-foot crosscut adit driven S. 30° W. through the next outcrop to the northwest established a 50-foot width of limestone at a depth of 15 feet.

Production: Undetermined. The small size of the quarry and unworn condition of the kilns indicate that very few tons of lime were produced.

References: Goodyear, 1890, p.151; Engel and others, 1959, p. 97-99, pl. 2.

Big Maria Mountains Limestone Deposits

Location: Secs. 20, 21, 22, 27, 28, 34, 35 (proj.), T. 4 S., R. 22 E., S.B.M., Big Maria Mts. quadrangle, 1951; about 15 miles northwest of Blythe on the western slope of the central part of the Big Maria Mountains, about 5½ miles east of Inca.

Ownership: California Limestone Products, 139 South Beverly Drive, Beverly Hills holds claims totaling over 3,000 acres in the Big and Little Maria Mountains. In 1962 the General Minerals Corporation, 300 Sixteenth Street, Denver, Colorado (P.O. Box 13, Blythe) leased placer claims totaling 3,560 acres from California Limestone Products. In 1965 the property was reported purchased by Chas. Pfizer & Co., Inc., P.O. Drawer AD, Victorville, California 92392.

History: Development of these properties by California Limestone Products started in 1951, when the company was incorporated. They continued active development work throughout the 1950's and sought to develop markets for ornamental marble, terrazzo chips, roofing granules, and lime. Limestone products, however, apparently were never marketed by California Limestone Products who were chiefly engaged in mining manganese and in the development of wollastonite for use in the manufacture of rock wool. Since 1962 the General Minerals Corporation has been developing the limestone deposits for terrazzo chips, roofing granules, poultry grit, and other limestone products. In February 1963 they had a small grinding plant in operation at the former Woolstone Corporation plant in Blythe located near Midland Road and the Santa Fe Railroad (NE¼ sec. 6, T. 6 S., R. 23 E., S.B.M.).

Geology: Extensive deposits of limestone, dolomite, and dolomitic limestone occur in the Big Maria Mountains. These deposits are included in a thick sequence of quartzite, wollastonite-bearing rock, and schist of the Paleozoic (?) Maria Formation which has been much deformed. Carbonate rock bodies are as much as 3 miles long and one mile wide, and irregularly-shaped carbonate bodies are as much as 2 miles in diameter. Bodies which are chiefly limestone are as much as 1½ miles long and half a mile wide. Some crystalline limestone masses locally contain gypsum and there are large bodies of siliceous dolomite with quartzite. The principal limestone bodies observed, and which apparently lie within California Limestone Products properties, are mostly in sections 21, 27, 28, and 34, 35 (proj.), T. 4 S., R. 22 E., S.B.M. In sections 34 and 35 (proj.) white to buff, fine to medium crystalline limestone crops out in a northwest-trending and gently northeast-dipping layer more than 1½ miles long and ranging from 500 to 2,000 feet in width. About one mile to the northwest in sections 21, 27, and 28 (proj.) a sequence of metamorphic rocks strikes northwest and dips about 50° northeast. Here the basal unit is a limestone layer about 100 feet thick and exposed along the strike for about 3,000 feet. This lower limestone is overlain by 500 feet of quartzite, schist, and wollastonite-bearing rock which is overlain by an upper limestone unit. This upper limestone layer ranges from 800 to 2,000 feet in width and has a strike length of about 8,000 feet. It is intruded by dark sills and faulted against schist. The lower carbonate unit (in secs. 27, 28; samples 1-4 below) is white to faintly salmon, massive, dense, fine to medium crystalline limestone and dolomite which weathers buff or light tan. The lower 150 feet (of an 800-foot wide exposure) of the upper carbonate unit (in sec. 21; samples 5-8 below) is off-white to white, massive, dense, fine to medium crystalline limestone, with some friable layers. Eight samples collected by the Division of Mines in March, 1956, and chemically analyzed by Abbot A. Hanks, Inc., San Francisco, were as follows:

Location	Sample no.	SiO_2	Fe_2O_3	Al_2O_3	CaO	MgO	P_2O_5
Lower limestone unit, secs. 27, 28, T4S, R22E, SBM. Type grab spls. from 100-ft. section.	1	1.31%	0.11%	0.22%	54.41%	0.35%	0.01%
	2	0.42	0.15	0.17	30.05	21.67	0.02
	3	0.12	0.15	0.34	55.28	0.22	0.01
	4	0.33	0.18	0.40	54.92	0.29	Trace
Upper limestone unit, sec. 21, T4S, R22E, SBM. Type grab spls. from 150-ft. section	5	2.94	0.11	2.76	47.69	3.92	0.16
	6	1.81	0.11	1.61	52.53	0.96	0.11
	7	7.20	0.16	4.58	48.80	0.29	0.10
	8	2.87	0.11	3.18	48.20	3.34	0.12

Development: Open cuts and prospect pits.

Production: Undetermined. Probably a few thousand tons, or less.

References: none.

C.H.G. 8/20/63.

Blind Canyon Deposit

Location: SE¼SW¼ sec. 18, T. 2 S., R. 5 E., S.B.M., Palm Springs 15' quadrangle, 1957; south margin of the Little San Bernardino Mountains on the west side of Blind Canyon, 2 miles north of Desert Hot Springs.

Ownership: Metropolitan Water District of Southern California, 306 West Third St., Los Angeles.

History: During 1960 a small tonnage of limestone was quarried for roofing granules and/or ornamental stone and used in the Desert Hot Springs area. Idle 1961.

Geology: An irregular lens-shaped pendant of pre-Cretaceous impure limestone (of the Chuckwalla Complex) strikes northwest along the ridge west of Blind Canyon. The limestone body has a maximum width of 500 feet and a length of 1,500 feet, but is interlayered with biotite schist and contains fingers of granitic rock. The limestone is fine to coarsely crystalline and is discolored along yellow-green serpentinized zones, but contains small patches of white material.

Development: Several faces in a small canyon have been blasted down, but there is no regular quarry.

Production: Undetermined, but apparently only a few tens of tons.

References: None.

C.H.G. 5/20/61.

Castro Quarry (Magstone Products)

Location: $N\frac{1}{2}N\frac{1}{2}NW\frac{1}{4}$ sec. 1, T. 3 S., R. 5 W., S.B.M., Riverside East quadrangle, 7½', 1953; isolated, low hill, a quarter of a mile east of the intersection of Arlington Avenue and the Gage Canal, in the City of Riverside.

Ownership: Loren Creed, Riverside (1945). Undetermined (1963).

History: Apparently the Castro quarry is the site of the former Magstone Products operation described by Tucker and Sampson (1945, p. 173). From 1938 to 1945 Howard Small, Riverside, operating under the name Magstone Products, was a producer of limestone. The stone was hauled to a plant on North Main Street in Riverside where it was crushed and screened. The material was sold as poultry grit and as limestone flour for use in poultry feeds. In 1945 the plant had a capacity of 8 tons per day. Production has not been reported since 1945 and the quarry has apparently been idle since that date. Residential construction was underway adjacent to the quarry in 1963 and it appears unlikely that the quarry will be reopened.

Geology: The quarry area is underlain by poorly exposed pre-Cretaceous limestone, schist and skarn intruded by quartz diorite. Larsen (1951, plate 1) assigned the metamorphic rocks to the Paleozoic and the intrusive rocks to the Cretaceous (Bonsall Tonalite. The metamorphic sequence strikes about N. 35° E. and appears to dip about 50° SE. The limestone is medium to coarse crystalline, gray to white. The exposed mass of limestone and skarn is 400 feet long and 30 to 45 feet wide. The limestone is in two bodies, a north body about 350 feet long and 25 to 45 feet wide, and a small south body about 35 feet long and 10 feet wide. The two limestone bodies are separated by about 20 feet of skarn.

Development: Three side-hill cuts have been made in the limestone. The south mass and adjacent skarn contains one irregular quarry about 80 feet long more or less along the strike, and 5 to 20 feet wide. About 100 feet to the north an irregular quarry across the north mass is about 40 feet by 45 feet; 70 feet north of this quarry is a semicircular quarry about 40 feet long on the strike of the limestone and about 20 feet wide.

Production: Total undetermined, probably a few thousands of tons.

References: Tucker and Sampson, 1945, p. 173; Logan, 1947, p. 271; Larsen, 1951, plate 1.

C.H.G. 7/31/63.

Glen Avon (Mathews, Mira Loma) Limestone Deposit

Location: SW¼ sec. 2, T. 2 S., R. 6 W., S.B.M., San Bernardino quadrangle, 1954; southern slope of the western Jurupa Mountains, north of Glen Avon Heights at the north end of Fleming Street and about 7 miles northwest of Riverside.

Ownership: Mark Tungate, 275 Larchmont Blvd., Los Angeles (1942). Undetermined (1963).

History: Quarry opened about 1928 by W. B. Mathews, 1032 North Oakland Street, Pasadena. For several years limestone was shipped to Los Angeles where it was ground for poultry grit. After a long period of idleness the property was again active in 1942 and was then known as Mira Loma Dolomite. Miller Brothers Truck Company was the operator in 1942 and was shipping rock at $4.75 per ton to Bethlehem Steel Company and other iron foundries in Los Angeles. A crushing and screening plant was located just below the quarries. The property has been idle since before 1950.

Geology: Limestone occurs in two parallel lens-like bodies within a bedded sequence of siliceous metasedimentary rocks. This metamorphic sequence has been termed the Jurupa Series of questionable Paleozoic age, but some workers believe it may be Triassic (Mackevett, 1951, 14 p.). The limestone bodies dip steeply north and strike nearly due east. They have maximum exposed dimensions of about 1,000 feet long and 80 feet wide, and are separated by about 60 feet of schist. In places the limestone has been intruded by small fingers of granitic rock. The limestone is light gray to white, medium- to coarse-grained crystalline material, and is faintly banded.

Development: The upper limestone body has been mined at its east end by means of two open cuts parallel to the strike of the body. Each cut is about 150 feet long, 25-30 feet wide with 30-foot maximum depth. About 500 feet downslope to the southwest the lower limestone body has been explored by two small circular quarries, each about 20 feet in diameter and 20 feet deep.

Production: In mid 1929 shipments of 150 tons per month were made to Los Angeles and total shipments to that time were 500 tons. In September, 1942, shipments were 500 tons per month. Later shipments, if any, unknown. Total production probably no more than several thousands of tons.

References: Tucker and Sampson, 1929, p. 516; Tucker and Sampson, 1945, pl. 35, nos. 239, 240; Mackevett, 1951, 14 p., pl. 1.

C.H.G. 1/21/63.

Guiberson (Whitewater) Deposit

Location: SE¼ sec. 22, NW¼SW¼ sec. 23, T. 3 S., R. 3 E., S.B.M., Palm Springs quadrangle, 15', 1957; steep north margin of the San Jacinto Mountains, adjacent to San Gorgonio Wash three quarters of a mile south of Palm Springs Station, within the Palm Springs city boundary.

Ownership: S. A. Guiberson, 1000 Forrest Avenue, Dallas, Texas (1945). Undetermined (1963).

History: In 1894 (Crawford, p. 393) mentioned an undeveloped "white marble" at this location. By 1929 this property, which included 160 acres, had been explored by means of three adits driven south from San Gorgonio Wash and a number of open cuts. During the 1930's the Metropolitan Water District of Southern California examined the deposit (5 drill holes were put down) to determine its suitability for the manufacture of portland cement to be used in construction of the Colorado River Aqueduct. In 1955 the United States Cement Corporation examined the area in connection with their proposed cement plant near Cabazon. Opposition by residential property interests was the announced reason for abandoning the project. Apparently such continuing opposition precludes the exploitation of this deposit.

Geology: A sequence of pre-Cretaceous schists and carbonate rocks strikes about N. 50° W. and dips 65° NE. The limestone is white to gray and medium to coarsely crystalline. In places thin limestone beds 2-10 feet thick occur interbedded with mica schist, but much of the carbonate rock is massive and uncontaminated by other sediments. The limestone is, however, in some places contaminated by granitic dikes, dolomite, and schist. On the Guiberson property the area which is underlain mostly by carbonate rock is about 1,500 feet long and has a maximum width of 1,000 feet. This carbonate mass extends southeast into the Southern Pacific deposit (see herein) and the entire mass is about 4,000 feet long with a maximum width of 1,250 feet. According to Tucker and Sampson (1945, p. 172) five drill holes on the Guiberson property penetrated a maximum thickness of 110 feet of limestone, and that was not continuous. Reserves of carbonate rock are large but the quality of rock throughout the deposit is not known. Tucker and Sampson (1929, p. 516) listed one analysis as follows: SiO_2, 0.74%; Al_2O_3, 0.004%; Fe_2O_3, 0.008%; CaO, 53.29%; MgO, 2.39%.

Development: Three short adits and a number of open cuts.

Production: By 1947 no production of limestone had been reported from this deposit, and apparently there has since been none.

References: Crawford, 1894, p. 393; Tucker and Sampson, 1929, p. 515-516; Tucker and Sampson, 1932, p. 6, pl. 1; Tucker and Sampson, 1945, p. 172; Logan, 1947, p. 271).

C.H.G. 7/2/63.

Jensen Quarry

Location: SW¼ sec. 5, T. 2 S., R. 5 W., S.B.M., San Bernardino quadrangle, 15' 1954; southeastern part of the Jurupa Mountains, half a mile north of Sunnyslope and about 4 miles northwest of Riverside.

Ownership: Riverside Cement Company, Division of American Cement Corporation, Mill Office, P.O. Box 832, Riverside.

History: Jensen quarry was apparently opened during World War I by the Riverside Cement Company as a source of limestone for the company's cement plant at Crestmore, 2½ miles to the east. The quarry was shut down in 1927 and large-scale operations were not resumed until 1948 when Jensen quarry again became the major source of limestone for the Crestmore plant. In February 1954, the underground mine at Crestmore was shut down and Jensen quarry supplied all the limestone until March, 1955 when work started on a new underground mine at Crestmore. This mine went on full production in June, 1956 and limestone from the Jensen quarry has not since been utilized for portland cement manufacture. From 1953 to 1960, Sno-Top Rock Products Company produced limestone roofing granules and fines for asphalt tile filler and other industrial purposes from Jensen quarry at a small crushing and screening plant on the property. In November 1961, this operation was taken over by Snow Rock (see herein) who early in 1963 were producing white aggregate from the Jensen north quarry.

Geology: Limestone, associated with sileceous metamorphic rocks and intruded by Cretaceous Bonsall Tonalite, crops out in the quarry area over a crudely triangular-shaped area about 2,000 feet by 1,500 feet in plan. The limestone bodies strike northeast, dip 60°-80° S.E., and have apparent maximum thicknesses of at least 200 feet. The metamorphic complex has been termed the Jurupa Series of questionable Paleozoic age but some workers believe it may be Triassic in age. The limestone crops out boldly, is white, and is mostly medium- to coarse-grained calcite. Abundant graphite is disseminated in some of the limestone beds, and periclase, brucite, and hydromagnesite also occur. Rarer minerals such as spinel, pyrite, and diopside also occur and the mineral assemblage has been listed by Cooney (1956). Two undeveloped limestone bodies crop out in the SE¼ sec. 6 west and south of the Jensen quarry. The larger body is about 1,500 feet west of the quarry. It trends nearly north and is about 750 feet long and 350 feet wide. About 2,500 feet southwest of the quarry a somewhat hourglass-shaped body trends northeast and is about 1,000 feet long and ranges in width from less than 100 feet to more than 400 feet.

Development: The quarry includes three principal workings: the south quarry, the main quarry, and the north quarry. The south quarry is about 320 feet long in an easterly direction and 200 feet wide with maximum height of faces about 100 feet. The main quarry, in the central part of the limestone area and which furnished most of the limestone for cement manufacture since 1948, is nearly 450 feet long in a northwesterly direction and 200 feet wide. The north face is 230 feet high and the south face is about 100 feet high. The north quarry is irregular but has a total length of nearly 1,000 feet and has a steep southern face with maximum height of about 150 feet. This is the only quarry presently active (January, 1963) and is quarried by Snow Rock for white aggregate.

Production: Total production is undetermined, but apparently is several million tons. Early in 1963, production was about 100 tons per day.

References: MacKevett, 1951, 14 p.; Cooney, 1956.

C.H.G. 1/21/63.

Lamb Canyon (Snyder) Deposit

Location: NE¼SW¼, NW¼SE¼, sec. 32, T. 3 S., R. 1 W., S.B.M., Lakeview quadrangle, 7½', 1953; about 5 miles southwest of Beaumont in the northwestern San Jacinto Mountains on the east side of Lamb Canyon, near the crest of a prominent west-trending ridge.

Ownership: Undetermined.

History: The Lamb Canyon deposit probably was the source of limestone for Snyder's Kilns which in 1906 (Aubury, p.76) were reported to be 7 miles north of San Jacinto and operated by Ferdinand Snyder. The deposit was opened about 1896 and probably closed down shortly after 1906 and apparently has since remained idle. Two large steel-shell lime kilns are still standing on the south side of lower Lamb Canyon, about three quarters of a mile southwest of the quarries. The kilns were fired by wood, and the product was reported to be an excellent lime for sugar refineries.

Geology: Pre-Cretaceous limestone occurs in discontinuous lenses interbedded with mica schist and intruded by granitic rocks. This deposit, as well as a number of other limestone lenses, is part of a large mass of metamorphic rock that extends about 8 miles southeast from north of Lamb Canyon to Soboba Hot Springs. Several small layers of blue-gray to gray and white, fine to medium grained, crystalline limestone are exposed in two quarries and adjacent road cuts. The beds strike N. 55° W., and dip 55° NE. Although the rock appears to be high-calcium limestone all of the bodies observed are too small for economic operation. The sequence exposed in the road slot along the east side of the west or lower quarry from south to north is as follows: granite and schist; blue-gray limestone with minor schist and granite interleaves, 90 feet; gneissic granite, 30 feet; gray to white limestone, 30 feet (the layer that was mined); schist and granite containing about 6 thin limestone layers ranging from one foot to 4 feet in thickness, 200 feet. The limestone layers are exposed for a strike length of about 250 feet in the quarry and road cut. About 500 feet to the northeast a second sequence of schist and limestone, parallel to the first sequence, is exposed in a shallow road cut. Here three beds of gray to white, fine to medium grained, crystalline limestone are exposed over a distance of about 150 feet. The limestone beds are 3 to 4 feet thick and are interleaved with schist and intruded by granite. The beds can be traced along their strike up the ridge to a second quarry (east or upper quarry) about 500 feet southwest of the road cut.

Development: The west quarry, adjacent to the road, is a side-hill cut about 50 feet long, 50 feet wide, with face 25 feet high. The east quarry, above the road, is a side-hill cut about 50 feet long and 15 feet deep.

Production: Undetermined, probably no more than a few thousands of tons.

References: Aubury, 1906, p. 76; Logan, 1947, p. 271.

C.H.G. 7/2/63.

Marl and Travertine Deposits North of Blythe

Marl and travertine have formed local caps, flanking sheets and buttressed benches (~~fig.~~ Photo 1 __/) on spurs and foothills along the south and east flanks of the Big Maria Mountains, and the south, east, and north flanks of the Riverside Mountains; two arid ranges lying north of Blythe. These deposits are the remnants of a shore line of Pliocene(?) age, possibly that of a former, more northern lobe of the Gulf of California (Hamilton, 196~~1~~0, p. 276-277). The marl appears once to have been beach or near shore sand composed almost entirely of marine shells, shell fragments, and the tests of microorganisms. The travertine was probably the result of the precipitation of calcium carbonate from saturated, saline water. Many of these deposits grade downward into subjacent alluvium and talus and at some localities the interface between cemented debris and underlying loose regolith has been the site of deposition of manganese oxides.

To the date of the field visit ~~(1958)~~ these ~~unusual~~ deposits of calcium carbonate have been exploited in only a small way as a source of dimension stone (~~fig.~~ Photo 2 __/) and manganese ore. A local demand for agricultural marl is unlikely because of the natural alkalinity of soils in the Palo Verde Irrigation District.

References: Hamilton, 1960, p. 276-277; Thomas 1961, p. 69.

R.B.S. 4/10/58

Moore Limestone Deposit (Bautista Canyon Deposits)

Location: NE¼NE¼ sec. 34, T. 5 S., R. 1 E., S.B.M., Hemet quadrangle, 1957; about 7½ miles southeast of Hemet on the west side of Bautista Creek, about 1,500 feet west and 300 feet above the Bautista Creek road.

Ownership: Undetermined.

History: Deposit was quarried on a small scale in the middle 1920's by J. S. Moore, Winchester. Probably the rock was crushed and marketed as poultry grit. By 1929 the property was idle and apparently has since remained idle.

Geology: Pre-Cretaceous limestone occurs in discontinuous lenses and bunches interbedded with mica and hornblende schist and intruded by granitic rocks. The metamorphic sequence strikes northwest (roughly parallel to the trend of Bautista Canyon) and dips 65°-75° NE. Two lenses of fetid, coarsely crystalline, white to light gray limestone with some associated tactite, hornblende schist, and hornfels crop out across a southwest-trending gulch. The lower lens is 20-30 feet thick and extends both north and south of the gulch. The upper lens is separated from the lower lens by 50-100 feet of schist and granitic rock. This upper lens is best exposed along a fire break at the ridge top where the lens may have a maximum thickness of 100-125 feet. It does not appear to have much strike length and seems to pinch out rapidly to the south. Ground water has discolored the limestone to red an unknown depth from the surface and the rock is extensively fractured. Some of the limestone is graphitic and some is sky-blue similar to Crestmore rock. Reserves cannot be estimated without further development work and intrusions of granite may be encountered. Two random type samples collected by the Division of Mines in 1953 and chemically analyzed by Abbot A. Hank, Inc., San Francisco showed the material to be dolomitic as follows:

Sample No.	Insoluble	Fe_2O_3 and Al_2O_3	CaO	MgO	P_2O_5
B.C.-N1	11.46%	0.60%	38.92%	8.65%	0.12%
B.C.-N2	0.86	0.38	50.00	4.89	0.17

Development: Side-hill cut 50 feet long with face 20 feet high. Rock was lowered from the quarry to truck at road level by means of a gravity incline tram car. Apparently this was a small scale hand-methods quarrying operation.

Production: Undetermined, probably no more than a few hundred tons.

References: Tucker and Sampson, 1929, p. 516; Tucker and Sampson, 1932, p. 7, pl. 1; Tucker and Sampson, 1945, p. 172; Logan, 1947, p. 272.

C.H.G. 7/2/63.

New City Quarry

Location: S½ sec. 36, T. 2 S., R. 5 W., S.B.M., Riverside East quadrangle, 7½', 1953; northeast-trending, isolated hill on the north side of Central Avenue, three quarters of a mile east of Victoria Avenue in the City of Riverside.

Ownership: Undetermined (1963).

History: During the period from about 1930 to 1942 the City of Riverside quarried limestone for use in oil and macadam construction of city streets. Many of these streets are still in use in 1963, and apparently will continue to be serviceable for many years. The quarry was shut down because of World War II and apparently has not been reopened, but small amounts of remaining loose material may have been used intermittently. During the 1950's extensive residential construction began in the area and by 1963 the deposit was surrounded by homes and the floor of the old main quarry was occupied by a swim club. Future quarrying appears unlikely.

Geology: The quarry and adjacent hill are underlain by a sequence of pre-Cretaceous metamorphic rocks intruded by hornblende-biotite-quartz diorite. Larsen (1951, plate 1) mapped the metamorphic rocks as Paleozoic and assigned the intrusive rocks to the (Cretaceous) Bonsall Tonalite. The metamorphic sequence strikes about N. 40° E., dips 45° to 70° SE. and has a surface exposure of about 1,500 feet along the strike and a width of about 300 feet. The maximum true thickness of the metamorphic rocks is 200 feet at the south end of the deposit and thins to about 130 feet at the north end. The sequence exposed at the south end of the deposit, from west to east is: quartz diorite; limestone and predazzite, 40 feet; quartz diorite, 15 feet; pyroxene hornfels, 25 feet; quartz diorite, 10 feet, skarn, 5 feet; limestone and predazzite, 105 feet; quartz diorite. The limestone is medium to very coarse crystalline, white, gray, and light blue-gray. The maximum thickness of the west layer of limestone is about 40 feet and the east layer is about 120 feet in maximum thickness. At the north end of the deposit the west layer of limestone thins to less than 10 feet thick and the east layer thins to about 25 feet. Along the west edge of the east limestone layer is a thin garnet-pyroxene skarn zone, in most places about 2 feet thick. A number of minerals have been found in the quarry area and some have been reported by Murdoch and Webb (1956).

Development: Most of the quarrying was in the east limestone layer from one irregular side-hill quarry about 1,000 feet long opened on the south end of the deposit and extending along the strike of the limestone. This quarry was about 200 feet wide and had several irregular bench levels. At the north end of the deposit both the east and west limestone layers have been quarried from a side-hill cut about 200 feet long across the stike of the limestone layers and 150 feet wide. During the period of greatest activity in the middle 1930's crushing, sizing, and storage facilities were located at the quarry.

Production: Total undetermined, probably a few tens of thousands of tons each year during the 1930's. Apparently all of the limestone was used as broken and crushed stone in street construction.

References: Larsen, 1951, plate 1.

C.H.G. 7/30/63.

Nightingale Limestone

Location: Secs. 6, 8, 9, 10, 11, 12, T. 7 S., R. 5 E., S.B.M., Idyllwild quadrangle, 15' 1959, and Palm Desert quadrangle, 1959; on the north and northeast flanks of the Santa Rosa Mountains astride State Highway 74 at Nightingale.

Ownership: Palm Canyon Rock Products, Inc., 865 North Palm Canyon Drive, Palm Springs, holds an undetermined number of claims (known as the Beckelman-Lucas limestone deposit) in section 6 at the head of Palm Canyon. Henry B. Tuttle and Associates, 218 S. Palm Canyon Drive, Palm Springs, hold claims in the N½ sec. 8, under the name White Ridge Dolomite Claims. Section 9 is owned in part by Palm Springs Alpine Estates. In section 11, at the head of Deep Canyon, 50 acres of rugged terrain are owned by the H. T. Lucas Mining Company, 1534 North Hobart Blvd., Los Angeles 27.

Photo 27

History: Limestone in the Nightingale area has been known for many years (Merrill, 1917 /1919/, p. 551, fig. 4). Parts of these deposits have been known as Pinyon Flat, Harris, and Big Hill Deposits (Tucker and Sampson, 1945, pl. 35, no. 233, no.236; Logan, 1947, p. 271-272). In 1946 Wright (pl. 1) mapped the limestone exposed in T. 7 S., R. 5 E. The Lucas Mining Company developed their property in Deep Canyon since World War II and it was probably most active during the 1950's. A crushing and grinding plant was built at the quarry site but was abandoned in 1957 in favor of their present plant near Thousand Palms. In 1958 this operation was leased by Imperial Limestone Products, Inc., who operated the property until 1960 when the operation was again assumed by the H. T. Lucas Mining Company. This property has apparently been intermittently active since 1960.

Roofing granules and decorative stone have been the chief products to date.

Geology: The Nightingale limestone deposit is part of a narrow belt of carbonate rock which is irregularly exposed for a distance of about 6 miles from the head of Palm Canyon southeastward across the head of Deep Canyon and thence into Horsethief Creek. The limestone is part of a metamorphic sequence composed mostly of schist and gneiss which continues southeastward across the divide between Toro Peak and Martinez Mountain, and down the southwest side of Black Rabbit and Martinez canyons and on into San Diego County. In the Nightingale area Wright (1946, p. 11) estimated the thickness of the limestone unit to be as great as 200 feet. In the east part of section 6 the maximum width of outcrop is about 1,300 feet. The strike of the metamorphic rocks ranges from north, in Palm Canyon, to easterly in the Nightingale area. Dips range from about 30° east to 40° north. This and other similar limestone units are part of an extensive irregular mass of metasedimentary rocks named the Palm Canyon Complex by Miller (1944). Miller considered these rocks to be Paleozoic in age and they are intruded by Mesozoic granitic rocks of the southern California Batholith. Locally, especially in the Martinez Canyon area, the limestone is altered to impure marble and tactite. In the Nightingale area the limestone is white, medium to coarse grained, and, though strongly sheared, large masses contain no visible impurities.

The following data, submitted by Mr. Harry Beckelman, Palm Canyon Rock Products, Inc., is an analysis of one sample by The Eisenhauer Laboratories, Los Angeles, February, 1959: $CaCO_3$, 99.94%; CaO, 55.57%; MgO, 0.21%; Mg, 0.10%; Fe_2O_3, 0.04%; Al_2O_3, 0.06%; SiO_2, 0.43%; acid insolubles, 0.43%; H_2O, 0.27%; loss on ignition, 43.78%; specific gravity, 2.7; hardness 3.2.

Development: To date (1936) [1937] the principal site of mining has been a series of open cuts and benches, with faces as much as 75 feet high, extending through a horizontal distance of about half a mile in sections 11 and 12 on the Lucas property. In June, 1958, blasted rock was being handled with a front-loading dozer, a shaker screen, and belt loader, the raw product being trucked to the H. T. Lucas Co. roofing granule plant near Thousand Palms (Photo 41).

Production: A large tonnage of material appears to have been removed from the Lucas property but no accurate total was obtained. Late in 1962 the Thousand Palms granule plant was using about 200 tons of white limestone a month; a demand which required only sporadic quarrying.

References: Merrill, 1917 [1919], p. 91; Miller, 1944, p. 21-25; Tucker and Sampson, 1945, pl. 35, no. 233, no. 236; Wright, 1946, p. 11, pl. 1; Logan 1947, p. 271-272, pl. 37, no. 12.

C.H.G. 8/20/63.

Nonhof Deposit

Location: Sec. 16(?) T. 4 S., R. 7 W., S.B.M., Corona South quadrangle, 7½', 1954; northeastern flank of the Santa Ana Mountains, about 3 miles southwest of Corona in the vicinity of Hagador Canyon. Location not verified.

Ownership: E. R. E. Nonhof, 1116 Ramona Avenue, Corona (1924). Undetermined (1961).

History: Mr. Nonhof located one claim in 1915 on which he reported a bold outcrop of "lime", 1,500 feet long, about 70 feet wide, and 50 feet thick; developed by a short adit. The writer was unable to locate such an outcrop in 1953. Ruins of a small lime kiln are said to have been found in upper Hagador Canyon in 1907, but were not identifiable in 1953.

Geology: Several small exposures of pyrite and limonite-bearing medium-grained crystalline limestone crop out, and limy metashales occur in the (Triassic (?)) Bedford Canyon Formation in the area. Perhaps these materials were the source of "limestone" for the small kiln.

Development: Several short adits, and a number of prospect pits have been opened in the area.

Production: Undetermined.

References: Gray, 1961, p. 116-117.

C.H.G. 3/3/61

Riverside Cement Company, Division of American Cement Corporation (Crestmore) Deposit and Plant

Location: W½ sec. 2 (proj.), E½ sec. 3, T. 2 S., R. 5 W., S.B.M., San Bernardino quadrangle, 15' 1954; about 3 miles northwest of Riverside at Crestmore Siding at the eastern margin of the Crestmore Hills.

Ownership: Riverside Cement Company, Division of American Cement Corporation, Mill office, P.O. Box 832, Riverside.

History: The Crestmore deposit has been mined for more than 60 years. Apparently the deposit was first developed in the late 1890's by the American Beet-Sugar Company and in the early 1900's was operated by the Sky Blue Marble and Onyx Company for building stone and lime (Aubury, 1906, p. 75). In October 1909, the Riverside Portland Cement Company completed a dry-process plant which has since been in continuous operation. The first quarry was opened on Chino Hill and quarrying operations later were extended to the north side of Sky Blue Hill, the northeastern of the twin hills, and the North Star, Lone Star, and Wet Weather quarries were successively opened (Figure 52). Rip rap was taken from the Commercial quarry on the east side of Sky Blue Hill beginning about 1912, but later limestone from this quarry was used for the manufacture of cement. The Crestmore mine, in which a modified block-caving system of mining eventually was employed, was opened in 1927 to extract the Chino limestone beneath the floor of the Chino quarry. The mine was worked through a 5-compartment vertical shaft 350 feet deep and is one of the few operations known to have used block-caving techniques in the mining of limestone. Block caving at Crestmore has been described in detail by Robotham, 1934; Bucky, 1945; Wightman, 1945; and Long and Obert, 1958. In 1941, surface quarries, including the Little Hill or Henshaw quarry in San Bernardino County 1½ miles northwest of the plant, were reactivated to supplement the underground production and in 1948 Jensen quarry (described herein), 2½ miles west of the plant, became the major source of limestone. In February 1954, the Crestmore mine was shut down and Jensen quarry supplied all the limestone until March 1955 when work started on a new underground mine at Crestmore to continue extraction of the Chino limestone. This mine, utilizing a room and pillar system, went on full production in June 1956 and has since supplied all limestone requirements.

The Crestmore plant had a rated annual capacity of 2,000,000 barrels in 1914 and by 1945 was well over 3,000,000 barrels from 13 kilns. Early in 1958, Riverside Cement Company merged with the Hercules Cement Corporation of Pennsylvania and the Peerless Cement Corporation of Michigan and became the Riverside Division of the American Cement Corporation. Plans were announced for extensive modernization and expansion at Crestmore and in 1958 a new administration and laboratory building was completed.

During 1960-61, new secondary crushing facilities, new packaging and storage facilities, and a new white cement plant were completed. The new white cement plant, built adjacent to the existing gray cement plant, was the first new white cement plant built in the United States in many years, and is one of the few in the world and the only United States plant to use the dry process. The white plant went on stream in mid-1961 with a capacity of about 250,000 barrels from one rotary kiln (9 by 253 feet).

Late in 1961, work began on an extensive modernization program for the gray plant including silos and a complete new raw end with blending piles. This construction was completed in 1962 and later phases of the modernization program, which will include first the replacement of the finish end and finally enlargement of raw materials handling capacity and installment of new rotary kilns, were under way.

Geology: At Crestmore, limestone and siliceous meta-sedimentary rocks occur as a large screen in Cretaceous quartz diorite (Bonsall Tonalite). The metamorphic rocks have been called the Jurupa Series (Daly, 1935, p. 639-642) and are regarded as probably of late Paleozoic or early Mesozoic age. The limestone deposit consists of two roughly lenticular, nearly parallel, bodies which ~~crop out and~~ are separated by about 500 feet of quartz diorite at the surface (Figure 50). The limestone bodies strike north and dip about 45° east. At depth and to the east the dips flatten to about 25-30°, the two bodies thicken, and they are separated by only 100 feet of quartz diorite. This quartz diorite layer is ~~a very~~ important feature as it permits the underground extraction of the lower limestone body without disruption of the upper body, which is overlain by water-saturated alluvium. In the outcrop area the limestone bodies range from 200 to 300 feet, ~~in thickness,~~ but to the east the upper body (Sky Blue Limestone) is about 500 feet thick and the lower body (Chino Limestone, also called the Stanley Bed) is nearly 400 feet thick. The bodies extend about 2,500 feet along strike and are cut off at each end by quartz diorite. The limestone in both bodies is white, fine-to coarse-grained crystalline rock and contains varying amounts of brucite; the lower body contains extremely white rock and mill feed averages about 95 percent $CaCO_3$. In addition to being an important source of limestone, Crestmore is a world-famous mineral locality with nearly 150 recognized species. The minerals and geology at Crestmore have been described by many workers including Eakle, 1917; Woodford, 1943; Burnham, 1959; and Murdoch, 1961.

Development: Since June 1956, all mining has been done by means of an open-stope, room-and-pillar mine. Completed unsupported rooms are about 60 feet wide and 70 feet high and 200 feet or more long, extending horizontally across the width of the deposit. The rooms are mined in two steps with an initial 30-foot cut and then a 40-foot slice is taken from the floor. Drilling is by an Ingersoll-Rand jumbo mounting four 505 wet drifters and by Gardner-Denver Air Trac drills. A Pitman Giraffe, mounted on a diesel truck, is used for loading holes and scaling in the rooms. Roof bolts are used where necessary. After blasting, loading in the rooms is done with Marion 93-M electric shovels equipped with short boom and sticks and a three-yard bucket. Kenworth 802-E electric trucks transport a 30-ton load from the face to the surface up a spiral adit and ramp with 10 percent grade. In 1963, the average length of truck haul is 1½ miles and mining is on the 220-foot level, 680 feet below the surface, (ground elevation at coller of old shaft is 900 feet above sea level).

The electric trucks dump directly into the 60 by 84-inch primary jaw crusher. Secondary reduction to minus 3/8-inch mill feed is done in a Bulldog center-feed impact mill. These facilities supply both the white and gray plants. Secondary crushing output for gray plant feed is conveyed to a ground storage area where raw materials are automatically stored, blended, and reclaimed. This operation, installed in 1962, utilizes wing-type traveling tripper stackers, continuous samplers, and bucket-equipped digging wheels for reclaiming. From the storage area blended material goes by belt conveyor to the mill-feed bins in the raw grinding department. These operations are handled from a newly installed remote control room. Blended material is fed to 13 rotary kilns (8 feet 10 inches by 125 feet). This dry-process plant has a capacity of about 3,250,000 barrels.

In addition to limestone, raw materials used include: alluvium, from shallow pits just east of the plant; gypsum; iron ore; quartzite; and red clay from a company mine in Temescal Canyon (Corona clay pit, described herein). Special materials used in the white plant include selectively mined white limestone; white silica sand from a company pit in the Corona sand district (Smith silica pit, described herein) and a low iron clay.

The Crestmore plant manufactures portland cement Types I and II, block cement, plastic cement, gun plastic cement, and white cement. These products are marketed in bulk and in bags under the brand names "Riverside" and "Riverside White".

Production: From 1930 to 1954, 7,882,000 tons of limestone and granitic materials were extracted from the Crestmore mine by block-caving methods. Since 1956, production has been about 80,000 tons of limestone per month. Total production not determined.

References: Aubury, 1906, p. 75-76; Merrill, 1917 [1919], p. 555-559; Eakle, 1917, p. 327-360; Tucker, 1921, p. 324-325; Tucker and Sampson, 1929, p. 517-519; Daly, 1931; Robotham, 1934, 20 p.; Daly, 1935, p. 638-659; Woodford and others, 1941, p. 351-381; Woodford, 1943, p. 333-365; Bucky, 1945, p. 114-124; Tucker and Sampson, 1945, p. 173-174; Wightman, 1945, p. 215-224; Logan, 1947, p. 272-273; Burnham, 1954, p. 54-57; Burnham, 1954, p. 61-70; Persons, 1955, p. 76-78; Wightman, 1956, p. 33-36, p. 78; Wightman and others, 1957, p. 450-454; Long and Obert, 1958, 21 p.; Burnham, 1959, p. 879-919; Murdoch, 1961, p. 245-257; Utley, 1961, p. 127-130; Bowen and Gray, 1962 p. 7,10,11.

C.H.G. 2/21/63.

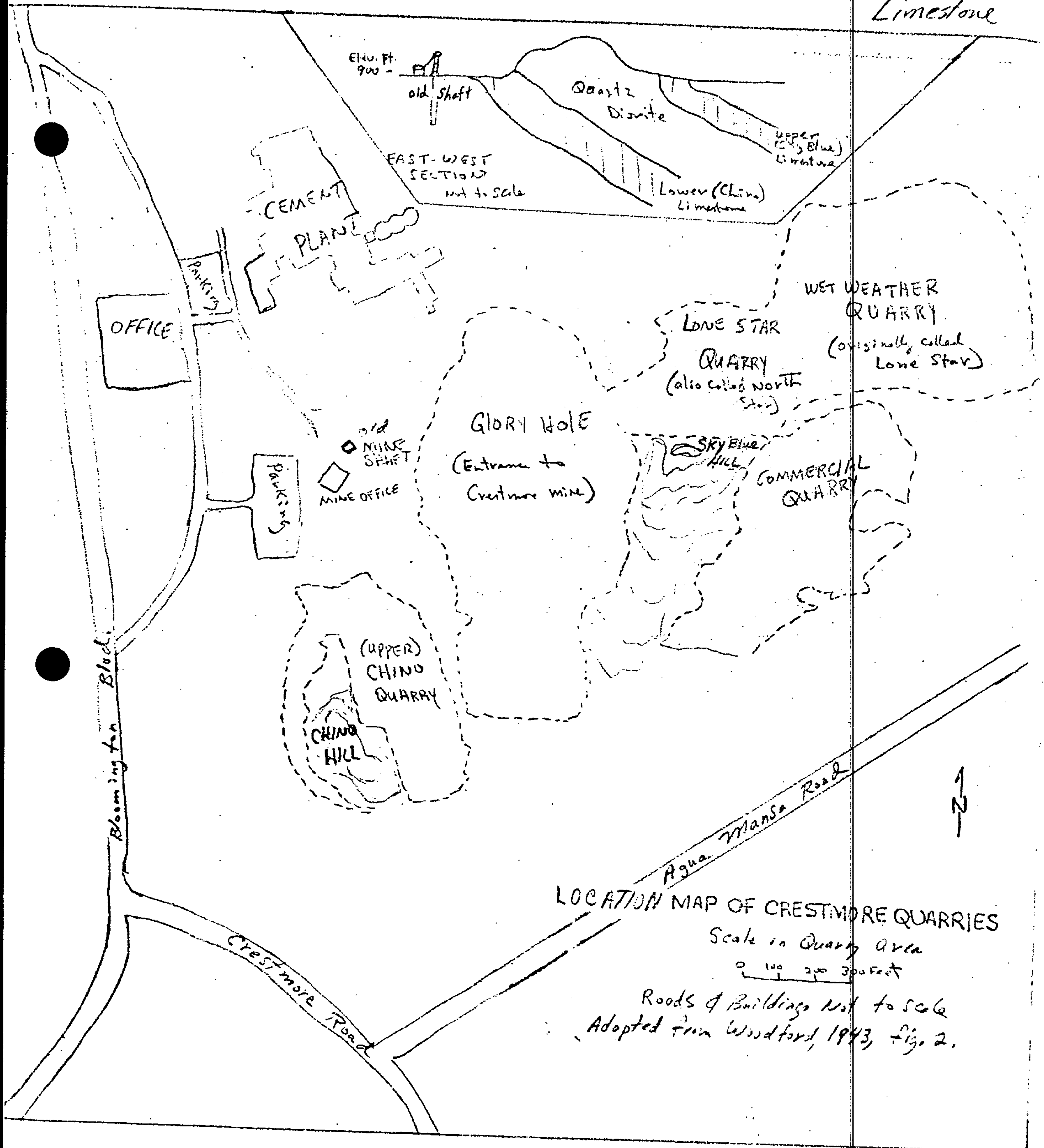

Elev. Ft. 900
old Shaft
Quartz Diorite
Upper (Sky Blue) Limestone
EAST-WEST SECTION not to Scale
Lower (Chino) Limestone
CEMENT PLANT
Parking
OFFICE
WET WEATHER QUARRY
(originally called Lone Star)
LONE STAR QUARRY
(also called North Star)
GLORY HOLE
(Entrance to Crestmore mine)
old MINE SHAFT
MINE OFFICE
Parking
SKY BLUE HILL
COMMERCIAL QUARRY
(UPPER) CHINO QUARRY
CHINO HILL
Bloomington Blvd.
Agua Mansa Road
Crestmore Road
N
LOCATION MAP OF CRESTMORE QUARRIES
Scale in Quarry Area
0 100 200 300 Feet
Roads & Buildings Not to Scale
Adopted from Woodford, 1943, fig. 2.

Figure 50

San Jacinto Rock Products Company's Limestone Deposit (Bautista Canyon Deposits)

Location: SW¼SE¼ sec. 35, T. 5 S., R. 1 E., S.B.M., Hemet quadrangle, 1957; about 8 miles southeast of Hemet on the west side of Bautista Creek on a steep hillslope, 150 - 200 feet above the creek level.

Ownership: San Jacinto Rock Products Company, G. W. Green, president, San Jacinto held one 20-acre claim in 1945. Undetermined (1963).

History: Quarry opened in 1926 as a source of poultry grit and was intermittently active as late as 1929. By 1932 the property was idle and apparently has since remained idle.

Geology: Pre-Cretaceous limestone occurs in discontinuous lenses and bunches interbedded with mica and hornblende schist and intruded by granitic rocks, apparently part of the same sequence as exposed at the Moore deposit, one mile to the northwest. The limestone strikes northwest and appears to dip about 45° SW. where exposed in two cuts, but the extent of the beds cannot be determined because of soil and talus cover. The upper cut is near a hornfels and granite contact, the upper limit of the limestone. Exposed in the cuts is massive, very coarsely crystalline limestone, some of which is graphitic. Ground water has discolored the limestone to red for an unknown depth from the surface and the rock is extensively fractured. The limestone appears to be of good quality but reserves cannot be estimated from present exposures and intrusions of granite may be expected. Three random type samples collected by the Division of Mines in 1953 and chemically analyzed by Abbot A. Hanks, Inc., San Francisco, were as follows:

Sample no.	Insoluble	Fe_2O_3 and Al_2O_3	CaO	MgO	P_2O_5
B.C.-S1	1.56%	0.26%	53.17%	1.30%	0.01%
B.C.-S2	0.92	0.26	54.24	0.94	0.01
B.C.-S3	0.86	0.22	54.85	0.46	0.01

Development: Two side-hill cuts. Lower cut is about 150 feet above creek level and is 100 feet long, 15-20 feet wide, with face 30 feet high. The second cut is about 80 feet above and is about 50 feet long, 10 feet high, and 15 feet wide. Blasted rock was allowed to roll downhill to the road where it was loaded onto a truck and hauled to San Jacinto for grinding in the company's plant.

Production: 500 tons by 1929, apparently little, if any, later production.

References: Tucker and Sampson, 1929, p. 519-520; Tucker and Sampson, 1932, p. 8, pl. 1; Tucker and Sampson, 1945, p. 172; Logan, 1947, p. 273.

C.H.G. 7/2/63.

Sims Limestone Deposit

Location: $W\frac{1}{2}NW\frac{1}{4}$ sec. 7, T. 4 S., R. 1 E., S.B.M., and $E\frac{1}{2}NE\frac{1}{4}$ sec. 12, T. 4 S., R. 1 W., S.B.M., San Jacinto quadrangle, $7\frac{1}{2}$', 1953; Northern San Jacinto Mountains about 7 miles southeast of Beaumont, 1 mile south of the end of Highland Springs Avenue in the foothills above the south end of San Jacinto Nuevo y Potrero.

Ownership: Harold V. Sims, P.O. Box 16, San Jacinto holds an undetermined acreage of unpatented mining claims (1958).

History: Property located by Mr. Sims many years ago. Considerable exploration work has been done, but the property has not been put into production. In the early 1950's Kaiser Steel Corporation made an extensive examination of the property and field examinations have been made by at least one cement company. Access to the property is difficult because of the pattern of adjacent private land ownerships and the deposit was idle in July, 1963.

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Geology: Pre-Cretaceous limestone and schist interfingered by granite occurs in two irregularly shaped bodies. The metamorphic sequence strikes northeast and dips steeply northwest. The larger metamorphic rock mass is about 1,500 feet long and 1,250 feet wide; the smaller mass, 500 feet to the west across a deep canyon, is about 750 feet long and 500 feet wide. Both of these bodies are largely limestone and dolomite, but also contain interfingered schist and granite. The limestone is gray to white, fine to very coarse crystalline, and contains some thin, irregular, seams of gray dolomite, as well as several large, spotty and irregular pods of dolomite. In places the limestone is banded and in other places contains a few small graphite crystals and graphitic steaks. Three main bodies of high calcium, coarse, white crystalline limestone are exposed. Perhaps each of these high grade bodies contains as much as 200,000 tons of readily available limestone. The deposit also contains several small masses of reddish-pink, medium grained dolomite which might find favor as a decorative or building stone.

In March, 1957, the Division of Mines collected seven samples from the east body and these samples were chemically analyzed by Abbot A. Hanks, Inc., San Francisco, as follows:

Sample No., location, and description		SiO_2	Fe_2O_3	Al_2O_3	CaO	MgO	P_2O_5
SM-1.	N. end of the S. ridge where best ls. is exposed; glassy, blue-grayish -white, coarsely xline ls.; very uniform, av. grain size about 0.6 cm.	0.67%	0.03%	0.17%	55.18%	0.28%	0.01%
SM-2.	N. end same ridge as spl. 1. Mass of medium to fine-grained, blue-gray, uniform rock about 20 ft. long and 2 ft. thick.	4.28	0.19	1.09	52.20	0.47	0.01
SM-3.	Near N. end of S. ridge; thin, irregular dol. seams cutting coarser-grained ls.; light blue-gray, fine xline rock with coarse calcite bands.	0.58	0.27	0.18	36.73	15.91	0.01
SM-4.	Near S. end of best ls. mass; coarse -grained (1 cm.) glassy white ls., with sparse segregations of fine graphite.	0.24	0.06	0.07	55.53	0.22	0.02
SM-5.	W. side of S. ridge in fire break; reddish-pink, medium grained dol. in a single mass about 4 ft. wide.	0.60	0.36	0.15	34.47	17.76	.14
SM-6.	"Gully" section along trail, type rock; coarsely xline, glassy white rock with black graphite xls. and a few graphitic streaks.	0.16	0.03	0.05	55.72	0.13	0.01
SM-7.	North sub lens, on trail near N. end of deposit; coarsely xline bluish-gray and glassy white variegated ls. containing some small graphite xls.	0.24	0.05	0.06	55.14	0.54	0.01

Development: The limestone bodies have been explored by trails, and extensive bulldozer cuts and jeep roads, and perhaps by drilling.

Production: None.

References: Fraser, 1931, map facing p. 540.

C.H.G. 7/2/63.

Snow Rock

Location: SW¼ sec. 5, T. 2 S., R. 5 W., S.B.M., San Bernardino quadrangle, 1954; southeastern part of the Jurupa Mountains, half a mile north of Sunnyslope and about 4 miles northwest of Riverside. Plant is at the northwest end of 27th Street.

Ownership: American Cement Corporation, Riverside Division, P.O. Box 832, Riverside. Leased to and operated by Snow Rock Division (7000 27th Street, Riverside) Sun Valley Mills, Room 702, Glendale Federal Building, Glendale 3.

History: In 1953, the Sno-Top Rock Products Company began operating a limestone-crushing plant at Jensen quarry (described herein). White limestone and marble that contained excessive magnesia were trucked about half a mile to the plant from the quarry, then active as a source of limestone for cement manufacture. At the plant the material was crushed, screened, and bagged, mainly for white roofing granules. Fines were used for asphalt tile filler and other industrial purposes. Sno-Top discontinued operations in 1960 and in November, 1961, the plant was taken over and put into operation by Snow Rock who, in 1963, continue to make crushed limestone products.

Geology: Pre Cretaceous medium- to coarse-grained crystalline, light gray to white limestone (see Jensen quarry herein).

Development: Snow Rock utilizes part of the Jensen north quarry area. In January, 1963 quarrying is from a segment of the north Jensen quarry about 200 feet long with face about 75 feet high. After blasting rock is loaded by a 1½-yard dipper shovel on Euclid 15-ton end-dump trucks for transport to the plant. Some secondary breaking is done at the quarry utilizing jack-hammer drilling. At the plant, trucks discharge to a Traylor 28-inch by 36-inch primary jaw crusher which feeds a surge bin. From the bin rock goes to a 10-inch by 20-inch secondary jaw crusher and then to an Overstrom vibrating screen. Oversize goes to a hammermill and then to 16-by-16 rolls. Final crushing in two small hammer mills to make the fine size reduces the material to minus 12 mesh. Finished material goes by elevator for storage in two silos. Most of the material is marketed in bulk, but some is bagged. Two sizes are produced, minus 12 mesh to minus 16 mesh; and minus 3/8-inch to plus 1/8-inch. The product is marked as white aggregate, mostly in the Los Angeles area under the trade name "Snow Rock". It is used chiefly to manufacture white concrete blocks and for white gunite sand.

Production: Plant capacity is 100 tons per day maximum, and about 60 tons if making fines only.

References: Gay, 1957, p. 574.

C.H.G. 1/23/63.

Unknown Prospect

Location: NW¼SW¼ sec. 32, T. 4 S., R. 6 W., S.B.M., Corona South quadrangle, 7½', 1954; northeastern slope of the Santa Ana Mountains, 7 3/4 miles southeast of Corona, just east of Bedford Motorway.

Ownership: Undetermined.

History: Undetermined.

Geology: Discontinuous lens, 20 to 30 feet wide, and about 1,000 feet long, of dark gray fine-grained limestone. Weathers light gray. Apparently in part brecciated. Strikes N. 65° E., dips 75° NW. Occurs within graywacke and slate of the Triassic(?) Bedford Canyon Formation. Reserves are apparently small. Analysis by Abbot A. Hanks, Inc., June 1956 of one random type sample collected by the writer was as follows:

SiO_2	Fe_2O_3	Al_2O_3	CaO	MgO	P_2O_5
9.18%	0.80%	9.18%	43.74%	0.83%	0.03%

Development: Undeveloped prospect.

Production: None.

References: Gray, 1961, p. 117.

C.H.G.

Whitestone Deposit

Location: SE¼ sec. 8, S½ sec. 9, E½ sec. 17, T. 2 S., R. 5 E., S.B.M., Joshua Tree 15' quadrangle, 1955, and Thousand Palms quadrangle, 1958; south flank of Little San Bernardino Mountains along east Blind Canyon 3 miles northeast of Desert Hot Springs.

Ownership: Secs. 9 and 17, Southern Pacific Land Co., 65 Market Street, San Francisco 5, leased to Edwin T. Murphy and Harry Feldman (1959); claims in sec. 8, Edwin T. Murphy and Harry Feldman (1959).

History: Claims were located and some development done in 1959.

Geology: Several small pendants of crystalline limestone or dolomite occur in foliated biotite diorite gneiss and biotite schist (Chuckwalla complex). One carbonate body in the E½ sec. 17 is about 100 feet long, 8 feet thick, and concordant with the gneiss. This limestone is coarsely crystalline and white, but with tiny pink brucite crystals and patches of yellow serpentine (Proctor, 1958, p. 38). In the S½ sec. 9, a lens of limestone about 150 feet in diameter crops out.

Development: Undetermined.

Production: Undetermined.

References: Proctor, 1958, p. 38.

C.H.G. 5/20/61.

Whitlock Limestone Deposit

Location: NE¼ and E½SE¼ sec. 28, and secs. 27, 34, T. 6 S., R. 4 E., S.B.M., Idyllwild quadrangle, 15' 1959; San Jacinto Mountains about 3 miles east of Kenworthy Station, at the head of Bull Canyon.

Ownership: Robert M. Harris, 2380 Monterey Road, San Marino owns 11 claims totaling about 1,200 acres. (1963).

History: These claims were located as association placers about 1929 by Alan M. Whitlock and associates. To date limestone has not been mined from this property but the limestone has been extensively sampled and explored by means of roads and open cuts. About 1953 the area was examined by the National Cement Company which planned to erect a cement plant at Hemet. Part of this plan included transporting limestone slurry by a pipe line from the quarry site to plant site over a distance of 29 miles with a drop in elevation of 3,900 feet. This proposal was abandoned for the announced reason that a zoning permit could not be obtained because of local opposition to the proposed plant site. Since 1953 the property has been examined by several limestone consuming industries but the distance from markets has delayed the commercial development of the Whitlock limestone. The claims are active and assessment work has been done each year.

Geology: The limestone deposits lie high on steep ridges several miles east of Garner Valley and are surrounded by granite. These carbonate rock bodies are part of a very large belt of pre-Cretaceous metamorphic rocks which trends northwest from just north of upper Palm Canyon near State Highway 74 to about one mile south-east of Tahquitz Valley. This mass of metamorphic rocks is mostly mica schist, but also contains hornblende schist, quartzite, and limestone and is about 15 miles long and ranges from about one to four miles in width. The metamorphic rocks are intruded by granite and several large irregular bodies of granite, as much as two miles long, occur in the central part of the metamorphic belt. The Whitlock limestone deposit lies along the western margin of the metamorphic belt near its southern end. Here the limestone-bearing sequence is several miles long and two or three thousand feet thick. The limestone ranges from coarsely crystalline bluish-gray rock to finer grained banded rock. It is friable at the surface and deeply jointed both northeast and at right angles to this trend. The apparent bedding is parallel to the main north to northwest-trending joint system. The limestone layers are somewhat interbedded with mica schist and some scarn rock and pegmatite dikes occur locally with quartz-rich pegmatites and scarn plentiful in small bodies near the granite contact. Granite intrusions, however, have not penetrated the limestone to any great extent. The largest continuous limestone bodies appear to be about 1,000 feet long and from 300 to 900 feet wide. In 1953 the Division of Mines collected one random type sample which was chemically analyzed by Abbot A. Hanks, Inc., San Francisco, as follows: Insoluble, 1.14% Al_2O_3 and Fe_2O_3, 0.56%; CaO, 54.37%; MgO, 0.56%; P_2O_5, 0.05%.

From information furnished by Mr. Robert M. Harris (written communication, 1962) the average of 13 samples, each from a different part of the property, composed of 3 grab samples and 10 chip samples across limestone beds ranging from 30 feet to 350 feet in width was as follows: SiO_2, 1.56%; Al_2O_3 and Fe_2O_3, 0.92%; CaO, 52.8%; MgO, 1.21%; loss, 42.81%; and from 2 samples S, 0.0075%. These same samples showed the following ranges: CaO, 50.51-54.80%; MgO, 0.48-3.82%; SiO_2, 0.30-3.15%; Al_2O_3 and Fe_2O_3, 0.18-2.45%. Reserves of high-quality limestone apparently are very large. One private report estimated at least 900,000,000 tons in sight (personal communication, R. M. Harris, 1956).

Development: The deposit has been extensively sampled and a number of prospect pits, cuts, roads, and trails have been made in the course of development.

Production: By July, 1963, apparently none.

References: Fraser, 1931, map facing p. 540.

C.H.G. 7/2/63.

Magnesite

Hemet Magnesite Mine

Location: NW¼ sec. 31, T. 5 S., R. 1 W., S.B.M., Winchester quadrangle, 7.5', 1953; 3½ miles east and half a mile south of Winchester.

Ownership: The mine is patented, and in 1958, was owned by Mr. Roy Boswell of Los Angeles. Mr. Fletcher Nichols of Hemet held an adjoining claim on the same deposit (Schwarcz, 1958).

History: This magnesite deposit appears originally to have been discovered and explored in the search for gold (Hess, 1908, p. 38).

Between 1908 and about 1912 the deposit was worked for magnesite by the California Magnesite Co. for use as cement (Gale, 1914, p. 516). By 1917 this venture had failed and the mine was idle (Merrill and Waring, 1917, p. 119). In 1925 it was reported (Bradley, p. 61-65) that the mine had changed hands a number of times, that development and production had continued, and that the deposit was last mined in 1919 by the Welman-Lewis Co. of Los Angeles for Innes-Speiden & Co., Inc. of New York, lessees. By 1929 the machinery had been removed (Tucker and Sampson, 1929, p. 521). The mine has remained idle.

Geology: The Hemet Magnesite mine is on the crest of a northwest-trending ridge ~~formed~~ underlain by the northeast flank of a northwest-plunging, overturned, isoclinal fold. ~~(fig. 1)~~. The rocks in the mine area consist of schist, gneiss, quartzite, and intensely altered limestone which have been intruded by amphibolite, peridotite, and pegmatite. The mine explored a magnesite-filled stockwork in a body of altered peridotite exposed on the ridge crest. The ore body is exposed through a horizontal distance of about 700 feet and has an average width of about 150 feet. Its depth has not been determined. The stockwork fillings of magnesite form intersecting veins ranging in thickness from a fraction of an inch to about 4 inches. Gale states (1914, p. 519) that recoverable magnesite comprises about 10 percent of the mined rock and gives the following analysis of the magnesite:

SiO_2	6.17%
Al_2O_3 + Fe_2O_3	0.80
CaO	trace
MgO	43.80
CO_2	45.02
undet.	4.14

Schwarcz (1958) states that the vein material consists of an intergrowth of fine-grained magnesite and opaline silica. The peridotite matrix was studied in thin section by Schwarcz who gives the following composition:

Magnesite	15%
Olivine	1%
Enstatite	3%
Talc	20%
Irresolvable	60%
Matrix (magnesite, limonite, opal serpentine(?))	
Serpentine	tr.

Development: At present (1962) the underground workings of the mine are inaccessible. In 1925, Bradley (p. 62-64) gave the following description:

> "Mining is done by open cut and glory hole. A tunnel has been driven N.60°E. in the main quarry floor to cut the deposit through drifts along the orebody running N.40°W. The south drift connects by a chute with the glory hole 50 ft. below the top, and a raise in the north drift has been put up to tap the glory hole. The latter gives backs of 75 ft. Drifting will be continued southeast to determine the length of the orebody. It was the intention of the operators to glory-hole the entire top of the hill."
>
> "Surface equipment includes mechanical conveyors, screens, washers, a 6' x 60' rotary kiln, grinders and packing house."

A subsequent report (Tucker and Sampson, 1929, p. 521) states simply that:

> "A cross cut at a lower elevation is connected with the glory hole by a series of raises."

Production: Undetermined but probably small. In 1925, the kiln capacity was reported to have been 30 tons of calcined magnesite per 24 hour day (Bradley, 1925, p. 65).

References: Hess, 1908, p. 38-39; Gale, 1914, p. 516-619; Merrill and Waring, 1917, p. 539; Tucker, 1921, p. 327-328; Bradley, 1925, p. 61-65; Tucker and Sampson, 1929, p. 521; 1945, p. 175, pl. 35; Schwarcz, 1958, unpublished.

R.B.S.

Manganese

Manganese ore in grades ranging from 20% to 45% Mn has been produced in Riverside County in quantities exceeding 25,000 tons valued at more than $1,500,000. Production has been sporadic, having been restricted largely to periods of the two world wars or the aegis of federal stockpiling programs (1953-1959). In Riverside County, the most productive manganese mining areas have been the north end of the McCoy Mountains and the southeastern end of the Little Maria Mountains. These two mountainous desert areas are in the central part of the county about 20 miles northwest of Blythe.

In these areas manganese oxides, of probable hypogene origin, form fissure and void fillings in fault-zone breccias. The country rock has been replaced to a limited extent. Replacement appears to be the greatest where the rock is carbonate. The ore is largely the hard, psilomelane type and the bulk of the mine-run material, which ranges from 10% to 35% Mn, has required beneficiation.

Mining on a small scale has been both by open pit and underground. Milling facilities have operated at Inca siding and Ripley. By 1961, the Ripley plant had been dismantled, but the Inca facilities were still available. The fines from the Inca plant were further treated at a small Humphreys Spiral plant at Tasco siding just north of Blythe (Photos 30 and 31). Much of the ore milled at Ripley came from the Mule Mountains area in Imperial County.

With the closing of the government carlot program, August 5, 1959, manganese mining in Riverside County ceased abruptly.

Arlington-Black Jack Mine

Location: Secs. 18 and 19, T. 4 S., R. 20 E., S.B.M., Midland quadrangle, 15', 1952; at the north end of the McCoy Mountains, 30 miles by road northwest of Blythe.

Ownership: Georges F. Kremm, 161 E. Ontario, Chicago, Illinois (1959).

History: The earliest report on manganese from this area refers to a mine called the Black Bird from which ore was shipped during the spring of 1916 (Merrill and Waring, 1917, p. 545). By 1918 the names Black Jack mine or Schellenger claims were being used for claims which probably were situated just west and northwest of the property described herein but which are on the same vein system (Bradley, and others, 1918, p. 54-56). The name Arlington appears to have been applied to one or more claims which may represent a southeastward expansion of activities on the old Black Jack claims.

photo 28

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E. E. Schellenger, Blythe, leased claims to Robert A. Kinzie and associates in 1915. In 1917 and 1918, the property was leased by Charles F. Bradford and associates, Blythe (Tucker and Sampson, 1929, p. 492). A note on a dispute over Bradford's purchase of the property and a description of the mine was made by Trask (1950, p. 177-178). The Arlington-Black Jack mine was active during World War II, at which time it was owned by Fred W. and Walter Kroger, Pomona, and Lewis I. Berck and others, Monrovia, who had leased it to Arlington Manganese Company (Tucker and Sampson, 1945, p. 149).

In 1956, the Aspen Mining Company mined ore which was concentrated in mills at Inca Siding and Tasco Siding north of Blythe. The concentrate was sold to General Services Administration under the carlot program (Davis, 1957, p. 331, fig. 17). From 1957 to late in 1958, under the same program, this mine was operated by California Limestone Products, Blythe. The property was then leased to Mines Contracting Company until the close of the carlot program, August 5, 1959.

Photo 29

Geology: The rock in the mine area is massive, sheared and jointed, granite porphyry of Paleozoic (?) age. Numerous, north-northwest to north-northeast-trending, steeply-dipping faults cross the area. The faults are part of a system exposed in an area of about two square miles at the extreme north end of the McCoy Mountains. The fault zones are occupied by brecciated country rock in irregular, tabular masses as much as 20 feet wide. The fissures and cavities of the breccia have been filled almost completely by oxides of manganese, principally psilomelane. The ore minerals appear to have replaced the host rock to a small extent. Traces of iron oxides are present. Mine-run ore ranges from 28 to 35 percent Mn. Higher grade ore has brought some shipments to averages above 40 percent.

Development: Two adits bear south-southeast on a fault which strikes N. 25° W., and dips 55° SW. The lower adit is near the base of the slope. The upper adit is about 125 feet higher on the fault zone. Its portal is in the face of a cut 100 feet long, 15 to 20 feet wide, and about 50 feet high.

Photo 30

A D.M.E.A. loan was obtained by California Limestone Products for a 900 foot crosscut and 500 feet of drifts to explore parallel fault zones to the west of the old workings. When visited (Nov. 20, 1958) the crosscut, which was started at a point about 300 feet in from the portal of the upper adit, had been driven about 800 feet west and roughly 500 feet of drifts completed on 4 faults crossed by the new exploration (fig. 51). The new ore bodies are proving to be narrower than those in the old workings, few exceeding 5 feet in width. Though occasional streaks of high grade are found, most of the ore is a mixture of breccia and manganous oxides. When visited (Nov. 20, 1958) work was in progress extending a drift north from the new crosscut at a point about 300 feet west of the old adit. At that time the drift was about 40 feet long. Some ore has been taken from the drifts and short raises which have explored ore shoots. Except for a few stulls, no timber is used in the new workings. In the old workings, - especially at the base of the stopes, considerable timber and sheathing was used and is still largely intact owing, in part, to the dryness of the mine.

Figure 51

In addition to the underground exploration a considerable amount of ore ~~is~~ was being removed in 1958 from several open cuts 300 to 500 feet west of the upper adit. Activity is centered on a cut in which ore as much as 3 feet wide is exposed for about 300 feet along the strike. This fault strikes N. 15° - 30° E. and the dip ranges from 75° SE. to vertical. Two other ore-bearing faults parallel it to the northwest. One of these crosses a shallow ravine about 200 feet northwest of the above described cut. At this point a pit about 50 feet long and 18 feet deep explores a 3-foot vein. According to one of the miners, a high grade body up to 3 feet wide was removed from this site. The second vein, about 200 feet up the slope to the west, is exposed for 400 to 500 feet, is up to 4 feet wide, but is as yet unexplored.

Production: Accurate figures are wanting on the yield of specific properties in the district. Leases have changed hands frequently. Local milling facilities at Inca Siding have received ore from other near-by mines, and, though most of the ore is milled, a considerable tonnage has been hand cobbed and sorted and high grade shipments made directly to the purchasers. The following data are for the Arlington-Black Jack and nearby claims. ~~(Fig. 7)~~

Photo 31

Year	Ore (tons)	Reported average Percent Mn
1915	1,500	40+
1917-1918	3,000	45
1942-1945	8,500	20-42
1953-1955	-	-
1956-1958	*	28-35

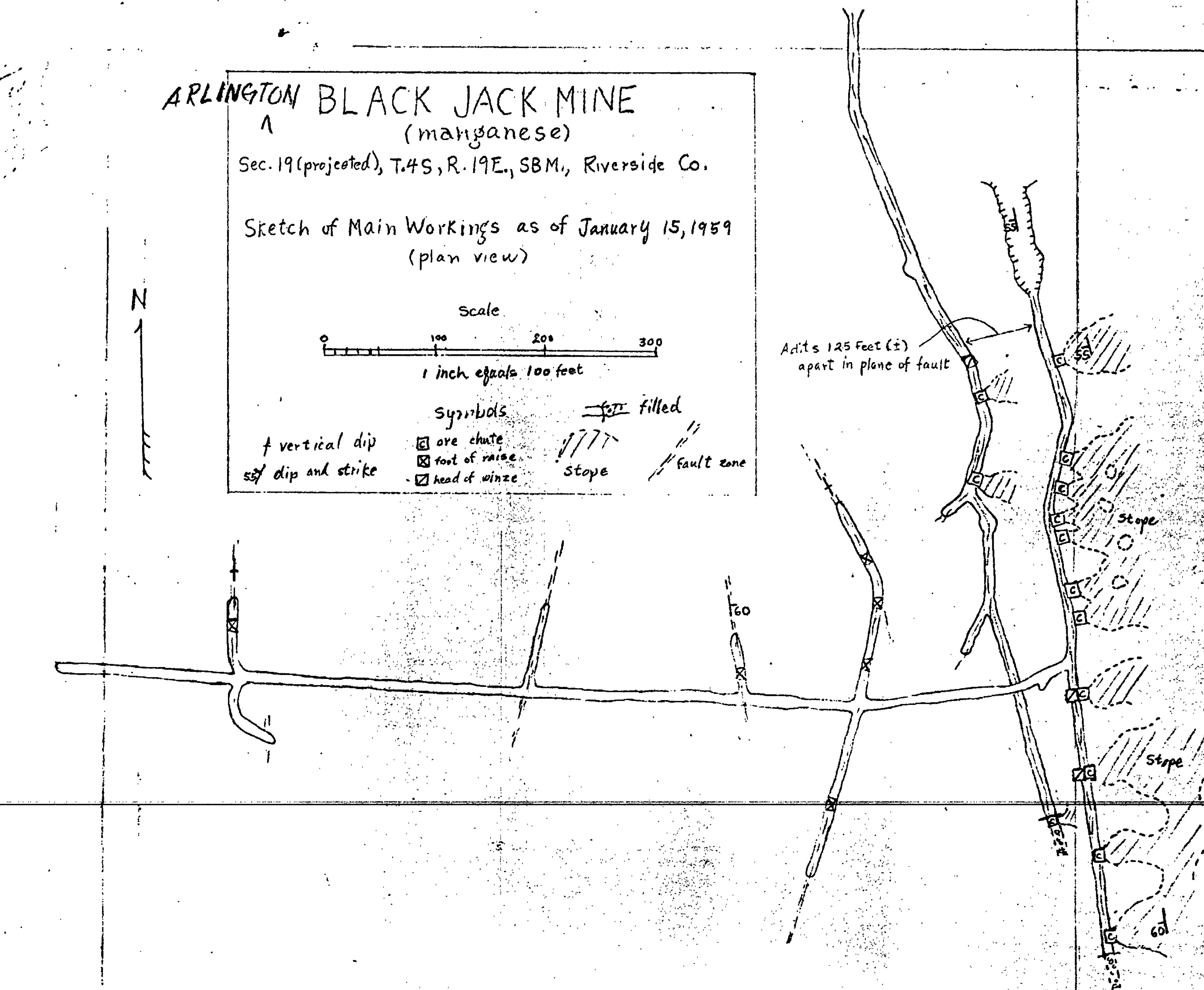
*In November, 1958, 60 tons a day being sent to mill at Inca Siding. Duration of production undetermined.

Idle, 1960.

References: Merrill and Waring, 1917, p. 545; Bradley and others, 1918, p. 54-56; Jones, 1920, p. 196-197, pl.9; Tucker and Sampson, 1929, p. 492; 1945, p. 149; Hewett, et al., 1936, p. 85, map sheet 2; Jenkins, et al. 1943, p. 82-83, 154; ~~Trask, 1950, p. 177-178~~; Davis, 1957, p. 331, fig. 17.

R.B.S. 11/20/58.

MANGANESE
FIG. 5



Arlington No. 3 (Black Metal) Claim

Location: N½ sec. 19 (proj.), T. 4 S., R. 20 E., S.B.M., Midland quadrangle, 1952; near the north end of the McCoy Mountains.

Ownership: Georges F. Kremm, 161 E. Ontario, Chicago, Illinois. Under lease to Dan Figueroa, P.O. Box 453, Blythe (1959).

Geology: Mineralized breccia (up to) 3 feet wide lies along a vertical fault zone in granite porphyry, striking N. 30° E., which is poorly exposed for about 50 feet low on the west side of a shallow canyon. The principal ore mineral is psilomelane, which forms banded fissure fillings in the fault breccia. Pyrolusite is present and what might be manganite forms layers of columnar crystals in the psilomelane. Thin encrustations of calcite are common.

Development: A vertical shaft was sunk 150 feet on the fault. At the bottom of the shaft a 220-foot drift bears northeast and a 150-foot drift southwest. A ventilation shaft connects the south drift with the surface. When visited (January 1959) stoping was in progress along the drifts. Stopes had reached the surface about twenty feet on either side of the shaft collar but the relationship of these stopes to those along the drifts was not determined.

Production: When visited in 1959 the mine was yielding about 1 carload of concentrates (federal carlot program specifications) per month. The mine was idled by the termination of the carlot program (August, 1959).

References: None.

R.B.S. 1/16/59

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Beal-McClellan (Black Eagle and Newport, Brum and Newport) Property

This report is based largely on information contained in a ~~recently published~~ description by Engel, Gay and Rogers (1959, p. 75-76).

Location: Sec. 23, T. 5 S., R. 4 W., S.B.M., ~~U. S. Army Corps of Engineers~~, Lake Elsinore quadrangle, 15', 1942; on the ridge line of the west side of Railroad Canyon.

Ownership: G. S. Beal and R. W. McClellan, Elsinore, and G. R. Smith, La Habra, hold a patent (1950) on what was formerly railroad land.

History: As early as 1900, development was reported in the area of this deposit (Aubury, 1906, p. 336), but not until the second world war was ore removed on a commercial basis.

Past reports describe under "Elsinore deposits" two showings of manganese in secs. 23 and 24, T. 5 S., R. 4 W., S.B.M., a "West group" in section 23 on the west side of Railroad Canyon, and an "East group" in section 24 on the east side of the canyon.

A comparison of these reports with field observations made in 1955 confirms the speculation by Trask (1950, p. 181) that these descriptions were based on observations at the Beal-McClellan deposit. All workings reported in section 23 (e. g. Aubury, 1906, p. 336; Bradley, 1918, p. 58; Merrill, 1919, p. 546; Tucker, 1929, p. 493; Jenkins, 1943, p. 83; Trask, 1950, p. 182-183; and Tucker, 1945, p. 150) apparently apply to the Beal-McClellan deposit.

The East group of Elsinore claims (Merrill, 1919, p. 546) was reported to be half a mile north of the West group and to extend as far as 1½ miles east of the railroad in the bottom of Railroad Canyon (Bradley, 1918, p. 58). Merrill (1919, p. 546) indicates that this group includes three parallel veins that crop out discontinuously for a strike distance of several hundred feet, the central vein being poorly exposed but possibly 16 to 20 feet wide. A later report (Bradley, 1918, p. 58), quoted with slight modification by Trask (1950, p. 182-183), apparently applies this description of the central vein of the East group to a vein on the West group, actually the Beal-McClellan property (Engel, 1959, p. 76-77).

Geology: The deposit parallels the bedding planes of slate that here strikes N. 60° to 65° W. and dips 50° NE. The manganese-bearing zone is 3 to 4 feet wide as exposed in mine workings, and can be traced discontinuously for more than 250 yards down a steep draw eastward. The manganese impregnates a siliceous layer, apparently a somewhat recrystallized, banded chert (Trask, 1950, p. 180-182).

Just east of the ridge line, manganese minerals occupy nearly the whole width of the chert zone as exposed in mine openings. To the east and west manganese content in the zone decreases and is seen as parallel dark bands in the chert and siliceous slates. Similar dark banding occurs in the slates just northwest of the ridge line exposures.

The ore consists of black manganese oxides, both hard and soft, apparently formed by partial to complete oxidation of rhodonite. Prismatic rhodonite crystals as long as 0.2 of an inch have been reported (Trask, 1950, p. 181). Dark-brown, massive, opaline material, sparingly present, has been tentatively identified as neotocite or bementite (Trask, 1950, p. 181). An analysis of a sample from the property showed 34.42 percent manganese, 9.52 percent silica, and 0.14 percent phosphorus (Bradley, 1918, p. 57). A dump sample contained 30.87 percent manganese (Trask, 1950, p. 182). The most completely oxidized, hence most valuable ore appears to be within 20 feet of the ground surface and to grade downward into unreplaced rhodonite and chert.

Development: Mining has been confined to the richest part of the exposed portion of the zone which is in the 75-foot segment just east of the ridge line. About 50 feet below the ridge line an irregular drift adit extends about 80 feet into the hillside. The first 40 feet of the adit has been extended upward into an irregular open stope about 25 feet high and 3 or 4 feet wide.

The 10-foot crosscuts into the hanging wall, at about 40 and 60 feet from the portal of the adit, penetrate barren slate. About 150 feet below and east of the main workings, black and white banded siliceous rock, apparently the strike extension of the chert band, has been prospected in a small cut, but no ore has been removed. About 450 feet farther east along the strike similar material ~~carries~~ contains a 2-foot width of black manganese-bearing rock where exposed in an inclined open-cut about 30 feet long, 10 to 15 feet wide, and as much as 5 feet deep.

Production: Trask (1950, p. 181) states that a production of 50 tons is listed from the claim; the 1941 production was said to be 30 tons. In 1945, the property was idle, but it was reported that several cars of ore previously shipped to Kaiser Steel Company at Fontana contained 30 to 35 percent manganese (Tucker, 1945, p. 150). No subsequent work has been done to alter the estimate that no more than 100 tons of additional oxide ore could be expected from the developed ore bed (Trask, 1950, p. 182).

References: Aubury, 1906, p. 336; Bradley, 1918, p. 58; Merrill, 1919, p. 546; Jenkins, 1943, p. 83; Tucker, 1945, p. 150; Trask, 1950, p. 181; Engel and others, 1959, p. 75-77.

R.B.S., from Engel and others.

Big Bullett Manganese Claims

Location: NW¼ sec. 31, T. 6 S., R. 11 E., S.B.M., Mortmar quadrangle, 7.5', 1958; at the western edge of the Orocopia Mountains, 2 miles southeast of Shavers Well.

Ownership: Leland Noblitt, Brawley.

History: One, of a reported 20 claims, was being worked in 1945 (Tucker and Sampson, 1945, p. 149-150), but any previous or subsequent history was not found.

Geology: This deposit is exposed on the west slope of a ridge formed in strongly foliated schistose rocks striking N. 30° - 40° W. and dipping 20° - 35° NE. Manganese oxides occur in lenticular masses, as much as 3 feet thick in an irregular zone of contorted and silicified schist, ranging from 4 to 7 feet in thickness, which parallels the foliation of the country rock. The manganiferous zone is exposed for about 500 feet up the slope and across the crest of the ridge. It appears to be thinning to the southeast. To the northwest the deposit is covered by alluvium.

The manganese minerals apparently were deposited as compact masses of radiating crystals in vugs and fissures in the contorted zone. Much of the crystalline material has altered to porous, amorphous clots and layers of pyrolusite, a light and friable ore.

Development: The deposit has been explored by an open cut 20 feet long and 8 feet deep and sever l shallow prospects.

Because of intermixed quartz , this ~~Mn~~ manganese-bearing material would have to be concentrated by some means in order to be of commercial grade. In most present mills it probably would yield an excessive proportion of fines because of its light, friable texture.

Production: In 1945 about 10 tons of manganese oxides had been mined. This material was reported to ~~carry~~ contain 30 percent manganese (Tucker and Sampson, 1945, p. 149-150). Idle, (1960).

References: Tucker and Sampson, 1945, p. 149-150, pl. 35.

R.B.S. 2/10/60

Black Ace (Doran) Mine

Location: SE¼ sec. 23 (proj.), T. 3 S., R. 18 E., S.B.M., Palen Mountains 15' quadrangle, 1952; 30 miles, by road, northeast of Desert Center at the north end of the Palen Mountains.

Ownership: L. W. Coffin, and others, 1280 Dwight Way, San Bernardino.

History: This property was formerly known as the Doran Manganese claims. W. C. Doran, the original owner, located the property in 1915 (Bradley, 1918, p. 57-58). No record was found of how long Doran held the property or the extent of development, however, by 1929 he was referred to as the former owner (Tucker and Sampson, 1929, p. 493). A description of the claims ~~is included~~ was made by ~~in California Division of Mines Bulletin 152~~ (Trask, (1950, p. 182) which is a modification of the earlier description by Bradley (1918, ~~p. 57-58)~~. During 1953 this deposit was worked under lease by Ike Kusisto.

Geology: The country rock in the mine area appears to be a sequence of layered volcanic rocks; probably the McCoy Mountains formation ~~(Miller, 1944, p. 32)~~. Where observed, in and about the mine, these rocks are hydrothermally altered.

A shear zone as much as 50 feet in width strikes N. 20° E. across a northwest-trending ridge and dips about 65° SE. It is exposed in a ravine in the northeast side of the ridge and several hundred feet down the southwest slope. A mixture of manganese oxides, chiefly of the psilomelane type with lesser proportions of manganite and pyrolusite, occurs as fissure and breccia fillings in the shear zone. Such manganese oxide bodies are irregular, tabular masses ranging from a fraction of an inch to 20 feet in width. Intermixed country rock is the chief impurity. Thin incrustations of calcite are common.

Development: The shear zone has been entered on 2 levels; both in the ravine in the northeast slope of the ridge. The lower level is an adit driven south-west 150 feet on an ore body as much as 6 feet wide. A raise, fitted with a loading chute, was driven to the surface from a point about 115 feet from the portal. A 12-foot crosscut turns 65° to the right at a point 85 feet from the portal. It turns left into a 30-foot drift roughly parallel to the main adit but no ore is exposed. The upper workings are about 100 feet farther up the ravine. They consist of 2 short drift adits, one on the footwall and one along the hanging wall of the shear zone and parallel with an open cut. The open cut is about 75 feet long and 20 feet high from which an adit extends another 50 feet southwest. An orebody 20 feet wide is exposed in the face of the cut and in the adit. The adit along the hanging wall side of the shear zone extends about 20 feet southwest. A 2-foot-wide vein has been stoped to a height of about 25 feet along most of its length. The footwall adit runs southwest about 40 feet along a narrow shear. At its end a narrow, 50-foot raise follows an ore body about 18 inches wide.

The portals of all the adits except that in the open cut are timbered but otherwise little timber was used.

The ore from the upper workings was dumped into the ravine and channeled into the raise coming up from the loading chute in the lower adit. From the portal of the lower adit ore was lowered down some 400 feet of inclined railway to a loading bunker in the canyon below.

Production: The only report of yield is a small tonnage of ore, containing 31 percent manganese, in 1953 (Ike Kusisto, personal communication). When visited (February, 1959) the mine was idle, however, the property appeared to have been only recently idled. Judging from the extent of the workings a considerable total tonnage must have been shipped; probably during the recent government stockpiling programs.

References: Bradley, 1918, p. 57-58; Tucker and Sampson, 1929, p. 493; Miller, 1944, p. 32; Trask, 1950, p. 176-185.

R.B.S. 2/5/59

Black Rock Claim

Location: W½ sec. 22, T. 3 S., R. 23 E., S.B.M., Big Maria Mountains quadrangle, on the south slope of Quien Sabe Point, 25 miles north of Blythe.

Ownership: Harley K. West, 2362, 246th St., Lomita, California and Ruth Richardson, Box 185, Othello, Washington (1958).

History: A recent claim (1958).

Geology: The Black Rock claim is underlain by mica schist cut by granite pegmatite dikes and at least one shear zone. The sheared and mineralized rocks are exposed for about 50 feet across the crest of a ridge east of the camp site. They occur at the junction of the shear zone and a pegmatite dike. Oxides of manganese and iron are associated with barite and quartz in fissure fillings in a zone as much as 3 feet wide including both schist and pegmatite.

Development: Little more than discovery and assessment work, in the form of shallow pits and trenches, had been done at the time of the writer's visit (December 1958).

Production: None.

References: None.

R.B.S. 12/17/58.

Black Strike (Grosse Claims) Claim

Location: N½ sec. 19, (proj.), T 4 S., R. 20 E., S.B.M., Midland 15' quadrangle, 1952; at the north end of the McCoy Mountains.

Ownership: Georges F. Kremm, 161 E. Ontario, Chicago, Illinois. Leased to Dan Figueroa, P.O. Box 453, Blythe (January 1959).

History: The Black Strike claim appears to coincide with part of a former group of claims known as the Grosse Manganese claims (Bradley, and others, 1918, p. 58; Tucker and Sampson, 1929, p. 493) from which ore was being shipped during the 1920's.

Geology: Two converging faults, one striking N. 20° W. and dipping 70° SW. and the other striking N. 10° E. and dipping 75° NW., are exposed on the north side of a shallow canyon. Both faults include irregular bodies of brecciated and mineralized granite porphyry country rock as much as 6 feet wide. Manganese ore minerals, chiefly psilomelane but with minor amounts of pyrolusite and manganite, were deposited in the fractures and openings of the fault breccia. Though not well exposed on the surface, this deposit ~~could probably be traced northward to the Black Jack and proven to be part of the same deposit.~~ may be a southward extension of the Black Jack vein.

Development: Two adits, one driven 200 feet N. 20° W. on one fault and the other, 75 to 100 feet up the slope to the northwest, driven 80 to 100 feet N. 10° E. of the other fault, were under development in January, 1959. Along both adits the more favorable concentrations of ore are being stoped, and have been stoped to the surface at several points.

The older workings explored outcrops in the canyon bottom immediately to the south. Seasonal flooding is filling the old shafts and stopes with debris and would hinder their reopening.

Production: At least 2 carloads of manganese ore shipped from the old workings during the year 1918 (Bradley and others, 1918, p. 58). The current yield is 1 carload per month (lessee, personal communication, January 1959).

References: Bradley and others, 1918, p. 58; Tucker and Sampson, 1929, p. 493.

R.B.S. 1/16/59.

George (Red Rock) Claims

Location: E½ sec. 32 (proj.) and W½ sec. 33, (proj.), T. 4 S., R. 20 E., S.B.M., Midland quadrangle, 15 1952; on the east slope of the McCoy Mountains, half a mile northeast of the St. John Mine, about 9 miles by road west of Inca Siding.

Ownership: James F. and Bertha C. George, 3165 S. Spring St., Blythe, hold 8 claims - Bertha 1-5 and G & G 1-3 (1958).

History: In 1918 this property was described under the name Red Rock mine (Trask and others, 1950, p. 179-180). It was owned at that time by E. E. Schellenger of Blythe and operated under lease by Dee Clark of Blythe.

Geology: The mine area is underlain by sheared, granite porphyry, cut by at least 6 closely-spaced, north- to north-northwest-trending, vertical- to steeply northeast-dipping faults. The faults are poorly exposed through horizontal distances of 50 to 100 feet across a low, narrow, east-trending spur. They comprise zones ranging in width from 1 to 4 feet filled with brecciated country rock, manganese oxides, barite, and calcite. The manganiferous fissure and void fillings range from 0 to 1 foot in width. The manganese oxides, barite, and calcite commonly occur as discreet, alternating layers, about one inch in thickness, suggestive of sequential deposition. Recurrent movement on the faults has brecciated the manganiferous material along narrow, irregular zones within the larger fault zones and the resulting mixture of rock and mineral matter is cemented by calcite.

Careful mining and sorting would yield small quantities of high-grade ore but the bulk of the material would demand beneficiation. Concentration by gravity methods might prove difficult because of the abundance of barite in the deposit. The specific gravity of barite ranges from 4.3 to 4.6; that of psilomelane, the type of ore here involved, is 3.3 to 4.7.

Development: Five fault zones have been exposed in 2 discontinuous trenches as much as 12 feet deep and 150 feet long and 3 open cuts as much as 20 feet deep at the face. The open cuts are in the south flank of the spur and the trenches extend northward across its crest. The 2 trenches and 3 open cuts are evenly spaced through a horizontal distance of about 300 feet.

Production: By October, 1918 one rail car of ore had been shipped (Trask and others, 1950, p. 180). No other record was found.

References: Trask [illegible]s, 1950, p. 179-180.

R.B.S. 1/14/59.

Langdon Mine

Location: W½ sec. 17, T. 4 S., R. 21 E., S.B.M., Midland quadrangle, 1952; about 3½ miles by road northwest of Inca siding.

Ownership: California Limestone Products, Blythe, (January, 1959).

History: In 1918 the Langdon mine was owned by H. N. Mabery, Los Angeles, and Chas. E. Brown, Mecca, who were shipping 4 tons of ore daily. (Bradley, and others, 1918, p. 59). During World War I, 1,500 tons of ore were shipped from the Langdon and claims nearby but from the end of the war until as late as 1943 the property remained idle (Trask, and others, 1943, p. 83, 156). During 1944 this mine was under lease to J. Figueroa, who made several small shipments of ore to Metal Reserve Company's stockpile at Parker, Arizona. The ore was reported to carry 35 to 40 percent manganese and 8 percent silica. In 1945 the claims were again idle (Tucker and Sampson, 1945, p. 150). From 1951 to 1958 the present owner worked the Langdon. When visited in January of 1959 the mine was under lease to Virgel Denning who was shipping ore to the federal government through the "carlot" program (terminated August 5, 1959).

Geology: A fault zone trends about N. 30° W. along the eastern base of a group of low hills. The zone includes a large volume of brecciated, gray- to pink Paleozoic (?) limestone which contains oxides of manganese as fissure and cavity fillings. The ore is chiefly of the hard, psilomelane type. The fault zone appears to dip northeast and is as much as 100 feet wide.

Most of the ore bodies occur as veins one inch or less wide. Some larger ore bodies have been encountered, but larger masses tend to be full of voids surrounded by coalescing, botryoidal surfaces. Thin crusts of calcite are common.

Development: Prior to 1951, this deposit was developed by means of adits, drifts and shallow shafts in an effort to discover local concentrations of ore. Mining under the current ownership has been largely by open pit, the object being to remove large quantities of milling-grade ore. In the process, the former workings are being destroyed. When visited (January, 1959), the mineralized zone had been exposed for about 1,000 feet by a series of joined pits as much as 100 feet wide and a maximum of 60 feet deep. Ore is trucked to a mill at Inca Siding.

Production: About four carloads of concentrates (40.00+ percent Mn.; 15 percent max. -20 mesh) per month were being shipped when the property was visited in 1959.

References: Bradley, Walter W., and others, 1918, p. 59; Tucker, 1921, p. 328-329; Trask, and others, 1943, p. 82-83, 154; Tucker and Sampson, 1945, p. 150. R.B.S. 1/13/59.

(Paddy Faulkner Claim)

Lucky Boy Mine

Location: NW¼, sec. 24 (proj.), T. 3 S., R. 20 E., S.B.M., Midland quadrangle, 15' 1952; 3½ miles northwest of Midland, at the south end of a low, elongate ridge.

Ownership: Undetermined.

History: This claim is reported to have been located in 1942 by Herman Kiel under the name Paddy Faulkner Claim, (Wilson, 1943, p. 185). Details of its subsequent history were not found but it is apparent that a few tons of ore have been removed from the property.

Geology: The mine area is underlain by schist which strikes N. 60° - 80° E., dips 55° - 65° NW., and includes two thin limestone units about 100 feet apart. A vertical fault strikes N. 30° W. across the claim (Figure 52). There is a right-lateral separation of about 18 feet where this fault cuts the limestone units. The limestone is strongly sheared and further deformed by drag near the fault. Mineralizing solutions appear to have followed the fault, and to have selectively replaced the sheared limestone by oxides of manganese. Manganese mineralization is confined to the fault zone and the truncated limestone units on its southwest side. The ore is a porous mixture of psilomelane, pyrolusite, sericite, and calcite. The ore-bearing limestone units are 10 and 15 feet wide and crop out for about 100 feet down the slope between the trace of the fault and the alluvium to the southwest. Thin stringers of ore are irregularly exposed on weathered limestone surfaces.

530 Figure 52

Production: Undetermined.

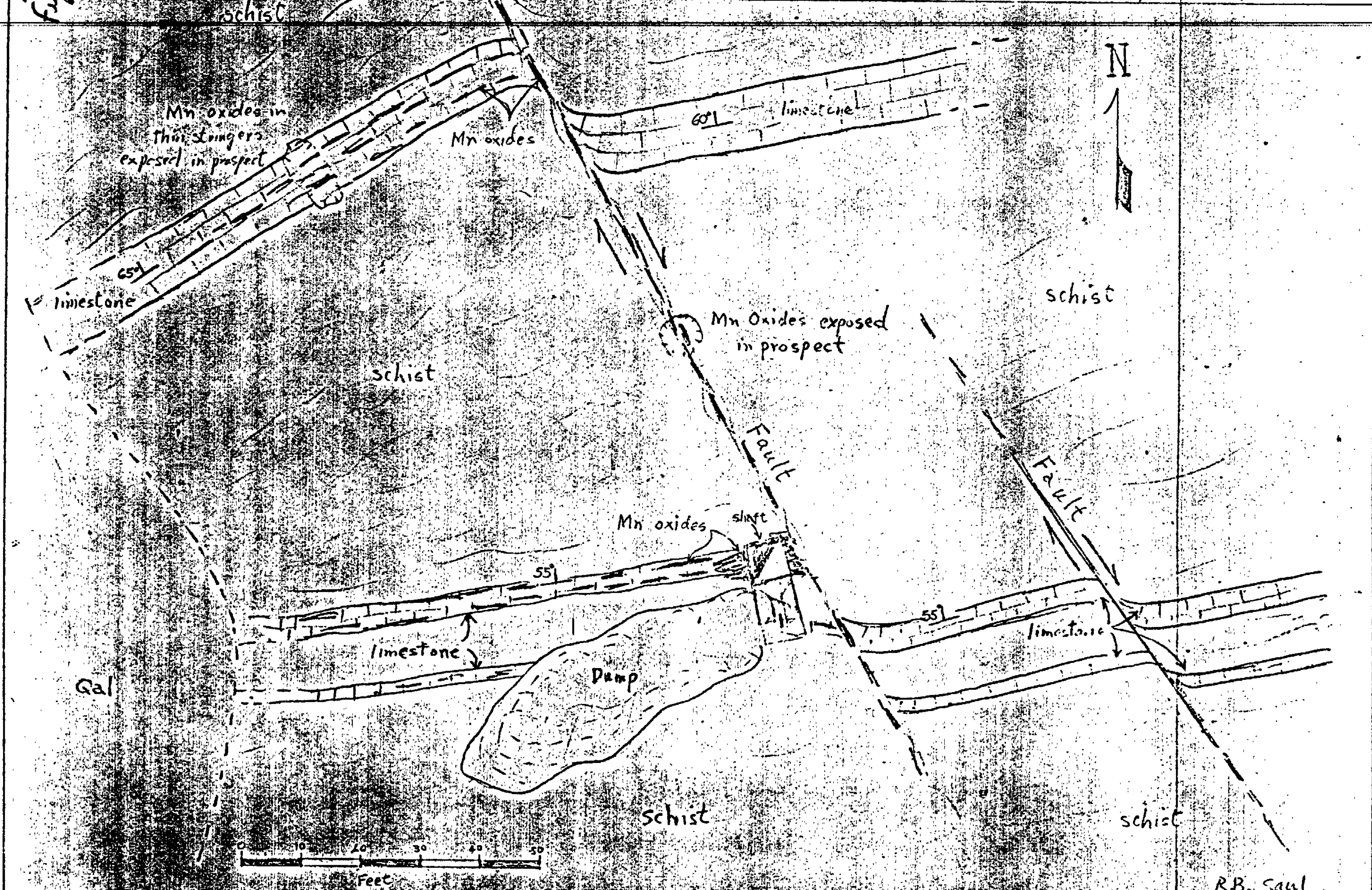
Development: A 50-foot shaft inclined 50° NW. was sunk on an ore shoot as much as 10 feet wide at the junction of one of the limestone units and the fault. When visited (Feb. 1959) a head frame was intact at the collar. The down-slope limestone outcrops was (were) explored by shallow prospect pits and one shallow trench was dug in the fault zone about midway between the limestone units. All of these prospects expose some (Mn) (manganese) oxides but no presently mineable ore bodies.

References: Wilson, 1943, p. 185.

R.B.S. 2/3/59

Manganese
Lucky Boy
Figure 57.

A Geologic Sketch of The Lucky Boy
Manganese Mine
RIVERSIDE COUNTY CALIF.
NW 1/4, Sec. 24 (proj), T. 3S., R. 20E., S.B.M.



(Social Manganese Mine)

Manganese Canyon Group

Location: SW¼ sec. 13, and NE¼ sec. 24, T. 4 S., R. 19 E., S.B.M., Midland quadrangle, 1952; at the north end of the McCoy Mountains.

Ownership: Dan Figueroa and Sons, P.O. Box 453, Blythe.

History: Hudson (1950, p. 180) gave a brief description of what appears to have been early (1918) development on one of the original claims (Social Manganese mine) of this group. The present owner was active on this property in 1958.

Geology: Fault planes occupied by masses of mineralized breccia as much as 15 feet wide cut sheared and jointed granite porphyry. The breccia zones are exposed on the sides of a steep canyon and on the ridges in the rugged area immediately west of the Black Jack claims (see herein) and are a part of the same mineralized fault system. The faults form a large-scale boxwork of northeast and northwest-trending breaks which are vertical or dip steeply northwest or southwest.

Photo 32

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The ore is of the psilomelane type with some pyrolusite and interlayered crystalline oxides which may be manganite. The oxides comprise fissure and void fillings, ranging from thin coatings to irregular masses as much as a foot thick and several tens of feet in lateral extent in the fault breccia. The explored fault zones are in a group exposed on a ridge in the angle formed where the canyon turns south. Here, four fault zones are exposed about 200 feet above the canyon floor. The widest of these is as much as 15 feet wide. It strikes obliquely down the ridge N. 15° W., and dips 70° SW. and is joined, near the crest of the ridge and on the north slope, by the other 3 narrower faults which strike N. 25° E., N. 40° E. and N. 25° E. The lowest of these 3 faults dips 55° NW.; the other 2 are vertical.

Development: The widest fault is explored by an open-cut, as much as 40 feet deep, on the north slope near the crest of the ridge. The other 3 faults are opened on the crest of the ridge and about 50 feet across the west slope by shallow open-cuts. Half way down the north slope the westernmost of the narrower faults is followed south about 140 feet by an adit in which the ore is as much as 5 feet wide. A 190-foot adit was driven S. 75° E. into the west slope about 100 feet below the ridge-crest workings in an apparent attempt to crosscut the mineralized faults. The adit reached a 12-foot-wide ore body. About 15 feet from the portal a raise was driven to the surface. An ore chute was installed and ore from the ridge above allowed to gravitate down the slope into the open raise. In addition, the workings on the ridge were served by an aerial tramway down the north slope.

The ridge, which forms the north and west sides of the canyon, has been extensively prospected and trenched by former operators and one cut, on the north side of the canyon, appears to have been mined by the current owner. It is about 50 feet long, and 15 feet deep on an ore body as much as 6 feet wide in a fault striking N. 20° W., and dipping 70° SW.

Production: According to the owner, in 1958, 4 carloads of ore were shipped from this mine on the government carlot program; the ore was milled at Inca Siding. No earlier figures were given.

References: ~~Hudson, F. S.~~ Trask, 1950, p. 180.

R.B.S. 1/15/59

Yellow Stone (Giant Chief) Claim

Location: NW¼ sec. 24 (proj.), T. 3 S., R. 20 E., S.B.M., Midland quadrangle, 15' 1952; on a low outcrop of limestone and schist about 2,000 feet southeast of the Lucky Boy mine and about 3½ miles northwest of Midland.

Ownership: Ellen Wendling, Box 344, Blythe, California (January 1959).

History: The Yellow Stone claim is a relocation of the former disputed Giant Chief claim described by Wilson in 1943 (Trask, 1950, p. 183).

Geology: A complex of limestone and schist units appear to be faulted along the southwest side of a low, limestone knoll which rises a few feet above the gravel-covered surface of a pediment. The planar structure of the rocks strikes N. 80° E., and dips 40° NW. The limestone unit exposed on the knoll contains numerous thin veins of manganese oxides. The principal ore mass thus far visible in the workings appears to consist of a tabular body of psilomelane-type oxides as much as a foot wide which lies in a shear zone parallel to the schistosity and roughly coincident with a limestone unit, just north of the limestone knoll.

No fault is exposed in the workings but, as suggested, one might lie just southwest of the knoll. If such a fault is a controlling factor, as is true at the nearby Lucky Boy mine, more extensive ore bodies may yet be found along it.

Development: A single open pit about 15 feet deep was dug on the mineralized shear zone north of the limestone knoll. The ore is exposed in its west wall.

Production: Undetermined.

References: Wilson, 1943, see Trask, 1950, p. 183.

R.B.S. 2/3/59.

Ida V. Mine

Location: Near the center of sec. 10, T. 7 S., R. 2 E., S.B.M., Hemet quadrangle, 15', 1957; low on the east slope of Coahuila Mountain.

Ownership: Undetermined (1958).

History: The original date of location was not determined, but the Ida V. claim was relocated in 1954 by Charles I. Rossman and others. The mine probably was operated late in 1954 and during 1955.

Geology: A muscovite-rich dike is exposed on the Ida V. property. It strikes N. 40° W. and dips 25° NE., is 10 to 15 feet wide and is poorly exposed for about 500 feet up a brush-covered ridge. The dike consists of quartz, feldspar, muscovite and biotite mica, black tourmaline, and garnet. The dike shows no consistent zoning, but local concentrations of mica, garnet, and black tourmaline, are present. The relative proportions of the constituents were not determined because of limited exposure of the pegmatite body and the poor condition of the mine. Books of brittle, herring-boned muscovite, 4 inches across the cleaved face and 6 inches thick, are exposed near the portal of the adit.

Development: A single drift adit about 40 feet long was driven in the process of removing a concentration of muscovite mica crystals. When visited (June, 1958) the adit was partially caved and the road, leading to the property from Pomroy's ranch, was in bad repair.

Production: According to T. C. Pomroy, a local resident, the mica ~~ran out~~ was mined out after a small tonnage had been shipped (presumably during the 1954-1955 period), to a Los Angeles paint manufacturer to be ground and used in their products ~~(T. C. Pomroy, personal communication)~~.

References: None.

R.B.S. 6/27/58.

Johnson Deposit

Location: SW¼ sec. 9, T. 3 S., R. 6 E., S.B.M., Thousand Palms quadrangle, 15' 1958; south margin of the Little San Bernardino Mountains about 8 miles southeast of Desert Hot Springs, in the first canyon east of East Wide Canyon.

Ownership: Southern Pacific Land Company, 65 Market Street, San Francisco 5.

History: The deposit was worked briefly in 1940 by a Mr. Johnson. A few tons of biotite and vermiculite were mined, crushed at the site, and hauled to San Bernardino where the material was expanded in a rotary kiln. About 1958, the property was leased by Christopher Mines, Inc., who prospected the property for vermiculite and uranium. At that time the deposit was examined by the California Zonolite Company, but was not put into operation because of estimated small reserves of high-grade vermiculite.

Geology: A mass of hornblende-pyroxene-biotite schist occurs in foliated quartz biotite gneiss and biotite schist (Chuckwalla Complex). The hornblende-biotite schist mass crops out along both sides of the canyon and is about 900 feet in diameter with most of the body lying on the east side of the canyon. Locally the body is altered to hydrobiotite and vermiculite (Proctor, 1958, p. 45). According to Proctor (1958, p. 46) there is an estimated 50,000 tons of altered rock.

Development: Several steep faces along the canyon have been blasted down, but no regular quarry has been opened.

Production: Probably about 100 tons to perhaps a few hundred tons in 1940.

References: Proctor, 1958, p. 45-46.

C.H.G. 5/20/61

Pine Knot (Lucky Day, Lucky Lay) deposit

Location: SE 1/4 NW 1/4 sec. 6, T. 2 S., R. 7 E., S.B.M., Joshua Tree quadrangle, 15', 1955; Joshua Tree National Monument, 7 1/2 miles south of Joshua Tree on the east side of Lower Covington Flat at its south end, about 200 feet above the valley.

Ownership: A. M. and M. C. Roberts, E. L. and Lois Boren (1942). Undetermined (1960).

History: The Pine Knot claim was located at some unknown date prior to the establishment of Joshua Tree National Monument in 1936. No recent work was observed in January 1960.

Geology: Medium- to coarse-grained, banded, quartz monzonite gneiss contains pods of impure biotite. The biotite occurs as black to grayish green, small thin plates. The mica pods range in thickness from 2 inches to 3 feet, and are as much as 6 feet long where exposed in pits. Some of the pods strike N. 65° W. and dip 45° NE.; others strike N. 70° E. and dip 40° NW.

Development: Mica pods have been explored by one pit about 10 feet in diameter and 6 feet deep, and by 4 small cuts, each about 6 feet deep.

Production: Undetermined.

References: None.

C.H.G. 1/27/60

Mineral Point

Lord Deposit

Location: Undetermined, probably was in the area of $NW\frac{1}{4}$ sec. 14, $NE\frac{1}{4}$ sec. 15, T. 4 S., R. 7 W., S.B.M., Corona South quadrangle, 7½', 1954; northeastern flank of the Santa Ana Mountains, 3½ miles southwest of Corona, between Main Street and Hagador Canyons.

Ownership: Undetermined. May be part of several claims held by Josephine Middleworth, 847 West 9th Street, Corona, or on patented ranch land owned by W. H. Redding, 1008 South Pacific Avenue, San Pedro (1957). See Middlesworth Clay deposit herein.

History: Aubury (1906, p. 339) reported a bed of fine-grained, light-colored, yellow ochre 8 feet wide in a deposit of fire clay. In 1905, George W. Lord, Corona, was the operator. Apparently long idle.

Geology: (Paleocene) Silverado Formation clays crop out in this area.

Development: Numerous prospect pits and open-cuts and several caved adits.

Production: Undetermined.

References: Aubury, 1906, p. 339; Merrill, 1917 [1919], p. 579; Symons 1930, p. 156; Gray, 1961, p. 117.

C.H.G. 3/6/61.

National Paint and Color Company Deposit

Location: Undetermined, probably was in the NW¼ sec. 14, T. 4 S., R. 7 W., S.B.M., Corona South quadrangle, 7½', 1954; northeastern flank of the Santa Ana Mountains, 3½ miles southwest of Corona, northwest side of Main Street Canyon.

Ownership: Undetermined.

History: According to Aubury (1906, p. 339). the National Paint and Color Company produced about 20 colors of natural pigments (ochre, red oxide, vermillion red, grays, etc.) in Corona in 1905. Long idle.

Geology: The National Paint and Color Company is reported (Aubury, 1906, p. 339) to have held extensive clay deposits near Corona; one tract of 20 acres contained a 5-foot bed of ochre stated to be of a very choice quality. This bed of ochre was not observed in 1957, but clays of the ~~Paleocene~~ Silverado Formation crop out in the area.

Development: Undetermined.

Production: Undetermined.

References: Aubury, 1906, p. 339; Symons, 1930, p. 156; Gray 1961, p. 117.

C.H.G. 3/6/61.

Paint Mine

Location: Undetermined, probably was in the area of the NW¼ sec. 14, NE¼ sec. 15, T. 4 S., R. 7 W., S.B.M., Corona South quadrangle, 7½', 1954; northeastern flank of the Santa Ana Mountains, 3½ miles southwest of Corona, between Main Street and Hagador Canyons.

Ownership: Undertermined.

History: This property was developed by G. W. Lord, Corona, before 1905 and in 1905 was owned by the Corona Pressed Brick and Terra Cotta Company. The deposit was reported to be about 500 yards northwest of the Lord deposit, described herein. Long idle.

Geology: Paleocene Silverado Formation clays crop out in this area.

Development: Undetermined.

Production: Undetermined.

References: Aubury, 1906, p. 339; Symons, 1930, p. 156; Gray, 1961, p. 117.

C.H.G. 3/6/61.

Molybdenum

4 L's (Dorothy Ann) Prospect

Location: The extreme southwest corner of sec. 34, T. 4 S., R. 2 E., S.B.M., Lake Fulmor quadrangle, 7.5', 1956; near the intersection of San Jacinto Ridge Truck Trail and Stone Creek, about 8 miles, by road, northwest of Idyllwild.

Ownership: C. H. Brooks (1958).

History: Bob Appleton of Pine Cove is reported to have stated that this property was worked for molybdenum, probably during the first World War (personal communication, Norman Sanders, 1961).

Geology: The mine area is underlain by granitic rock, probably Mesozoic in age, that forms much of the San Jacinto Mountains. A thin quartz vein was noted by Mr. Sanders in the upper workings. The presence of molybdenum-bearing minerals was not proven.

Development: The only development observed in July, 1958 was a 40-foot adit driven N. 75°W. in sheared and apparently barren granitic rock. Norman Sanders reports that there is, in addition, a 60-foot adit driven N. 50° W. from which extend two, 60-foot drifts bearing N. 16° E. and a 20-foot raise to the surface. These are a short distance up the slope from the truck trail and the 40-foot adit and are obscured by brush.

Production: The small extent of the workings and the observed and reported narrowness of the veins, suggest the yield of this mine, if any, was probably small.

References: None.

R.B.S. 7/22/58.

Peat

Burro Flats Deposit

Location: SE¼ sec. 14, T. 2 S., R. 1 E., S.B.M., Cabazon quadrangle, 7½', 1956; south edge of Burro Flats, at the head of Potrero Creek, about 4 miles north-northeast of Banning.

Ownership: U. S. Government; leased to the Morongo Corporation with the permission of the Morongo Indian Tribe.

History: Development was started by the present lessee in the fall of 1956.

Geology: Ground water, dammed in a sagpond on a fault of the San Andreas fault system has resulted in the development of a peat bog. The peat is composed mainly of the compacted and partly decomposed remains of reeds, rushes, and sedges (grasses). The deposit underlies an irregular area of about 21 acres and ranges from 0 to 16 feet in thickness. It is wedge shaped in profile being thickest along the south margin adjacent to the fault. The peat thins to the north where it becomes interbedded with clay, silt, and gravel.

Development: The bog has been partly drained to facilitate mining. The exposed surface of the peat is loosened with a harrow and allowed to dry, in place, to about 25 percent water by weight. The peat is loaded into trucks with a power shovel, ground in a plant adjacent to the bog, and trucked to a bagging plant near Banning.

Production: Since 1956 production has been irregular. Current output is somewhat seasonal because the principal market is to golf clubs who use the peat as a conditioning material in seeding and maintaining greens and fairways. The present (November, 1960) yield is about 1,000 yards per month.

Grinding is done according to specifications of the users. ~~A broader market is anticipated by the operators in sale of this product to home gardners.~~

References: Saul, 1960, p. 8-9.

R.B.S.

Perlite

Great Western Exploration Company Perlite ~~Prospect~~ (Deposit)

Location: Secs. 26 and 27, T. 8 S., R. 18 E. (proj.), S.B.M., Chuckwalla Spring Quadrangle, 15', 1953, on the south slope of the Little Chuckwalla Mountains about 10 miles westerly from Wiley's Well.

Ownership: Eight claims owned by Great Western Exploration Co. Inc., Room 908, 408 S. Spring Street, Los Angeles.

History: The perlite deposits on these claims are said to have been discovered in 1947-48, by George B. Gibford and associates, but were never worked until 1961 when a small plant was erected to obtain perlite for testing purposes. The property was idle in November 1961.

Photo 33

Geology: The perlite occurs in lens-like bodies associated with flows of rhyolite and discontinuous layers of pumiceous tuff breccia. These flows of rhyolite and perlite rest unconformably upon andesite and are overlain unconformably by flows of basalt. In the vicinity of the perlite claims, the sequence of volcanic rocks dips in a southeasterly direction and has a strike that ranges from northeasterly to almost north. There are three main bodies of perlite in the mapped area (figure 53). The largest body is approximately 4,000 ft. in length and ranges in thickness from 50 to 130 ft. The perlite in this body is pumiceous, light gray in color, and expands satisfactorlily. The screening plant is located near the southern end of the medium-sized body of perlite which measures about 1,200 ft. in length, and ranges in thickness from a few feet to 80 feet. The perlite in this lens is the dense, medium gray onion skin variety and it too expands satisfactorily. Near the southern end of the mapped area is the third body of perlite which measures at least 1,000 ft. in length and is probably no more than a few tens of feet in thickness. This perlite too is pumiceous and is similar in all respects to the perlite in the large body. It occurs between two flows of perlitic rhyolite, but probably does not constitute a large source of perlite since one would need to mine the perlite by

figure 53

underground methods after stripping the surface. Several small faults in the area dislocate the perlite bodies, however, none of the faults is of sufficient magnitude to materially effect the mining of the perlite.

Comments: Considerable testing has been done on the various grades of perlite (pumiceous perlite and dense onion skin perlite) and all tests indicate that the perlite will expand satisfactorily and may be used as aggregate for acoustical insulating plasters or in the manufacture of wall board.

Development: Development consists principally of shallow trenching in several areas where perlite crops out, and the removal of debris from other areas where the perlite was not exposed.

The deposit contains substantial reserves.

C.W.C. 3/1/62

Photo-34

GEOLOGIC MAP

of part of

The GREAT WESTERN COMPANY PERLITE PROPERTY

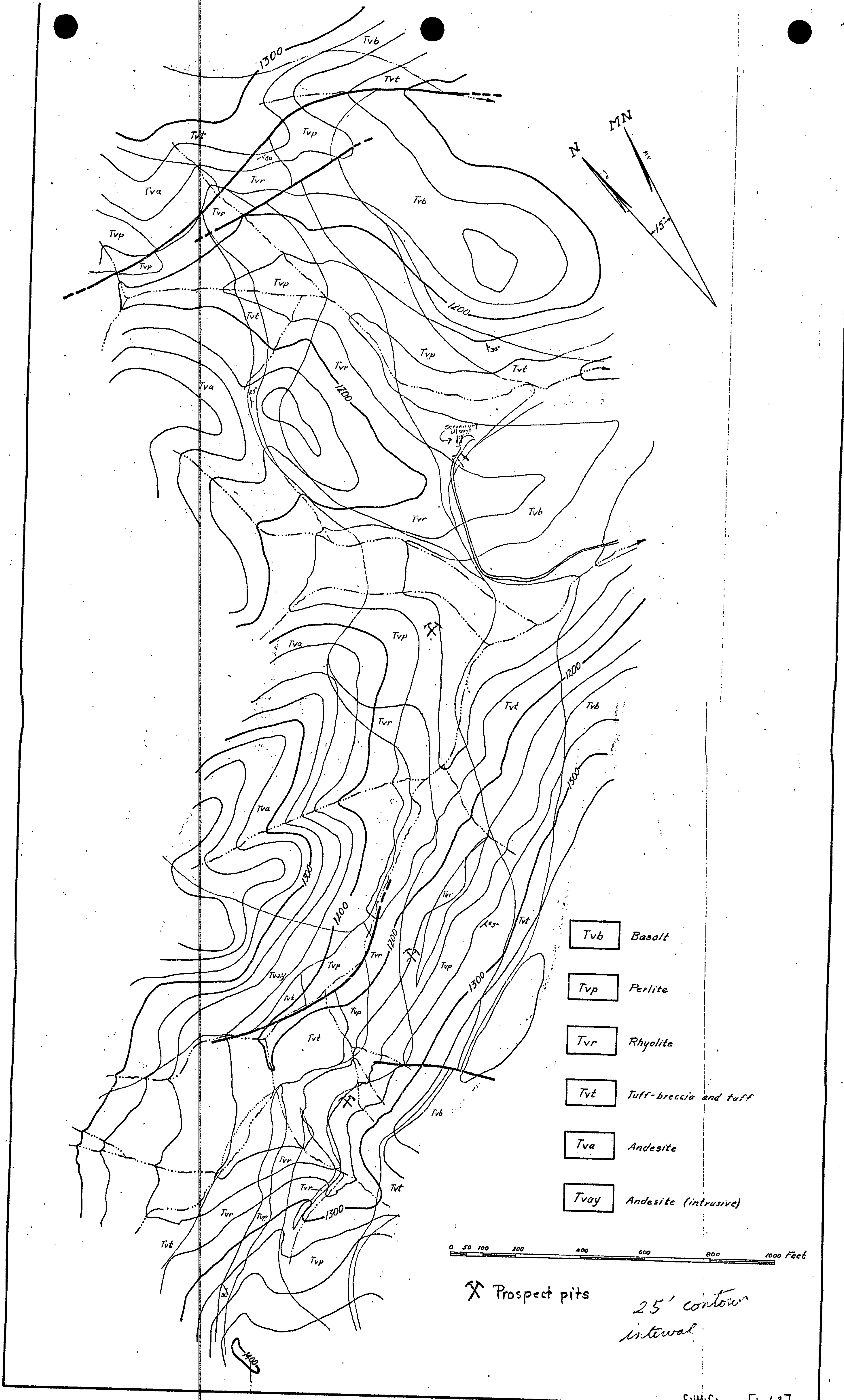
Little Chuckwalla Mountains, Riverside County

California

Sections 26 and 27, T. 8 S., R 18 E (projected)

Geology and Topography by

Charles W. Chesterman, 1949


N
MN
15°
1300
1200
1400
Tvb Basalt
Tvp Perlite
Tvr Rhyolite
Tvt Tuff-breccia and tuff
Tva Andesite
Tvay Andesite (intrusive)
0 50 100 200 400 600 800 1000 Feet
Prospect pits
25' contour interval
C.W.C. [1-62]

Petroleum

Exploration for oil has been carried on in Riverside County for more than 50 years. Prior to 1966 the area of chief interest, and the only one in which any success had been achieved was in the southeastern Puente Hills in the vicinity of Prado Dam (Plate 2/). Here, sedimentary rocks of Miocene and Pliocene age are folded and faulted along the trace of the Chino fault. Oil and gas accumulated in structural traps comprise the Mahala oil field (Michelin, 1958). The southeastern end of this field (about sixteen percent of the mapped area of the field) extends into Riverside County from adjacent San Bernardino County (Gaede, 1969, pl. 1).

In the Mahala oil field the oil has accumulated in a faulted anticline. It is produced from three sand zones: the Abacherli, which is 50 feet in average thickness and reached at average depth of 2,500 feet; the Lower Michelin, which is 200 feet in average thickness and reached at average depth of 1,500 feet; and the Upper Michelin, which is 250 feet in average thickness and is reached at an average depth of 1,250 feet. All three sands are in the Puente Formation (Upper Michelin). The Abacherli sand yields 24-gravity oil. Both Michelin sands yields oil of 27 gravity. Only a small proportion of the oil produced from the Mahala field has come from the few wells drilled within Riverside County. Exploration and extension of the producing area of the field has been northwestward, in San Bernardino County. The first well, Mahala Oil Company well No. 1 was completed in 1921. The early history of drilling in this field is detailed in an account by Gaede and Dosch (1955). By the end of 1957 there were 13 completed well in a proven area of 100 acres (Durham and Yerkes, 1964). In 1970 Mahala oil field comprised 29 operating wells in 230 proven acres. Only one of the 29 wells was in the Prado Dam, (Riverside County) area (California Division of Oil and Gas, 1970).

The Prado-Corona oil field was discovered in 1966 (Gaede, 1969) just east of the Mahala oil field and adjacent to the northwest boundaries of the City of Corona, in Riverside County. This is the first field of importance lying entirely within Riverside County. In 1969 it consisted of two oval shaped areas, each less than a mile long, that were about one mile apart on a northwest-trending line across the Santa Ana River (Gaede, 1969, pl. 1). The northwest part of the field is designated the Sardco area, the southeast part is designated the Goedhart area.

The structure of the Sardco area is a faulted anticline. Northwest-trending normal faults formed blocks in which petroleum accumulated. The northwest and southeast productive limits had not yet been determined in 1969 (Gaede). By 1972 the Sardco area comprised eight wells in 125 proven acres (Russel Farrell, personal communication).

The structure of the Goedhart area is similar to the Sardco area and is part of the same structural trend. By 1972 the Goedhart area comprised 6 wells in 122 proven acres (Charles Howell, personal communication).

In the Prado-Corona field, drilling has penetrated strata ranging in age from Upper Eocene through Holocene in the Sardco area, and from Upper Cretaceous through Holocene in the Goedhart area. The deepest well in the Sardco area reaches a total depth of 3,214 feet and in the Goedhart area, 3,984 feet. There are two producing zones in the field, the Upper and Lower Hunter in the Soquel member of the Puente Formation. The units yielding the gas and oil comprise sandstone and conglomerate averaging 150 feet in thickness in the Sardco area. These rocks have an average porosity of 36 percent and an average permeability of 174 millidarcys with a range from 31 to 435 millidarcys. In the Sardco area, wells have initial daily yields from the combined Upper and Lower Hunter zones of between 13 and 168 barrels of 15 to 18.5-degree gravity oil and 0 to 25 Mcf. of gas. In the Goedhart area, wells completed in the Lower Hunter oil zone have initial yields of 12 to 45 barrels of 15-degree gravity oil (Gaede, 1969).

Dry gas is found in the Goedhart area in the Upper Hunter zone. Wells have restricted initial daily yields ranging between 1,100 and 2,200 Mcf. of gas, with average tubing and casing pressures of 800 and 850 psi, respectively. The gas consists of 98 percent methane by volume and contains 0.066 gallons of liquid per Mcf.; Btu rating is 1,018 per cubic foot (Gaede, 1969).

By 1970, accumulated production in the Prado-Corona oil field totaled 174,130 bbl. of oil and 3,064 Mcf. of gas. Preliminary figures for 1971 are: 70,408 bbl. of oil, 10,099 bbl. of water, 1,200 Mcf. of wet gas, and 382,449 Mcf. of dry gas (California Division of Oil and Gas).

Table 4/ Exploratory Wells Drilled Outside of Oil and Gas Fields in Search of Oil or Stratigraphic Information in Riverside County.*
Those lying in the Prado Dam-Corona area are plotted on Plate 2/.

* Data from California Division of Oil and Gas annual summaries of operations

T.	R.	Sec.	Owner and Well Name	Date Started	Date Abandoned	Total Depth	Remarks (geology at bottom unless otherw indicated)
2S	7W	35	Tannehill, L.B; No. 1	2-20	1925	580	Elevation 605'
2S	6W	15	Kosanke, J.F.; No. 1	3-36	1937	896	Showof oil and gas reported.
2S	5W	31	Arl Oil Co.; No. 1	9-22	pre-1925	1125?	
2S	3W	14	Cheney Oil Lease Syn.; No. 1	3-23	1926	1950	
2S	2W	16	Midway Oil Syn. (Beaumont Midway Oil Co.); No. 1	3-22	1926(?)	5358	
2S	2W	35	Alberta Oil Co.; No. 1		1933	3180	
2S	2W	35	Smith, S.V.; Haskell 1	12-52	1933	1332	Quaternary
2S	1W	12	Riverside County Oil Co.; No. 1	11-20	pre-1925	2235	
2S	3E	25	Painted Hills Oil Assn.; No. 1	5-20	1925	1400	
2S	4E	11	Amundson, Floyd; No. 1	6-26	1926	212	
2S	4E	14	Century Oil Assn.; No. 1	4-21	pre-1925	500	
2S	4E	30	Painted Hills Oil Assn., No. 2	11-21	pre-1925	400	
2S	4E	33	Wallenberg; Daisy 1	1918			
2S	6W	19	Prosper, D. Smith: "Smith & Scott" #2	10-24-57	11-1-57	651	Dry hole, bottomed in granite: base of fresh water sands 90'; elevation at collar 680'.
2S	6W	20	Prosper D. Smith: "Smith & Scott" #1	5-12-57	11-1-57	411	Dry hole, bottomed in granite; base of fresh water sands 80'; elevation at collar 690'.
2S	6W	30	Southern California Petroleum Corp. "Taber Estate" Core Hole 1	12-11-44	12-30-44	210	Dry hole, bottomed in granite; sand and gravel to granite contact at 192'.
3S	7W	2	Corona Oil Co.; No. 1	11-20	1921	400	

855

3S	7W	7	Julian S. Gould "T.B.G."	6-62	1965	1880	Miocene; elevation 520
3S	7W	8	Cherrydale Oil Co.; Cherrydale 1		1952	2478	Miocene
3S	7W	9	Airways Petroleum Corp.; Santa Anaheim 1	9-49Susp.	1950	2830	
3S	7W	26	Neuvo Oil Co.; No. 1				
3S	7W	33	Ciroco Oil Co.; Ciroco-Wright 1	11-51	1952	1520	1954 deepened to 4027 Frank Pettyridge
3S	6W	25	Easton-Monell; No. 1		1933	3090	
3S	5W	6	Arl Oil Co.; No. 1	11-21	pre-1925		Granite
3S	4W	12	Mathews, Roland & Dalziel; No. 1	10-22	1927	2610	Granite ?
3S	2W	15	Moreno Oil Co.; No. 1	10-20	1925	1700	
3S	2W	26	Nuevo Oil Co.; No. 1	12-20	1928	2225	
3S	1W	1	Beck, Frank; No. 1	1-31		450	Converted to water well.
3S	1W	12	Beaumont Expl. Co.; John Drew 1	6-53	1953	2215	Pliocene
3S	1W	15	Rippeto, L.W. (Beaumont Crude Oil Co.): No. 1	3-21	pre-1925	1925	
3S	2E	5	Clark, L.R.; No. 5		1928	1960	
3S	3E	1	C & K Oil Co. "Moore"	11-55	1961	868	Alluvium
3S	3E	2	Parsons Petroleum Co.	12-62	1963	460	Alluvium 0-270; Basement (decomposed granite) 270
3S	3E	9	Cabaxon Oil Co. (Cabazon Central Oil Co.); No. 1	8-22	pre-1925	600	
3S	4E	4 or 5	Western Dev. Corp. (Banning Oil Co.); No. 1	4-21	1930	975	
3S	7W	3	Clifford A. Robinett "Pinkerton" #1	8-31-54	9-8-54	1068	Dry hole, bottomed in shale.
3S	7W	14	John L. Smith "Sullivan" #1	12-9-57	12-12-57	352	Dry hole, bottomed in granite. Elevation 600' above sea level
3S	7W	15	J.B. Nelson "Lillibridge" #1	11-17-56	2-3-57	1360	Dry hole, bottomed in Middle Puente; cemented to 750' and converted to water well 6/56; elect. log- 500'-1346'; elevation 525' above sea level.
3S	7W	15	Joseph A. Traver, Opr. "Traver-Government" 2	6-67		1340	Puente (upper Miocene)

3S	7W	16	Santa Fe Drilling Co. "Sardco"	10-63	1963	2672	Upper Mohnian (Div. C 1, 230; basement 2500
3S	7W	22	J.B. Nelson "Lillibridge" Government #1	9-3-58	9-17-58	1711	Bottomed in Lower Mohnian; dry hole; elect. log. 285'-1200'; elevation 535 above sea level
3S	7W	22	J.B. Nelson "U.S." #1	1-30-58	5-6-58	1829	Dry hole, bottomed in volcanic rocks of possible Miocene age; elect. log 155'-1825' elevation 450' above sea level.
3S	7W	29	U-Tex Oil Company "Prado Dam" #1	1-23-57	2-10-57	2438	Dry hole, bottomed in gray, hard ss-- no oil showings-- no water; elevation 625'
3S	7W	7	Julian S. Gould, "T.B.G." #1	6-14-62	10-10-62	1880	Dry hole; bottomed in shale Upper "Michelin" zone; a few traces of oil and gas; elevation 520'.
3S	7W	7	Julian S. Gould "T.P. Gov." #1	11-1-59	Idle	1388	Light showings of oil at several depths; operations suspended; elevation 619'.
3S	7W	8	Cherrydale Oil Co. "Cherrydale"	6-51	1962	2497	Soquel, Div. D. (Upper Miocene)
3S	7W	18	C.D. Howe "Cree" #1	11-14-57	12-3-57	3075	Dry hole; top of Mohnian at 2505; elevation 600'.
3S	7W	18	C.D. Howe "Prado Oil Co." #7	8-1-58	8-7-58	2900	Dry hole, showed traces of oil; top Upper Mohnian Div. C, 2360; top "Michelin" zone, 2620; elevation 509'.
3S	7W	18	C.D. Howe "Wilcox" #1	5-18-57	6-29-57	4490	Small yield of oil and gas, no production; bottomed in Upper Miocene; Mohnian 2705-3595; Delmontian 1980-2700; elevation 790'.
3S	7W	18	Shaffer Rentals, Inc. "Hudson" #2	3-29-60	4-9-60 Idle	3909	Appears to have pumped oil; bottomed in ss. and sh. elevation 920'.

3S	7W	18	Atlantic Oil Co. "Atlantic Aros" #1	4-14-57	5-9-57 Idle	3853	A small producer, appears to have bottomed in or just below oil sand; elevation 850'.
3S	7W	18	Prado Basin Oil Co. "Gov. T N.P.-C" #1	10-4-59	10-25-39	4609	Dry hole; bottomed in Lower Mohnian; top of Michelin 3225, top of Yorba sh. 3650, top of Yorba sd. 4460; elevation 768'.
3S	7W	17	Alpoil Company "Gov. TMp-C" #1	11-2-60	11-13-60	3569	A small yield; appears to have bottomed in sediments; top of Delmontian 1560? 1680? top of Upper Mohnian 2280 Div. C, top of Yorba sh. 2660 Div. D, top of Yorba sd. 3345 Div. D, elevati 475'.
3S	7W	17	Alpoil Company "Gov. T.M.P.-D" #1	7-16-60	7-29-60	3626	Dry hole; bottomed in Puente fm.; top of Delmontian 1630, top of Upper Mohnian 2260 Div. C, top of Yorba Shale 2690 Div. D, top of Yorba sd. 3500 Div. D.; elevation 477'.
3S	7W	20	Macrate Oil Co. G-G1	2-16-57	3-29-57	3613	Small yield; bottomed in ss. probably Miocene; elevation 487'.
3S	7W	20	A.L. Hunter, Operator "Sardco" #1	11-19-60	11-29-60	3747	Small yield; bottomed in Miocene sediments; Yorba shale (in Div. D 2710, Mohnian Div. D? 3747; elevation 475'.
3S	7W	20	A.L. Hunter, Operator "Sardco" #2	3-13-61	6-28-61	3337	Small yield, no commercial production; bottomed in siltstone top of Yorba sh. 2655; elevation 482'.
3S	7W	19	Cree Oil Company "Prado-Government" #1	10-11-56	11-10-57	2600	In sediments at 1963', dry hole, elevation 493'.
3S	7W	22	E.J. Fife and R.E. Fife, Sr. "Gov't"	4-65	1965	190	Alluvium (Recent); elevation 530'

3S	7W	22	Joseph A. Tarver "Tarver-Government"	12-64	1965	1177	Miocene; elevation 539'.
3S	7W	23	Roy E. Fife, Jr.	11-62	1965	1569	Miocene; elevation 546'.
3S	7W	28	C.D. Draucker "Shaw"	10-68	1968	2800	Upper Hunter 2624; Sespe 2680-28 (Oligocene)
3S	7W	29	Al Godfrey Drilling Co. "Botiller" 1	7-15-54	10-31-54	4726	Bottom not reported--probably in seds; dry hole; elevation 575'.
3S	7W	29	Isaac M. Stewart 1 "Stewart"	3-3-56	3-26-36	1890	Dry hole; bottomed in bouldery sand, elevation 575'.
3S	7W	34	Edgington Oil Refineries, Inc. "Pipkin" #1	6-8-61	7-8-61	4371	Dry hole; base of Puente Div. E? 2820; elevation 920'; in seds at 4367'.
3S	7W	28	Edgington Oil Refineries Inc. "Thomas" #1	4-14-61	5-5-61	4575	Dry hole; base of Repetto; 1550? top of Puente (same); Middle Eocene Santiago Fm. 3200?; Upper Cretaceous 4510? elevation 667'.
3S	7W	30	Pacific Drilling Co. "Savi"	11-68	1968	4380	Div. E. (Upper Miocene) elevatio 467'.
3S	7W	30	Pacific Drilling Co. "Trudell"	1-67	1968	3992	Repetto 0-1040; Delmontian 1040; Div. c 1400; Div. D 1880-3992 (Upper Miocene)
3S	7W	30	Pacific Drilling Co. "Savi" 1	11-68	1969	4331	Div. D (Yorba) 250-680; Div. D (Soquel) 680-2395; Div. D (Yorba) 2395-3300; Div. E (LaVida) 3300-4331; Miocene; elevation 466'.
3S	7W	30	Pacific Drilling Co. "Savi" 2	4-69	1969	805	Recent-Pleistocene)-120; Div. D (Yorba) 120-620; Div. D (Soquel) 620-805; Upper Miocene; elevation 488'.

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3S	7W	33	Pethybridge and Erlich "Wright" #1	11-12-51	11-30-51	1505	Gas showings; no production; bottomed in black shale; elevation 826.5'.
3S	7W	33	A.L. Hunter "V.O.W.M." #1	11-15-61	11-29-61	4157	No production; Silverado fm. 50-1040; Cretaceous (Ladd Fm.), 1040-2540; Chino fault, 2540-2600; Mohnian D, 2600-26400; Olig-M. Eocene (Sespe-Santiago) 2640-3935; Paleocene (Silverado) 3935-4157; elevation 780'.
3S	3E	1	C & K Oil Co.; Moore No. 1	1957	—	—	
3S	5E	35	The Texas Co.; "Edom" Shore 1	1954	—	7468	
4S	6W	17	Reed, Kenneth E.; Kincheloe 1	1-50	3-50	609	Elevation 950'.
4S	6W	21	Hammerling, Max N.; M.N.H. 1	11-51	3-52	797	Non-commercial gas and oil shows; top granite 763; converted water well.
4S	6W	28	Elkhorn Petroleum Co.; "Heinlein" #1	4-49	5-49	950	
4S	6W	28	Frontier Petroleum Co.; "Barger" #1	1-49	2-50	1060	Elevation 998'.
4S	6W	28	Johnson, C.H. (Fife Bros.; Orangethorpe Oil Co.); "Heinlein" #1 (Orangethorpe 1)	1-49	1951	678	
4S	6W	28	Palm, Peter; No. 1	6-50	6-50	825	Bottomed in ss and sh; elevation 1005'.
4S	6W	28	Trabuca Oil Co.; No. 1	5-25	1931	4500	
4S	6W	28	Trabuca Oil Co.; No. 1-A		1931	4490	
4S	6W	28	McFadden, M.A. "Uncle Bill"	1-63	1963	781	Sespe (Oligocene)
4S	6W	28	Red Star Oil Co. ~~"Red Star-Earl"~~	~~12-62~~	~~1963~~	~~2910~~	~~Vaqueros 240; Sespe 840; Santiag~~ 1500; basement (volcanic-Paleocen 2250-2910

4S	6W	29	V.O.D. Oil Co. Inc.; "Berghofer" 1	11-50	1953	1823	
4S	6W	34	Mankin, John & Johnson (Frontier Petroleum Co.); Case 1	2-50	2-50	845	Elevation 1164'.
4S	2W	2	Neuvo Oil Co.; No. 1		1926	2225	
4S	1W	21	Grayco Oil; San Jacinto 1	Susp.	1951	210	
4S	1E	30	Wonder Oil Co.; Stroh 1	10-42	1942	2800	
4S	6W	17	A.W. Duncan	—	—	—	Wildcat; elevation about 1000'.
4S	6W	28	McFadden "Uncle Bill:			800	Elevation 800'.
4S	6W	28	Red Star Oil Co. "Red Star-Earl" #1	12-30-62	3-26-63	2910	Elevation 1080'; never produced
4S	6W	28	Notterman, Nick L. "Notterman" 1	5-56	7-56	851	Elevation 1150'; gr. Sandy sh.
5S	6W	3	Kronisch, E.; Christopher 1		1925	1190	
5S	6W	3	Kronisch, Eugen; "Christopher	10-51	1963	1090	Quaternary
5S	6W	12	Berghofer, Victor; "Berghofer" 1	2-50	1950	1062	
5S	5W	26	St. Pierre, Andrew, J.; "St. Pierre" 1	9-51	1952	936	Showings reported at 400'.
5S	5W	36	Great Coastal Oil Corp.; No. 1	9-34	1937	2991	Basement
5S	2W	16	Dorn, Ella Chisholm; No. 1	3-50	1950	216	
5S	1W	10	Hemet Petroleum Corp.; No. 1	5-27	1931	3625	
5S	1E	23	Pioneer Oil Syn.; No. 1	8-21	1923	460	
5S	7E	11	C.H.S. Co., Ltd.; "Bobbie" 1	12-50	1951	1901	Fine-grained gray sand.
6S	4W	18	Arnold, Anne; Conklin-Walker 1	5-52	1952	2306	Eocene?
7S	3W	14	Murrietta Valley Oil Co.; No. 1	6-23	1925-26	1120	Jurassic
7S	3W	23	Albert Petroleum Corp. (Fidelity Realty Corp.); Watt 2	7-29	1939	2786	Jurassic
7S	3W	23	Fidelity Realty Corp., Ltd. (Hall, Holtz & Hennessy); Watt 1	6-28	1929	956	
7S	3E	21	Bent, Crawford H.; Bent 1	8-51	1951	383	Granite
7S	10E	25	Spindle Top Oil Assn., No. 1	2-23	1937	3800	Pliocene?
8S	1W	13	Palomar Petroleum Co. "Tyrrell" 1	11-46	1948	2594	

ELEMENTS
RARE-EARTH (~~MINERALIZATION~~)

The emphasis given to prospecting for radioactive minerals by the ground and airborne reconnaissance work of the U. S. Geological Survey in conjunction with the U. S. Atomic Energy Commission in the Live Oak Tank - White Tank areas in Riverside County during 1949 and 1952 (Moxham, 1952) soon led to serious local prospecting and the discovery of radioactive material in the Music Valley area. This area, in north central Riverside County, contains the principal occurrences of rare-earth elements found to date in the County. At first these deposits were thought to contain uranium, but by 1959 no more than traces of uranium had been found, whereas xenotime, the thorium-bearing phosphate of yttrium, was determined to be the main radioactive mineral and to represent the only material of possible commercial interest. All of the deposits in the Music Valley area are similar in nature and occur in the Pinto Gneiss of Precambrian (?) age.

In a general way, the rare-earth mineral deposits in the southern Music Valley area occur in a northwest-trending belt about three miles wide and six miles long ~~(Figures 1 and 2)~~. Shallow and relatively barren prospect pits dot the mountains on both sides of the valley.

Xenotime is almost entirely confined to the Pinto Gneiss, in which it is irregularly distributed and only locally concentrated in sufficient quantity to give an abnormal radioactive anomaly, and to be of possible commercial interest. It nearly always occurs in biotite-rich lenses, pods, and folia in the gneiss.

Mineral concentrations appear to have formed early, either before or during metamorphism of the gneiss. If the gneiss is a metasedimentary rock, the rare-earth minerals could well have been detrital grains in the original sediment, perhaps concentrated locally along bedding planes. These planes might represent zones of relative weakness in which growth of xenotime could readily be accomplished during metamorphism. The majority of evidence and the best evidence point to a detrital origin for the rare-earth minerals modified later by metamorphism.

The future commercial development of these deposits depends mostly on the development of new uses for yttrium and its compounds. Current research by the U. S. Bureau of Mines should lead to new applications of yttrium and reduced costs of separating the metal from its sub-group associates, thus creating a new demand for the metal.

There are no quoted prices for xenotime concentrates and any sales of concentrates will have to be made by contract with potential purchasers. Dow Chemical Company and Lindsay Division of American Potash and Chemical Corporation are the major purchasers in the United States.

With additional exploration work in order to gain a better idea of reserves, and the consolidation of all the properties to be operated through one concern with one mill, the now marginal mineral material could be of economic interest when a market develops.

The grade of the deposits and the extent of mineralization have not been fully determined.

Ajax Prospect

Location: E 1/2 sec. 6, T. 2 S., R. 10 E., S.B.M. (proj.), Valley Mountain quadrangle, 15', 1956; Pinto Mountains, Gold Park, 9.2 miles S. 32° E. of Four Corners, Twentynint Palms.

Ownership: Milton E., and Earl C. Tubbs, 8315 East Fifth Street, Downey, own 2 unpatented claims (March 1959).

History: Probably located during the period of uranium prospecting during the middle 1950's.

Geology: The (Precambrian) Pinto Gneiss is locally intruded by porphyritic hornblende diorite. Several minor faults cut the strongly foliated gneiss. No mineralization was observed here and no radioactive anomaly was detected.

Development: Four shallow prospect pits are dug in the Pinto Gneiss. The upper two are in a northeast-trending and minor fault zone. The claims were not being worked in March 1959.

Production: None.

References: ~~None.~~ Evans, 1966, p.12

J.R.E. 3/19/59

Baby Blue (Dixie Girl) Prospect

Location: N-½ sec. 9, T. 2 S., R. 10 E., S.B.M. (proj.), Valley Mountain quadrangle, 1956; Pinto Mountains, Music Valley, 10.7 miles S. 39° E. of Four Corners, Twentynine Palms, ~~(see pl. 1)~~.

Ownership: James E., Charles R., and Harold R. Stewart have filed one unpatented claim (March 1959).

~~History: See Rare Earth commodity section.~~ None

Geology: Pinto Gneiss, composed of 30-50 percent biotite with abundant quartz and oligoclase, and minor amounts of microcline and orthoclase, is well exposed in a shallow vertical cut. Folia of biotite, a fraction of an inch to 2 inches thick, trend northwest and dip south from 25° - 50°. The folia are closely interspaced with quartzo-feldspathic zones, and locally are interrupted by coarse-grained augens of oligoclase. Meager amounts of xenotime occur in the biotite folia and are readily visible only ~~in thin section~~ under high magnification. Radioactive anomalies are very mild and the maximum reading recorded was 0.06 milliroentgens per hour above background.

Development: A 6-foot to 9-foot vertical cut 12 feet long and an 8-foot deep pit several tens of yards to the west comprise the workings. The prospect was not being worked in March 1959.

Production: None.

References: ~~None.~~ Evans, 1964, p. 16

J.R.E. 3/17/59.

Desert View Claim

Location: Secs. 31 and 32, T. 5 S., R. 10 E., S.B.M., Cottonwood Spring quadrangle, 15' 1958; Little San Bernardino Mountains, about 16 miles east of Indio and 1¼ mile northwest of Cactus City.

Ownership: Willis Murphy, Rt. 3, Box 1076, Yucaipa, owns 1 unpatented lode claim (January 1960).

History: In 1952, the claim was owned by Willis Murphy and E. H. Kreuger of Yucaipa Valley (Walker, Lovering and Stephens, 1956, p. 26).

Geology: Pinto Gneiss is cut by several muscovite-garnet pegmatite dikes. One dike trends north, dips west and is as much as 2 feet thick. It has been partly exposed about 50 feet along the strike. Radioactive rare-earth bearing minerals (probably monazite and/or xenotime) are apparently sparsely and locally distributed in the gneiss. The dikes were not detectably radioactive.

An assay of two selected specimens collected in pits adjacent to the discovery monument show an equivalent uranium content of 0.13 and 0.15 percent, and a uranium content of 0.01 and 0.005 percent, respectively (Walker, Lovering, and Stephens, 1956, p. 26).

Development: Several shallow pits and bulldozer scrapes plus a 35-foot trench are cut in the Pinto gneiss; generally along dike-gneiss contacts.

Production: None.

References: Walker, Lovering, and Stephens, 1956, p. 26.

J.R.E. 1/28/60.

Live Oak Tank Area

Location: Secs. 17 and 16, T. 2 S., R. 9 E., S.B.M. (proj.), Lost Horse Mountain quadrangle, 1958; Joshua Tree National Monument, about 9½ miles south of Twenty-nine Palms, and 1 mile northeast of Jumbo Rocks Campground.

Ownership: Undetermined.

History: The Live Oak Tank area was examined by D. G. Wyant of the U. S. Geological Survey on December 13, 1948 as part of a study of radioactive deposits in California.

Geology: Monazite-bearing black sand of Recent age occurs in discontinuous patches on the surface of a dry wash. The sand patches range in length from a few inches to several feet, and are from 1 mm. to half an inch thick. Most of the sand was derived from White Tank ~~Quartz~~ Monzonite, and probably was deposited on the surface of the dry wash in the closing stages of the last flash flood. Samples of White Tank ~~Quartz~~ Monzonite and Pinto Gneiss were analyzed for equivalent uranium, and uranium content (Table 1). Most of the anomalous radioactivity in this area was attributed to thorium in monazite and xenotime, and to a lesser extent to radioactive titanite, zircon, and biotite (Walker, Lovering, and Stephens 1956, p. 25).

Development: None. Good gravel and dirt roads provide ready access to the area.

Production: None.

References: Walker, Lovering, and Stephens, 1956, p. 25).

J.R.E. 1/25/60

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Sample number	Analyses: Field * (MR/hr)	Analyses: Laboratory eU (percent)	Analyses: Laboratory U (percent)	Description
DW-79:				
246.....	0.04	0.008	0.003	3' chip, hornblende-biotite inclusion (Pinto gneiss) in White Tanks monzonite
247.....	.05	.005	.001	Placer, Recent gravel, incl. black sand; average material
248.....	.03	.002	.000	10' chip, schist inclusion (Pinto gneiss) in White Tanks monzonite
249.....	.02	.004	.000	Grab, chips of White Tanks monzonite from area 50' square
250.....	.05	.011	.001	Placer, black sand skimmed from surface dry wash
251.....	.02	.004	.003	Grab, chips of White Tanks monzonite from area 50' square
DW-80:				
252.....	.60 app.	.035	.005	Grab, biotite-feldspar porphyritic sill or dike in Pinto gneiss

* Average reading at the outcrop. Background included. Average background was 0.025 MR/hr.

Table 5 Table 4. Sampling data, Live Oak Tank area, Riverside County, California (after Walker, Lovering, and Stephens, 1956, p. 25).

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Peerless Nuclear Minerals Deposits

Location: Secs. 5, and 8, and 16 (?), T. 2S, R. 10 E., S.B.M., (proj.) Valley Mountain quadrangle, 15' 1956; Pinto Mountains, about 10 miles east-southeast of Four Corners, Twentynine Palms (see pl. 1).

Ownership: Carlos J. Bassler, Jr., and Francis E. Bassler, 2112 Cedar Street, Alhambra own 17 unpatented lode claims (March 1959); E. O. Dunkin, et al., P. O. Box 482, Twentynine Palms own 7 unpatented lode claims (March 1959); all claims as of November 15, 1957 are leased to Peerless Nuclear Minerals, Inc., P. O. Box 243, Rialto, John E. Lund, president, Homer Van Dyke, secretary. Claims leased by Peerless Nuclear Minerals, Inc., include the Hansen Number 2, and Uranus numbers 2, 4, and 6. Several claims between the Uranus Group and the Hansen Group, known as the Thunderbird Group, are also leased by the company.

~~History: See Rare Earth commodity section.~~

Geology ~~of the deposits~~

Hansen Number 2 Deposit: A small pit is dug in weathered, and sheared Pinto gneiss cut by a narrow andesitic-basalt dike. Medium-to coarse-grained augens of oligoclase interrupt the thin biotite folia which contain small amounts of micoscopic xenotime crystals. Foliation trends north and northwest, and dips from 35° east to 60° northeast. Radioactivity is mild to medium in intensity and the maximum anomaly of 0.45 milliroentgens per hour was recorded in a shear zone at the northeast end of the pit.

Uranus Number 2 Deposit: Highly sheared Pinto gneiss is exposed by a bulldozer cut, and two shallow open cuts. Biotite folia in the gneiss are as much as 2 inches thick, but average only about 1 inch. Rock is weathered to a depth of 1 to 2 feet. Radioactivity is nil except in one small area where an anomaly of 0.33 milliroentgens per hour was recorded. Thin sections of gneiss here showed minor amounts of very fine-grained xenotime in biotite rich areas.

Uranus Number 4 Deposit: Several areas of anomalous radioactivity have been explored at the Uranus Number 4 deposit. An anomaly of 1.3 milliroentgens per hour was reported here by Walker, Lovering, and Stephens in 1956 (p. 26). Probably this reading was recorded at Pit 2 where the bulk of roughly 500 tons of Pinto gneiss has been removed and stockpiled at the Silver Bell processing plant 2½ miles north of Twentynine Palms on Utah Trail. The radioactivity of the stockpile ranges from 0.08 milliroentgens per hour to 0.24 milliroentgens per hour, averaging 0.11 milliroentgens per hour. Radioactive anomalies of mild to medium intensity are found near Pits 2, and 4. There are two areas that have relatively high readings; one is just south of Pit 4 (0.22 milliroentgens per hour), and the other near the face of Pit 2 (0.15 milliroentgens per hour). Radioactivity was more intense here before the removal of rock to the stockpile. A pronounced radioactive belt about 300 feet long and close to 60 feet wide extends from the area adjacent to Pits 3, and 6 through Pit 4 and open cut 5, to open cut 1. The central part of this belt has an anomaly of 0.12 milliroentgens per hour.

Gneiss in the vicinity of Pits 2 and 4 is chlorite-rich, well fractured and cut by a prominent north-trending and steeply west-dipping shear zone. A crumbly and highly-weathered andesitic-basalt dike is contained in this sheared zone. Broken and finely-sheared hornblende diorite is intruded into the gneiss and is exposed in the northeast part of Pit 2. A reddish-brown soil, one to three feet thick, caps the gneiss at the top of the ridge near Pits 3 and 6. The soil zone is well exposed near the top of Pit 3.

In addition to biotite folia, xenotime-bearing biotite-rich pods nearly one and one-half feet thick, and three to five feet long are interspaced with quartz-sodic oligoclase zones. The pods are exposed in the face of Pit 2 where the radioactivity is most intense.

Uranus Number 6 Deposit: Only one small area was found to be radioactive at this deposit. A moderately intense anomaly of 0.40 milliroentgens per hour was recorded at the top of the extreme south end of the elongate 11-foot deep cut. The anomaly was recorded in weathered Pinto gneiss which is in fault contact with hornblende diorite. A thin section study showed that irregular grains of altered xenotime are responsible for almost all the radioactivity. The alteration product is an orange to brown substance probably hydrous iron oxides. A few minute grains of allanite (?) were also observed.

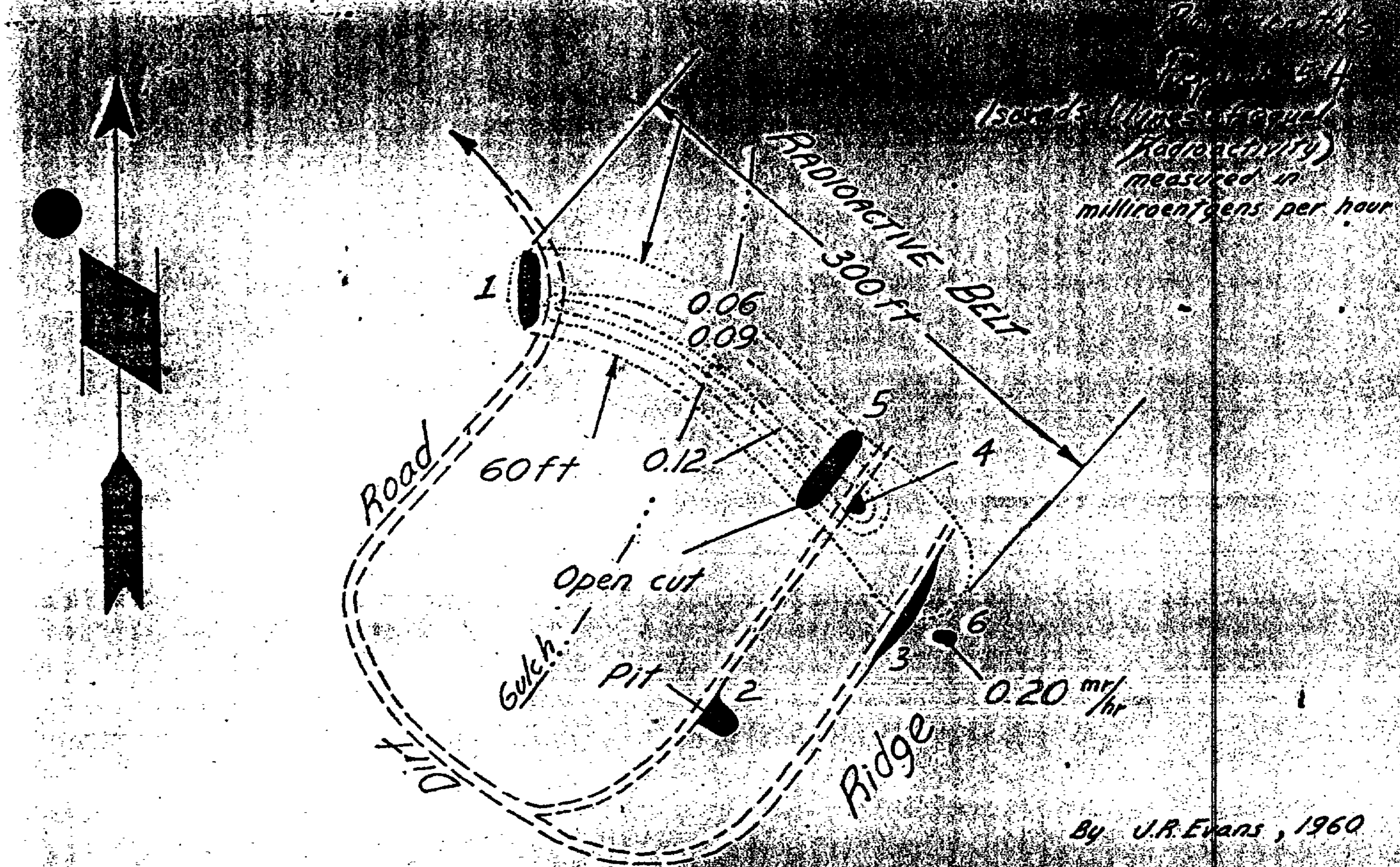
Foliation in the gneiss trends nearly west and dips southerly from 45° to 80°. In general the folia range from one-eighth of an inch to one-quarter of an inch in thickness. At the face of the cut, however, there are biotite rich pods as much as one and one-half foot thick.

A punky west-trending andesitic basalt dike, and an aplite dike both put the gneiss near the front of the cut. Bedrock in this area is capped by 6 inches to 1-foot of red-brown soil, and is much weathered two to three feet lower.

Production: None.

References: Walker, Lovering, and Stephens 1956, pp. 25-26.; Evans, 1964, p. 10.

J.R.E. March 1959.



URANUS NUMBER 4 DEPOSIT

Figure 54. Sketch of the workings at the Uranus Number 4 deposit showing the trend and extent of the radioactive belt.

Peerless Nuclear Minerals Deposits

U-Thor Deposit

Location: Sec. 21, T. 2 S., R. 10 E., S.B.M., (proj.), Pinkham Well quadrangle, 1943; Pinto Mountains, 12.7 miles, S.34° E. of Four Corners, Twentynine Palms (see pl. 1).

Ownership: Three lode claims, and a mill are owned by the Desert Dominion Mining and Milling Co., Inc., Wayne E. Chambers, president, 9262 Live Oak Avenue, Fontana.

History: See Rare-Earth commodity section.

Geology: The deposit is on top of a northwest-trending hill that rises abruptly about 500 feet above the sandy flat floor of Music Valley to a maximum elevation of 3,214 feet.

Much of the hilltop is underlain by highly radioactive Pinto gneiss. An anomaly of 1.7 milliroentgens per hour was recorded in a pit near the central part of the area mapped. An anomaly of 0.8 milliroentgens per hour was recorded in a less-pronounced center of radioactivity 90 feet southeast of the pit adjacent to a steep but shallow cliff. An elongate radioactive zone about 270 feet by 135 feet surrounds the pit area, and roughly defines the surface shape and areal extent of mineralized gneiss.

Gneiss in the pit area is extremely biotite-rich and contains abundant orange grains of xenotime, readily visible to the naked eye. Xenotime composes nearly 35 percent of some selected hand specimens. Minor quantities of monazite and allanite (?) are also present.

Hornblende diorite intrudes the gneiss, and is poorly exposed as two tabular bands nearly isolating a small central body of gneiss from two

Figure 55

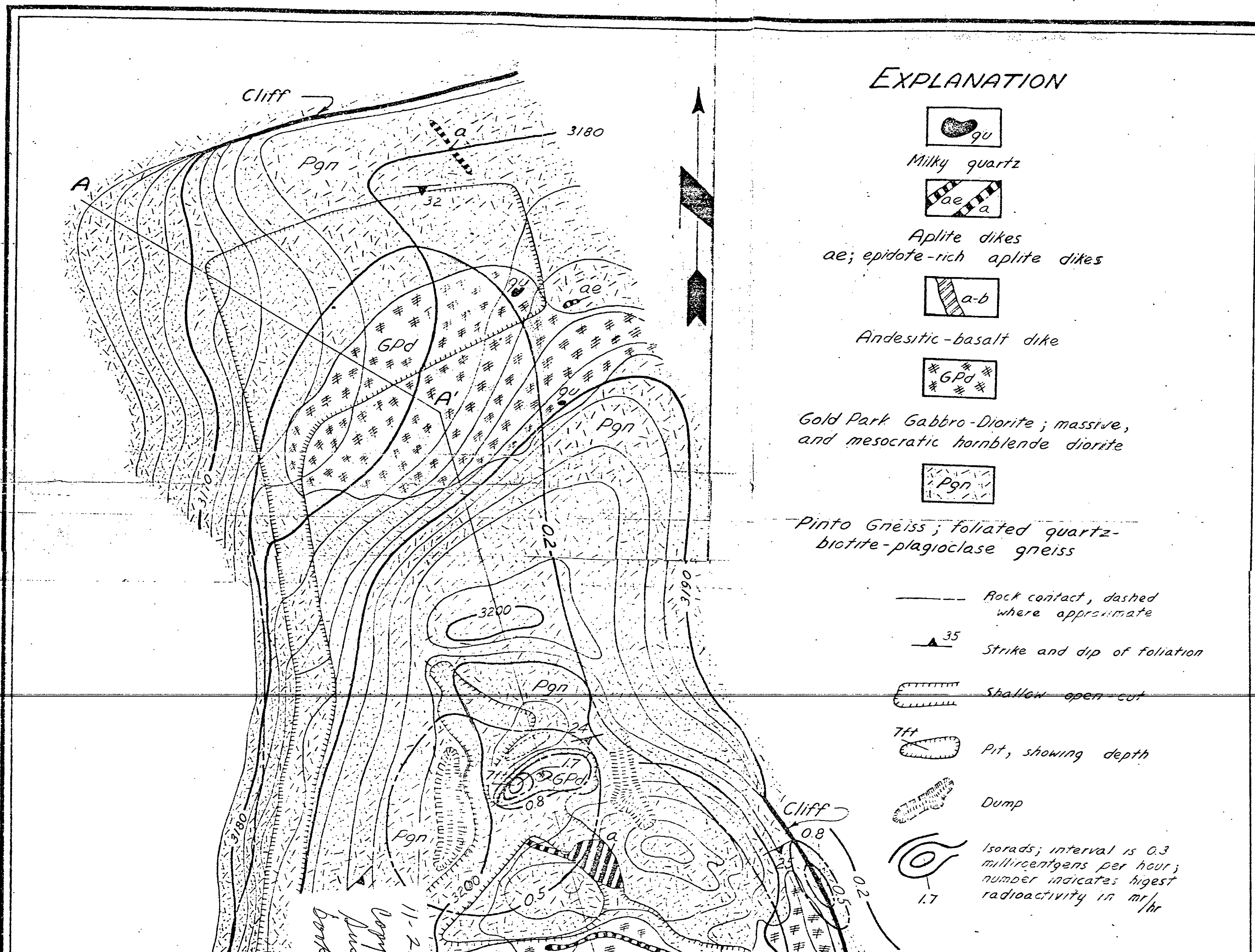
larger outlying bodies. Diorite is also exposed in the bottom of the pit. Foliation in the gneiss trends generally southwest and dips from 25° to 38° south. It is fairly constant in both direction and magnitude in each body of gneiss. The diorite-gneiss contact is graditional over two to four feet. In the contact zone the diorite contains as much as 15 percent biotite. Narrow aplite dikes, and small irregular bodies of quartz cut both the hornblende diorite and the gneiss. A small lenticular dike of andesitic-basalt cuts the diorite near its contact with the gneiss in the southeast part of the area mapped.

Development: Work consists of several shallow prospect pits and open cuts. The largest pit, in the center of the area mapped, is 37 feet long in an east-west direction, 7 to 15 feet wide and 1 to 7 feet deep. ~~Nearly 3 miles of often steep but good dirt road lead to the area from the sandy Music Valley road.~~ About 50 tons of mineralized gneiss have been removed from the pit, transported to the mill and stockpiled. The mill is $3\frac{1}{2}$ miles southeast of Twentynine Palms on Base Line Road, ~~near a sand and gravel plant~~.

Production: None.

References: ~~None.~~ Evans, 1964, p. 15

J.R.E. March 1959.


Cliff
A
A'
Pgn
GPd
a
ae
qu
32
3180
3190
3200
3110
0.2
0.5
0.8
1.7
24
Cliff
EXPLANATION
Milky quartz
Aplite dikes
ae; epidote-rich aplite dikes
Andesitic-basalt dike
Gold Park Gabbro-Diorite; massive, and mesocratic hornblende diorite
Pinto Gneiss; foliated quartz-biotite-plagioclase gneiss
Rock contact, dashed where approximate
Strike and dip of foliation
Shallow open-cut
Pit, showing depth
Dump
Isorads; interval is 0.3 millircentgens per hour; number indicates higest radioactivity in mr/hr

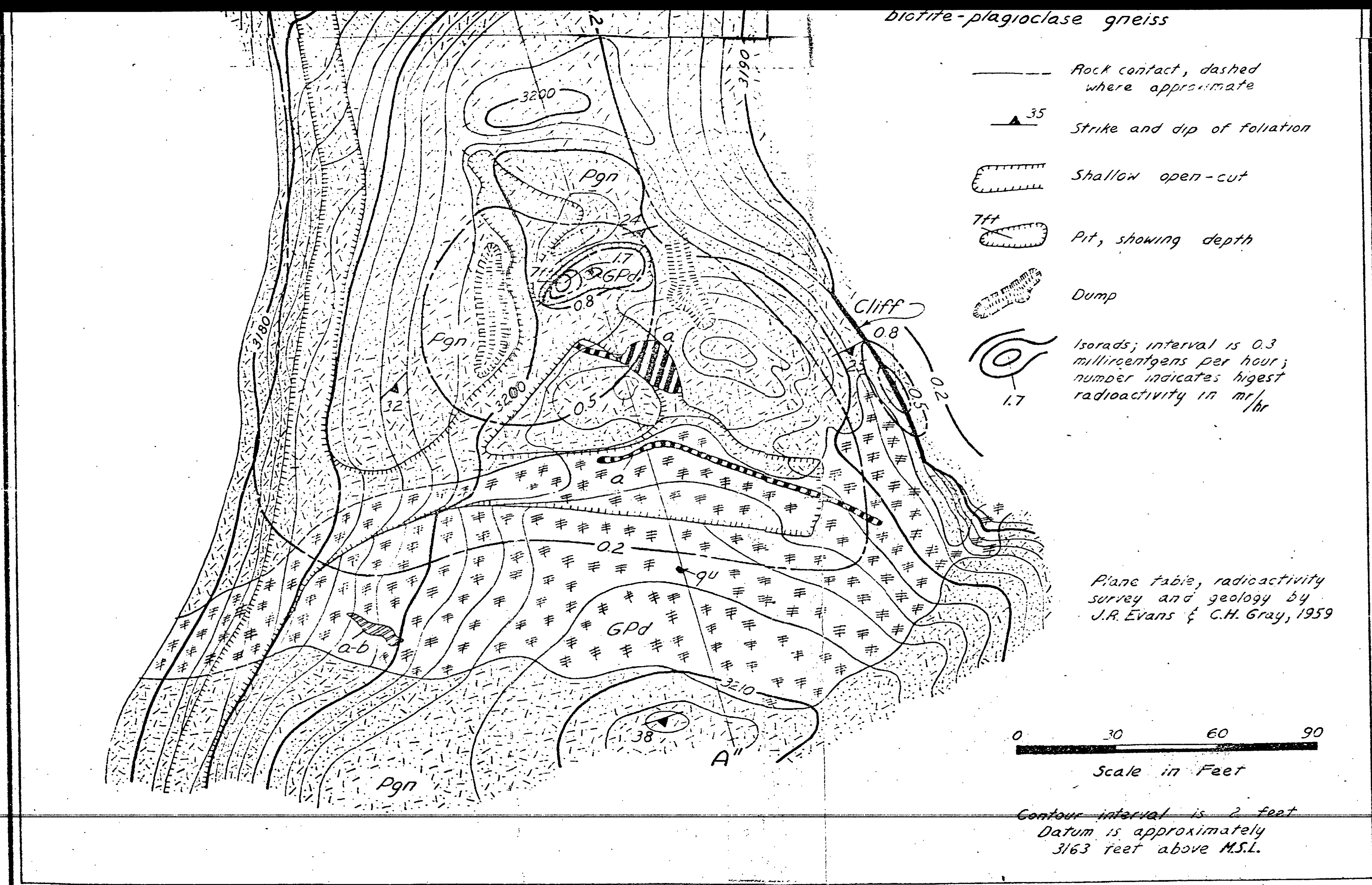


Figure 55. Geologic and isorad map of the U-Thor deposit.

Rare-Earths

Rock Products
Broken & Crushed stone
Figure 56 Roofing granules

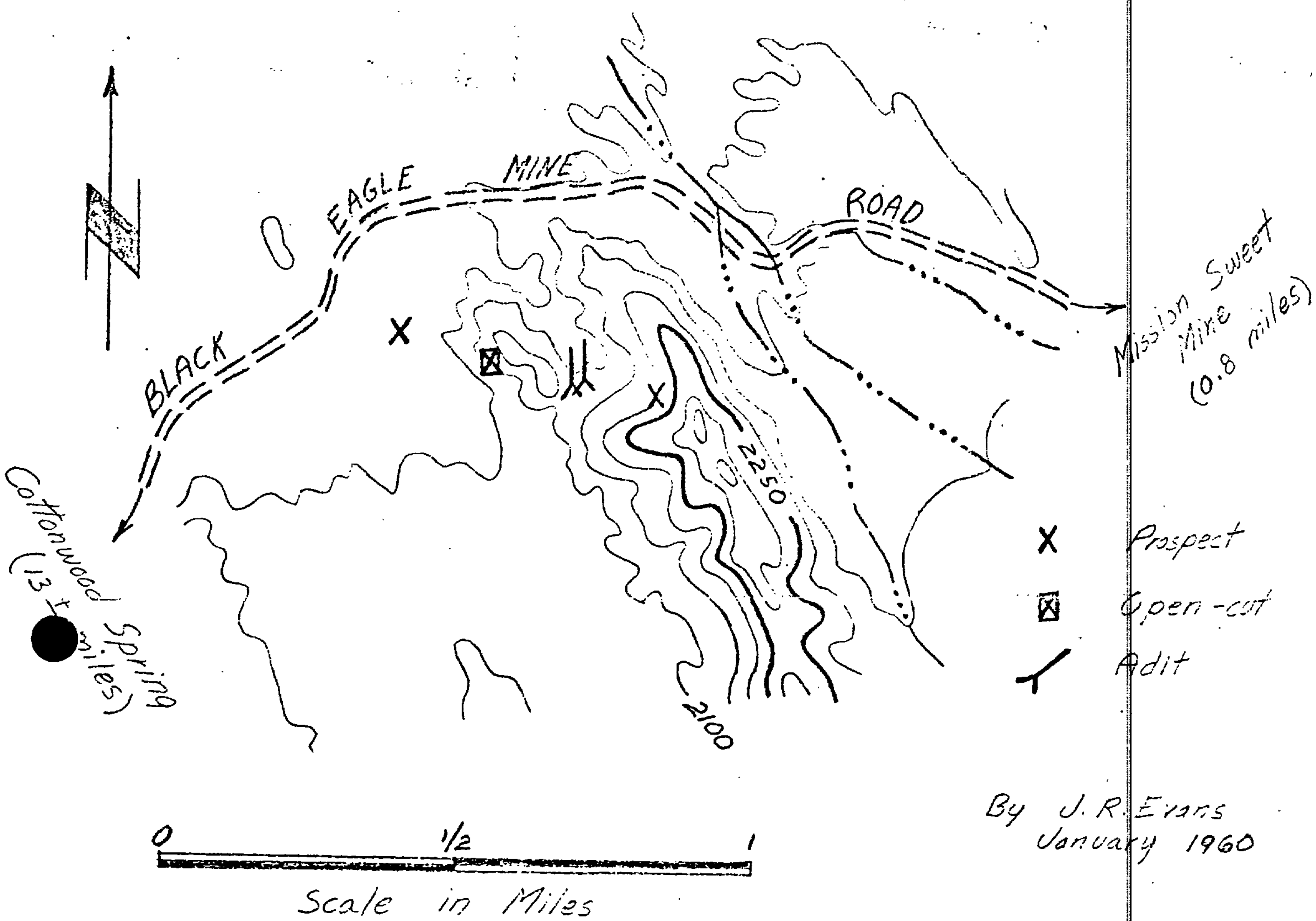


Figure 56. Sketch map showing the location of the Storm Sulfide (Green Giant - Long Green) deposit (topography from U.S.A.C.E. 15' Eagle Tank quadrangle, 1943).

Broken and Crushed Stone

Blarney Stone (Harlow, Corona) Quarry

Location: SW¼ sec. 15 (proj.), T. 4 S., R. 6 W., S.B.M., Lake Mathews quadrangle, 7½', 1953; about 6 miles southeast of Corona along the east side of Temescal Wash, half a mile south of Cajalco Road.

Ownership: ~~Mrs.~~ Miss Lela May Harlow, Cajalco Road, Corona. Leased by Stringfellow Quarry Company, P.O. Box 6, Riverside, and operated under the name Corona Quarries, Inc.

History: Area was first quarried about 1935 to 1939 by Pantages Construction who quarried rock for the A.T. & S.F. R.R. Co., probably for track ballast. Quarry was idle until 1953 when the Stringfellow Company together with the Livingston Rock and Gravel Company, Inc. reopened the quarry and began large scale operations. The quarry has since been intermittently active and has supplied broken or crushed stone to a number of projects including: Long Beach drainage canal, 1955; San Gabriel Canyon, 1957; Santa Ana River levee in Orange County, 1958; Long Beach area flood control channels, 1958-62. In January 1963 the quarry was being maintained on a stand-by basis.

Geology: Three rock types have been quarried from three adjacent bodies, each about a quarter of a mile by half a mile in plan. These Cretaceous rock bodies crop out along the railroad cut on the east side of Temescal Wash and from north to south are: dark gray, fine grained, San Marcos Gabbro; buff to gray, fine grained granophyre; and light gray to tan quartz monzonite. In addition, some masses of Bedford Canyon Formation (Triassic?) hornfels probably are included in these intrusive bodies. Although several distinct rock types are included in the quarry the rock might be described in more general terms as a closely to moderately jointed medium gray dense rock with a few phenocrysts and rust stained fractures. Tests on 3 samples from the Blarney Stone quarry made about 1939 by the District Laboratory, Corps of Engineers, U. S. Army, showed the following:

Specific Gravity	Absorption	L. A. Rattler, % loss at 500 Revs. average	minimum	maximum
2.71	0.3	13.4	15.8	11.0

Because of the joint pattern large size rock is not purposely produced as it would result in excessive waste and the quarry is used mostly as a source of rip rap but also yields some derrick stone. Any large boulders that do occur are stockpiled for special jobs.

Development: An irregular area nearly 2,000 feet long has been quarried, mostly on one level, along the railroad. The principal quarry area is about 1,000 feet long and 300 feet wide with sloping face 300 feet high. Some mining is done directly by 3-yard dipper shovels but in other places the rock is harder and requires drilling and blasting. Standard quarry equipment is employed such as Caterpillar tractors with front end loaders (rock baskets) and bulldozers, drop ball cranes, dipper shovels, jackhammers, and air Tracdrils. Facilities for making small sized material include grizzly, bin, jaw crusher, and vibrating screens. Processed material goes by belt conveyor to storage bins or stockpiles. About 50 percent of the rock mined is waste. A small proportion of this fine size material is sold for road base and other uses, but much of it must be stockpiled.

Production: In recent years when in full operation quarrying has been at the rate of 6,000 tons per day. In 1958 about 250,000 tons of small rock were furnished to the Orange County Santa Ana River Levee and since 1958 about 500,000 tons of rock have been furnished to Long Beach Area flood control channels. Total production is not known, but is believed to be more than one million tons.

References: none.

C.H.G. 5/21/63.

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Christopher Mines, Inc. Claims

Location: SW¼ sec. 36, T. 2 S., R. 3 E., S.B.M., Whitewater quadrangle, 7½', 1955; reported by (Proctor, unpublished thesis, 1958) to be between the Super creek Mine and Painted Hills Quarry (see herein).

History: Undetermined.

Geology: Same as Painted Hills Quarry (see herein).

Development: Undetermined.

Production: Undetermined.

References: Proctor, unpublished thesis, 1958.

R.B.S.

Haven Granite Company

Location: SW¼ sec. 9 (proj.), T. 2 S., R. 5 W., S.B.M., San Bernardino quadrangle, 1954; at Ormand Siding on the west side of the southern Crestmore Hills at the north end of Pacific Avenue, about 3½ miles northwest of Riverside.

Ownership: Haven Granite Company, 890 South Arroyo Parkway, Pasadena 2. Plant address Route 5, Box 319-A, Riverside.

History: In 1952, the Haven Granite Company built a small plant at the Ormand quarry (described herein) to process loose rock on the quarry floor for poultry grit. This plant has since been in continuous operation and the company is the largest producer of poultry grit in California.

Geology: The mineral material utilized is Cretaceous granodiorite (Woodson Mountain Granodiorite?), see Ormand quarry for description.

Development: A large tonnage of loose granodiorite remains on the floor of Ormand quarry from former large scale operations. Much of the material is of suitable size for the plant but some large boulders are split by blasting; drilling is by jackhammer. Loose rock is loaded by 3/4 yard Northwest 25 power shovel on to small end dump truck which hauls the material to the plant, about half a mile south of the quarry. Here the truck discharges over a grizzly feeder to a 20- by 30-inch primary jaw crusher which yields a 4-inch maximum product. Material then goes to a 4- by 6-inch secondary jaw crusher the product of which is elevated to shaker screens. Over-size goes through a scalper trommel screen and the plus 3/4-inch material is sent to a gyratory crusher and the minus 3/4-inch material goes to a roll crusher. The plant employs an extensive dust control system. Finished product, all of which is marketed for poultry grit, ranges from 3/16-inch to ¼-inch in size. Most of the grit is packaged in 100 pound paper bags, but some bulk material is sold. Material from this plant is marketed under the trade name "Haven Granite Grit" in six standard sizes throughout the western states, including Hawaii.

Production: Total undetermined, plant capacity is 60 tons per day.

References: Gay, 1957, p. 578-579.

C.H.G. 1/23/63.

Jameson Quarry

Location: SW¼ sec. 29, T. 3 S., R. 6 W., S.B.M., Corona South quadrangle, 7½', 1954; about one mile west of Home Gardens in low hills on the north side of old State Highway 18.

Ownership: Mrs. Mary C. Jameson, 316 East Olive Street, Corona, owns about 55 acres of patented ranch land (1957).

History: Small quarry opened at some unknown time before 1924. During 1939-40 it was operated extensively by J. B. Stringfellow, Riverside, and furnished rubble, riprap, derrick stone, and toe rock used to face Prado Dam and its abutments. The property then remained idle until about 1950 when Mr. Stringfellow quarried a small tonnage of rubble stone. Since 1950 the quarry has been inactive, except for the occasional gathering of small amounts of remaining loose material to be used locally as ornamental stone.

Geology: Pink, fine-grained, granular micropegmatite granite crops out over an area about 2 miles long and ranges from a quarter of a mile to three-quarters of a mile in width. The rock occurs as reddish-brown, sheet-like masses and is well jointed so as to break into crude rectangular blocks. Apparently there are substantial reserves of material suitable for small- or medium-sized rubble stone.

Development: Rock was quarried on one level from a north-south bench about 200 feet long with the face 10 to 50 feet high. Potential backs are about 80 feet.

Production: Large, but undetermined tonnage.

References: Gray, 1961, p. 87-88, 117.

C.H.G. 8/17/62.

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Ormand Quarry

Location: NW¼ sec. 9 (proj.), T. 2 S., R. 5 W., S.B.M., San Bernardino quadrangle, 1954; at Ormand Siding on the west side of the southern Crestmore Hills, at the north end of Pacific Avenue, about 3½ miles northwest of Riverside.

Ownership: Guy F. Atkinson Company, Santa Fe Avenue and 223rd Street, Long Beach, owns about 640 acres, most of which is in section 9.

History: The Ormand quarry was opened by the Hauser Construction Company in August 1925 to supply stone for the Long Beach Harbor breakwater. At that time the operation was locally called the Kumpe-Hauser quarry. By mid-1929, the Long Beach breakwater project had been completed and the quarry was furnishing rock for Rainbow pier at Long Beach. From late 1929 until 1944, the quarry was ~~only~~ intermittently active on a relatively small scale, but did supply rock for some Metropolitan Water District aqueduct dams and other similar structures. Apparently at least during part of this period it was known as the Rohl-Connolly quarry. About 1944, the quarry was acquired by the Guy F. Atkinson Company and during 1944-45 was operated on a large scale by Atkinson to supply rock for the Seal Beach breakwater. Since 1945, the quarry has been maintained on a stand-by basis and has furnished small tonnages of rock intermittently for several projects. Since 1952, the Haven Granite Company (described herein) has utilized rock blasted down during former large scale operations as a source of poultry grit.

Geology: Quarry opened in a large mass of Cretaceous granodiorite (Woodson Mountain Granodiorite?) which crops out over much of the north half of section 9. The granodiorite forms bouldery hills that rise abruptly to heights of 800 feet above the alluviated valley. The granodiorite ranges from fine- to coarse-grained, is light gray to gray, contains only a small proportion of ferromagnesian minerals, and in a few places contains dark inclusions. The entire quarry appears to be in granodiorite except for an area of schist and gneiss about 400 feet wide at the south end of the north-trending face. The granodiorite is dense, but is jointed and breaks into large blocks. Tests on 8 samples from the Ormand quarry made about 1939 by the District Laboratory, Corps of Engineers, U.S. Army, showed the following:

Specific gravity	Absorption	L. A. Rattler % loss at 500 Revs.		
		Average	Maximum	Minimum
2.78	------	38.4	41.9	34.7

Development: Main quarry, on one level, trends north. It is 2,200 feet long and the face has a maximum height of 290 feet. At the south end of the face is an unquarried area about 400 feet wide of schist and gneiss. Trending southeast from the unquarried area is a second face about 400 feet long and 200 feet high. All heavy duty quarrying equipment has been removed from the property. Quarrying methods used during the former large scale operations are described by Tucker and Sampson (1929, p. 509; 1945 p. 166).

Production: 1925-29 (2 million tons of riprap for Long Beach breakwater); 1944-45 (700,000 tons for Seal Beach breakwater); undetermined smaller amounts at various times. Since 1952, a few hundred tons per month of remaining loose rock has been crushed for poultry grit by the Haven Granite Company (See herein). Total production is probably well over 3 million tons.

References: Tucker and Sampson, 1929, p. 509; The Explosives Engineer, Oct. 1929; Tucker and Sampson, 1945, p. 166; Gay, 1957, p. 586.

C.H.G. 1/23/63

Painted Hills (Whitewater Sericite Schist) Quarry

Location: $E\frac{1}{2}$ sec. 35, $W\frac{1}{2}$ sec. 36, T. 2 S., R. 3 E., S.B.M., Whitewater quadrangle, $7\frac{1}{2}'$, 1955; on Painted Hill near the east bank of Whitewater River, 2 miles north of Whitewater.

Ownership: Kenneth J. Mackenzie, P.O. Box 133, Whitewater, holds 5 unpatented claims.

History: The Painted Hills Quarry was first reported as a source of sericite schist (Tucker and Sampson, 1945, p. 182, pl. 35), but the extent of actual quarrying prior to 1954, when the present owner acquired the property, was not determined. Since 1954 the property has been worked intermittently.

Geology: The Painted Hill area is underlain by a strongly foliated Precambrian igneous-metamorphic complex (Allen, 1957, pls. 1, 4). The strike of the foliation ranges from west to N. 30° W. and the dip from vertical to 40° N.E. The quarried product is a sericite-rich, iron-stained, flaggy- to massive, gneissic, granitic rock. It has been marketed locally and in Los Angeles as a decorative landscaping and building material and some has been ground for roofing granules. Soft, relatively pure sericite schist is present in the quarry as lenticular bodies ranging from 0 to as much as 20 feet in thickness.

Development: The quarry is opened in a natural ampitheater about a half mile in diameter, the south and southeast sides of which have been worked to a moderate extent by three open cuts 50 to 100 feet in width and depth.

Production: The owner stated that 600 to 700 tons of rock had been marketed in the period from July 1954 through October 1960.

References: Tucker and Sampson, 1945, p. 182, pl. 35; Allen, 1957, pls. 1, 4.

R.B.S. 10/20/60.

Palo Verde Dam Quarries

Location: NE¼ sec. 14, T. 5 S., R. 23 E., SW¼ sec. 18 and NW¼ sec. 19, T. 5 S., R. 24 E., S.B.M., Blythe N.E. quadrangle, 1951; about 13½ miles by road (U.S. 95), north of Blythe.

Ownership: Public domain (1958).

History: Riprap and fill material were first taken from these sites in 1945 when the U. S. Government built a temporary rock weir to restore the surface level of the Colorado River for the Palo Verde Irrigation District. The level of the river had dropped as a result of desilting in the lakes behind Boulder, Parker and Headgate Rock dams. During the years 1954 to 1958 material was quarried for the construction of the more permanent Palo Verde Dam (Palo Verde Irrigation District reports, 1954 and 1957).

Geology: Two quarries yielded materials for the diversion dam. One is just west of the damsite in sections 18 and 19. This quarry is in alluvium and adjacent to exposures of gneissic granite. Both the alluvium, which consists of gravel, sand, clay, and caliche, and the gneissic bedrock, were quarried. The heavier riprap was quarried from the walls of a narrow canyon in section 14, about 1½ miles northwest of the dam. The material is dense, finely crystalline, dolomitic limestone. It is wall bedded; individual beds range from one inch to ten feet in thickness. In the quarry the strike is northeast and the dip about 30° to the southeast. The thickness and extent of the formation was not determined.

Development: The quarry near the damsite consists of a shallow pit 150 feet to 200 feet in diameter and several cuts along a shallow arroyo. The riprap quarry in section 14 has two faces; one on either side of the canyon. The southwest face is about 400 feet long and 50 feet high. The other face, opposite it, is about 200 feet long and 50 feet high.

Production: The total yardage of material used in the dam projects was not determined.

References: Palo Verde Irrigation District annual reports for 1954 and 1957.

R.B.S. 11/19/58.

Sidebotham (Phillips) Quarry

Location: W½NW¼; NW¼SW¼ sec. 5, T. 4 S., R. 6 W., S.B.M., Corona South quadrangle, 7½', 1954; about 2 miles southeast of Corona, south of Temescal Wash and east of Compton Siding.

Ownership: Temescal Clay, Inc. c/o F. A. Stearns, El Cerrito, Corona, owns about 100 acres of patented land in section 5 (1963).

History: Two quarries opened in the middle 1930's to furnish rubble, riprap, and track ballast for the A.T. & S.F.R.R. Co., who reported production during 1935-39. The south quarry has since been inactive, but the north quarry was reopened and operated by Silberberger Constructors, Inc., Quest Haven Road, San Marcos, during the latter part of 1962. Early in 1963 it too was inactive. In July 1963, Silberberger Constructors again reactivated the north quarry to supply 50,000 tons of riprap material to the Orange County coastal area.

Geology: Rock exposed in the quarry area is an equigranular to somewhat porphyritic, medium-grained granodiorite. The rock is dark gray to blue-gray on weathered surfaces and dark greenish-gray on fresh surfaces and is hard, irregularly jointed, and breaks into large, blocky, generally unweathered masses. The north quarry has about one foot of red soil overburden and 3 to 5 feet of weathered granodiorite below the soil. The face shows a few thin seams of altered clay-like material. Tests on two samples from the Sidebotham quarry made about 1939 by the District Laboratory, Corps of Engineers, U. S. Army, showed the following:

		L. A. Rattler, % loss at 500 rpm		
Specific gravity	Absorption	Average	Maximum	Minimum
2.70	0.2	12.2	13.2	11.1

Development: Rock has been removed from two quarries in gentle, low hills. The south quarry (NW¼SW¼ sec. 5) is roughly circular in plan and about 250 feet in diameter. It was worked from a single level with the face 10 to 40 feet high, but has potential backs of about 80 feet. The second quarry is about half a mile to the north (NW¼NW¼ sec. 5) and is opened on one level about 500 feet long in a southeast-northwest direction with the bench about 150 feet wide. The face is from 25 to 75 feet high with potential backs of about 120 feet.

Production: Large, but undetermined total tonnage. In 1962 the north quarry furnished about 30,000 tons of riprap material for the San Pedro Cabrillo area.

References: Gray, 1961, p. 88-89, 117.

C.H.G. 8/20/62.

Temescal Canyon (Hawley, Pacific Rock and Gravel Co.)

Rock Quarry

Location: SW¼ sec. 33, T. 3 S., R. 6 W.; NW¼ sec. 4, T. 4 S., R. 6 W., S.B.M., Corona South quadrangle, 7½', 1954; one mile south of Home Gardens along the east side of Temescal Wash near its northwest end.

Ownership: James Spires, Anaheim owns the north quarry and Pacific Rock and Gravel Company, 400 East Arrow Highway, Arcadia owns the south quarry and adjoining property totaling 670 acres (July, 1963).

History: The Temescal Canyon Rock quarry was first opened in May 1957 by the Temescal Rock Products Company, Corona to supply stone for a levee being constructed along the Santa Ana River west of Riverside. By September 1957 Matich Brothers and Sundt Company Contractors, Colton was the operator. The quarried product included facing stone, toe stone, and derrick stone in several sizes ranging from 1 pound to 4,500 pounds. The levee project was completed in 1958 and the quarry was inactive until 1960 when Hawley Rock, Inc., 5277 North Vincent Avenue, Azusa reopened the quarry under the name Hawley Rock Quarry, Inc. to supply rock for flood control channels. The quarry has been intermittently active on a stand-by basis since 1961. In July 1963, the south quarry was acquired by Pacific Rock and Gravel.

Geology: Most of the rock in the quarry area is an equigranular to somewhat porphyritic granodiorite, a medium-grained, dark-colored intrusive rock of Jurassic or Cretaceous age. The granodiorite is dark gray to blue-gray on weathered surfaces and gray to dark greenish-gray on fresh fractures and forms subrounded hills. In the north quarry only granodiorite is exposed, but in the south quarry is exposed a small mass, about 300 feet long and 25 to 50 feet wide, of dark blue-black quartz latite porphyry. The porphyry is surrounded by the granodiorite. Large reserves are available, as the granodiorite crops out in a belt more than one mile long and about 1,000 feet in average width. In 1957 the U.S. Army Engineer Division Laboratory, Corps of Engineers, Sausalito, tested samples of the granodiorite and obtained the following data:

Weight lbs./cu.ft.	Apparent Specific gravity	Specific gravity Saturated, surface dry	Absorption	L.A.Rattler, % loss at 1000 rpm	
				Grade E	Grade F
169.7	2.721	2.712	0.19	19.2	19.7

Development: Two quarries about 1,250 feet apart on the east side of Temescal Wash. Here the rising topography provided a natural slope for the initial quarry face which was steepened by blasting to form a face about 60 feet high. Potential maximum backs are about 250 feet above the floor of Temescal Wash. In 1963 the north quarry was about 325 feet long and 200 feet wide with face 40 feet high; the south quarry was somewhat semicircular in plan and was about 150 feet long, 250 feet wide, and with face about 150 feet high.

Production: About 250,000 tons during 1957-58, and about 150,000 tons during 1960-61. Apparently since 1961 only small intermittent production.

References: Gray, 1961, p. 89-91, 117.

C.H.G. 7/20/63.

Stringfellow (Bly Brothers and McGilliard, Shannahan) Quarry

Location: NW¼ and SE¼ sec. 1, T. 2 S., R. 6 W., S.B.M., San Bernardino quadrangle, 1954; about 6 miles northwest of Riverside in the central part of the Jurupa Mountains, north of Glen Avon Heights at the north end of Pyrite Street.

Ownership: Stringfellow Quarry Company, P.O. Box 6, Riverside.

History: These quarries were first operated about 1900 by the West Riverside Granite Company. By 1905, Bly Brothers were working two quarries which furnished a large quantity of granite used for building purposes. The rock was shipped to Los Angeles for cutting and finishing at the firm's stoneyard. Annual production of 120 carloads of dimension stone and 1,200 carloads of riprap was reported for 1914, at which time the operation was known as Bly Brothers and McGilliard Stone Company. In 1923, about 150 tons of rock was shipped each month to Los Angeles where the rock was ground for use as roofing material and chicken grit. Since the 1920's, the principal product has been harbor riprap for breakwaters and seawalls (Long Beach breakwater 1925-29; Seal Beach 1944-49; Redondo Beach 1953-56; 1956-63 various harbor and flood control projects). During the 1940's, the property operated under the name Shannahan Quarries. The quarries were acquired by the Stringfellow Quarry Company about 1951 and have since been active each year.

Geology: The quarries are in a roughly rectangular shaped mass of Cretaceous Woodson Mountain Granodiorite about 2,000 feet by 1,000 feet in plan. Two sets of joints, one set trending east and about 8 to 10 feet apart, and the other set trending north assist quarrying operations. Overburden is generally not present, but weathered debris averaging 1 foot in thickness overlies the granodiorite in places.

Tests on 8 samples from the Shannahan quarry made about 1939 by the District Laboratory, Corps of Engineers, U.S. Army, showed the following:

Specific gravity	Absorption	L.A. Rattler, % loss at 500 revs.		
		Average	Maximum	Minimum
2.68	0.4	38.6	43.8	32.2

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Development: Two quarries and a few small prospect cuts. The smaller quarry, in the NW¼ sec. 1 and known as the old quarry, is circular in plan and about 300 feet in diameter with maximum face height of 150 feet. It has been inactive since before 1930. About 800 feet to the southeast and in the SE¼ sec. 1 is the new quarry. By 1929, it had been developed on one level 150 feet long with face height of 80 feet; in 1950, the bench was 700 feet long and 75 feet high; and by 1963, the quarry was L-shaped with a total length of 1,500 feet and maximum face height of 200 feet. Primary blasting is infrequent and is usually by the coyote hole method, secondary shooting is by jack hammer drilling. Loading at the quarry is by 3/4 yard to 3 yard power shovels or crane and rock hook, depending on rock size. To make small sizes material is trucked to an adjacent plant which utilizes a feeder grizzly, jaw crusher, and standard Hewitt Robins screens to size the rock. Products include riprap, derrick stone, and building stone. Most of the material used for flood control riprap is 4 inches or larger, with a range of 1-inch to 15-inches. Material as large as 3 to 4 tons is also quarried.

Production: By 1929 the property is [was] reported to have yielded about 600,000 tons of stone and since 1951 the Stringfellow Quarry Company has produced about 750,000 tons. In recent years production has averaged 50,000 to 75,000 tons per year, and some years more than 200,000 tons are shipped. Total production is unknown but certainly is well over one million tons.

References: Aubury, 1906, p. 42-44; Merrill, 1917 [1919], p. 585; Tucker and Sampson, 1929, p. 508; Tucker and Sampson, 1945, p. 166; Mackevett, 1951, p. 13, pl. 1; Gay, 1957, p. 573, 586.

C.H.G. 1/21/63.

Super Creek Mine

Location: SW¼ sec. 36, T. 2 S., R. 3 E., S.B.M., Whitewater quadrangle, 7½', 1955; on the southeast flank of Painted Hill. The property is reached by means of an unimproved dirt road extending northeastward 2 to 3 miles from Whitewater.

Ownership: In 1958, three claims were held by a man named Grossman (Proctor, ~~unpublished thesis~~ 1967, p. 39).

History: Undetermined.

Geology: Same as Painted Hills Quarry (see herein).

Development: Assessment work in the form of roads and open cuts (1959).

Production: Undetermined.

References: Proctor, ~~unpublished thesis~~ 1968, p. 39, ~~1958~~ R.B.S. 12/59.

identified

Unknown Pit

Location: SW¼NE¼ sec. 4, T. 5 S., R. 6 W., S.B.M., Corona South quadrangle 7½', 1954; northeastern flank of the Santa Ana Mountains, about 8 miles southeast of Corona, on a ridge midway between Bixby and Anderson Canyons.

Ownership: Alfred H. and Sue M. Beazley, 601 Fern Drive, Fullerton, own patented ranch land in this area (1957).

History: Pit opened during 1956. Idle 1957.

Geology: Brownish-gray, soft, much weathered biotite quartz diorite (phase of the San Marcos Gabbro). Largely altered to clay minerals, breaks into very fine-grained material.

Development: Shallow bulldozer cut.

Production: Small amount scraped from ridge in 1956, probably used locally by ranchers to surface unpaved roads.

References: Gray, 1961, p. 118.

C.H.G, 3/6/61.

identified

Unknown Pit

Location: NE¼NW¼ sec. 9, T. 4 S., R. 6 W., S.B.M., Corona South quadrangle, 7½', 1954: northwest of El Cerrito Village and about 3½ miles southeast of Corona.

Ownership: Minnesota Mining and Manufacturing Company, 900 Bush Avenue, St. Paul, Minnesota (P.O. Box 276, Corona) (1957).

History: Undetermined. Idle 1957.

Geology: Light brownish-gray, soft, weathered quartz monzonite (Home Gardens Quartz Monzonite Porphyry) with minor hard, light gray blocks.

Development: Two small, nearly connected quarries totaling about 100 feet in length with face from 10 to 25 feet high. Mined by power shovel without blasting.

Production: Small intermittent production, probably used locally to surface unpaved roads.

References: Gray, 1961, p. 118.

C.H.G. 3/6/61.

Decomposed Granite

Decomposed, crystalline, igneous rock commonly called decomposed granite or D.G. is widely available in western Riverside County in areas underlain by the rocks of the Southern California Batholith. Such material is favored for road base work because it compacts well, yet remains permeable; characteristics not generally found in sand or soil.

Contractors seeking sources of D.G. must generally contact local land owners and it is usually agreed that pit sites will be left in a graded and orderly condition.

During 1961, the following firms were reported producers of decomposed granite in Riverside County:

Name	Address
Corona Dee Gee Co.	Corona
Gilbert A. Morris Excavating Co.	P.O. Box 194, Idyllwild
Riley Materials Co.	6740 Pedley Rd., Arlington

Photo 39

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Dimension Stone

Blue-Gray Granite Quarry

Location: NE¼NE¼ sec. 14, T. 4 S., R. 4 W., S.B.M., Steele Peak quadrangle, 7½', 1953; about 1½ miles southwest of Val Verde in low, rounded hills half a mile southwest of the intersection of Cajalco Road and Seaton Avenue.

Ownership: N. B. Walters, 28 Chapel Street, Alhambra (1945). Undetermined (1963).

History: In 1929 the quarry was under lease to E. Johnson and one man was employed in the production of monumental stone. By 1945 the quarry was idle and remained idle in 1963. Periods of activity since 1945, if any, are not known, but the size of the quarry suggests that it may have been a source of broken or crushed stone, rather than monumental stone, at some period. ~~At various times~~ this quarry has been known by different names including Johnson, Perris, Riverside Quarry, and Riverside Granite Company.

Geology: Rock exposed in the quarry faces is light gray, medium-to coarse-grained quartz diorite with abundant ferromagnesian minerals (Cretaceous Bonsall Tonalite). In places the rock contains abundant, irregular gneissic inclusions, mostly cobble sized or smaller. The surface is weathered irregularly to depths of 5 to 10 feet, and in places irregular weathered zones extend to the bottom of the exposed quarry faces. According to Tucker and Sampson (1929, p. 508) the material being quarried was a fine-grained granite having a very uniform mineral pattern which made it an ideal monumental stone. In 1963 only limited areas of such rock were observed in the quarry faces. Tests on four samples from this quarry made about 1939 by the District Laboratory, Corps of Engineers, U.S. Army, showed the following:

	L. A. Rattler, % loss at 500 Revs.		
Specific Gravity	Average	maximum	minimum
2.69	65.7	100.0	48.7

Development: Oval shaped side-hill quarry about 180 feet by 150 feet with maximum face of 40 feet opens from end of a railroad spur. The quarry connects to a slot along the spur about 250 feet long, 80 feet wide and 20 feet deep. This slot may have also been quarried. Equipment in use when the quarry was active in 1929 included an air compressor, jackhammers, and a stiff-legged derrick. Apparently monumental stone was selectively quarried, judging from the large amount of large boulders in the waste pile at the north end of the railroad slot. These boulders might be a source of rubble or riprap for small local construction projects. It appears unlikely, however, that this quarry will be a favorable future source of monumental stone because of the problems presented by irregular weathered zones, deep overburden, and irregular distribution of inclusions.

Production: Total undetermined; 250 cubic feet per month in 1929.

References: Tucker and Sampson, 1929, p. 508; Tucker and Sampson, 1945, p. 166.

C.H.G. 7/1/63.

Delano Black Granite

Location: W½W½SE¼, W½ and NE¼ Gov't. Lot 7, SW¼ Lot 2, SE¼ Lot 3, E½ Lot 6, Lots 9 and 12 sec. 32, W½ NW¼ sec. 33, T. 4 S., R. 4 W., S.B.M., Steele Peak quadrangle 7½', 1953; bouldery terrain of the Gavilan Hills about 5 miles west of Perris in western Riverside County, along both sides of Santa Rosa Road at the old Virginia (Virginia-Shay, Missing Link) mine (fig. 42), adjacent to the Royal Black granite quarry (see herein).

Ownership: Bert Gilmer and associates, 4325 East San Miguel, Phoenix 18, Arizona hold a 160-acre association placer claim (Delano mining claim, W½W½SE¼, W½ and NE¼ Gov't. Lot 7, SW¼ Lot 2, SE¼ Lot 3, E½ Lot 6, Lots 9 and 12 sec. 32, excluding patented areas) and own 80 acres of fee land (W½ NW¼ sec. 33).

History: This area was extensively prospected for gold before 1900 with some activity through the 1940's. A number of old shafts, adits, and pits in section 32 reflect this early search for metals. Monument stone was quarried briefly about 1930 from several small workings north of Santa Rosa Road in the NW¼ section 33. Apparently this was the first stone operation in this area and was followed in 1936 by the opening of the adjacent Royal Black granite quarry. After an idleness of nearly 35 years the property again became active in June 1964 when the Delano mining claim was located. By October 1964 stone had not been shipped but location work had been done and development work was in progress.

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Geology: This property is underlain by part of the same body of distinctive reddish-brown or bronze-weathering basic igneous rock as described under Royal Black granite quarry (which see herein).

Two samples were collected by geologists of the California Division of Mines and Geology in October 1964, from a shallow face opened at the NW Corner of SW¼ NW¼ SE¼ sec. 32, on the south side of a prominent drainage. Preliminary microscopic examination of these samples showed the following:

Sample G-1: Biotite quartz norite.

Hypautomorphic-granular, medium to coarse grained. Melanocratic appearing.

Labradorite	70%	(Mineral percentages approximate)
Hypersthene	12%	
Biotite	8%	
Quartz	6%	
Augite	4%	

Minor hornblende, apatite, K-spar, zircon and ores.

931

Sample G-2: Pyroxene-biotite-hornblende quartz diorite. Hypautomorphic-granular, medium to coarse grained. Melanocratic, but in hand specimen lighter in color than G-1.

Andesine	53%	(Mineral percentages approximate)
Hornblende	15%	
Biotite	15%	
Augite	12%	
Quartz	4%	
Hypersthene	1%	

Minor K-spar(?), apatite, zircon, and ores, and white mica, secondary after plagioclase.

Development: Several small faces have been opened and roads built or repaired throughout the property. Sampling and testing are reported to have been done. In the NW¼ section 33, about 300 feet north of Santa Rosa Road on the south slope of a low knoll is an open-cut bench about 50 feet wide with face 12 feet high. This cut apparently was made when the property was first quarried about 1930.

Production: A few tons of monument stone in the 1930's. By December 1, 1964 the present operators had not yet placed the property in production.

References: Dudley, 1935, p. 501, 506, map facing p. 506; Larsen, 1948, p. 46, 47.

D.M.M. & C.H.G. 12/1/64.

Dendrite Deposit

Location: Sec. 14, T. 2 S., R. 12 E., S.B.M. (proj.), Pinto Basin quadrangle, 15'; 1963; Pinto Mountains, nearly 600 feet northwest of the Duplex mine and about 6 miles southeast of New Dale (site).

Ownership: Walt Rose and Charley Wade, General Delivery, Twenty-nine Palms, own at least one unpatented claim.

History: The deposit was discovered in the late 1950's by the present owners. Stone is quarried only intermittently as no permanent market has been established.

Geology: Massive, Mesozoic quartz monzonite is cut by a N. 80° W.-trending, steeply southwest-dipping, very fine-grained dike. The dike is 10 feet in average width, pale green, and discolored by black dendrites of manganese oxide. As the dendrites are fernlike in appearance, the name "Fern Rock" has been applied to quarried stone. The dike extends for at least several tens of yards west and east from the quarry pits, but is only locally stained with manganese dendrites, and probably does not contain commercial material alongs its entire length. The rock is well cleaved near the surface and appears fairly easy to quarry to a depth of 15 feet.

Development: A small tonnage of stone has been removed from shallow open cuts and trenches which have exposed the dike about 30 feet along the strike.

Production: None, as of March 1970.

References: None.

J.R.E. 3/10/60

Riverside County
Rock Products
Dimension Stone

Royal Black Granite Quarry

Location:. E½SE¼, E½W½SE¼, SE¼ Gov't. Lot 7 sec. 32, NW¼SW¼, W½NE¼SW¼ sec. 33, T. 4 S., R. 4 W., S.B.M., Steele Peak quadrangle 7½', 1953; bouldery terrain of the Gavilan Hills about 5 miles west of Perris in western Riverside County, quarry is a quarter of a mile south of Santa Rosa Road and the old Virginia (Virginia-Shay, Missing Link) mine (f,4,42).

Ownership: Royal Black Granite Quarry, P.O. Box 487, Escondido (Robert N. Johnson and others, P.O. Box 123, Perris) holds a 160 acre association placer claim (Royal Black mining claim, E½SE¼, E½W½SE¼, SE¼ Gov't. lot 7 sec. 32, excluding patented areas) and owns 60 acres of fee land (NW¼SW¼, W½NE¼SW¼ sec. 33).

History: ~~This area was extensively prospected for gold before 1900 with some activity through the 1940's. A number of old shafts, adits, and pits in section 32 testify to this early search for metals.~~ Apparently this property was first quarried for dimension stone in 1936 when Emil Johnson opened the Royal Black granite quarry at the site of the present quarry and also at the hillcrest a quarter of a mile to the southwest, where most of the quarrying was done. This quarry was active until 1948 as a source of dimension stone and a few larger blocks. According to the owner polished black facing stone on the Los Angeles Times building was supplied from this quarry, as was facing stone for buildings as far distant as Canada and Oregon.

After an idleness of about 25 years the Royal Black mining claim was located in August 1963, a large Guy derrick was installed and quarrying began. The quarry was largely inactive during most of 1964, but some development work was done on other parts of the property.

Geology: The quarry area is underlain by a distinctive reddish-brown or bronze-weathering basic igneous rock. On fresh surfaces the rock is black and commercially is termed "black granite", although microscopic examination indicates it ranges from gabbro-norite to quartz diorite in composition. This rock mass is an unusual part of the southern California batholith for several reasons. First, physically, it is an extremely constant, even grained, massive rock and at every place observed is inclusion free. Secondly it occurs as exceptionally large unfractured blocks. Blocks at least 20 to 30 feet square are seen in the quarry face; the blocks being separated by seams and cracks. In addition the composition of the rock is uncommon for rocks of the Southern California batholith. As is usual in "black granite" the rock does not display well defined rift, grain or hardway splitting directions, such as are commonly seen in regular granite bodies.

Dudley (1935, p. 501, map facing p. 506) named this rock the Virginia Quartz-Hypersthene Norite because of its occurrence near the old Virginia mine and its composition. He reported that microscopic examination showed the rock to contain 51% plagioclase (labradorite), 6% orthoclase, 14% quartz, 12% hypersthene, 8% biotite, and 6% augite and hornblende with the accessory minerals zircon, apatite, rutile, and magnetite. Dudley's map shows this rock body to extend west from the Virginia mine for a distance of about 3 miles and to range from about 3/4 mile to ½ mile in width. The area is included in the large region later studied by Larsen (1948), but because of the scale of the map Larsen (1948, pl. 1) included the Virginia Norite with his San Marcos Gabbro. Larsen (1948, p. 46-47) did recognize and describe an east-west body of quartz norite located about 6 miles west of Perris, apparently the same rock body earlier described and mapped by Dudley (1935).

Photo 40

A brief geologic examination of the area made by geologists of the California Division of Mines and Geology in August and October 1964, suggests that rocks of the same type and apparent quality as the dark colored rock being quarried may exist throughout most of an area about one mile long and perhaps three quarters of a mile wide. Within this area there are also zones of pale whitish gray to gray rock which may be in bodies large enough for quarrying. Preliminary microscopic examination of two samples of the dark rock, one (N-1) from the active quarry (Fig. 42) and one from a prospect at the guy station east of the quarry (59-2), showed the following:

Sample N-1: Quartz diorite.

Hypautomorphic-granular, medium to coarse grained.

Melanocratic appearing.

Andesine	56%	(mineral percentages approximate)
Biotite	16%	
Augite	14%	
Quartz	13%	
Hypersthene	1%	

Minor K-spar, hornblende, apatite, zircon and ores.

Sample 59-2: Quartz diorite.

Hypautomorphic-granular, medium to coarse grained.

Melanocratic appearing.

Andesine	60%	(mineral percentages approximate)
Quartz	15%	
Pyroxene	12.5%	
(Clinopyroxene, orthopyroxene)		
Biotite	12.5%	

Minor K-spar, hornblende, apatite, zircon, ores

Tests made on samples from the Royal Black granite quarry were as follows:*

Compressive strength: method of test ASTM C170-50

Sample number	Compressive strength
1	32,600 psi
2	29,500 psi
3	35,100 psi
Average	32,400 psi

Absorption test: method of test ASTM C97-47

Sample number	Absorption
1	0.03%
2	0.03%
3	0.03%
Average	0.03%

*Testing by Twin City Testing and Engineering Laboratory, Inc., 2440 Franklin Ave., St. Paul 14, Minn. dated Oct. 10, 1963 - test data courtesy of Royal Black Granite Quarry, P.O. Box 487, Escondido, California.

Development: Principal quarry is a single north-south bench level about 300 feet long, 100 feet wide, with face 50 to 75 feet high. In addition several faces have been newly opened or reopened near the crest of the hill above the quarry, but have not been quarried during the present operation.

In the quarry large blocks are loosened and trimmed by careful blasting. Loosened blocks are then moved from the face by means of a Guy derrick with 115-foot high mast and 100-foot boom, loaded on trucks, and transported to rail cars at Perris. Blocks shipped are in the range of 8 to 30 tons and have dimensions in the range of about 5'x5'x15' to 5'x8'x12'.

The blocks are shipped for finishing to the Delano Granite Works, Inc., quarries and manufacturers of structural and monumental granites, Delano, Minnesota. Here the blocks are trimmed and cut to desired sizes for building facing stone and monument stone. After polishing the finished stone is trucked to the job site. In 1963 this stone was used in Ogden, Utah and late in 1964 was scheduled for a new Federal building in New York City, a job that will require shipment of about 3,000 tons of stone.

Production: About 1,000 tons to Nov. 1, 1964. The rock is sold for $5.50 per cubic foot on rail cars at Perris.

References: Dudley, 1935, p. 501, 506, map facing p. 506; Larsen, 1948, p. 46, 47.

D.M. ~~M.~~ Morton & C.H.G. 12/1/64.

Sand and Gravel

Since 1949 the annual value of sand and gravel produced in Riverside County has been measurable in terms of millions of dollars (table 1/). Prior to 1955 most of the reported production came from quarries within the county. However, the sand and gravel industry has become increasingly flexible and mobile and the compilation of statistics for any given area can be misleading. Since 1955 much of the aggregate used in the more urban areas of the west end of the county has been transported as "ready-mix" or bulk raw material from plants and quarries in adjacent San Bernardino County.

Because Riverside County is undergoing rapid economic growth and a population increase which, between 1950 and 1960, exceeded that of any one of 15 states in the nation (Jamison, 1960, p. 3), increasing numbers of producers of building materials are establishing plants within the county. Riverside is the chief center of urban growth in the county. Future suburban development in the Perris-Hemet-San Jacinto area is probable and the increasing popularity of the Coachella Valley resort areas should stimulate a growing demand for building materials.

Construction of concrete bridges, abutments, and highways and the mixing and application of black top entail the transport of a variety of materials from relatively fixed sources. County, state and federal authorities involved in road-building activity maintain some local sources of materials but frequently place contracts with private companies. Much road base material, fill, and riprap are obtained from sites convenient to construction locations, usually as a one time operation.

When the state supplies plans and specifications for highway work to interests bidding for contracts, it will (upon request and for a small fee) supply test data on materials available or involved in the work areas. Data for Riverside County are at the State Division of Highways, District 8, Materials Department, 247 3rd Street, San Bernardino.

Most sand and gravel concerns have one, or possibly several, permanent quarries. Many have, in addition, portable equipment to handle on-site jobs such as highway work or to obtain a particular grade of material from a source richer in that grade than their permanent pit.

Photo 36

The sand and gravel deposits of Riverside County consist of stream channel gravel, terrace deposits, and alluvial fan deposits. Rarely, if ever, will a single site yield a balanced supply of all grades of sand and gravel. It is common practice to employ crushing equipment but in sandy deposits, such as those found in the Riverside, Hemet, and Indio areas, supplementary supplies of rock must sometimes be sought. For general soundness of material and abundance of supply the alluvial fans and stream channel deposits along the north side of San Gorgonio Pass have proven to be one of the best sources of gravel in the western half of Riverside County.

In the sparsely populated eastern half of Riverside County the principal markets for aggregate are the agricultural communities along the Colorado River; Blythe, Ripley, and Palo Verde.

Photo 37

Abundant sand and gravel is present in stream channel and alluvial fan deposits along the margins of the mountainous areas of the eastern half of the county. In much of the desert area, however, alluvial material which underlies and adjoins the present water courses appears to have remained unworked by water since early Quaternary time and perhaps longer. In such material, a desert soil profile has become established, a result of which is the formation of a dense layer of caliche or hard pan. Indeed, in some areas there appears to be a succession of such layers (see herein under Chuckwalla Spring placers in gold section). Thus, what once was loose gravel is now, in part cemented. A different problem exists in the area underlain by the Palo Verde Mesa, overlooking the flood plain of the Colorado River. Here, the Colorado River appears to have reworked the valley fill during Quarternary time. Although the material contains less caliche, there is a high proportion of fine silt and sand. Reworked fragments of clay-rich sediment are common in this deposit. Local firms have found that these clay fragments hang up in washers, or, if allowed to remain in the aggregate cause "pop-outs" in concrete. (See tabulated list for a description of deposits.)

Photo 38

Specialty Sand

Corona Silica Sand Deposit (Owens-Illinois Glass Co., Corona Sand Plant No. 96; P. J. Weisel Industrial Sand Co.)

Location: NE¼ sec. 21; SE¼ sec. 16, T. 4 S., R. 6 W., S.B.M., Corona South quadrangle, 7½', 1954; 6 road miles southeast of Corona athwart State Highway 71 on west side of Temescal Wash.

Ownership: Louis A. Weisel, et al., La Habra, own about 550 acres of patented land in secs. 15, 16, 21 and 22, T. 4 S., R. 6 W., S.B.M. The Owens-Illinois Glass Company, 330 Sansome Street, San Francisco (P.O. Box 298, Corona) holds under lease about 140 acres in secs. 16 and 21 (1957).

History: The Corona silica sand deposit is the oldest continuously operated source of silica sand in southern California and continues to be the principal source. The deposit was opened and developed in the early 1920's by the P. J. Weisel Industrial Sand Company who operated the plant until 1945 when it and the deposit were taken over by the Owens-Illinois Glass Company. A new and much larger plant was erected in 1947 near the site of the old plant which was dismantled. The new plant began production in 1948 and has since been in continuous operation.

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Geology: Sand is obtained from a quartz-rich facies in the lower part of the Paleocene Silverado Formation and is apparently nonmarine. The deposit consists of gently dipping, thinly bedded and locally cross-bedded white sandstone. Where exposed in the active pit west of the highway and in the old quarry face east of the highway, the usable sandstone is about 120 feet thick. In the mine area the Silverado Formation is exposed over an irregularly shaped rectangular area about 2,000 feet wide and 3,000 feet long. The sandstone is covered by overburden ranging from several feet of older alluvium in low-lying areas, to 20 feet or more of Quaternary terrace gravels, which cap the deposit unconformably on several low hilltops. The sandstone is coarse-grained to pebbly and is weakly cemented by clay and contains lenses of gray or grayish-green silt and sandy clay. The sand size particles are almost wholly angular to subangular quartz grains, and the pebbles, which are rounded, are of quartz and feldspar. Abundant pearly gray to black flakes of mica commonly give the sand a distinctive schistose appearance. About 30 to 40 percent of the deposit is clay, silt, and fine sand (-200 mesh); 60 to 70 percent is sand and small pebble sized (+200 mesh to ¼-inch); and generally less than 10 percent is large pebbles (+¼-inch to ½-inch).

Development: Inactive quarry east of the highway is 600 feet long and 600 feet wide with face about 120 feet high. The active open pit is west of the highway. In 1956 this pit was crudely triangular in plan, and had dimensions of about 800 feet by 450 feet by 700 feet and a maximum depth of about 120 feet. Since 1956 overburden has been stripped from a large area about 1,250 feet by 800 feet in plan adjoining the north edge of the pit and present mining is in this north extension of the pit. Both the mining operation and the processing plant have been described by Gray (1961, p. 97-101). The function of the plant is to remove clay and iron-bearing constituents from the sand and to produce high grade silica sand suitable for use in the manufacture of glass. Two grades of sand are produced: "flint" sand (Fe_2O_3 content 0.03% to 0.035%) which is used to make colorless glass, and "amber" sand (Fe_2O_3 content 0.04% to 0.10%) which is used in the manufacture of amber- and green-colored glass containers. Waste pond material contains a large proportion of clay. After settling this material is sold to a number of companies for use as a constituent in the manufacture of common clay products.

883

Production: Initial capacity of the plant in 1948 was 90 tons per hour of crude sand with output of about 30 tons of finished flint sand and 15 tons of amber sand per hour. In recent years production has been at the rate of about 20,000 tons per month. The product is shipped to the Los Angeles area.

References: Tucker and Sampson, 1929, p. 504; Tucker and Sampson, 1945, p. 163-164; Gray, 1961, p. 97-101, 119.

C.H.G. 6/20/63.

Coronita Ranch Sand Deposit

Location: SW¼ sec. 16, E½SE¼ sec. 17, T. 4 S., R. 6 W., S.B.M., Corona South quadrangle, 7½', 1954; 6½ road miles southeast of Corona along the east margin of lower Bedford Wash a quarter of a mile west of State Highway 71.

Ownership: Coronita Ranch, Joel D. Middleton, 9531 Heather Road, Beverly Hills, and Donald C. McMillan, 8704 Colima Road, Whittier, own 240 acres of patented ranch land.

History: This property was first explored for glass sand in April 1957, when 10 drill holes were put down in the SW¼ sec. 16 along the southeast margin of and east of Bedford Wash. The work was under the direction of Mr. Meredith C. Brown. Early in 1958 the property was taken under option by the Del Monte Properties Company, Pacific Grove, who did additional drilling and sampling in this area and also on other parts of the Coronita Ranch in secs. 17, 18, 19, and 20, T. 4 S., R. 6 W., S.B.M. Although beneficiation tests and analyses of samples indicate that the sand is probably of glass grade (Brown, 1957) the deposit has not been mined.

Geology: The Coronita Ranch sand deposit adjoins the west edge of the Corona silica sand deposit (described elsewhere in this report) and apparently is the northwest extension of the same sequence of Silverado Formation sandstones and clayey sandstones which have been mined for many years. On the Coronita Ranch property the Silverado sandstone crops out in one small exposure on the east bluff of Bedford Wash. Here it strikes N. 45° W. and dips 8° to 10° SW. The remainder of the property is covered mostly by older alluvium, but one small hill is capped by terrace deposits. Low hills, which rise along the south margin of the property east of Bedford Wash, are underlain by the Sespe and Vaqueros formations. Five drill holes, ranging from 26 to 90 feet in depth, encountered overburden only; five other drill holes encountered medium- to coarse-grained Silverado sandstone, siltstone, and sandy clay with abundant greenish-gray mica. These holes all bottomed in this formation at 90 feet, with overburden ranging from 2 to 24 feet.

Development: Drilling and sampling only.

Production: None.

References: Brown, 1957, 8 p.; Gray, 1961, p. 101-103, 119.

C.H.G. 8/22/62.

Jackson and Havens Deposit

Location: Undetermined, probably in the SW¼ sec. 11(?) T. 4 S., R. 7 W., S.B.M., Corona South quadrangle, 7½', 1954; northeastern margin of the Santa Ana Mountains, 3 miles southwest of Corona, midway between Main Street and Hagador Canyons.

Ownership: George W. Lord, Corona (1924); undetermined (1961).

History: Reported under development in 1924 by Jackson and Havens, Riverside; this deposit, discovered in 1917, was worked intermittently prior to 1924, but apparently not since. During 1922, sand was shipped to the Union Tool Company, Los Angeles. By 1956, all equipment had been removed.

Geology: A bed of white "molding" sand about 30 feet thick composed of coarse, white sub-angular arkose ~~(Paleocene~~ Silverado Formation?) overlain by about 2 feet of gravel and soil overburden (Quaternary terrace deposit?) was reported under development by Jackson and Havens in 1924.

Development: The deposit was worked by open cuts, the material being loaded into small mine cars and transported to loading bins.

Production: Undetermined but apparently small.

References: Gray, 1961, p. 120.

C.H.G. 3/7/61.

887

Nonhof Deposit

Location: NW¼ sec. 10, T. 4 S., R. 7 W., S.B.M., Corona South quadrangle, 7½', 1954; northeastern margin of the Santa Ana Mountains, 3 miles southwest of Corona, west side of lower Hagador Canyon.

Ownership: Arthur Weirick, Chase & Skyline Drive, Corona (1956).

History: This deposit, discovered in 1900, is reported to have been productive before 1907 (personal communication, Mrs. Irene J. Ware, Corona) and may be one of the glass sand deposits noted by Aubury (1906, p. 375) as under development by the Corona Pressed Brick Company about 1905. In 1956, the workings were not identifiable and may have been destroyed by work at the adjacent McKnight clay mine. Long idle.

Geology: In 1924, Mr. Nonhof reported a bedded deposit of sand, 50 feet thick, in unconsolidated sands, gravels, and clays (~~of Paleocene~~ Silverado Formation). Sand deposit covered about 2 acres with a 5-foot thick overburden of gravel and soil (Quaternary terrace deposit).

Development: Consisted of open cuts and one 50-foot adit in 1924.

Production: Undetermined, but probably small.

References: Aubury, 1906, p. 375; Gray, 1961, p. 120.

C.H.G.

888

Smith Silica Pit (Jones, Hoag Ranch, Sand Deposit)

Location: SW¼ sec. 17, T. 4 S., R. 6 W., S.B.M., Corona South quadrangle, 7½', 1954; about 4 miles southeast of Corona, between Bedford and Joseph Canyons.

Ownership: Riverside Cement Company Division of the American Cement Corporation, P.O. Box 832, Riverside, owns 80 acres of patented ranch land.

History: The Jones deposit, on the old Hoag Ranch, was owned in 1925 by A. E. Jones of Corona who did some open cut development work and erected a wooden loading bin. Apparently there was little or no production of glass sand from this property, but small amounts of sand may have been produced and used as foundry sand in the 1920's. In 1958 the property was acquired by the Riverside Cement Company who did extensive drilling and sampling. Early in 1961 the property was put into production as a source of white silica sand for use in the manufacture of white portland cement at the company's new white plant at Crestmore.

Geology: The deposit is composed of generally massive, poorly consolidated, white sandstone which is locally conglomeratic. It is probably of Pliocene age. Indistinct bedding appears to strike northwestward and dip about 20° southeast. The sandstone consists mostly of quartz and feldspar. In places the unconsolidated sand contains very little mica and has no visible impurities, elsewhere it contains much mica, occasional sandy clay layers, clay shale clasts, and cobbles of granitic, volcanic, and metasedimentary rock. The mixed sandstone and conglomeratic sandstone is exposed over an area about 1,000 feet square. An overburden, 5 to 10 feet thick, of older alluvium covers the central and southern part. Tucker and Sampson (1929, p. 505) state that the iron content of the raw material was reported to contain 97.45 percent silica and was upgraded to 97.54 percent silica after washing and screening and that the iron content ranged from 0.09 percent to 0.11 percent.

Development: The property has undergone extensive drilling and sampling. Mining is from a side hill open cut about 300 feet long and 200 feet wide with face 10 feet high. Mining is done by tournapull equipment and bulldozer, which in a period of several days mines about one year's supply of sand. The sand is hauled by truck-trailer equipment to Crestmore.

Production: Since mid 1961, about 10,000 to 15,000 tons each year.

References: Tucker and Sampson, 1929, p. 505; Sampson and Tucker, 1931, p. 443; Tucker and Sampson, 1945, p. 163; Gray, 1961, p. 103, 119.

C.H.G. 6/20/63.

Temescal Canyon Silica Sand Deposit

Location: NE¼ sec. 29, T. 4 S., R. 6 W., S.B.M., Corona South quadrangle, 7½', 1954; 5 miles southeast of Corona, southeast of Bedford Motorway, and north of McBribe Canyon.

Ownership: Arthur E. Garratt, 3340 Eastern Avenue, Los Angeles 32, owns sec. 29, formerly railroad land (1957).

History: Area prospected for glass sand years ago (probably in the 1920's) by means of several shallow pits from which a small production may have been obtained. Early in 1956, the Ottawa Silica Company, Ottawa, Illinois, took the property under option and explored in this area and also in the W½ sec. 28. The property was not put into production.

Geology: Coarse, weakly indurated, white arkose of probable upper Eocene to lower Miocene age (undifferentiated Vaqueros and Sespe formations) crops out over much of the N½NE¼ sec. 29, but the flat topped ridges in this area are capped by Quaternary terrace gravels. South of these exposures is a fault sliver of Paleocene Silverado Formation, composed of sandstone, clayey sandstone, and clay, which crops out along the northeast side of the Elsinore fault and extends from McBribe Canyon northwest along the margin of the Santa Ana Mountains. The fault sliver is about 600 feet wide and 2,000 feet long.

Development: Eight 18-inch diameter drill holes were put down in the NE¼ sec. 29 in 1956 and the remainder of the area was explored by numerous bulldozer cuts and trenches.

Production: Undetermined, probably none.

References: Sampson and Tucker, 1931, p. 444; Gray, 1961, p. 103, 119.

C.H.G. 8/24/62.

Broken and Crushed Stone
Roofing Granules

Storm Sulfide (Green Giant-Long Green) Deposit

Location: Sec. 4, T. 4 S., R. 13 E., S.B.M. (proj.)., Pinto Basin quadrangle, 15', 1963; Eagle Mountains, about 13 miles northeast of Cottonwood Spring and 7.5 miles northeast of the East Pinto Basin Road-West Pinto Basin Road-Black Eagle mine road intersection (figure 56).

Ownership: Barry Storm, P. O. Box 74, Inyokern, owns two unpatented lode claims (February 1960).

History: In August 1957, the property was owned by Henry B. Tuttle, 218 South Palm Canyon Drive, Palm Springs. At this time, Mr. Tuttle owned 4 unpatented lode claims: Green Giant nos. 1 and 2, and Long Green nos. 1 and 2. The Green Giant no. 2 (open-cut site, fig. 56-1) was leased to the Lucas Mining and Milling Co., Thousand Palms (Harry T. Lucas, President). Green rock was mined and sold at $20 per ton for roofing granules (oral communication, 8/1/57, Henry B. Tuttle).

Geology: Irregular green bodies of mixed idocrase, garnet and epidote occur in a contact zone, as much as 20 feet thick, between light colored quartz monzonite, cut locally by narrow, dense black dikes, and bluish-gray calcitic dolomite weathering light tan.

Figure 56

Plate 41

Development: Workings consist of bulldozer scrapes, prospect pits, an open-cut, and two adjacent adits ([illegible]). The open-cut, from which rock for roofing granules was extracted, is 60 feet long, 40 feet wide, and 20 feet deep. The westernmost adit is about 75 feet long. It is driven north and is overhand stoped 15 feet to the surface 25 feet from the portal. Several tens of feet east is another adit driven north 15 feet. The property was idle when visited but may be worked intermittently.

Production: Undetermined.

Reverences: None.

J.R.E. 1/27/60.

Temescal Rock Quarry

Location: S½ sec. 4, T. 4 S., R. 6 W., S.B.M., Corona South quadrangle, 7½', 1954; about 4 miles southeast of Corona, on the east side of Temescal Canyon.

Ownership: Minnesota Mining and Manufacturing Company, 900 Bush Avenue, St. Paul, Minnesota (P.O. Box 815, Corona 1) owns patented land in secs. 4, 5 and 9, T. 4 S., R. 6 W., S.B.M. totaling about 1,000 acres (1957).

History: Quarry was opened about 1888 to furnish rock for macadamizing streets in Los Angeles and nearby towns. By 1914 the quarry was owned and operated by the Temescal Rock Company whose plant had a capacity of 1,500 to 2,000 tons of crushed rock products per day. About 1920 the quarry was purchased by the Blue Diamond Materials Company who used the rock for building aggregate and road metal until 1927 when the plant was destroyed by fire. The property remained idle until 1947 when it was reopened by the present owner to produce roofing granules and has been in continuous operation since.

Geology: The quarry is in Temescal Wash Quartz Latite Porphyry, a fine-grained, dark-colored, intrusive rock of probable Jurassic age. The quartz latite is blue-gray on weathered surfaces and blue-black to gray on fresh fractures. The rock consists of abundant white feldspar and quartz phenocrysts in a gray microcrystalline groundmass. It has good breakage qualities and is very hard.

Development: The quarry face is steep and nearly 400 feet high on one bench level. Mining continues to widen the bench, which is about 1,000 feet long, on that face. In 1956 the length of the quarry, on the same bench, was extended about 900 feet to the south. The original north part of the quarry, however, continued to be the chief source of rock. Quarried rock is moved by belt conveyor to a processing plant in the canyon below the quarry. The function of the plant (described by Gray, 1961, p. 93-95) is twofold; first the material is crushed and screened into sizes suitable for various types of roofing granules and second, artificial colors are applied and bonded to the granules. Granules are produced in a variety of sizes and a wide range of colors. The major output is fine-grained material in the range 10 to 35 mesh used for processed roofing; additional but smaller amounts of coarse granules are produced for built-up roofing. During the 1950's these coarse granules were colored and bagged at a small plant on East Third Street, Corona, north of the city park, but about 1960 this plant was dismantled and the operation moved to a portion of the main plant in Temescal Canyon.

In addition to roofing granules this operation yields at least three by-products. Since 1956 reject material (-28 mesh) from the crushing operations has been used by several plants in sewer pipe manufacture. In 1963 Fontana Paving, Inc. erected an asphalt plant in Temescal Wash about one mile northwest of Temescal Rock Quarry from which quarry waste is used to make asphalt paving. The asphalt plant also utilizes decomposed Cajalco Quartz Monzonite and sandy alluvium from the east side of Temescal Wash adjacent to the plant. Also in 1963 Pomona Ready Mix Concrete erected a batch plant just west of the asphalt plant. Crushed rock for Concrete ~~gravel~~ is supplied from the Temescal Rock Quarry and sand is mined from Temescal Wash adjacent to the plant.

Production: Initial capacity of the Temescal Canyon plant was about 100,000 tons of granules each year. This has been substantially increased and by 1963 was over 200,000 tons.

References: Goodyear, 1888, p. 506; Merrill, 1917 ~~1919~~, p. 586-587; Tucker, 1921, p. 331-332; Tucker, 1924, p. 45; Allen, 1923, p. 887-890; Bradley, 1923, p. 95; Tucker and Sampson, 1929, p. 508, 524; Tucker and Sampson, 1945, p. 166-167; Ingram, 1949, p. 457; Utley, 1949, 5 p.; Megaphone, 1951, p. 6-7; Jahns, 1954, p. 21; Gray, 1961, p. 93-95.

C.H.G. 6/20/63.

Salt

The first attempt to collect and market salt in the area now included in the county was that of the New Liverpool Salt Company. In 1884, this company began work harvesting a natural layer of salt, ranging in thickness from 10 to 20 inches, which had formed on the then dry surface of the Salton Sea. The plant was located at Salton, a station on the Southern Pacific Railroad near the northeast margin of the playa surface. The following quote from Bailey (1902, p. 124) outlines the method and working conditions of the enterprise.

"The sight at the salt works is an interesting one, for thousands of tons [of salt] are piled up like huge snow drifts, and a large force of men is busy preparing and packing, ready for market, salt of all grades and kinds. The workmen are Indians.... belonging to the Coahuilla tribe, and are large, well-developed men, who are not affected by the dazzling sunlight, and who are able to work ten hours a day with the thermometer registering 150° in the sun. The Indians operate cable plows, that cut salt furrows 8 feet wide and 6 inches deep, each plow harvesting over 700 tons of pure salt per day. A portable railroad conveys the salt to the works."

This operation continued until the flood of 1905-1907 left the plant under 60 feet of water (Brown, 1923, p. 11-12, pl. 4; Ver Planck, 1957, p. 115).

A later attempt to win salt from this basin was made in 1927 by Seth Hartley who experimented with solar evaporation near Caleb at the north end of the sea. A crop of 1,500 tons was harvested in 1929 (Tucker and Sampson, 1929, p. 526) but no further activity was reported (Ver Planck, 1957, p. 115).

The two other desert basins in Riverside County--Palen Dry Lake and Ford Dry Lake northeast and east of Desert Center--do not appear to contain extensive deposits of evaporites although some well water in that area is strongly charged with dissolved mineral matter. Salt is no longer produced in Riverside County.

Table 6. SOIL SURVEYS

Soil is as much a part of the earth as the rocks from which it is derived and it is our most important basic natural resource. (Accordingly it is appropriate to include the following source data in this report.)

Soil and Land Classification Surveys in Riverside County

Adapted from a state-wide compilation by Walter W. Weir, Department of Soils, University of California, Berkeley

Name of Survey	Date	Made by	Area Surveyed	Type of Survey	Scale of Maps
Soil Survey San Bernardino Valley	1904	1	portions of area around Riverside and Perris Valley	soil, semi-detail	1" = 1 mi.
Soil Survey Riverside Area	1915	1,2	western part of county	soil, detail	1" = 1 mi.
Reconnaissance Soil Survey Central Southern Area	1917	1,2	county west of desert	soil, recon	1" = 2 mi.
Soil Survey Indio Area	1903	1	lower portion Coachella Valley	soil, semi-detail	1" = 1 mi.
Soil Survey Coachella Valley	1923	1,2	344 sq. mi. S. portion of valley	soil, detail	1" = 1 mi.
Soil Survey Palo Verde Area	1922	1,2	423 sq. mi. Palo Verde Valley	soil, detail	1" = 1 mi.
Soils of Palo Verde Mesa	1946	2	40 sq. mi. Palo Verde Mesa	soil, detail	1" = 1/2 mi.
Soils of Portion of Palo Verde Valley (Between Levee and River)	1947	2	about 60 sq. mi. along river	soil, detail	1" = 1 mi.

Name of Survey	Date	Made by	Area Surveyed	Type of Survey	Scale of Maps
Reconnaissance Soil Survey of San Diego Region	1915	1,2	strip 6 mi. wide along SW edge of county	soil recon	1" = 2 mi.
Mira Loma SCD	1914 (41)	3	6,500 Ac NW corner of county	SCS, detail	1" = 1320'
Elsinore-Murrieta-Anza SCD	1953 (IP)	3	92,634 Ac Sw portion Co.	SCS, detail	1" = 660'
Riverside-Corona SCD	1953 (IP)	3	2,540 Ac W. end of county	SCS, detail	1" = 660'
San Gorgonio SCD	1953	3	106,662 Ac N. central portion of county	SCS, detail	1" = 660'
San Jacinto Basin SCD	1953 (IP)	3	96,133 Ac W. central portion of county	SCS, detail	1" = 660'
Yucaipa Valley SCD	1952	3	south of Yucaipa	SCS, detail	1" = 660'
West End SCD	1953 (IP)	3	west of Riverside	SCS, detail	1" = 660'
Southwest Riverside County Reconnaissance	1945	3	288,000 Ac	SCS recon	1" = 660'
Santa Margarita Investigations Land Classification	1953	4	portion of Santa Margarita Ranch	LC recon	1/250,000
Chuckawalla Valley	1939	5	120,000 Ac	LC, semi-detail	---
Coachella Valley	1942-43	5	142,000 Ac	LC, detail	1" = 1 mi.
Soil-Geologic Survey	1943	6	areas in NF only	soil and geology recon	1/2" = 1 mi.

1 USDA U.S. Department of Agriculture, Soil Survey Division
2 UC University of California, Department of Soils
3 SCS U.S. Department of Agriculture, Soil Conservation Service
4 DWR Division of Water Resources, Department of Public Works
5 USBR U.S. Bureau of Reclamation
6 CFRES California Forest and Range Experiment Station, Forestry Bldg., University of California, Berke
--- Information not currently (1954) available

Reference copies of local soil surveys are on file in the office of the University of California Farm Advisor and your local Public Library.

Some of the published soil surveys are still available. Inquiries may be mailed to:

Agricultural Publications
207 University Hall
University of California
Berkeley 4, California

Explain your need. A limited number of surveys are available and not all requests can be granted.

Talc

Palen Mountains Talc Deposit

Location: Sec. 18 (proj.), T. 5 S., R. 18 E., S.B.M., Sidewinder Well 15' quadrangle, 1952; 15 miles northeast of Desert Center at the southwest edge of the Palen Mountains.

Ownership: Not determined (1959).

History: In 1945, this property was held by E. T. Herman, El Segundo, and Leslie C. Mott, Los Angeles (Tucker and Sampson, 1945, p. 182). It was idle then and when visited in March, 1959.

Geology: The area of the deposit is underlain by metasedimentary rocks of the McCoy Mountains Formation. ~~(Miller, 1944, p. 32)~~. A shear zone as wide as 60 feet strikes N. 70° W. across the north slope of a steep ridge and dips 70° SW. It is traceable for approximately three-quarters of a mile between its faulted southeast end and the alluvium to the northwest. The shear zone comprises irregular masses of talcose schist and friable, white talc. The following analysis, submitted by the owners (1945), appeared in a previous report (Tucker and Sampson, 1945, p. 182).

Photo 42

	Percent
Silica (SiO_2) ----------------------------------	60.70
Iron and aluminum oxides (Fe_2O_3 and Al_2O_3) ---	1.95
Calcium oxide (CaO) -------------------------	trace
Magnesium oxide (MgO) ----------------------	30.88
Water (H_2O) ----------------------------------	4.50

Development: The principal development is at the east end of the outcrop. It consists of shallow open cuts and a 30-foot crosscut driven from the footwall through solid talc. About 10 feet from the face of the crosscut there is a 10-foot winze.

Production: Undetermined.

References: Tucker and Sampson, 1945, p. 182, pl. 35.

R.B.S. 3/12/59.

Tunnel Claim

Location: NE¼ sec. 23, T. 7 S., R. 11 E., S.B.M., Orocopia Canyon quadrangle, 7.5', 1958; reached by an unimproved road which extends northward from a Coachella Canal siphon marked as the site of BM 67 on the topographic map.

Ownership: Undetermined.

History: Undetermined.

Geology: A shear zone, about 40 feet wide containing talcose, chlorite-actinolite schist crops out through a strike distance of about 500 feet on a steep slope cut in flaggy, quartz-biotite gneiss. The zone strikes N. 60° W., and dips 30° SW.

Development: The deposit is opened by several open-cuts; one in the canyon wall, the others higher on the slope to the northwest. ~~The adit, shown on the topographic map, either never existed or is now covered.~~

Production: Undetermined.

References: None.

R.B.S. 2/26/60.

Tin

The first~~, and still the most important,~~ ~~reported~~ discovery of tin in California was in the Temescal district, Riverside County, prior to the Civil War, probably in 1853 (Hanks, 1884, p. 120-122). Presumably the initial discovery was at Cajalco Hill (site of the Temescal or Cajalco mine). Exploration stopped with the outbreak of the Civil War, but was resumed in 1868, and in 1869 a 15.34 ton shipment of ore was made to San Francisco (Page and Thayer, 1945, p. 1). Subsequently ore was mined during 1891 and 1892 and later in 1928-29. During the early 1940's the U. S. Geological Survey examined the area and an open-file report was prepared (Page and Thayer, 1945, 24 p., 13 figs.), but the mines have remained idle. The total production of tin from Riverside County is estimated at about 130 long tons, all of which apparently came from the Temescal (Cajalco) mine.

The Temescal (Cajalco) mine and several neighboring properties which together comprise the Temescal tin district are confined to an area of approximately 15 square miles about 5 miles southeast of Corona and 11 miles southwest of Riverside. Here a mass of quartz monzonite contains a group of tourmaline-quartz veins in ~~which~~ a few of which recoverable amounts of cassiterite have been found. Probably several hundred veins have been seriously explored in the Temescal district and numerous smaller stringers and tourmalinized zones also exist. The veins are commonly zoned or banded, but most of the veins that are a foot or less in width consist entirely of mottled tourmaline rock or silicified rock. In the wider parts of the veins, where mineralization was more intense, their centers are occupied by a layer of fine-grained tourmaline a few inches wide. The veins apparently replaced the quartz monzonite along fissures soon after it solidified. Assays indicate that almost all of the veins contain 0.03 to 0.1 percent tin, but samples assaying more than 0.1 percent have been collected in very few places. Cassiterite occurs as disseminations and as bunches and stringers in the tourmaline-quartz rocks (Page and Thayer, 1945, 24 p., 13 figs.).

In addition to the Temescal district traces of tin in Riverside County are reported in the Elsinore district, about 15 miles to the southeast. The area at the Chief of the Hills group (see herein) was prospected in the late 1920's but no tin was produced. In the mid-1930's prospectors sought tin in the hills a few miles east of Elsinore but little or none was found (Engel et al., 1959, p. 77).

American Flag and Monarch Mines*

Location: Reported to be "2 miles east of Elsinore", not identified in 1955. Reported to comprise 12 claims in 3 groups.

Ownership: Undetermined.

History: Area prospected for tin in the mid-1930's.

Geology: Triassic(?) slates and quartzites (Bedford Canyon Formation) and granitic rocks (Bonsall tonalite?) and basic dikes. No veins; "dikes" are mainly colored streaks in granitic rocks.

Development: Explored by at least 20 open cuts, pits, and shallow shafts. Six samples taken from places designated by former owners as carrying 22 to 80 lbs. tin per ton were found to contain less than 0.4 lb. tin per ton; less than 0.2 lb. nickel and 0.4 lb. cobalt.

Production: Apparently none.

References: Bedford and Johnson, 1946, p. 10; Engel et. al., 1959, p. 77, 126.

C.H.G. 8/7/62

* Adapted from Engel et al., 1959, p. 77, 126.

Black Rock (North Black Rocks) Deposit

Location: Secs. 18, 19, T. 4 S., R. 5 W., S.B.M., Lake Mathews quadrangle, 7½', 1953; 7½ miles southeast of Corona and half a mile south of Lake Mathews on both sides of Cajalco Road.

Ownership: In 1945, holdings comprised 400 acres owned by W. B. Moore, Moore Bros., 711 Baker Building, Walla Walla, Washington. Present (1962) extent of holdings and ownership not determined, but at least part of the area is owned by the Metropolitan Water District of Southern California, 306 West Third Street, Los Angeles, California.

History: The Black Rocks Tin Syndicate sampled about 40 veins in the NW¼ sec. 18 in 1927-29 by means of one inclined shaft and prospect pits on the veins (Page and Thayer, 1945, p. 23). The property has been idle since the 1930's.

Geology: Tourmaline-quartz veins and pipes in quartz monzonite. Tucker and Sampson (1945, p. 151) reported twelve tourmaline veins striking northeast, dipping 60° SE., and ranging in width from 4 to 30 feet. According to Page and Thayer (1945, p. 24) about 310 samples were taken by the Black Rocks Tin Syndicate and only occasional assays showed more than 0.08 percent of tin, and the highest was 0.18 percent.

Development: One inclined shaft sunk to a depth of 125 feet (Tucker and Sampson, 1945, p. 151) and a few prospect pits.

Production: Undetermined, but apparently none.

References: Tucker and Sampson, 1929, p. 495-96; Sampson, 1935, p. 516; Tucker and Sampson, 1945, p. 151; Page and Thayer, 1945, 24 p., figs. 4, 6; Bedford and Johnson, 1946, p. 10; Gray, 1957, p. 643.

C.H.G. 8/10/62.

Chief of the Hills Group*

Location: NE¼ sec. 4, NW¼ sec. 3, T. 6 S., R. 4 W., S.B.M., Elsinore quadrangle 7½', 1953; east side of high point on ridge one mile west of Railroad Canyon Dam, about 2 airline miles east of Elsinore.

Ownership: J. M. Mack, C. L. Berry, and Mary Briner, Elsinore (1926); public domain (1945); undetermined (1962).

History: Area prospected in the late 1920's and 5 claims were located in December 1926. By 1929, the property was idle and there is no report of renewed activity.

Geology: Country rock is Triassic(?) slate, quartzite, and metaconglomerate of the Bedford Canyon Formation; beds strike N.5° to 20°W., dip 80°E. Comb quartz veins 2 to 3 inches wide on edge of metaconglomerate body; much discoloration by iron, manganese(?) oxides. Tin reported to occur as reddish brown crystals lining cavities in minutely crystalline tourmaline associated with 5 fine-grained granitic dikes (Tucker and Sampson, 1929, p. 496); tin minerals not found in 1954. Reported assays of 0.30 to 2.21 percent tin (Tucker and Sampson, 1929, p. 496), and 7 percent tin (Segerstrom, 1941, p. 551).

*Adapted from Engel et al.; 1959, p. 77, 126.

Development: Prospected by shallow trenches and 100-foot vertical shaft with crosscuts driven 20 feet east and 10 feet west at bottom. West crosscut reported driven in material that assayed 0.31 to 1.22 percent tin (Tucker and Sampson, 1929, p. 496). Shaft open but inaccessible in 1954, inhabited by owls.

Production: None ~~production.~~

References: Tucker and Sampson, 1929, p. 496; Sampson, 1935, p. 516; Segerstrom, 1941, p. 551; Tucker and Sampson, 1945, p. 152, pl. [illegible] 35; Larsen, 1948, p. 133; Larsen, 1951, p. 49; Engel et al., 1959, p. 77, 126.

C.H.G. 8/7/62.

Holmes Ranch Deposit

Location: NW¼ sec. 12, T. 4 S., R. 6 W., S.B.M., Lake Mathews quadrangle, 7½', 1953; about 6 miles southeast of Corona and 1½ miles southeast of Cajalco Hill, along Cajalco Canyon west, and adjacent to, Cajalco Dam and Spillway.

Ownership: In 1945, Tucker and Sampson (p. 152) reported the ranch consisted of 560 acres owned by Lawrence Holmes, Arlington, California. Ownership and extent of holdings ~~was~~ were not determined in 1962.

History: Probably first prospected during the late 1800's, when the nearby Cajalco Mine was active. By 1929 (Tucker and Sampson, p. 496), the property was under option to Southern California Tin Corporation, but other than sampling no development work had been done on the vein. The area was included in studies made by the U.S. Geological Survey in the 1940's (Page and Thayer, 1945~~, 24 p. 12 figs.~~) but has remained idle.

Geology: A group of tourmaline veins in quartz monzonite occur in the SW¼ sec. 1 and the NW¼ sec. 12. The veins trend about N. 20°E. and most dip 50° to 80° NW., but a few dip 60° to 65° SE. Fifteen samples contained only traces of cassiterite (Page and Thayer, 1945, p. 23). Tucker and Sampson (1945, p. 152) reported the vein outcrop to be from 6 to 15 feet in width.

Development: Two shafts of undetermined extent are on either side of Cajalco Canyon, but apparently not on tourmaline veins. These two shafts are said to have been sunk during construction work at Cajalco Dam during the 1930's. The veins have been explored by means of several trenches and pits.

Production: Undetermined, apparently none.

References: Tucker and Sampson, 1929, p. 496; Sampson, 1935, p. 516; Tucker and Sampson, 1945, p. 152; Page and Thayer, 1945, 24 p. 13 figs.; Bedford and Johnson, 1946, p. 9.

C.H.G. 8/10/62

Moore Deposit

Location: Secs. 13, 14, 23, 24, T. 4 S., R. 6 W., S.B.M., Lake Mathews quadrangle, 7½', 1953; about 7 miles southeast of Corona and 2 miles southeast of Cajalco Hill.

Ownership: 600-acre ranch held by Robert L. Moore estate, Riverside, California in 1945. Present (1962) owner and extent of holdings not determined.

History: Said to have been discovered in 1891 and some development work done during 1927-29. Idle since the early 1930's.

Geology: Series of parallel quartz-tourmaline veins in Mesozoic quartz monzonite. The veins strike northeast, are reported to contain copper oxides, and chalcopyrite is disseminated in the wall rock (Tucker and Sampson, 1945, p. 152).

Development: Several shallow shafts 20 to 40 feet deep on different veins.

Production: Undetermined, apparently none.

References: Tucker and Sampson, 1929, p. 496; Sampson, 1935, p. 516-517; Tucker and Sampson, 1945, p. 152; Bedford and Johnson, 1946, p. 10.

C.H.G. 8/10/62.

Prospect* (Name undetermined)

Location: SW¼ sec. 4, T. 6 S., R. 4 W., S.B.M., Elsinore quadrangle 7½', 1953; southern base of low hills about one mile east of Elsinore, about ¼ of a mile west of city dump.

Ownership: Undetermined.

History: Area prospected for tin in the mid-1930's; idle many years.

Geology: Deeply weathered diorite and gabbro (San Marcos gabbro) cut by sheared aplitic dike 5 ~~ft.~~ feet wide, traceable more than 100 yards trending N. 65° E.

Development: Tin minerals reported sought in several shallow pits along the southeast edge of the dike, and a 30-foot shaft, caved at the bottom and inaccessible at the westernmost exposure of the dike.

Production: Little or no production.

References: Larsen, 1948, p. 133; Larsen, 1951, p. 49; Engel et al., 1959, p. 77, 127.

C.H.G. 8/7/62.

*Adapted from Engel et al., 1959, p. 77, 127.

Prospect* (Name undetermined)

Location: $S\frac{1}{2}$ sec. 22, $N\frac{1}{2}$ sec. 27, T. 5 S., R. 4 W., S.B.M., Elsinore quadrangle, $7\frac{1}{2}$', 1953; about 3/4 of a mile southeast of Highway 74, about $3\frac{1}{2}$ airline miles northeast of Elsinore.

Ownership: Undetermined.

History: Area prospected for tin in the mid-1930's; idle many years.

Geology: Granitic Pegmatite dike trends northeasterly through quartz diorite (Bonsall tonalite) near contact with Triassic(?) slates (Bedford Canyon Formation). Traces of topaz and tourmaline were exposed in a shallow cut, but tin-bearing minerals were not observed in 1954.

Development: Shallow open cut.

Production: No production.

References: Larsen, 1948, p. 133; Larsen, 1951, p. 49; Engel et al., 1959, p. 77, 127.

C.H.G. 8/7/62

* Adapted from Engel et al., 1959, p. 77, 127.

South Black Rock Deposit

Location: NW¼ sec. 19, T. 4 S., R. 5 W., S.B.M., Lake Mathews quadrangle, 7½', 1953; about 7 miles southeast of Corona and 1½ miles south of Lake Mathews.

Ownership: 80-acre tract owned by Hewitt S. West in 1945. Ownership and extent of holdings not determined in 1962.

History: By 1929, the property had been explored by means of several shallow shafts and was under option to the American Tin Corporation but was idle (Tucker and Sampson, 1929, p. 497). The area was examined during the 1940's by the U.S. Geological Survey (Page and Thayer, 1945, 24 p.) and has since remained idle.

Geology: Tourmaline-quartz veins in quartz monzonite. According to Page and Thayer (1945, p. 24) the veins strike N. 30°-60° E. and, for the most part, dip 65°-80° SE. In places they are as much as 30 feet wide and are continuously exposed for as much as 800 feet. More than 150 assays of samples taken by the Black Rocks Tin Syndicate (about 1927-29) indicate that the average grade of these veins is probably between 0.03 and 0.05 percent of tin. The upper 30 feet of shaft No. 2 averages about 0.10 percent of tin over an average width of 56 inches.

Development: Two shallow inclined shafts sunk on the veins, and several shallow pits and trenches.

Production: Undetermined, apparently none.

References: Tucker and Sampson, 1929, p. 497; Sampson, 1935, p. 517; Tucker and Sampson, 1945, p. 152; Page and Thayer, 1945, 24 p. 13 figs.; Bedford and Johnson, 1946, p. 10; Gray, 1957, p. 643.

C.H.G. 8/10/62.

Temescal (Cajalco) Mine

Location: Secs. 2, 3, 10, 11, T. 4 S., R. 6 W., S.B.M., Lake Mathews quadrangle, 7½', 1953; 5 miles southeast of Corona and 1¼ miles west of Lake Mathews. The principal workings (Williams or No. 1 shaft and Robinson shaft) are in the SW¼ sec. 2, just northeast of Cajalco Hill.

Ownership: In 1945, the holdings comprised 870 acres owned by Tinco Corporation, Richmond, Virginia. Amertin Incorprated, 1 North 6th Street, Richmond 19, Virginia was the owner of record in 1957. In the early 1960's, the mine area and a large tract of adjacent land were acquired by the Lake Mathews Farming Company, Route 2, Box 98, Corona, California.

History: Tin was discovered in the Temescal district prior to the Civil War, probably in 1853. A vertical shaft had been sunk 95 feet when the outbreak of the Civil War stopped the work. Exploration was resumed in 1868, and in 1869 a 15.34 ton shipment of ore to San Francisco was said to have yielded 6,895 pounds of tin (Page and Thayer, 1945, p. 1). However, the first production of record was in 1891. Ore was mined during 1891 and 1892 and later in 1928-29. In 1942, a modern 100-ton mill was erected and 1,400 tons of surface vein material was put through with a recovery of less than a pound of tin oxide per ton (Tucker and Sampson, 1945, p. 154). During the period 1940-45 the U. S. Geological Survey mapped and sampled the area in considerable detail; the Cajalco mine was partly unwatered and the upper part of the old stope was examined. This investigation resulted in an open file report (Page and Thayer, 1945). Since 1945, the owners have attempted to reactivate the mine, but the property has remained idle. By 1963, a considerable acreage of citrus orchards had been planted in the area immediately north and west of the mine.

Geology: Tin, in the mineral cassiterite, is associated with veins and pipe-like masses of tourmaline-quartz rock in coarse-grained quartz monzonite (mapped as a phase of the Woodson Mountain granodiorite by Larsen, 1948, p. 132-133, plate 1). According to Page and Thayer (1945, p. 7,8) the average width of the veins, including spotted tourmaline rock and silicified rock, probably is 1 to 2 feet, although some of the veins are 6 feet wide, and in places a few are 15 to 20 feet wide. Most of the veins are less than 1,000 feet long and are discontinuous, although one vein system is about 4,800 feet long. The downward extent of the veins is not known but the Cajalco vein was followed to a depth of 690 feet and was not bottomed. Most of the veins, including the Cajalco vein, are in coarse-grained quartz monzonite, strike from about N. 20° E. to N. 50° E., and dip ~~from~~ 50° to 85° NW.

The Cajalco vein is exposed on the surface discontinuously over a length of 550 feet and has been explored continuously over a length of 1,000 feet. It strikes about N. 55° E. and dips from 55° to 80° NW. On the surface the vein is as much as 5 feet thick and, as exposed in the mine workings, ranges from 1 inch to 5 feet 10 inches. Maps of the mine indicate that two ore shoots were developed. One was about 70 feet and the other 160 feet in strike length, and the larger one had a dip length of about 240 feet. The Cajalco vein averages about 0.15 percent of tin. The cassiterite occurs as disseminations and as bunches and stringers in the tourmaline-quartz rocks. The ore that was milled is reported to have averaged in the range of 2 to 5 percent SnO_2 (Page and Thayers, 1945, 24 pp., 13 figs.).

Development: The principal workings at the Temescal mine explored the Cajalco or No. 1 vein and consist of an adit, a vertical shaft (the Robinson) now caved, an inclined shaft (the Williams or No. 1) that extends to a vertical depth of 540 feet, a raise to the surface from stope No. 1, and more than 5,800 feet of drifts and crosscuts on seven levels (Page and Thayer, 1945, p. 15). Other veins in the area have been explored by numerous shafts and adits with drifts and crosscuts. Considerable stripping and trenching also have been done on the veins. Most of the underground workings, including the stopes by means of which the two ore shoots were mined, are now inaccessible.

Production: The entire production apparently came from two connected cassiterite-bearing ore shoots in the Cajalco vein. According to Segerstrom (1941, p. 543) about 113 long tons of tin ~~were~~ was produced from the district. Page and Thayer (1945, p. 2) arrive at a figure of about 130.5 long tons, using data from Rolker (1895, p. 537) and Segerstrom (1941, p. 543).

References: Hanks, 1884, p. 120-122; Goodyear, 1888, p. 506; Crossman, 1890; Benedict, 1890, p. 450-453; Fairbanks, 1893, p. 111-113; Rolker, 1895, p. 537; Fairbanks, 1897, p. 39-42; Merrill, 1917 /1919/, p. 547-550; Tucker, 1924, p. 46; West, 1928, p. 131-132; Tucker and Sampson, 1929, p. 497-499; Sampson, 1935, p. 517-518; Segerstrom, 1941, p. 533-34, 543, 550-551; Tucker and Sampson, 1945, p. 153-154; Page and Thayer, 1945, 24 p. 13 figs.; Bedford and Johnson, 1946, 14 p.; Larsen, 1948, p. 132-133, pl. 1; Larsen, 1951, p. 48, 49, pl. 1; Pampeyan, 1952; Gray, 1957, p. 641-644.

C.H.G. 8/9/62.

Tungsten

Riverside County tungsten production started in 1942 and ended in 1956, with some of the included years showing no recorded yield. ~~As shown on plate~~ accurate figures from which to derive year-by-year totals were not found, ~~however,~~ at best tungsten has been a minor commodity in the county.

The largest single source of tungsten has been the Pawnee mine (see herein) in the Beauty Peak area, the holdings of which lie largely in San Diego County. The other properties appear to have yielded only small quantities of concentrates.

Scheelite ($CaWO_4$) has been found in gold districts in association with quartz veins and igneous dikes. Traces of scheelite have been found in contact zones in the igneous-metamorphic complex of the Big Maria Mountains at the eastern end of the county, but the most promising prospects have been in tactite bodies in the metamorphosed rocks of the San Jacinto and Santa Rosa mountains and the Beauty Peak area.

There are no known high-grade tungsten deposits in Riverside County and activity in tungsten mining has been largely dependent upon the government stockpiling programs authorized between 1946 and 1959. Stockpile purchase of tungsten concentrate was authorized under the Strategic and Critical Materials Stock Piling Act (Public Law 520, approved July 23, 1946) and the Defense Production Act of 1950 (Public Law 774 , approved September 8, 1950). Purchase of concentrates from domestic producers was terminated in December 1956, and the last contract for the acquisition of foreign concentrate was fulfilled in 1959.

Aztec (Chuckwalla Tungsten Mine) Claim

Location: Sec. 22 (?), T. 6 S., R. 15 E., S.B.M., ~~U. S. Army~~ Corps of Engineers Chuckwalla Mountains quadrangle, 15', 1945; 5¼ miles south of Desert Center and 2 miles west of Aztec Well.

Ownership: Last reported (1958) owner was Bonnie L. Bowers, et al., 302 San Antonio Avenue, San Diego 6.

History: Tucker and Sampson, (1945, p. 154, pl. 35) described a property under the name Chuckwalla Tungsten Mine, which resembles the Aztec but the location given is about five miles to the east near Corn Spring. The Aztec once was called the Chuckwalla Tungsten Mine but this may simply be a duplication of names.

According to papers found on the property, in 1949 and 1950 the Aztec was held by Oscar F. Neuerberg, 8094 El Capitan, La Mesa, but the earliest date of the present owners claim was not determined.

Geology: The Aztec Claim is on a quartz vein ranging from 0 to 4 feet in thickness which strikes N. 40° - 70° W. across a low granite ridge through a distance of about 200 feet. The vein dips 35° - 40° SW. Scheelite is present as scattered crystals and as thin, lenticular bodies as much as 1½ inches wide. It is characterized by a straw-yellow to honey-brown color. In addition, the vein carries scattered, small bunches of pyrite, chalcopyrite and galena. Most of the pyrite has altered to iron oxides and secondary copper minerals.

Development: A crosscut adit has been driven into the west slope of the ridge (Fig. __). The vein was reached about 10 feet from the portal and a drift was run 40 feet southeast. Two short raises extend 10 and 15 feet to the surface from the drift. An open-cut has been dug on the east slope of the ridge with the apparent purpose of starting a drift adit to join the working in the west slope. Some trenching has been done on the outcrop.

Production: Undetermined. Idle, 1960.

References: Tucker and Sampson, 1945, p. 154, pl. 35.

R.B.S. 2/24/60.

Crescent Deposit

Location: SE 1/4 sec.28, T. 4 S., R. 23 E., S.B.M. (proj.), Big Maria Mountains SE. quadrangle, 7 1/2', 1955; Big Maria Mountains, about 18 miles north of Blythe.

Ownership: Undetermined.

History: Clyde H. Reynolds located the Crescent claim in May 1954.

Geology: Much of the work is in a tactite zone, as much as 10 feet thick, between intrusive (Mesozoic?), leucogranite and tan-colored wollastonite-bearing, Paleozoic (?), carbonate rock. The wollastonite-bearing rock trends northwest, dips 41° SW, and locally is coated with black desert varnish. The tactite is composed largely of garnet, green diopside and chlorite, and minor amounts of green prismatic epidote and clear to cloudy scheelite, all in a matrix of brown medium-grained limestone.

Development: Several pits and trenches, the largest about 15 feet in length, have been dug south into the tactite zone. In the adjacent gulch, numerous small pits, open cuts, and trails have been gouged out. All work here is in wollastonite-bearing rock, and no mineralization was observed. A good dirt road leads from the property, passing by several Giant Indian Intaglios, to a junction with U. S. Highway 95 about 17 miles north of Blythe. Elevation of the prospect is about 800 feet. It is idle.

Production: Undetermined.

References: Miller, 1944, p. 32.

J.R.E. 12/19/58.

Garnet Queen Mine

Location: NE¼SE¼ sec. 20, T. 7 S., R. 5 E., S.B.M., Toro Peak quadrangle, 15' 1941; on the east slope of Santa Rosa Mountain at an elevation of 6,000 feet.

Ownership: Santa Rosa Tungsten Corporation holds the mineral rights to this property (1958).

History: ~~This property~~ The Garnet Queen Mine was first worked in 1898, in search of gold. Subsequent activity has been devoted to the exploration of a scheelite-bearing deposit. In 1941 a small concentration plant was installed by Elliot and associates, Glendale, California (Tucker and Sampson, 1941, p. 582) but no record of activity in subsequent years was found.

Geology: The Garnet Queen Mine explores one of a number of scattered, scheelite-bearing tactite bodies in a belt of pre-Cretaceous schists which strikes east to southeast across the granitic terrane of Santa Rosa Mountain (Wright, 1946, pl. 1). When visited in 1958, the ore body was not exposed. Tucker and Sampson (1941, p. 582) state that the width of the tactite ranges from 2 to 6 feet and its attitude is N. 8° E., 70° S. It is composed of quartz, garnet, epidote, diopside and 0.7 percent WO_3, contained in sparsely distributed scheelite.

Development: The workings consist of an open trench about 100 feet long and a 30-foot vertical shaft. The vertical shaft was sunk in 1896. It is reported to have followed gold-bearing quartz stringers (Tucker and Sampson, 1941, p. 582). ~~Idle.~~

Production: The plant built in 1941, had a capacity of 10 tons per day. The concentrate was reported to have contained 60 percent WO_3 (Tucker and Sampson, 1941, p. 582) but the amount shipped was not determined.

References: Tucker and Sampson, 1941, p. 582; 1945, p. 154; Wright, 1946, pl. 1).

R.B.S. 6/26/58.

Lucky Strike Mine

Location: NE¼ SW¼ sec. 33, T. 8 S., R. 3 E., S.B.M., Warner Springs quadrangle, 15' 1939; about one mile north of Chihuahua Creek and just east of the road connecting Duranso and Chihuahua valleys.

Ownership: Undetermined (1958).

History: Undetermined.

Geology: The Lucky Strike mine is in an area of pre-Cretaceous gneissic metamorphic rocks cut by thin pegmatite dikes. A tactite zone is exposed in an area about 200 feet square on a low ridge, on the north side of a canyon. The tactite consists of garnet, quartz, epidote, calcite and presumably, some scheelite, though none was found in samples taken.

Development: The tactite body was explored by an adit of undetermined but probably short length, driven eastward into the side of the ridge. The portal is badly caved. In addition, several shallow pits and trenches indent the crest and sides of the ridge.

Production: Undetermined. Idle.

References: None.

R.B.S. 7/21/58.

Pawnee (Carr, Oak Grove) Mine

The following information is taken in part from a report by F. H. Weber, Jr., done in the course of his work in San Diego County.

Location: NE¼ sec. 6, T. 9 S., R. 3 E., (San Diego County), and sec. 31, T. 8 S., R 3 E., (Riverside County), S.B.M., Warner Springs quadrangle, 1939; about 6 miles northeast of Oak Grove, along the boundary between San Diego and Riverside Counties.

Ownership: Verdi Development Company, 2623 Hyperion Ave., Los Angeles 23, holds 5 unpatented claims (1957).

History: The tungsten-bearing deposits on the lower southeast slopes of Beauty Mountain were first prospected in 1917 by Bert Simmons and John Wentworth of Aguanga who located 18 claims in the area, and perhaps produced a small quantity of tungsten-bearing concentrates. The deposits were then idle until the Pawnee deposit was developed and worked on a small scale in the late 1930's by Frank Carr of Aguanga. In the 1940's, it was worked by E. L. and William Carr. The Pawnee Mine Incorporated, of Beverly Hills acquired the Pawnee property in 1951 and sold it to the Verdi Development Company in late 1955 or early 1956. It has been idle since 1956.

Geology: The tungsten-bearing deposits in the Beauty Mountain area consist of bodies of tactite enclosed concordantly in metamorphic rocks composed chiefly of schist and gneiss. Small irregular intrusive bodies of granitic rocks cut the metamorphic rocks. Of chief interest on the Pawnee property are two bodies of tactite about 1500 feet apart, on a narrow north-trending interfluve that abutts Chihuahua Creek on the south. The more productive of the two lies in San Diego County, about 400 feet north of Chihuahua Creek and 150 feet north of the mill. This body strikes N. 20°-25° E. and dips about 85° southeast. It ranges in length from 55 to 70 feet, and in width averages about 8 feet. The body has been worked vertically to a depth of about 140 feet. It is composed of a medium- to coarse-grained aggregate of quartz, brown garnet, epidote, calcite, diopside (?), and scheelite. The ore probably averaged about one percent tungsten trioxide.

The second body of tactite lies about 1,500 feet to the north of the more productive body, on the west side of the ridge, and in Riverside County. It has yielded only a small amount of tungsten ore. The body strikes north-northwestward and dips steeply southeast. Its dimensions were estimated by L. C. Penhoel (unpublished consulting report, 1953) as follows: length, 75 feet or more; width, 45 to 55 feet. It probably averages about ½ percent tungsten trioxide.

Development: The more productive body is developed by a 180-foot shaft from which drifts trend north-northeastward and south-southwestward on the 90- and 140-foot levels, respectively. The two drifts range in length from 70 to 90 feet and lead to stopes. From a point 50 feet south of, and 35 feet lower than the collar of the shaft, a drift adit trends N. 10° E. From this drift, the orebody was stoped to the surface, to leave a trench-like glory hole which ranges in depth from 10 to 40 feet, and in width from 10 to 15 feet.

Production: Total production from the deposits in the area is probably slightly more than 3,000 units of tungsten trioxide (WO_3).

Ore was milled on the property. The mill was still mainly intact in 1958, and contained a jaw-crusher, rolls, ball mill, and 2 concentrating tables. It had a capacity of about 1 to 2 tons per hour.

References: Hess and Larsen, 1921, p. 260-261; Tucker, 1925, p. 353; Tucker and Sampson, 1940, p. 48; 1941 p. 583-584; 1945, p. 156; Partridge, 1941, p. 318; Jenkins, 1942, p. 344, 353; Kerr, 1946, p. 161; Eng. and Min. Jour., Mar. 1956, p. 132.

F.H.W. 6/58.

Tubbs Claims

Location: Sec. 5 (proj.), T. 7 S., R. 15 E., S.B.M., ~~U. S. Army Corps of Engineers,~~ Chuckwalla Mountains quadrangle, 15', 1963; on the southwest side of a northwest-trending canyon 9 miles by dirt road southeast from U. S. Highways 60 and 70, and 8 miles south-southwest of Desert Center. These claims are just southwest of the Red Cloud Group (fig. 39).

Ownership: Elmer E. Tubbs, 516 Eye Street, Bakersfield, holds five unpatented claims.

History: This ground once was worked for gold in the late 1800's and may be the site of the long abandoned Keystone, Blackbird, and Monarch Mines (Orcutt, 1890, p. 901), and/or the Liberty group (Tucker and Sampson, 1929, p. 453).

Geology: This deposit lies in the plane of a fault which strikes N. 10° W. and has a vertical- to steeply-northeasterly dip. The fault zone is as much as 20 feet wide and well exposed for several thousand feet. The deposit comprises a quartz vein containing pyrite and secondary oxides of iron, a basic dike, and a silicified zone ~~ranging~~ from 7 to 10 feet wide. The tungsten-bearing quartz appears to have filled and altered fractured portions of the basic dike. The resulting silicified material contains minor proportions of iron oxides, lavender fluorite, and scheelite. According to the owner, a significant proportion of the tungsten-bearing quartz contains about 1 percent scheelite.

Development: Although no systematic mining has been done for scheelite the deposit has been ~~well~~ prospected by means of a 50-foot shaft, a 50-foot adit, two 30-foot adits, and numerous open cuts and trenches some of which probably represent the search for gold by previous owners.

Production: Undetermined. ~~Idle.~~

References: ~~None.~~ Orcutt, 1890, p. 901; Tucker and Sampson, 1929, p. 483.

R.B.S. 1/21/60.

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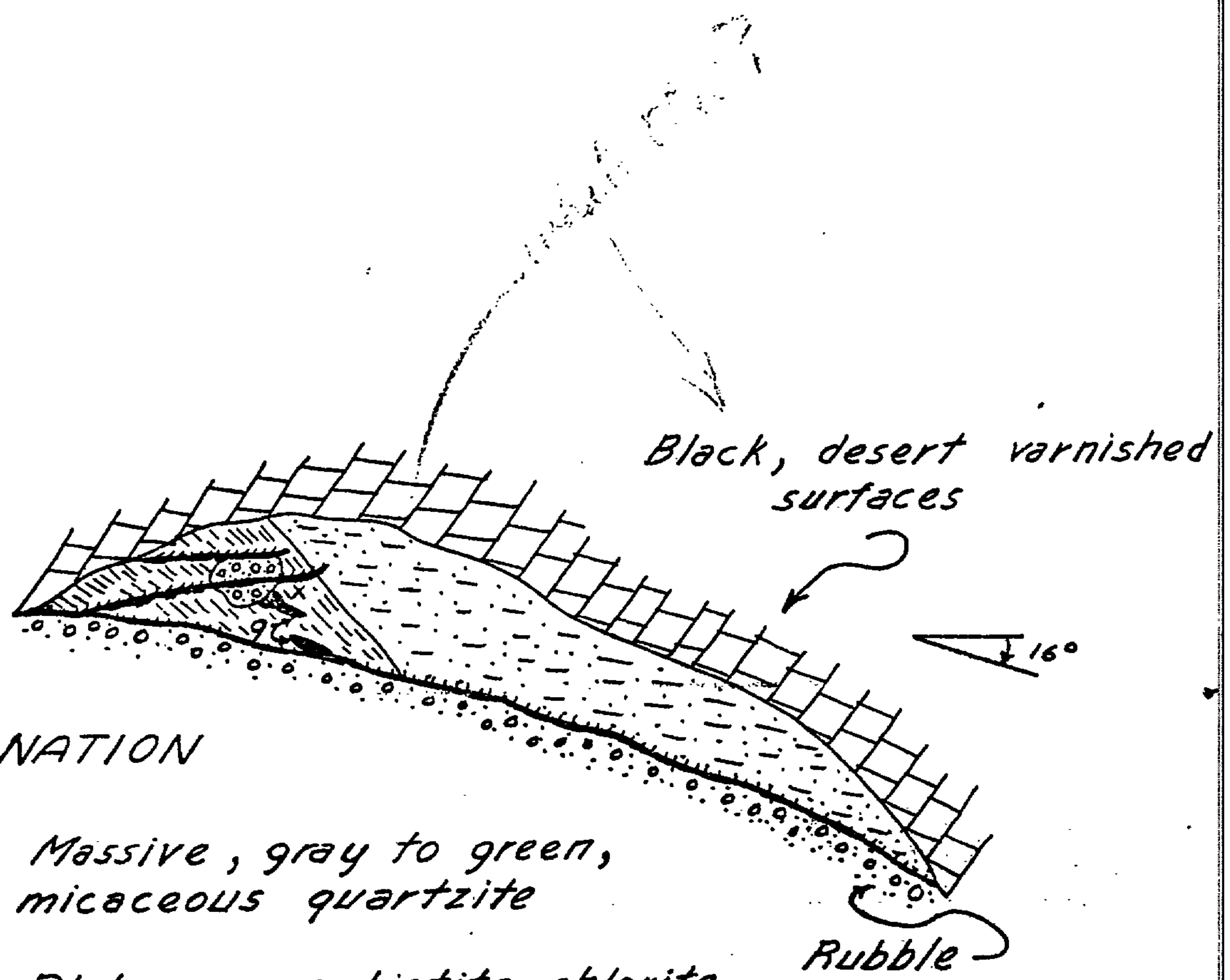
Figure 2. Looking southeast into the face of an open cut above adit 1 and below and to the right of a larger open cut (figs. 1/ and 3/).

of figure 54



EXPLANATION

- Massive, gray to green, micaceous quartzite
- Platy, green, biotite, chlorite schist
- Veins of milky quartz
- Floor of open cut
- x Sample locality (uranophane-bearing rock)

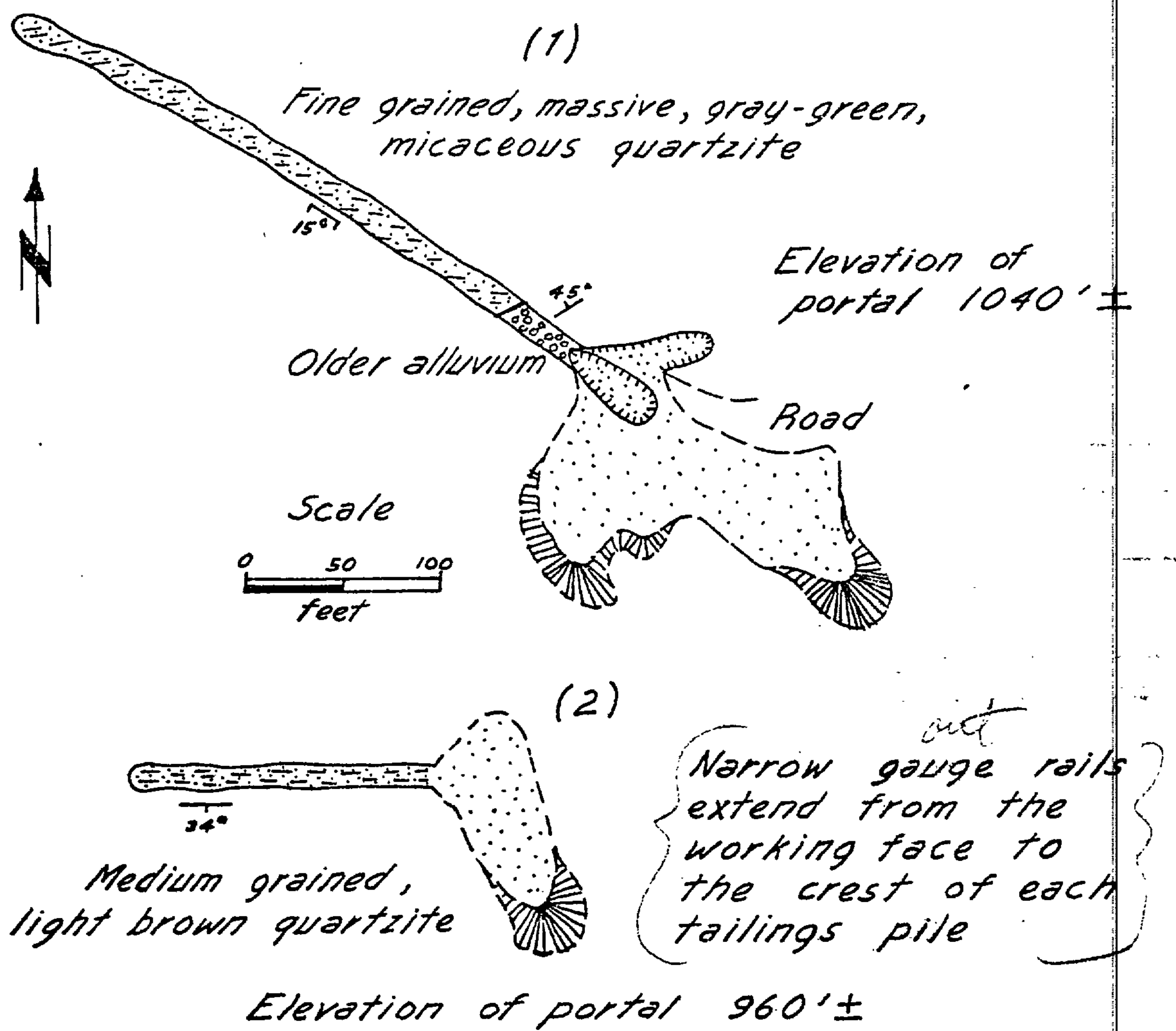
Scale

0 12.5 25
feet

By James R. Evans
November 1958

Uranium

figure 57.



By James R. Evans
November 1958

Figure 57 (1) Sketch map of adits in the northwest (1) and northeast (2) part of section 23, Caproni-Woock uranium groups.

Production: N. A. Caproni reports that between early 1956 and mid-1958, 44 tons of ore, containing between 0.27 and 0.67 percent U_3O_8 ~~were~~ was shipped to the A.E.C., in Denver, Colorado.

References: Miller, 1944, p. 32.

J.R.E. 11/18/58.

Geology: Exploratory work is in fractured and jointed, west-trending metamorphic rocks which form the southern part of the McCoy Mountains. The metamorphic rocks, referred to by Miller (1944, p. 32) as the McCoy formation, are composed largely of gray to greenish-brown metaconglomerate, quartzite, schist and slate with some gray to white quartzite. They have been warped into a broad arch that plunges east. A thin veneer of black desert varnish coats the metaconglomerate and quartzite surfaces. Veins of milky quartz, ranging in thickness from 0 to 15 feet, crop out locally. Thin patches of drusy uranophane and autunite occur as coatings on some of the rock exposed by surface excavations, and at the fact of a 238-foot adit.

Development: Numerous open cuts and shallow prospect pits dot the south slope of McCoy Peak. An adit 238 feet long and 2 large open cuts are in the northwest part of section 23, midway up the south slope of a west-trending ridge (figs. 2/, 2/, and 3/). Another adit, 155 feet long, is in the northeast part of section 23 on the east slope of a south-trending ridge, about half a mile east of the previously mentioned adit (fig. 1/). The areas of exploration are accessible by fair and good dirt roads which join U. S. Highways 70 and 60 about 16 miles west of Blythe. The claims were not being worked in November 1953.

996 Figure 57

Ironwood #1 Prospect

Location: NW 1/4 sec. 20, T. 3 S., R. 23 E., S.B.M. (proj.), Big Maria Mountains NE. quadrangle, 7 1/2', 1954; Big Maria Mountains, about 20 miles north of Blythe and 3 miles west of Quien Sabe Point.

Ownership: Undetermined.

History: Guy Waite and Cyrus H. Ferguson, Box 29, Parker Star Route, Blythe, located the Ironwood #1 claim in March 1956.

Geology: The prospect is in fine to medium-grained, Precambrian hornblende granite. Thin pegmatite dikes occur locally and may contain radioactive minerals. No mineralization was observed and no radioactive anomaly was recorded.

Development: A 9-foot burrow has been dug into the east side of a stream bank at about a 1,000 foot elevation.

Production: Undetermined.

References: None

J.R.E. 12/16/58

Northeast No. 1 Claim

Location: E½ W½ sec. 19, T. 6 S., R. 21 E., S.B.M., McCoy Spring quadrangle, 1952; about 2 miles north of U. S. 60-70 and 12 miles west of Blythe on the south margin of the McCoy Mountains.

Ownership: Joseph and Charles Safranck, 4219 Lennox Blvd., Lennox.

History: Undetermined.

Geology: This property lies along the east face of a narrow, north-northwest-trending ridge of sheared, meta-sedimentary rocks. A secondary, yellow radioactive mineral resembling carnotite is unevenly distributed along shear zones in which it has impregnated porous material and formed thin crusts and fissure fillings. The deposit is exposed in an area several hundred feet long and about 100 feet wide. Its full extent and average grade was not determined when visited in October of 1960.

Development: The radioactive area has been opened by several bulldozer cuts but no systematic exploration appears to have been done.

Production: Undetermined.

References: Butler, Finch, and Twenhofel, 1962.

RBS. 10/17/60

999

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Uranium

The uranium boom of the late 1940's and early 1950's encouraged many people to stake claims in Riverside County but none of these holdings had yielded saleable ore in profitable quantites (through 1962).

Secondary uranium minerals are present as thin fissure fillings and crusts in fractured metamorphic rocks in scattered localities and several gold mines and prospects have been found to contain mildly radioactive, unidentified material (see also tabulated list under Radioactive Deposits).

Caproni-Woock Groups

Location: SE¼ sec. 13, SW¼ sec. 14, (proj.), and N½ sec. 23, N½ sec. 24, T. 6 S., R. 20 E., S.B.M., (proj.) McCoy Spring quadrangle, 15' 1952; McCoy Mountains, about 17 miles west of Blythe on the south slope of McCoy Peak.

Ownership: N. A. Caproni, 510 N. 4th St., Blythe, owns the Real McCoy group of 29 unpatented claims, the Melody group of 15 unpatented claims, and the Kings Ransom group of 7 unpatented claims. N. A. Caproni and W. R. Woock, 339 E. Lockport St., Lodi, own the Royal Flush group of 155 unpatented claims (N. A. Caproni, oral communication, November 1958).

History: Undetermined.

Ram Deposit

Location: SE 1/4 sec. 4, T. 2 S., R. 11 E., S.B.M. (proj.), Valley Mountain quadrangle, 1956; Pinto Mountains, 7.2 miles S. 16° W. of Old Dale (junction of the Twentynine Palms Highway and the Gold Crown Road).

Ownership: R. H. Morath, E. Adamson, and B. Raush, 11060 Brink, Norwalk, own at least 13 unpatented claims (October 1959).

History: Undetermined.

Geology: The Ram deposit is in an area underlain by blue-gray and buff quartzite and coarse-grained tan to white limestone beds of Paleozoic (?) age (fig. 58). Lenses of uraninite (UO_2) no more than 1 inch thick are almost entirely altered to the secondary uranium minerals carnotite-$K_2(UO_2)(VO_4)_2 \cdot nH_2O$, uranophane - $Ca(UO_2)_2(SiO_3)_2(OH)_2 \cdot 5H_2O$, and cuprosklowskite - $Cu(UO_2)_2(SiO_3)_2 \cdot 6H_2O$. The lenses occur in some of the numerous fractures, joint planes, and minor faults in blue-gray quartzite. Locally surfaces of the quartzite are coated with yellow and yellow-green secondary uranium minerals.

Figure 59

1000

Development: Three prospect pits, a 15-foot rectangular open cut, and a 30-foot adit are cut in the west slope of a north-trending ridge (fig. 58/). Several other prospect pits are across the canyon to the west, and also adjacent to the road leading north toward the Groover mine.

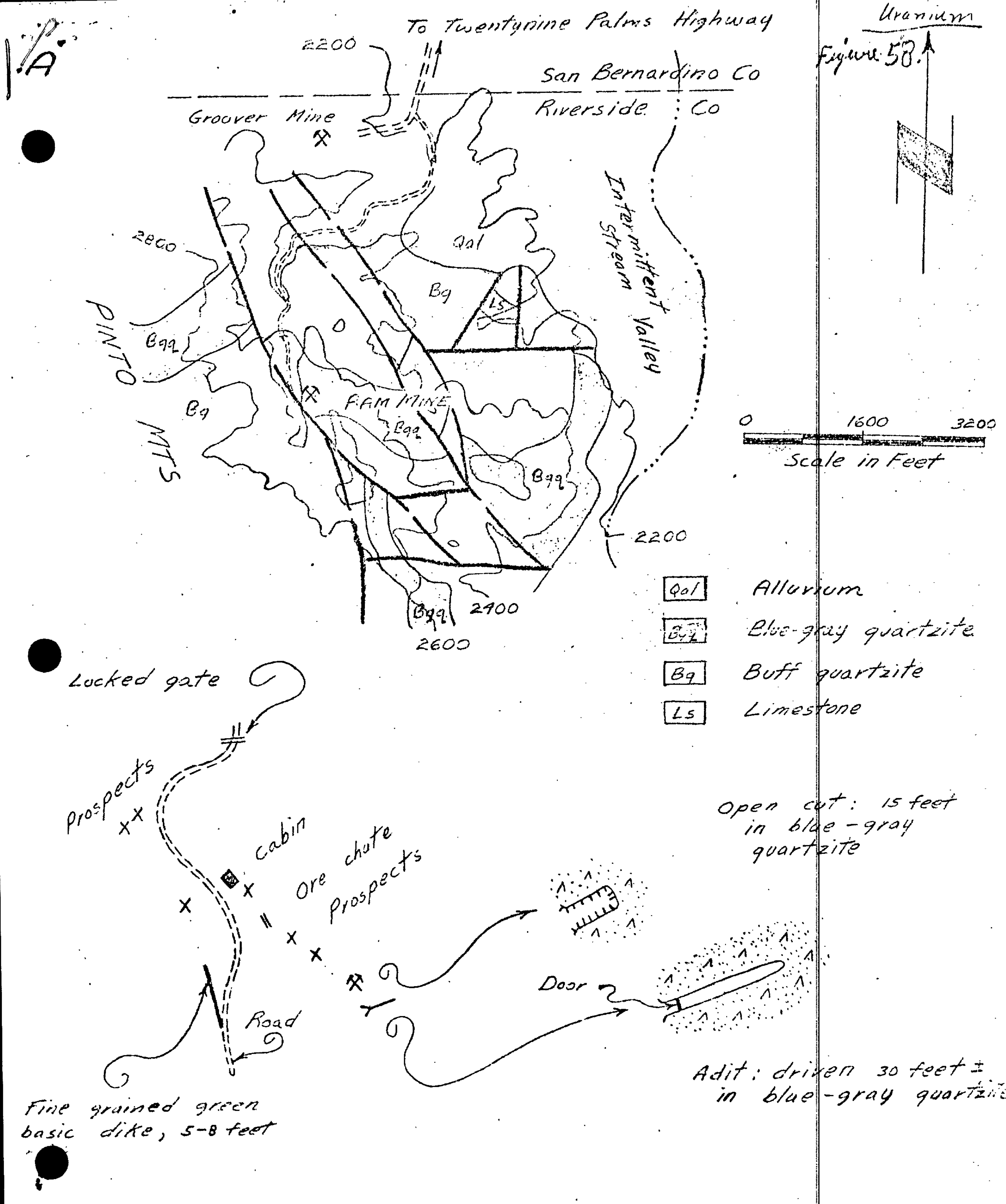
Production: Undetermined.

References: None.

J.R.E. 10/12/59.

Figure 1. Geologic sketch maps (A and B), showing the location, geology (A), and principal workings (B) of the Ram deposit (topography from U.S.G.S. 15' Valley Mountain quadrangle, 1956).

Figure 58.



By James R. Evans
October 1959

(Geology modified from an anonymous source)

Water Resources

Riverside County water resources have been studied in a series of separate investigations each of which has been confined to a specific basin or desert region. Much of the material in this section is based upon reports (listed in the bibliography) by the following authors:

Walter C. Mendenhall, 1909, Coachella Valley)

Gerald A. Waring, 1919, (San Jacinto and Temecula basins)

Eckis, Rollin F., 1934, (Riverside, Arlington and Temescal basins)

Wayne MacRostie, 1953, (Elsinore Basin)

David B. Willets and others, 1954, (Colorado River Basin)

Robert W. Bean, 1955, (San Jacinto and Elsinore Basins)

L. R. Illingworth, 1956 (Santa Margarita River Investigations)

Wayne MacRostie and A. J. Dolcini, 1959 (Santa Ana River investigation)

Fred Kunkel, 1963, (Pinto Basin)

Surface water

~~The accompanying map~~ Figure 59 shows the principal watersheds, basins, water bodies and aqueducts in Riverside County.

Figure 59

The principal sources of surface water in the western half of the county are the San Bernardino and San Jacinto mountain ranges, and Agua Tibia and Palomar mountains. Except for the San Jacinto Mountains, these catchment areas lie outside the county boundaries. The sparse (~~surface flow~~ runoff) in the desert east of the Coachella Valley (~~is in dry~~ enters) washes in which water flows only during storms or unusually wet seasons. The Colorado River adjoins the eastern edge of the County.

The Santa Ana River gains a fairly sustained flow of good water from the San Bernardino Mountains, although the surface flow is only intermittent. The high quality of this water is attributed to storage of rain and melted snow in granitic and metamorphic rocks from which a minimum of dissolved matter is derived. Downstream tributaries drain areas underlain in part by sedimentary rocks containing more readily soluble minerals and connate brines.

The Whitewater River extends from headwaters on the southeast slope of the San Bernardino Mountains to the Salton Sea. It flows through its entire length only under flood conditions. In its headwater region the Whitewater River has a sustained flow of good water but this seldom extends beyond the canyon mouth at Whitewater, at or near which point it percolates into the alluvium and into the groundwater basin of Coachella Valley. In its lower reaches the channel of the Whitewater River has been deepened to afford drainage for irrigated lands. Here water entering the Salton Sea contains nearly 5,000 parts per million total dissolved solids.

The San Jacinto River flows from headwaters on the southwest slope of the San Jacinto Mountains to a terminus in the Elsinore Basin. ~~(Storage and diversion have dried most of the stream bed during much of the year.)~~ Little surface flow reaches the Elsinore Basin except in times of flood because of Railroad Canyon Dam. The San Jacinto River is one of the important sources of groundwater recharge in the San Jacinto and Perris valleys. Water discharged from the Railroad Canyon Reservoir recharges the groundwater supply in the Wedco area southeast of Elsinore.

The upper 5 miles of the Santa Margarita River and most of its headwater tributaries lie within Riverside County. This river flows southwest from Temecula to the Pacific Ocean. The headwater area includes the watershed of Murrieta Creek and most of the watershed of Temecula Creek. Murrieta Creek drains the Elsinore ~~Fault~~ basin as far northwest as Wildomar and is joined by smaller creeks which drain areas as far northeast as Domenigoni, Diamond, and Weber valleys. Temecula Creek and its tributaries drain the north slopes of Agua Tibia and Palomar mountains and Oakgrove Valley to the southeast in adjoining parts of San Diego County; areas as far east as Coahuila and Burnt Valleys and northeast as far as Reed Valley below the southwest slopes of Red and Little Coahuila mountains.

Most of the stream beds in the Santa Margarita River watershed are dry during much of the year. Surface water quality varies both areally and with rate of flow but in general it is suitable for irrigation and domestic use.

Ground water

Ground water is that water in the zone of saturation lying below the water table. The quality, quantity, and distribution of ground water is governed by geologic and climatic history and the modifications of human use and development.

Riverside County comprises a part of the earth's crust which is cut by at least two major fault systems and many local fault and fracture systems. Groundwater storage tends to be compartmented in discreet basins, especially in the fault-bounded valleys of the eastern desert area. Annual recharge from rainfall is small and in most basins water encountered in wells represents accumulated storage. Water quality generally is better in basins from which there is a regular subsurface discharge. In the western half of the county water commonly is sought in buried stream courses. One such source is a north-trending, bedrock canyon underlying the alluvium in the Arlington and Riverside areas. Another canyon, cut in bed rock, appears to control subsurface drainage in the Moreno, Perris, San Jacinto and Menifee valleys. Some wells in the Menifee Valley have yielded over 1,000 gallons per minute when pumped, but some trouble has been encountered with water mineralized by buried organic materials. In parts of the above named valleys both pumping and recharge are hindered by the low permeability of the sediments. As the basins filled the gradients of the influent streams decreased and the basin fill was capped mainly by fine deeply weathered material. Rain water commonly ponds and evaporates without penetrating the valley floor. Some permeable sands comprise narrow, irregular channel filling which wells encounter only by luck. Some wells must penetrate numerous permeable sand layers to support pumping. As a general rule sediments become more coarse and permeable with depth but in many wells near basins margins bed rock is reached before adequate yield is assured.

The area surrounding Corona is called the Temescal Basin. This basin occupies the Elsinore Fault Zone from Elsinore northwest to the Santa Ana River. It is drained through Temescal Wash. Groundwater in Temescal Basin is derived mainly through percolation from Temescal Wash and numerous small water courses draining the northeast slope of the Santa Ana Mountains. Some additional water is gained from irrigation return and possibly from underflow from Arlington basin, to the northeast, through Arlington Gap. On rare occasions Temescal Wash receives overflow from Lake Elsinore, the last outflow having occurred in 1917. As a result the water of Lake Elsinore usually contains substantial concentrations of salt.

Because of poorer lower tributary water and effluent seepage from ground water or sewage, the quality of water in subsurface flow tends to be markedly poorer in the Santa Ana River during the summer months, especially below Prado Dam at the western tip of the county.

The northwest end of the Coachella Valley is the only desert area which receives runoff from timbered highlands in or adjacent to the county. In the Whitewater area the well depths are about 500 feet. At Palm Springs wells range from 100 to 200 feet in depth. Southeast of Indio ground water is encountered within 50 feet of the surface. Early wells in the Coachella area yielded surface artesian flow from ground water confined beneath impermeable surface material. Artesian effects still exist in wells of that area but do not reach the surface. Ground water quality shows an irregular, progressive decrease from Whitewater to the Salton Sea. One change is a decrease in calcium ions and an increase in sodium ions. The total amounts of dissolved mineral matter are small, however, and in the irrigated areas of the southeast end of the Coachella Valley many farmers use well water to supplement imported Colorado River water and a few prefer its exclusive use. Natural mixing of imported water with ground water is inhibited by fine-grained sediments which underlie most of the irrigated areas.

In the desert area lying between Indio and Blythe the principal proven groundwater storage areas are Pinto Basin and the basin underlying Chuckwalla Valley.

In Pinto Basin, ground water is deeper than 95 feet below the surface. In 1953, Kunkel estimated the storage capacity of the upper 100 feet of saturated alluvium in the central part of the basin to be about 250,000 acre-feet. The water in Pinto Basin is the sodium sulfate type containing less than 1,000 ppm (parts per million) dissolved solids. It would be considered of good general quality save for a fluoride content from 2.0 ppm to as high as 2.7 ppm. The U.S. Public Health Service (1946) set a mandatory upper limit of 1.5 ppm of fluoride for drinking and culinary water supplied by interstate carriers and others subject to federal quarantine regulations. Sodium ion concentrations in water from several wells in the basin are between 200 and 300 ppm which is high enough to make the water of doubtful quality for irrigation.

The water in Pinto Basin is the result of long accumulation. Subsurface flow is eastward toward a narrow channel between the east end of the Eagle Mountains and the Coxcomb Mountains. Here, groundwater is reported to discharge across a subsurface barrier into the lower, adjacent basin underlying the Chuckwalla Valley.

Until recent years, wells in the Chuckwalla Valley have yielded water of poor quality. Total dissolved solids are reported to range from 420 ppm to as high as 4,372 ppm with fluoride concentrations that range from 1.7 ppm to 35.0 ppm. This water is from wells ranging in depth from 15 feet to 400 feet. Depth to water is reported to range from 11 feet to 70 feet. In the early 1960's several wells were drilled to depths ranging from 700 feet to 900 feet. Water of improved quality is reported from these deep wells but no chemical data were obtained. No data on reserves or groundwater movement were obtained for the Chuckwalla Valley. Palen and Ford dry lakes are base levels for surface drainage.. Judging from surface drainage the Wiley Well area, east of the Little Chuckwalla Mountains, appears to be the most likely site for subsurface discharge from the Chuckwalla Valley if such drainage exists.

Groundwater recharge in the Palo Verde Valley is by percolation from the Colorado River and sporadic discharge from desert washes, primarily McCoy Wash. The City of Blythe draws water from wells for domestic use. The well water has a higher total-dissolved-solids analysis than the river water. Like the river water, available analyses show no fluoride.

Early efforts to develop water supplies in Riverside county consisted mainly in the use of natural springs, streams, and sinking shallow wells. In the desert, miners usually had to transport water. Six wells were dug in Pinto Basin during the various periods of mining activity. By the later 1950's two of these had been destroyed and two had fallen into disuse. In the early 30's the Metropolitan Water District dug Pinto Well at the outlet of Pinto Basin. Kaiser Steel Corporation has used Pinto well since 1949, and in 1957 completed a nearby well. The water from these wells is used at the Eagle Mountain mine and beneficiation plant. By 1959 Kaiser's annual consumption from the wells was 1,700 acre feet. From 1933 through February 1956 the water level in Pinto Well had lowered about 2.5 feet. From February 1956 through October 1960 water levels in both wells was down 14 feet. The old well and new well are 482 feet and 675 feet in depth respectively; in 1960 water levels were 102.62 feet and 114.22 feet below the surface.

Conservation and supplement

Using local sources of water as a basis of judgement, much of Riverside County is water deficient. The Palo Verde Valley, Pinto Basin (and possibly the Chuckwalla Valley), the southeast half of the Coachella Valley (southeast of Indio) and the watershed of the Santa Margarita River are areas in which natural reserves meet or exceed the demands of development.

Various systems of water conservation, flood control and importation are in use to supply the demands of the populous western half of the county. The south fork of the San Jacinto Rivers was dammed in 1895 by the Lake Hemet Water Company. The reservoir (Lake Hemet) has a capacity of 14,000 acre-feet. In 1928 the Temescal Water Company dammed the main channel of the San Jacinto River to form Railroad Canyon Reservoir with a capacity of 12,000 acre-feet. The Gage Canal Company constructed the 1,000 acre-foot Mockingbird Canyon Reservoir in 1914. In 1949 the Vail Company completed Vail Dam and reservoir on Temecula Creek the maximum reservoir capacity of which is about 49,500 acre-feet.

The U. S. Army Corps of Engineers has engaged in flood-control work; Prado Dam is the most extensive of their projects in Riverside Co. This earth-fill dam blocks the head of Santa Ana Canyon at the east end of Chino Hills. It is 2,280 feet long and 106 feet high. The project was started in 1938 and completed in 1941. Flood waters are controlled by other smaller structures such as the Bautista Creek Debris Basin near Hemet, completed in 1961.

In some areas in and adjacent to Riverside County special spreading and percolation basins are used to facilitate recharge of groundwater basins with water which might otherwise be lost to the sea.

To supplement the generally deficient native water supplies of the coastal basins of southern California two Colorado River aqueduct systems have been constructed and in 1965, county officials hope that an additional supply will be available some time in the 1970's from the distribution system of the (California Aqueduct ~~Feather River Project~~).

The Colorado River Aqueduct was started in December, 1932 and completed in June, 1941. From the Intake at Parker Reservoir to the terminal storage and water conservation basin of Lake Mathews in western Riverside County, the aqueduct comprises 92 miles of tunnels 16 feet in diameter, 63 miles of concrete-lined canal, 55 miles of concrete lined conduits, 29 miles of inverted siphons totaling 144 in number, and 321 miles of power lines from Hoover Dam to power 5 pumping plants of 9 pumps each. The Colorado River Aqueduct serves portions of six counties including Riverside County. In Riverside County the area served is included in two water districts known as the Western Municipal Water District and the Eastern Municipal Water District. The Western Municipal Water District comprises Riverside, Elsinore, Corona, and some unincorporated areas. The Eastern Municipal Water District includes Hemet, Perris,San Jacinto and surrounding unincorporated areas.

Irrigation water is imported to the Coachella Valley through the Coachella Canal. This canal was built during the late 30's and early 40's. It draws water from the All American Canal which heads at Imperial Dam at the southeastern edge of Imperial County. The Coachella Canal extends from the southeast corner of Imperial Valley northwest along the northeast side of the Imperial and Coachella valleys to the northwest edge of Indio. From Indio the canal water is delivered as far southwest as the Oasis area through the Oasis Lateral.

The Palo Verde Valley is served by the Palo Verde Irrigation District. This district's water is drawn from the Colorado River at Palo Verde Dam about 10 miles north of Blythe. The Palo Verde Irrigation District has established water rights dating back to 1887. Between 1908 and 1955 the District irrigated all cultivated land within 90% of its gross valley area by gravity from the river. Following the construction, in 1942, of Headgate Rock Dam, below Parker Dam, the desilted water of the Colorado River began to degrade the river bed. The water level dropped and the District had to install pumps. The U.S. Government constructed a temporary rock weir in 1945 to maintain the water level at the canal intake. By 1958 a permanent dam (Palo Verde Dam) was built about 1,000 feet downstream from the loose rock weir. A stable head is now maintained for the district's irrigation system.

R.B.S.

Wollastonite

Deposits of wollastonite of varying purity are exposed in extensive areas in the Big Maria, ~~and~~ Little Maria ~~Mountains~~ and ~~the~~ Arica Mountains, 16 to 20 miles northwest of Blythe (fig. [illegible]). Wollastonite of high purity forms pods which range from a few inches to as much as 1,800 feet in maximum length. The most extensive wollastonite body appears to form the core of a shallow anticline plunging west-northwest on the west side of the Big Maria Mountains (Troxel, 1957, p. 693, 694). The mineralization is probably a result of dynamo-thermal metamorphism.

Most of the area underlain by wollastonite-bearing rocks is covered by placer claims of U. S. Gypsum Co., Midland, and California Limestone Products, Blythe. The latter firm has tentatively explored a deposit in the Little Maria Mountains with plans for its ultimate use as a raw material at the~~ir~~ rockwool plant of Woolstone Inc., north of Blythe. The deposits in the Little Maria Mountains were acquired in 1965 by Chas. Pfizer & Co., Inc who continued exploration work.

The principal use, to date (1961), of wollastonite from the Maria Mountains is for decorative rock. Because float fragments of the material weather with a directional grain, in shades of gray and brown, the material has been marketed under the trade name of "Driftwood Stone". Jontz Stone Co., 185648 E. Highway 60-70, Blythe and Lawrence Johnson, Mineral Exploit Co., P.O. Box 821, Blythe, were marketing this rock in 1961.

The float fragments of weathered wollastonite are gathered from hillsides and alluvial surfaces, trucked to Blythe and sold to dealers.

Although production figures were not obtained, the popularity of the rock suggests that a large tonnage has been marketed, mostly in the Los Angeles area and possibly east to the Phoenix area.

Limited amounts of wollastonite have been used as a ceramic raw material in California but industry demands have thus far been met by wollastonite from a deposit in New York State (Troxel, 1957, p. 697). Consistency of grade and milling characteristics have yet to be established for the Riverside County material described above.

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Tabulated List of Mines and Mineral Deposits

Riverside County, California*

Asbestos

Riverside County

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Dunn Asbestos deposit	Secs. 32 and 35, T6S, R5E, SBM, 4 mi. northwest of Nightingale Camp.	Elmer E. Dunn, Pinyon Flat (1945)	Amphibole asbestos in belt of serpentinized rocks. Asbestos in narrow fractures and shears.	Worked through open cuts (Tucker 1945, p. 158, pl. 35).

*This tabulation contains data primarily on deposits not described in the text. Alternate or discarded names of described deposits are in this list. It is not a complete index of deposits. The symbol (t) means, see text for description.

Asbestos

Riverside County

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Perris Asbestos deposit	Sec. 2, T5S, R4W, SBM, 2 mi. southwest of Perris.	I. O. Walser, Los Angeles (1945).	Amphibole asbestos in veins 6 in. to 2 ft. wide in sheared granitic rock.	100 tons reported shipped to Soto Battery Box Manufacturing Co. in 1930. Worked through open cuts. Reported worked out in 1945 (Tucker 1945, p. 159, pl. 35).

Asbestos

Riverside County

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Serpentine Hill claims	Sec. 35, T6S, R5E, SBM, just east of Pinyon Flat.	Undetermined (1961)		(Tucker 1945, pl. 35).

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
5	Atlas Pit	S½S½NE¼SW¼ sec. 26, T4S, R6W, SBM. 8½ miles southeast of Corona on the northeast side of Temescal Wash, at the western margin of the Gavilan Hills, ½ mile north of Arcilla Siding.	International Pipe and Ceramics Corporation, 2901 Los Feliz Blvd., Los Angeles 39	Much of the property is underlain by Triassic(?) Bedford Canyon Formation, but across the northern part is a band of residual claystone derived by weathering of Bedford Canyon Formation. In 1963 clays exposed in the pit included gray plastic, brown plastic, red mottled, and "bone" clays. Clay beds strike nearly east-west and dip 15° to 30° northerly.	15 acres. Apparently mined by the Atlas Fire Brick Company in the 1920's for use at their Los Angeles Plant. Later acquired by Gladding, McBean and Co. Inactive for many years since the 1920's but reactivated in 1960 and mined as part of the adjoining Corona Clay Pit of Riverside Cement Co. In 1963 the Atlas pit was about 150 feet long on several irregular bench levels with maximum face about 50 feet high. Part of the red mottled clay and all of the gray plastic clay goes to the Corona plant of International Pipe and Ceramics Corp. The remainder of the red mottled clay goes to the Crestmore plant of Riverside Cement Co., and the "bone" clay goes to their Oro Grande plant. After stripping mining is by Caterpillar D-8 equipped with ripper and bulldozer. Front end Caterpillar loader loads clay directly into truck and trailer units for transport to the plants. (Dietrich, 1928, plate 10 facing p. 162).

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
7	Brown (J. W. Wilson)	N½ sec. 23 and 24, T1S, R23E, SBM, 3 miles south-southwest of Vidal along the Riverside-San Bernardino County line.	This is near or part of claim held by Mr. Brown, Vidal	The area is a badlands cut in Late Tertiary and/or Quaternary strata deposited in a lake, estuary, or bay. At least one bed contains pelycepod remains of undetermined systematic and ecologic affinities. Shark teeth have been reported from this locality. Impure, ~~bentonitic~~ clay forms a unit as much as 20 feet thick.	The principal exposures lie in San Bernardino County where clay beds have been mined on a small scale. The material is ground at a small plant at Vidal and sold for use in well drilling. Samples from this deposit were once tested and found unsuitable for ceramic use. (Dietrich, 1928, p. 181-182, 340; Tucker, 1929, p. 502).
	Brown Star claims				See Middlesworth clay deposit (t)
	Castillo deposit				See Castillo, under coal (t)
	Corona clay deposit				See Bedford Canyon clay deposit (t)
	Corona shale mine				See Dry Ranch Clay Co. and Wardlow shale deposit (t)
	Dutch placer				See Kremmer clay deposit (t)

Clay

Riverside County

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
16	Elsinore Joint Property	$W\frac{1}{2}NE\frac{1}{4}$, $SE\frac{1}{4}NE\frac{1}{4}$ sec. 26, T5S, R5W, SBM. Low hills 2 miles southeast of Alberhill.	Pacific Clay Products, 1255 West Fourth Street, Los Angeles owns a half interest with International Pipe and Ceramics Corp., 2901 Los Feliz Blvd., Los Angeles 39.	Northern part of property covered by Quaternary terrace deposits. Southern part underlain by Paleocene Silverado Formation (upper part) green clay shale and micaceous arkose; beds strike northwest, dip 15°S.; southeastern part underlain by Silverado Formation (lower part) white, and red, white and buff mottled claystone, beds strike northwest, dip 6°S.	120 acres held in alternate 10 acre blocks by the two owners. Only the Hoist pit area (see herein in text), idle since 1912, has been mined. Both owners have done drilling and made bulldozer cuts on their respective parcels of land in recent years. In June 1963 the International Pipe and Ceramics Corp. drilled several tests holes in their area just south of the old Hoist pit. One drill hole was as follows: Buff sandy overburden, 25 feet; red clay, 45 feet; buff and gray clay, 20 feet. Holes were drilled to 90 feet and the two observed were still in clay at 90 feet. (Dietrich, 1928, p. 181, plate 10 facing p. 162).

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
17	El Sobrante	NE¼ sec. 26, T4S, R6W, SBM. 8½ miles southeast of Corona on the northeast side of Temescal Wash, at the western margin of the Gavilan Hills, ½ mile north of Arcilla Siding.	Pacific Clay Products, 1255 West Fourth St, Los Angeles	Central part of property underlain by Triassic(?) Bedford Canyon Formation slate, argillite, and quartzite which strikes northwest and dips about 40° northeast. Along the east side of the property the Bedford Canyon Formation is overlain by nearly flatlying green clay shale and micaceous arkose of the upper part of the Paleocene Silverado Formation. Along the west margin of the Bedford Canyon Formation is a narrow band of residual claystone derived by weathering of the Bedford Canyon Formation. This band of claystone trends northeast and ranges in width from a featheredge to about 200 feet. The west portion of the property is underlain by nearly flat lying green clay shale and micaceous arkose of the upper part of the Silverado Formation, which overlies the band of residual claystone.	Property consists of 160 acres. Held by Pacific Clay Products since before 1928. So far as known no development work has been done. (Dietrich, 1928, plate 10 facing p. 162, p. 181; Rogers, 1959, pl. 5).

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Evans Shafts	NE¼ sec. 31, T5S, R4W, SBM, east side of State Highway 74, half a mile northeast of North Elsinore.	Undetermined	Surface covered by Quaternary alluvium. Clay not exposed.	Stauffer (1945, map Station 4) listed the area as ...."Evans shafts and incline to the fire clay." In 1963 only a small caved working was found in this location, but a shallow depression suggests the presence of caved underground workings. (Stauffer, 1946, map Sta. 4).

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
22	Findley Prospect Fin[illegible]r clay deposit	SE¼NW¼ sec. 2, T5S, R6W, SBM. 9 miles southeast of Corona in low hills in Temescal Valley, 1 mile south of Arcilla Siding.	Undetermined	Area covered by Quaternary terrace deposits. Underlain by Triassic(?) Bedford Canyon Formation with upper surface weathered to form residual claystone. Thin (10 to 15 feet) discontinuous exposures of Paleocene Silverado Formation green clay shale and micaceous arkose. Small exposure of pink mottled clay.	Small prospect pit, date unknown. See Fyle Canyon clay deposit

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Freeman	Undetermined; probably various deposits between Main Street and Hagador Canyons about 3½ miles southwest of Corona	Undetermined	Clay-bearing Paleocene Silverado Formation sandstone and siltstone crop out in this area.	(Gray, 1961, p. 77-78, 111).

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
25	Harlow Pit Hoag-Rich clay pit	SW¼NW¼ sec. 15 (proj.), T4S, R6W, SBM. 5 miles southeast of Corona at the south side of lower Cajalco Canyon east of Temescal Wash.	Miss Lela May Harlow, Cajalco Road, Corona	Thin band of Paleocene Silverado Formation siltstone and clay shale strikes northwest and dips 45° NE. Silverado Formation crops out at base of a low hill and overlies residual claystone formed by weathering of Triassic(?) Bedford Canyon Formation. Hill is capped by Quaternary terrace deposits.	Pit opened by Liston Brick Company about 1954 as a source of material for their nearby brick plant. Both the Silverado Formation and residual claystone have been mined on a small scale up to the present (1963) as needed. Pit is a sloping side-hill cut about 150 feet long and 100 feet wide. Sequence exposed in main working in June 1963 was buff mottled claystone with red and gray pods, about 20 feet thick; overlain by red, sandy, clay soil about 5 feet thick. See Jones clay pit (Tu)

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Hoff Ganister Fire Brick Company	Undetermined			By 1928 some prospecting had been done by core-drilling and test-pitting. In 1929 property was reported to be 100 acres in sec. 22, T.5 S., R. 5 W., S.B.M. Apparently this property is now part of the holdings of International Pipe and Ceramics Corporation (Sloan pit area), or possibly is within the Alberhill Mines of Pacific Clay Products. (Dietrich, 1928, p. 174; Tucker and Sampson, 1929, p. 500; Sampson, 1935, p. 519).
	Hoffman deposit				See Jones clay deposit (t)
	Leo Lorenzo				See Kroonen clay deposit (t)

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Lord Deposit	Undetermined; may be same as Middlesworth clay or part of Corona placer described herein	Undetermined	Undetermined	George W. Lord, Corona reported light gray, fine-grained fire clay under development in 1905. (Aubury, 1906, p. 233; Gray, 1961, p. 71, 72, 78, 112).
	McVicar pit				See Susie placer (?)
	Morton deposit				See Elsinore Clay Co. (?)

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
39	Murphy Pit	N½NW¼ sec. 35, T4S, R6W, SBM. 8½ miles southeast of Corona on the northeast side of Temescal Wash, at the western margin of the Gavilan Hills, ¼ mile west of Arcilla Siding.	Pacific Clay Products, 1255 West Fourth St., Los Angeles	Residual mottled claystone derived by weathering of Triassic(?) Bedford Canyon Formation and Jurassic (?) quartz latite porphyry occur in the western part of the property. Claystone is overlain by terrace deposits. Eastern part of property is underlain by Bedford Canyon Formation and quartz latite porphyry. According to Tucker and Sampson (1945, p. 162) red and yellowish-brown clay about 30 feet thick was overlain by 20 feet of overburden. In 1963 only residual pink mottled clay was observed with a terrace deposit overburden of at least 10 feet.	50 acre tract. Pacific Clay Manufacturing Co. owned and operated a large pit here in 1904 and the pit was still active in 1920, operated by the Pacific Sewer Pipe Co. By 1945 the Murphy pit was a side hill cut with a face 200 feet long and 50 feet high, operated by Pacific Clay Products. By 1963 an area about 1,250 feet long and 500 feet wide contained several irregular pits, the largest about 500 feet long, 200 feet wide, and 50 feet deep. Property has been idle since 1959. (Aubury, 1906, p. 223-224; Merrill, 1917 [1919], p. 569; Boalich and others, 1920, p. 89-90; Tucker and Sampson, 1945, p. 161-162; Stauffer, 1946, map Sta. 26).

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
45	Park Red Ball	E½NW¼ sec. 26, T4S, R6W, SBM. 8½ miles southeast of Corona on the northeast side of Temescal Wash at the western margin of the Gavilan Hills, ½ mile north of Arcilla Siding.	Liston Brick Co. Lionel P. Liston, P.O. Box 7, Corona	Northeastern part of the property is underlain by Triassic(?) Bedford Canyon Formation and Jurassic(?) quartz latite porphyry. Nearly flat lying green clay shale and micaceous arkose of the upper part of the Paleocene Silverado Formation crop out in the eastern and central part of the property. These sediments overlie residual claystone derived by weathering of Bedford Canyon Formation metamorphic rocks. The claystone crops out in the southwestern part of the property and ranges in width from 500 feet to 750 feet.	The Blue Face, Cross Cut, Grand View, and Oak Tree placer mining claims totaling 85.04 acres were patented to Thomas E. Parks and others in 1914. Acquired by Liston Brick Co. about 1950. Apparently the property has not been mined; but has been explored in recent years by drilling. (Aubury, 1906, p. 224; Dietrich, 1928, plate 10 facing p. 162, p. 180; Rogers, 1959, pl. 5). See Middleworth dg. F (L)

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
49	Quintet	W½NW¼ sec. 26, T4S, R6W, SBM. 8½ miles southeast of Corona on the northeast side of Temescal Wash, at the western margin of the Gavilan Hills, ½ mile north of Arcilla Siding.	Pacific Clay Products, 1255 West Fourth St. Los Angeles	Much of the property is underlain by Jurassic(?) quartz latite porphyry, but the central and southeastern portions are underlain at different points by residual clay derived from weathering of quartz latite porphyry and Bedford Canyon Formation metamorphic rocks. Exposures of the clays range in width from 75 feet to 500 feet. The residual clays are overlain by nearly flat lying green clay shale and micaceous arkose of the upper part of the Paleocene Silverado Formation.	Quintet placer mining claim of 88.79 acres was patented to Pacific Clay Products in 1926. The property has not been mined but has been extensively explored in recent years by means of drilling. (Dietrich, 1928, plate 10 facing p. 162, p. 180; Rogers, 1959, plate 5).

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
52	Silt deposit (name undetermined)	$E\frac{1}{2}$ sec. 5, T5S, R3W, SBM. $1\frac{1}{2}$ miles southeast of Perris along the San Jacinto River.	Undetermined	Quaternary river silt and silty clay.	Colton Cement Plant is reported to have used clay at some period, before 1906 from the area of the San Jacinto River where traversed by the Santa Fe Railroad (Aubury, 1906, p. 224). No trace of former workings was found in 1963.
	Sky Ranch clay mine, west pit				See Wardlow shale mine

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
53	South Pit	SE¼SW¼ sec. 35, T4S, R6W, SBM. 8½ miles southeast of Corona in low hills in Temescal Valley, southwest side of Temescal Wash, 3/4 mile south of Arcilla Siding.	Pacific Clay Products 1255 West Fourth St, Los Angeles	Area covered by Quaternary terrace deposits. Underlain by Triassic(?) Bedford Canyon Formation with upper surface weathered to form residual claystone. Thin (10 to 15 feet) discontinuous exposures of Paleocene Silverado Formation green clay shale and micaceous arkose. In 1942 the pit exposed a high alumina clay horizon about 4 feet thick. The sequence exposed in the main part of the pit in 1963 was as follows: Bouldery, sandy overburden, 10-15 feet; red and gray mottled clay, 5 feet; white clayey sand, 2 feet; gray-white plastic clay, 1½ feet; red and gray mottled clay, 1½ feet; "bone" clay, 10 feet. The beds strike about N. 70° W., dip 10° SW., but in places appear to be nearly flat-lying. Overburden ranges from 10 to 30 feet.	28 acre tract. Pit probably opened after 1926. By 1942 it was being mined by Pacific Clay Products who have continued to mine intermittently until the present (1963). In 1945 the pit was a side-hill cut 250 feet long and 30 feet high; overburden was 10-15 feet, white siliceous fire clay 12-18 feet, red clay 15 feet. By 1963 the active pit was about 300 feet long, 200 feet wide, and 30 feet deep. Clay is mined by contract about once a year, stockpiled, and hauled to the Los Nietos plant as needed. Total production is unknown, but in recent years has been a few thousand tons each year. Clay reserves in the immediate pit area appear to be small. (Tucker and Sampson, 1945, p. 162; Stauffer, 1946, Map Sta. 24). 18

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
58	Temescal Lease	NW¼SW¼ sec. 35, T4S, R6W, SBM. 8½ miles southeast of Corona in low hills in Temescal Valley, southwest side of Temescal Wash, ½ mile southwest of Arcilla Siding.	Pacific Clay Products, 1255 West Fourth St., Los Angeles	Area covered by Quaternary terrace deposits. Underlain by Triassic(?) Bedford Canyon Formation with upper surface weathered to form residual claystone. Thin (10 to 15 feet) discontinuous exposures of Paleocene Silverado Formation green clay shale and micaceous arkose.	Triangular shaped 20 acre tract. Prospected but not developed for clay, in use as a stockpile area in 1963.

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
59	Temescal Water Co.	NE¼SW¼, NW¼SE¼ sec. 35, T4S, R6W, SBM. 8½ miles southeast of Corona in low hills in Temescal Valley, southwest side of Temescal Wash, ½ mile south of Arcilla Siding.	Temescal Water Co., 707 Main Street, Corona. Leased in part to Atlas Sewer Pipe Co., 10009 South Painter St., Whittier and in part to Mission Clay Products Co., 16961 East Santiago Blvd., Olive.	Area covered by Quaternary terrace deposits. Underlain by Triassic(?) Bedford Canyon Formation with upper surface weathered to form residual claystone. Thin (10 to 15 feet) discontinuous exposures of Paleocene Silverado Formation green clay shale and micaceous arkose. The pit active in 1942 exposed pink mottled clay and a high alumina clay horizon about 4 feet thick with overburden 10 to 30 feet. The 1963 pit sequence was: sandy conglomerate overburden, 10 feet; dark red clay, 15 feet; gray plastic clay, 3 feet; buff and red mottled clay, 3 feet. Beds strike about N. 55° W., dip 10° SW., but in places appear to be nearly flat-lying.	Pit in NE¼SW¼ sec. 35 opened in 1926 by open cut 25 feet wide and 40 feet long. In 1942 the pit was operated by Emsco Clay Co. and was about 300 feet long, 250 feet wide and 50 feet deep. This pit was inactive in January 1963, and apparently had been idle for some time. The active pit in 1963 is at the west side of Temescal Wash in the NW¼SE¼ sec. 35. It is a somewhat L-shaped side-hill cut about 300 feet long, 150 feet wide, and 30 feet deep. Mining for both lease holders is done by the Corona Clay Company utilizing bulldozers, rippers, power shovels, and front-end loaders. The several types of clay are stockpiled separately and transported as needed to the Atlas Sewer Pipe Company plant in Whittier and Mission Clay Products Company plant in Olive. The Corona Clay Company has mined this area for a number of years, probably since the late 1940's. Production of a few thousand tons each year, total undetermined. (Dietrich, 1928, p. 181, 329; Stauffer, 1946 Map Sta. 25).

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
60	Terra Cotta Eighty	W½SW¼ sec. 26, T5S, R5W, SBM. Low hills 2 miles southeast of Alberhill.	Pacific Clay Products, 1255 West Fourth Street, Los Angeles	Most of the area is covered by Quaternary terrace deposits. Triassic(?) Bedford Canyon Formation crops out along the western margin of the property and green clay shale and micaceous arkose of the Paleocene Silverado Formation (upper part) crop out along the northern and eastern margins.	80 acres held by present owner since before 1926. May be site of the Dolbeer and Hoff Coal prospect, active in the 1880's (see in text under Coal). Area apparently has not been mined for clay. Drilling in the north part of property by Pacific Clay Products in the early 1960's is said to have penetrated commercial clays at depth. (Dietrich, 1928, p. 181, plate 10 facing p. 162).

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
61	Terra Cotta Plant Site Tillotson Refract Co.	NE¼SW¼ sec. 26, T5S, R5W, SBM. Low hills 2 miles southeast of Alberhill.	Pacific Clay Products, 1255 West Fourth Street, Los Angeles	East half of property covered by Quaternary alluvium; Paleocene Silverado Formation (upper part) green clay shale and micaceous arkose crops out in west half. Property drilled in the early 1960's by Pacific Clay Products who reported clay encountered at minable depths.	40 acres held by present owner since about 1912. In 1905 the California Fire-Proof Construction Company was operating a plant at this site for the manufacture of sewer pipe, earthenware, and hollow bricks. Earlier the plant was owned by the Dolbeer Estate. By 1912 the plant was controlled by the Pacific Sewer Pipe Company, and is said to have been destroyed by fire that year. In 1905 the source of clay was the Alberhill pits, but earlier clay had been mined from 2 pits on the hillside at the factory. May be site of the Dolbeer and Hoff Coal prospect (see in text under Coal). By 1920 the plant had been dismantled. (Aubury, 1906, p. 222; Merrill, 1917 [1919], p. 570; Boalich and others, 1920, p. 90; Dietrich, 1928, p. 181, plate 10 facing p. 162). [illegible]

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
64	Tropico (Temescal) Tract	S½SW¼ and W½SE¼ sec. 26, T4S, R6W, SBM. 8½ miles southeast of Corona on the northeast side of Temescal Wash, at the western margin of the Gavilan Hills, ¼ mile north of Arcilla Siding.	International Pipe and Ceramics Corporation, 2901 Los Feliz Blvd Los Angeles 39	Eastern part of the property is underlain by Triassic(?) Bedford Canyon Formation and Jurassic(?) quartz latite porphyry. The western part is underlain by residual clay derived by weathering of quartz latite porphyry and Bedford Canyon Formation. According to Dietrich (1928, p. 173) red, pink-mottled and blue plastic clays have been mined from this tract.	Property consists of 172.65 acres. Acquired by Gladding McBean and Co. in the mid 1920's from Tropico Potteries. By 1925 the principal pit was 800 feet long, 500 feet wide and had a maximum face height of 150 feet. There were also some underground workings of unknown extent. The pit was idle in 1925 and has been idle much of the time since. The property was last active in 1949 when some mining was done in open pits. By 1963 work on adjacent properties had obscured or destroyed much of the former Tropico Tract workings. (Dietrich, 1928, plate 10 facing p. 162; p. 173-174).

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
55	Twin Springs (Temescal Sixty) prospect	NW¼NW¼ and N½NE¼ NW¼ sec. 12, T5S, R6W, SBM. In Temescal Valley 4 miles northwest of Alberhill, on the west side of Highway 71.	Temescal Water Co., 707 Main Street, Corona	Gypsiferous clay shale and sandstone (Paleocene Silverado Formation) crops out over an oval shaped area 200 feet wide and 500 feet long just west of the railroad cut. Shale strikes northeast, dips 40° NW. Clay was not exposed in January 1963, but the property is said to contain a bed of steeply dipping "bone" clay.	Pacific Clay Products held 60 acres under lease for many years. Prospect was explored many years ago, probably before 1928, by means of an adit, which was not located in 1963. Apparently the adit had disappeared before 1946. (Dietrich, 1928, p. 181, pl. 10 facing p. 162; Sutherland, 1935, p. 71; Stauffer, 1946, map station 23).

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Hancock's Brick Yard	SE¼ sec. 6, T2S, R4W, SBM. 3½ miles northeast of Riverside.	Hancock Brick Co. 21516 Main Street Highgrove.	Red clay soil was mined for many years from pit 10 to 20 feet deep.	Plant for the manufacture of common red brick; located in San Bernardino County. Incorrectly listed as a Riverside County location in previous reports. Probably so located because prior to about 1915 the plant and shallow pits were located in the SE¼ sec. 14, T. 2 S., R. 5 W., S.B.M., on the bluff just southeast of Fairmont Park in Riverside, in the area later occupied by the Southern Sierras Power Co.

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
34	Los Angeles Brick and Clay Products Company				See under clay section in text.

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Mission Clay Products				See: Mount Clay Products.

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
38	Mount (Mission) Clay Products	SE¼ sec. 34, T4S, R6W, SBM. 9 miles southeast of Corona in low hills in Temescal Valley, ¼ mile west of State Highway 71.	Mission Clay Products Company 16961 East Santiago Blvd. Olive	Area covered by Quaternary terrace deposits.	Late in 1958 a small plant utilizing a beehive kiln was erected by William J. Mount for the manufacture of vitrified sewer tile and drain pipe and common red brick. Raw materials used included soil from the plant area and clay purchased from the Corona Clay Co. Plant was idle in January, 1963 and by June 1963 had been acquired by Mission Clay Products.

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Prado Tile Company	Vicinity of Prado Dam Spillway, 4 miles west of Corona.			For many years at a plant at the settlement of Prado, West of Corona, hand-made roofing tile and Mexican pottery were manufactured from clays supplied from the Corona area. The plant (or plants?) which was operated at different times by the Prado Tile Co., La Olla Tile Co., and the Casa Blanco Tile Co., was closed about 1940 when the Prado flood control project acquired the former site of Prado. (Dietrich, 1928, p. 180; Gray, 1961, p. 63).
	Alberhill Coal and Clay Co. mine				Coal See Alberhill Coal and Clay Co. (t)
	Hoag Ranch deposit				See Jones clay deposit (t)
	Hoffman's prospect				See Jones clay deposit (t)
	Jones deposit				See Jones clay deposit (t)
	K[illegible] group				See Kramer clay deposit (t)

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
75	Aztec [illegible]	Reported to be in Sec. 30 (proj.), T. 4 S, R. 20 E., SBM, high on the west slope of the McCoy Mountains. Accessible only by trail.	Undetermined	Probably similar to the Eagle Nest (herein)	(James F. George, 316 S. Spring, Blythe, personal communication). → Eagle Nest mine (t)

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
76	Big Basin (Hines) Copper Prospect	NW¼NE¼ sec. 3, T4S, R6W, SBM. In a highland valley one mile northwest of Cajalco Hill and the Cajalco tin mine.	Lake Mathews Farming Co. Route 2, Box 98 Corona	Jurassic Temescal Wash Quartz Latite Porphyry cut by shear zone which strikes N.45°E., dips 45°NW. Several small black tourmaline dikes which strike nearly north also crop out in the area. Across about 80 feet of highly altered rock in the shear zone are 4 parallel "veins" or mineralized shears ranging from a few inches to 6 feet in width. Mineralization consists of reddish-brown to black iron oxide, malachite and chrysocolla coatings and a few spots of azurite.	Area was prospected for copper carbonate before 1915. In 1946 the area was prospected by bulldozer trenching over an area some 500 feet by 50 feet, with a few isolated trenches about 1,000 feet southwest of the main trenches. Soil overburden ranged from 2 to 6 feet and trenches penetrated as much as 10 feet of copper-bearing quartz latite. A vertical shaft had been sunk to a depth of 20 feet in 1946, and an old 35 foot shaft had been filled by the trenching. About a carload of "shipping ore" was stockpiled on the property in Oct. 1946 from which a random type sample was selected. This sample was assayed by Abbot A. Hanks Inc., San Francisco and showed 0.025 oz. gold and 16.57 oz. silver per ton and 2.69% copper. In January 1963 no evidence of former prospecting was found, the shaft was in use as a waste water sump and the area had been planted to avocado and citrus trees. (Div. Mines Field Report No. 131; Waring, 1919, p. 15).

Corona Pathfinder, no. 53

Copper

Riverside County

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
79	Collins Prospect Crescent	NE¼ sec. 4 (proj.), T4S, R6W, SBM. Half a mile east of Temescal Canyon, about 500 feet above the canyon floor.	Wesley R. Collins 19951 Gavilan Road Riverside	Jurassic(?) Temescal Wash Quartz Latite Porphyry. Steeply-dipping shear zone trends northwest, exposed in open cut 200 feet north-west of shaft. Sample from small stockpile near the shaft was much altered; mineralization consisted of black tourmaline, reddish-brown to black iron oxide and sparse thin coatings of malachite and chrysocolla.	Area prospected in 1956 and 2 carloads of copper ore shipped to A.S. & R. at Midvale, Utah. Smelter assay is said to have shown 0.8% Cu. In 1962 a vertical 2-compartment shaft was sunk. In January 1963 it was filled with water to within 25 feet of the surface. Size of dump suggests shaft may be about 100 feet deep. Several bulldozer cuts have been made along the shear zone both east and west of the shaft. Inactive in January, 1963, but head frame and hoist house remained on the property. Intermittent prospecting apparently is being done. Not mine (?) 32

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Electric Copper and Gold ~~mine~~	Sec. 25, T6S, R4W, SBM, 5 mi. southeast of Elsinore. Not verified (1961)	Undetermined	A mineralized zone as much as 20 feet wide in schist near a contact with granitic rock. Reported to carry copper, silver, and gold in cuprite, chrysocolla, chalcopyrite, and pyrite.	Developed through a 60-ft. inclined shaft, a 20-ft. crosscut and 20 ft. of drifting. (Tucker 1929, p. 470; 1945, p. 125, pl. 35).
	Hope				See Anderson mine (L)
	Lion's Den claims				See Little Mountain claims (L)

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Copper

Riverside County

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Mountain King ~~(claim)~~	Sec. 23, T4S, R20E, SBM.	Undetermined		(Tucker 1945, pl. 35).

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Palen Copper mines	Sec. 22, T5S, R18E, SBM, on west side of Palen Mts.	Undetermined	Reported as a vein 50 ft. wide in quartzite and porphyry and a ledge in sandstone, quartzite and granulite.	Explored through shallow shafts, cuts and prospects. Reported to have ore containing as much as 30 percent copper. (Aubury 1908, p. 341; Tucker 1945, pl. 35; Eric 1945, p. 294).

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Silver Joe	Sec. 18 or 19, T4S, R19E, SBM, on the east slope of the Palen Mts. about 1 mile southwest of the Homestake (see herein under copper)	Floyd Vernoy and B. H. Craig, 938 Maple, Beaumont (1962)	A northwest-trending shear zone contains sporadic quartz lenses ranging from 0 to 6 inches wide. Vein material comprises fractured, euhedral quartz crystals, as large as one-half inch in diameter and 2 inches long, cemented with chalcocite and secondary carbonates. Shear zone traceable about 300 feet (Personal communication, Tomo Ito, 1963).	Developed through an 8-foot shaft and shallow prospects.

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	American Encaustic Tiling Co. Brown deposit Blum mine	Reported to be in SE¼ sec. 28, T4S, R2W, SBM, about 3¼ mi. east of Nuevo.	Undetermined	Diorite cut by dike comprising massive quartz and segregations of feldspar, about 100 ft. wide and exposed for 1,500 ft.	Explored by open cuts of undetermined extent. Mined on a small scale in 1920's (Sampson 1931, p. 421-422; 1935, p. 521; Tucker 1945, pl. 35). See Perris Mining Co.

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Dunn (claim)	Sec. 2, T7S, R5E, SBM.	Undetermined		(Tucker 1945, pl. 35).

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Ensley-Spaulding (deposit)	T6S, R2W(?), SBM, 7 mi. southwest of Hemet.	Undetermined	Reported to be several small lenses (probably pegmatite) in granite. Feldspar one ft. thick pinching out at shallow depth.	Four cars (presumably feldspar) shipped by 1929 (Tucker 1929, p. 504).

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	La Borde (deposit)	Reported to be in sec. 28, T4S, R2W, SBM, about 3 mi. east of Nuevo.	Undetermined	Feldspar occurs as irregular lenses and masses in pegmatite dike of unreported extent in diorite.	About 2,000 tons of feldspar reported shipped by 1931 (Tucker 1929, p. 505; Sampson 1931, p. 422; 1935, p. 521; Tucker 1945, pl. 35).

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Machado deposit	SE¼ sec. 9, T5S, R2W, SBM, about one mile west of Homeland on the south margin of the Lakeview Mts.	Undetermined	Feldspar-quartz pegmatite dikes as much as 30 ft. wide strike N.40°E., dip at low angles northwest, country rock diorite.	Explored by open cuts and trenches of undetermined extent. Reported to have yielded 60 cars feldspar prior to 1931. (Tucker 1929, p. 505-506; Sampson 1931, p. 423-424; 1935, p. 521; Tucker 1945, pl. 35).

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Morgan Ranch (deposit) Nuevo	Reported to be in sec. 28, T4S, R2W, SBM, about 3 mi. east of Nuevo.	Undetermined	Feldspar and quartz in parallel, northwest-trending dikes of unspecified dimensions.	(Sampson 1931, p. 424; 1935, p. 521; Tucker 1945, pl. 35). see Southern Pacific deposit 42

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Patterson (deposit)	Reported to be in sec. 29, T4S, R2W, SBM, about 2 mi. east of Nuevo.	Undetermined	Parallel, feldspar-quartz-rich pegmatite dikes strike N.40°W., dip 60° NW.; are 20 to 30 ft. wide and exposed for 200 ft.	Reported developed through 50-ft. adit to bottom of glory hole. (Sampson 1931, p. 424; 1935, p. 521; Tucker 1945, pl.35).

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Riverside Cement	E½ sec. 29, T4S, R2W, SBM, probably on west slope of ridge in NE¼ of section.	Undetermined	Feldspar-rich pegmatite dikes of unreported thickness and extent.	This deposit was worked by Riverside Portland Cement Co., prior to 1929, for feldspar to be used in their plant near Riverside. (Tucker, 1929, p. 506; 1945, pl. 35; Sampson 1931, p. 425).

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	San Jacinto Rock Products Co.	Sec.?, T5S, R1W, SBM, on southwest slope of Polly Butte, 3 miles south of Hemet.	Undetermined	Undetermined	Probably Hemet Silica deposit (see herein).

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
98	Spicer Silica	SE¼SW¼ sec. 29(?), T2S, R4W, SBM. Low hill just west of U.S. Highway 60 and 395. May be in SW¼ sec. 21 low on west margin of Box Springs Mtns., ¼± mi. east of Santa Fe RR.	Undetermined	According to Tucker and Sampson (1929, p. 506-507), two small lenses of quartz occur in granite and strike N. 65° W., dip 55° SW. The quartz lenses were reported to have a maximum thickness of 3 ft., were about 10 ft. apart, and had been exposed for about 12 feet along the dip. In sec. 21 narrow beryl and columbite bearing pegmatite dikes occur in quartz diorite.	In sec. 29 is a side-hill semicircular cut about 150 ft. long, 75 feet wide and 15 feet deep. This cut may be the Spicer silica described by Tucker and Sampson (1929, p. 506-507), but in 1963 the faces were slumped and the quartz lenses were not observed. Several thin pegmatite dikes, as much as 8 inches thick, occur in blue-gray quartz diorite (Cretaceous Bonsall Tonalite). In sec. 21 several workings, the largest of which is a trench 40 ft. long, expose pegmatite dikes. This location more closely matches the early descriptions of Tucker and Sampson. No production, idle in 1929 and apparently has since remained idle. (Tucker and Sampson, 1929, p. 506-507; Sampson and Tucker, 1931, p. 444; Tucker and Sampson, 1945, pl. 35). 4b

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
99	Stone and Alexander Quarry	NE¼ sec. 19, T2S, R5W, SBM. About 4 miles west of Riverside on the southeast slope of the Pedley Hills, a quarter of a mile northwest of Limonite Ave.	C. P. Stone, 845 So. Hill St., Los Angeles (1929). Undetermined (1963)	Pegmatite dikes in Cretaceous Bonsall Tonalite. Five dikes about 40 feet apart strike N. 45° W., are vertical to steeply northeast dipping, and are about 1,500 feet long. Dikes range in width from 6 feet or less to 25 feet and are composed of quartz and orthoclase feldspar with very little biotite.	Open cuts and trenches. In 1929 an open cut at the foot of the hill was 15 feet deep and 30 feet long with an adit driven 25 feet into the hill. This open cut explored a northwest-trending vertical pegmatite dike 25 feet wide. In 1963 these workings were mostly filled, but a face about 10 feet high and 25 feet long cut in a quartz-orthoclase feldspar dike remained. About 1,000 feet northwest of this cut and on top of the hill is a trench some 80 feet long with an average depth of 10 feet. This trench explores a quartz-orthoclase feldspar dike six feet wide. The quarry was idle in 1929 and apparently has since remained idle. In 1963 residential development surrounded the lower filled workings and residences covered the hills below the upper trench. (Tucker and Sampson, 1929, p. 507; Sampson and Tucker, 1931, p. 425).

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Warren deposit	Reported to be in E½ sec. 21, T4S, R2W, SBM, about 4½ mi. east of Nuevo.	Undetermined	Parallel quartz-feldspar-rich dikes of unreported extent.	Developed through open cut 70 ft. deep by 25 ft. wide and 50 ft. long and an underlying adit which connects with the open cut by two 25-ft. raises. Also other short adits and shallow cuts. (Tucker 1929, p. 507; 1945, pl.35).

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Weir Feldspar ~~deposit~~	Reported to be in NE¼ sec. 29, T4S, R2W, SBM, about 2½ mi. east of Nuevo.	Reported to be patented; held in 1931 by A. C. Weir, Los Angeles	Narrow pegmatite dikes in granitic rock.	Prospected by series of open cuts. (Sampson 1931, p. 426; Tucker 1945, pl. 35).
	Williamson mi[illegible]				S[illegible] Coahuila Bra[illegible] (L)
	Yellow Queen				See White Prince dep[illegible] (L)

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Garnet

Riverside County

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Sunny Day (mine)	Near Indio	John I. Fassett, 271 W. 4th Street, San Pedro (1937)		(Eardley-Wilmot, 1937, p. 23; Troxel, 1957, p. 24).
					Gems
	April Fool				See Belo Horizonte claim (t)
	California Gem				
	Columbia Gem				
	Beryl Crystal				See Schindler claims (t)
	Magee				See Anita mine (t)
	Silica Beryl				See Schindler claims (t)
	Simmons				See Fano mine (t)

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Gold

Riverside County

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Alice (mine)	T6 and 7S, R14 and 15E (?), SBM.		Abundance of chrysocolla noted by Orcutt.	No other record or field evidence of a mine of this name in the Chuckwalla Mtns. Ore type suggests mislocation from Riverside Mtns. (See Alice herein). (Orcut, 1890, p. 901; Merrill, 1919, p. 539).

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Gold

Riverside Co.

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Allen Placers	Sec. 12, T4S, R20E, SBM, in the Little Maria Mts.	U.S. Gypsum Co.	An area, partially covered by gravel, underlain by complexly folded and faulted gypsum, lime-stone, lime-silicate rocks and schist (see discussion under Marie Mountains deposits in gypsum section).	Patented in 1934, the Allen, Riverside and Victor were called the Allen Group Placers.
	American Flag				See Hidden Treasure claims (t)

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Gold

Riverside Co.

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Annie Laurie	Sec.?, T5S, R11E; Secs. 3,4, T4S, R13E, SBM.	Undetermined	Undetermined	A patented claim and millsite surveyed for Iron Chief Mining Co. in 1910 and tied to U.S. Mineral Monument no. 139 (Saul, 1962, p. 7).

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Gold

Riverside County

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Annie Rooney ~~mine~~	T2S, R12E, SBM.	Undetermined (1961)		(Merrill, 1919, p. 538).

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Gold

Riverside County

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Ardanelle (claim)	T6S, R16E, SBM, 3 miles SE. Corn Springs.	Undetermined	Vein on felsite-porphyry contact.	Open cut and drift (Tucker, 1929, p. 472).

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Gold

Riverside County

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Argonaut ~~group~~ Arica	NE¼ sec. 9, T6S, R4W, SBM, about 1½ miles east of Elsinore; ¼ mile south of Palisades prospect.	J. H. Wrench, Elsinore (1937)	Country rock diorite and gabbro, generallly fractured and deeply weathered. Gold was sought in or adjacent to aplitic and basic dikes of various attitudes.	A 14-ft. pit, 2 adits 12 and 75 ft. long, and shallow pits and trenches explore scattered dikes (Engel, 1959, p. 113). See Lum Gray mine (?)

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Arroyo del Toro ~~(prospects)~~	Secs. 6, 7 (?), T5S, R4W, SBM.	Undetermined (1959)	Granodiorite, slate and quartz latite porphyry.	Prospects. (Larsen, 1948, p. 130; 1951, p. 47; Engel, 1959, p. 113).

Gold

Riverside County

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Bankers (group)	Sec. 27, T6S, R15E, SBM, 4 miles west of Corn Springs	Undetermined (1961)		(Merrill, 1919, p. 540; Tucker, 1929, p. 473; 1945, p. 128, pl. 35).
	Baumonk				See Crescent (?)

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Binkley's diggings	Sec. 2, T6S, R4W, SBM, near the junction of Cottonwood Canyon and San Jacinto River about 3 miles east of Elsinore.	Undetermined		Active in 1876, extent or success undetermined (Merrill, 1919, p. 527; Engel, 1959, p. 113).

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Gold

Riverside Co.

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	[illegible]				[illegible]
	Black Diamond	Sec.? T5S, R12E	Undetermined	Undetermined	Tied to U.S. Mineral Monument No. 140. (Saul 1962, p. 7).
	Black Jack claims				[illegible] De Palmas (6)

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Black Eagle placer	Sec. 24, T8S, R5E, on or near Buck Ridge.	Undetermined		(Tucker, 1945, pl. 35).

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Black Warrior	Sec. 5, T5S, R23E, SBM.	Undetermined		Could be an older name for the Lindy Loop #1 deposit (see herein under iron) (Tucker, 1945, pl. 35).

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Black Warrior (See Blue Bell in this list)				
	Blackbird				See Tubbs claims (t), under tungsten-jill

Gold

Riverside Co.

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Blue Bell Blue Bell	Sec. 6, T2S, R24E	Undetermined	This property is in an area underlain by complexly folded and sheared carbonate and schistose rocks.	Two claims, the Black Warrior and Blue Bell, were patented by Vidal Mining Co. in 1922. At that time these claims were called the Blue Bell group. (Tucker 1945, pl. 35). See Golden Bell (?) 64

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Blue Goose	Sec. 23, T7S, R6W, SBM (proj.), near north rim of Verdugo Canyon, ½ mile south of Wheeler Ranch.	George W. Williams, Box 462, San Juan Capistrano, and Charles Christopherson, Box 205, San Juan Capistrano (1954)	Brecciated zone near contact of andesite and dacite porphyry replaced and filled by quartz, sericite, and limonite derived from oxidation of pyrite.	Undeveloped (1959) (Engel, 1959, p. 114).

Gold

Riverside County

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Bob Cat No. 1				See Purple Hope.

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Gold

Riverside Co.

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Bonanza	NW¼(?) sec. 29, T2S, R3E, SBM, in Cottonwood Canyon about 1 mile southeast of Cox Ranch and 5 miles northwest of Whitewater.	James Varia, 39067 Orchard St. Rt. 1, Cherry Valley; Chas. Armijo, 5313 Ave. L-10 Quartz Hill; James Kaiser, 1648 N. Florida Banning; Joseph Desmarias, 4315 Mountain Ave., San Bernardino.	A vein of unreported width and extent in a faulted and sheared complex of igneous and metamorphic rocks within the San Andreas fault zone.	Appears to be a relocation of an old, undescribed property. Developed through a 119-foot adit. No road to property (1963).

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Bonanza Crater (group)	Sec. 1, T4S, R10E, SBM (proj.).	Undetermined		(Tucker, 1945, pl. 35).

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Bonanza Lode	NE¼ sec. 26(?), T3S, R8E, SBM, 1 mile southwest of Pinyon Well, north slope of Little San Bernardino Mtns.	Undetermined (1960)	Quartz veins cutting coarse-grained quartz monzonite.	Location is from patent plats and Tucker and Sampson (1945, pl. 35, no. 24), but no mine was found here. May be an erroneous location; property could be in NW¼ sec. 26. In NW¼ sec. 26 quartz monzonite cut by quartz veins striking northwest and dipping steeply southwest. Here, veins explored by pits and shafts (See Hansen mine herein).

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Boulder (claim)	T6S, R15E, SBM, one mile west of Granite mine.	Undetermined	Vein reported to strike north and dip nearly vertically.	By 1917 mine comprised three shafts 30, 50, and 100 feet deep, a 200-foot adit and open cuts. (Crawford, 1896, p. 310; Merrill, 1919, p. 540).

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Brady prospect	NE¼ sec. 4, T6S, R4W, SBM, southwest slope of hills about 1½ miles east of Elsinore.	E. H. Brady, Elsinore (1937)	Contact of diorite and gabbro with schist where vein quartz accompanies a 4 to 6 foot wide aplitic dike, now much fractured and decomposed, that strikes N. 50° W. and is vertical.	Dike zone explored by 35-foot vertical shaft with lateral workings of undetermined extent, and two other shafts, one 15 feet deep with a 25-foot connecting adit and one 35 feet deep. (Engel, 1959, p. 114).

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Gold

Riverside County

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	C & C Consolidated ~~(mine)~~	4 miles west of Perris	Undetermined	Narrow vein in granitic rock.	Developed through a 150-foot adit and a shaft. (Crawford, 1896, p. 310; Merrill, 1919, p. 532).

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Champion (mine)	T6 or 7S (?), R14 or 15E (?).	Undetermined		Argentiferous lead ore, wulfenite noted by Orcutt. (Orcutt, 1890, p. 901).
	Chuckwalla				S. Bryan (?)
	Chuckwalla mt Placer G.				S. Bryan (?)

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Coffee (mine)	T6S, R15E, SBM, 4 miles west of Corn Springs.	Undetermined	Northwest trending vein as much as 18 inches wide.	Shaft 56 feet deep reported in 1917. (Crawford, 1896, p. 310; Merrill, 1919, p. 540; Tucker, 1945, pl. 35).

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Gold

Riverside County

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Colorado (mine)				See Justice.

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Gold

Riverside County

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Colorado (claim)	Sec. 36, T1S, R23E, SBM.	Undetermined		(Tucker, 1945, pl. 35).

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Gold

Riverside County

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Columbus (mine)	T2S, R12E, SBM.	Undetermined		(Merrill, 1919, p. 538).

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Corn Springs Placer (claim)	Sec. 28 (proj.), T6S, R16E, SBM, at Corn Springs 7½ miles southeast of Desert Center.	Undetermined	Alluvial deposit at east (drainage outlet) end of a narrow valley.	One patented claim. No record of production; probably small. (Saul, 1962, p. 4,7).
	Desert Gold Group				See Neck mine w/ Thelma Group

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Double Eagle (mine)	T8S, R20E, (?), SBM, probably on east slope of Mule Mountains.	Undetermined		(Merrill, 1919, p. 541).

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Gold

Riverside Co.

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Echo Valley	Secs. 1,2, T7S, R14E, SBM, on the southwest margin of the Chuckwalla Mts., about 1 mile southeast of the Model mine.	J. H. Barry, 8242 Garibaldi Ave., San Gabriel; Myron Smith, Box 8, Box Canyon Rd., Canoga Park		Once part of Chuckawalla and Model Group (see herein under Model). Purchased by these owners in 1941 (personal communication, J. H. Barry, 3/22/63).
	Edith				See Mammoth [illegible]
	El Dorado				See New El Dorado (L)
	Ensenparation				See Hidden (E)

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Ethel (mine)	T2S, R12E, SBM.	Undetermined		(Merrill, 1919, p. 538).

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Gold

Riverside County

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Fish (mine)	T7S, R12E (?), SBM, 6 miles northeast Dos Palmas and 12 miles northeast of Salton.	Undetermined	Reported to be a quartz vein.	Adit on vein. May be an old name for Dos Palmas (see herein). (Crawford, 1894, p. 221; 1896, p. 311; Merrill, 1919, p. 541; Tucker 1929, p. 477; 1945, pl. 35).

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Free Coinage and Charity ~~mine~~	T6 S, R13E, SBM.	Undetermined.	Quartz vein with some argentiferous galens and lead carbonate.	This might have been a different name for the Sterling mine (see herein). (Crawford, 1894, p. 221; 1896, p. 311; Merrill 1919, p. 541; Tucker, 1945, pl.35)
	Goat, Goat Basin	} -			See B[illegible] mine (t)
	Gold Coin				See Gold Galena (t)
	Gold Crown #2				See Rich Gold (t).
	Gold Flake				See N[illegible] (t)

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Gold

Riverside County

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Gold Hill mine	Sec. 3, T4S, R10E, SBM (proj.).	Undetermined		(Tucker, 1929, p. 479; 1945, pl. 35).
	Gold Master				

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Gold Prince				North extension of Good Hope, which see. (Merrill, 1919, p. 532).
	Gold Rose				See Brooklyn (l)
	Gold Tiger				See Black Bull
	Golden Chariot				See Golden Chariot (l)

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Golden Crown	Sec. 29? T6S, R4E, SBM, about 2 miles east of Kenworthy Guard Station	Dexter C. Mayne, 25889 Columbia St., Hemet	Narrow veins reported to be of good grade; presumably in a fault or shear zone in diorite. ~~as are most of the mines in the area.~~	One inaccessable, 100-foot shaft. Prospecting and trenching during 1962-63 have exposed (vein system through about 500 feet claim purchased by this owner early in 1962. (Written communication, Dexter C. Mayne, May, 1963.)

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Golden Key	Sec. ?, T6S, R16E.	Undetermined	Undetermined	Developed by 55-foot shaft, 20-foot tunnel, 45 feet of drifts, and a 5-foot by 20-foot open cut. Gold-silver ore produced 1934 to 1937, also contained 1.77% lead and recoverable copper. (Eric, 1948, p. 292; Goodwin, 1957, p. 602).

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Golden Rule (group)	Reported to be in sec. 30, T2S, R10E, SBM, south of Twentynine Palms in the Pinto Mountains.	Undetermined	Vein striking N.30°W. and dipping 80°W. occurs in gneissoid granite. Ranges in width from 1 to 2 feet. Diorite dike on footwall.	75-foot shaft on vein with drift 35 feet south at 50-foot level. Mine active in 1929 (Tucker and Sampson, 1929, p. 480).

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Golton (group) (Mineral Chief)	NW¼ sec. 20, T5S, R4W, SBM, about 2½ miles north-northeast of North Elsinore.	D. V. French and J. S. Hopper (1946)	Two vuggy quartz veins 1½ and 3 feet wide about 250 yards apart in northerly trending, steeply dipping zones, 3 to 5 feet wide, of shattered porous, iron and manganese-stained siliceous rocks in quartz latite porphyry.	West vein explored by 10-foot open cut and 15-foot inclined shaft; east vein by 65-foot adit. (Tucker, 1929, p. 480; 1945, pl. 35; Engel, 1959, p. 115).

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Good Hope (group)	Sec. 25, T2S, R3E, SBM, about 1 mile east of Whitewater Wash.	Undetermined		(Tucker, 1945, pl. 35).

Gold

Riverside Co.

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Gray	Sec. 24, T4S, R18E (proj.), SBM, in the central Palen Mts. about 2 miles southwest of the Homestake (herein under copper).	Undetermined	Undetermined	Patent was applied for on a single claim but no record was found that it was granted (U.S.B.L.M. records, 1932).
	Gray				See Lom Gray (?)

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Gray Eagle (see Waterloo in this list)				

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Great Eastern Grand Western	T2S, R12E, SBM.	Undetermined		(Merrill, 1919, p. 538). [illegible]

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Hager-Kale (mine)	Reported to be in sec. 2, T3S, R5E, SBM.	Undetermined	Vein quartz (probably in gneiss of the Chuckwalla Complex).	(Proctor, 1958, p. 142).
	Hensen, Hansen well				See Hansen mine ( )
	Hexie				See Hexahedron (!)

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Hidden Canyon claim	Sec. 23, T6S, R9E, SBM.	Undetermined		(Tucker, 1945, pl. 35).

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Hillerman (claim)	T2S, R12E, SBM.	Undetermined		(Merrill, 1919, p. 538).
	Hillside Group				See Brown mine (?).
	Indian Queen				See Indian R[illegible] Group

Gold

Riverside County

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Ingersoll (Ramona) ~~(mine)~~	Reported to be 50 miles northeast of Walters Station probably T2S, R12E, SBM.	Undetermined	A nearly vertical vein strikes north and ranges in thickness from 1 to 3 feet.	Two shafts, 40 and 80 feet deep (Crawford 1896, p. 311; Merrill, 1919, p. 538; Tucker, 1929, p. 482; 1945, pl. 35).
	J. Knife				S. Morning Star [illegible] (?)
	Juanita #5				See Mountain Queen mine (?)

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Jumping Jack	Sec. 32(?), T6S, R16E, SBM, about 1½ miles southwest of Corn Spring	Undetermined	Undetermined	Surveyed for patent in 1913; survey no. 5066, tied to U.S. Mineral Monument no. 146. Survey plats marked "rejected". Property developed through a 190-foot drift adit driven S.22°W., three inclined shafts of moderate depth, one short winze, and a vertical shaft of unmarked depth (data from plat map).

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Justice (Colorado) ~~mine~~	Sec. 32, T4S, R4W, SBM.	~~Undetermined; a patented claim and millsite.~~ Roger Clapp % [illegible] [illegible] 522 N. June Hollywood; a patented [illegible] millsite	A narrow quartz vein of reportedly high grade in diorite.	The old workings are caved and appear long neglected. (Merrill, 1919, p. 531; Tucker, 1929, p. 483; 1945, pl. 35).

Gold

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Katherin No. 2 placer (claim)	Sec. 1 (proj.), T2S, R12E, SBM, about ½ mile south of Gold Rose mine.	Ben Stauffer, P.O. Box 202, Johannesburg (1960)	Alluvium; probably fanglomerate.	Numerous shallow cuts, 25-foot adit and partly caved 40-foot adit to base of shallow shaft. (Oral communication, Michael R. Perkins).

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Lake View (prospect)	NW¼ sec. 4, T6S, R4W, SBM, about 1½ miles northeast of Elsinore.	Mack and Thurman (1937)	Deeply weathered and chloritized diorite includes shear zones containing alaskitic, aplitic, and pegmatitic dikes. Gold sought in shear zones which strike N. to NE., dip 35° to 60° SE.	Workings include pits 15 and 25 ft. deep about 75 ft. apart in a SW.-NE. line, with a 12-ft. adit driven northward between them, exploring different shear zones. (Engel, 1959, p. 116).
	La Plama				See Top of the World mine (2)
	La Rica				See Stone House mine (4)
	Laceter				See Lost Angel mine (3)

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Lee (prospect)	SE¼ sec. 14, T6S, R5W, SBM, east base of Elsinore Mountains about 2 miles southeast of Willard.	Undetermined	Fault contact between slate and quartzite and diorite and gabbro.	Explored by 25-ft. crosscut adit filled with sand to within 2 ft. of back. Neither ore mineralization nor definite vein visible. (Engel, 1959, p. 116).

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Liberty (group)	T7S, R15E, SBM, "in Red Cloud Canyon".	Undetermined	Quartz veins along a dike cutting gneiss. Average value reported to be about $6 per ton.	Development consists of open cuts and one adit. Reported as part of "old Red Cloud Group". This could be the same property as the Tubbs claims (see herein). (Tucker, 1929, p. 483).
	Liberty Gro[illegible]				See Tubbs claims (?) [illegible] tungsten
	Little Maggie				See Maggie mine (?)

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Little Pete (claim)	Sec. 31(?), T4S, R4W, SBM, 4 miles west of Perris.	Undetermined	Narrow, west trending vein containing arsenical pyrite.	(Crawford, 1896, p. 312; Merrill, 1919, p. 531; Tucker, 1929, p. 483; 1945, pl. 35).
	Long Shot #1				[illegible]

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Lone Star	Sec.?, T2S, R12E, SBM.	Undetermined	Undetermined	Patent survey no. 6330, tied to U.S. Mineral Monument no. 202; surveyed in 1945 (Saul 1962, p. 7).
	Los Angeles				See Brooklyn mine (L)
	Lost Parallel				See Hidden mine (L)
	Lucky Boy				See Elton mine (L)

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Lucky Lady group	Sec. 17, T3S, R11E, SBM (proj.).	Undetermined	Undetermined	(Tucker and Sampson, 1945, pl. 35) not confirmed.

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Lucky Lady claim	SE¼ sec. 19 (proj.), T7S, R17E, SBM.	Undetermined	Property not visited; probably resembles nearby Aztec and Rainbow claims which are northwest-trending gold-bearing quartz veins in gneissic country rock.	Developed during 1930's and worked for an unreported but probably short period. Explored by single shaft 75 feet deep from which an unspecified amount of ore of good grade was taken (J. Dupont, personal communication, April, 1959).

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Lucky Strike	Sec.?, T6S, R15E, SBM, in the Chuckwalla Mts.	Undetermined	Undetermined	Claim and mill site; patent survey no. 6400, tied to U.S. Location Monument no. 205; surveyed in 1947 (Saul 1962, p. 7).
	McHaney				See Desert Queen (L)
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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	McKinley Bill claim	T2S, R12E, SBM.	Undetermined		(Merrill, 1919, p. 538).

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Meek (group)	Sec. 15, T2S, R11E, SBM (proj.).	Undetermined	Undetermined	(Tucker and Sampson, 1945, pl. 35). Not confirmed.

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Mineral Chief (claim)				See Golton group.

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Minnie Ha-Ha claim	NE¼NW¼ sec. 32, T6S, R4E, SBM, about 2 miles east-southeast of Kenworthy.	E. M. and Hazel A. Olsen, 14548 Dalman, Whittier (1958)		County and Forest Service records.
	Missing Link				See Virginia mine ([illegible])
	Monarch				See Tubbs claim ([illegible]), under tungsten, gold
	Morgan claims				See Morning Star ([illegible])

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Mountain King	N½ sec. 29(?), T4S, R20E, SBM.	Undetermined	A vein reported to be as much as 30 feet wide strikes northwest. County rock is granite porphyry.	Developed through a 40-ft. shaft and 4 open cuts (Aubury, 1908, p. 342; Tucker, 1929, p. 471).

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Musick (claim)	NE¼ sec. 23, T5S, R4W, SBM, west side of Railroad Canyon, about 4½ miles northeast of Elsinore.	Undetermined	Quartz veins 1-2 in. wide strike N. 5°-20°W. dip about 70°NE. parallel to parting planes of slate.	Workings, now caved, comprise a shaft 40 ft. deep and shallow pits and trenches. (Engel, 1959, p. 117).

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Nicolite (claim)	Sec. 32, T1S, R24E, SBM.	Undetermined		(Tucker, 1945, pl. 35).
	Northern B[illegible]				See Tucker [illegible] map (?)

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	North Star (claim)	Sec. 33, T4S, R4W, SBM.	Undetermined		(Tucker, 1945, pl. 35).

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	O'Brien (mine)	Sec. 16(?), T4S, R4W, SBM, about 4½ miles northeast of Elsinore and 1 mile west of Good Hope mine.	Undetermined		(Crawford, 1894, p. 224; Engel, 1959, p. 118).

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Ohio (claims)	NE¼ sec. 1, T2S, R22E, SBM, at the southeast margin of the West Riverside Mtns.	R. F. Boyd and A. Geiger, Vidal (1958)	Gneiss cut by thin pegmatite dikes and quartz veins. Explored dike attitude approximately N.45°E., 70°SE.: composed of quartz, microcline, chlorite, calcite, and hematite.	A single, shallow, inclined shaft explores a poorly exposed pegmatite dike.

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	O K claim				See McKinley Bill.

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Onward ~~mine~~ mill	T2S, R19 or 20 E(?) SBM, probably in the Arica Mtns.	Undetermined		(Crawford, 1894, p. 224).
	Ophir				See Lucky Strike (t)

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Opulent (mine)	T6S, R14E(?), SBM.	Undetermined	Wulfenite noted here by Orcutt in 1888.	(Orcutt, 1890, p. 901).

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Oro Copio mine	Reported to be in sec. 6, T2S, R10E, and sec. 12, T2S, R9E, SBM (proj.), about 9½ miles southeast of Twentynine Palms in the Pinto Mtns. Gold Park area.	Undetermined	Narrow quartz veins striking N.10° E. in a shear zone in granite gneiss.	Three shafts, 50, 75, and 100 feet deep respectively, sunk on veins. Apparently active in 1921 when owned by Gold Park Consolidated Mines Co. and 1921-29. Last reported owned by Ellsworth Nickols, Santa Ana. (Tucker, 1921, p. 348; Tucker and Sampson, 1929, p. 486).

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Oro Plomo group	Sec. 19, T4S, R22E, (proj.) SBM, on the west side of the Big Maria Mountains.	Undetermined	Quartz vein in gneiss and schist.	Eight shallow shafts and several cuts. (Unpublished report).

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Oro Vista (mine)	Sec. 28, T7S, R5E, SBM, 6 mi. southwest of Nightingale.	Undetermined	Quartz vein on granite-schist contact.	(Tucker 1945, p. 141, pl. 35).

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Owens claim	NE¼ sec. 5, T5S, R4W, SBM, 3/5 mile due east of Good Hope mine.	William A. Owens, Route 2, Box 228E, Perris	Diorite aplite dike 3-5 ft. wide trends N. 10° E., discontinuously exposed for 100 yards or more through deeply weathered quartz diorite.	Gold sought in 4 shallow pits and shafts now largely caved in line trending for 75 yards N.25°E. across aplite dike. Deepest shaft is 30 ft. (Engel, 1959, p. 118).

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Oxbow (Group)	Sec. 36, T1S, R23E, SBM, in the Riverside Mountains.	John H. Ware, 408 N. 9th St., Santa Paula (?)		This group appears to have been adjacent to or near the Gold Dollar (see herein). A claim named "Oxbow" is held (1958), in addition to the Gold Dollar, by J. H. Ware (Merrill, 1919, p. 544; Tucker, 1929, p. 486; 1945, pl. 35; county records).

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Palo Verde ~~group~~	T8S, R21E(?), SBM, probably on the east slope of the Mule Mountains.			(Merrill, 1919, p. 541).
	Pitch [illegible]				See M[illegible]

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Paymaster (mine)	Sec. 15, T3S, R10E, SBM.	P.O. Murphy and E. Leith, Twentynine Palms (1945)	Vein in schist, strikes northwest, dip 40°SW, width 2 ft.	Inclined shaft sunk on the vein to a depth of 140 ft.; drifts on 50 and 100 ft. levels. Probably same as Black Warrior (see herein). (Tucker, 1945, p. 141).
	Paymaster				See Black Warrior ( )
	Peggy				See C[illegible] ( )

128

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Perris claim	Sec. 31, T4S, R4W, SBM.	Undetermined		(Crawford, 1896, p. 313; Merrill, 1919, p. 531; Tucker, 1929, p. 486; 1945, pl. 35).
	Pilot				See Triangle (L)

Gold

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Pinto Lode claim	Sec. 24, T6S, R4E, SBM, in Palm Canyon	Undetermined		(Tucker, 1945, pl. 35).

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Pinto placers	Sec. 21, T2S, R12E, SBM.	Undetermined		(Tucker, 1945, pl. 35).
	Pinyon Well				See New Eldorado mill (?)
	P-[illegible] Bey				See Cap Hunter (?)

Gold

Riverside County

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Porcupine (claim)	T2S, R12E(?), SBM.			(Merrill, 1919, p. 537).
	Postmaster				See Jim (t)
	Priest				See [illegible] (t)

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Punch claim	T8S, R21E(?), SBM, probably on the east slope of the Mule Mountains.	Undetermined		(Merrill, 1919, p. 541).

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Purple Hope (Bob Cat No. 1)	SE¼ sec. 24, T5S, R5W, SBM, on the north side of a prominent hill, about 2 3/4 miles east of Alberhill.	H. L. Long, W. E. Giles, M. Isaac, G. J. Isaac, 8232 South Nutwood Street, Anaheim (1954).	Metamorphosed tuff and related volcanic sediments; strike N.35°W., dip 60° SW.; form prominent outcrop in a shattered zone which is bleached and stained with iron and manganese oxides and includes abundant clayey gouge.	Explored by inclined shaft driven northwest; caved at 6-ft. depth; 15-ft. trench with 8-ft. face; several shallow pits. (Engel, 1959, p. 118-119).

Gold

Riverside County

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Ragged Top (group)	NW¼ sec. 18, T6S, R3W, SBM, in Cottonwood Canyon, 3 miles east of Elsinore.	Undetermined	Quartz veins in granitic rock.	Two adits 500 ft. apart driven 50 and 60 ft. SE. (Tucker, 1929, p. 486).

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Ramona (mine)				See Ingersoll (mine).

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Red Bird No. 1 Red Head	SE¼ sec. 24, T5S, R5W, SBM, on the northeast side of prominent hill about 2 3/4 miles east of Alberhill.	A. W. Meier and J. Taylor, address not determined (1947)	Metamorphosed tuff and related volcanic sediments about 100 yards east of contact with quartz latite porphyry. Dike-like outcrops trend N. 30° W., dip 60° W.	Explored and mined in open pit 20 ft. deep, 25 ft. wide, 35 ft. long and smaller pits. (Engel, 1959, p. 119). See Red Cloud group (?)

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Reliance	Sec. 25, T1S, R23E, SBM, on the north-west slope of the Riverside Mts.	Undetermined	Undetermined, probably schistose rocks cut by faults mineralized with primary and secondary copper minerals, gold and iron oxides.	Four claims; Fraction #2, Independence, Klondyke, and Reliance were patented in 1922, by W. F. Holt, as the Reliance group.

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Republican claim	T2S, R12E, SBM.	Undetermined		(Merrill, 1919, p. 538).

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Revenue claim	T2S, R12E, SBM.	Undetermined		(Merrill, 1919, p. 538).

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Richey (mine)				See Coffee (mine)
	Ronnie B				See Atlanta (4)
	Rosario				See Santa Rosa (3)
	San Diego				See Gold Crown (1)

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	San Jacinto (claim)	SE¼ sec. 10, T5S, R4W, SBM, northwest side of Highway 84 about ½ mile northeast of Good Hope mine.	Mrs. Velma L. Teater, 500 South Commonwealth, Los Angeles (1955)	Northeast extension of Good Hope vein.	Claim of Good Hope group. (Tucker, 1945, plate 35; Engel, 1959, p. 119).

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	San Mateo Canyon prospects)	T8S, R5 and 6W, SBM, lower San Mateo Canyon for about a mile north of its junction with Nickel (Quail) Canyon, and several miles south of that point.	Undetermined	Granodiorite and andesite porphyry contain unproved showings of gold, silver copper and iron.	Prospected intermittently since about 1900. Accessible by jeep since late 1940's. Most of this property appears to lie south of the Riverside-San Diego County boundary (Larsen, 1948, p. 132; 1951, p. 48; Engel, 1959, p. 119).
	Santa Fe				See Roosevell and Reil

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Schiller ~~claim~~	T2S, R12E, SBM.	Undetermined		(Merrill, 1919, p. 538).

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Riverside County

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Senate (mine)	T8S, R21E(?), SBM, probably on the east slope of the Mule Mountains.	Undetermined		(Merrill, 1919, p. 541).
	Sippi				See Lost [illegible] (?)
					145

Gold

Riverside County

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	S. S. Mine	T2S, R12E, SBM, "4 miles south of Virginia Dale".	Undetermined		Reported as a long abandoned mine which once produced some good ore. (Crawford, 1894, p. 224; 1896, p. 314; Merrill, 1919, p. 538; Tucker, 1929, p. 487).
	Star				See Frank Hall (5)
	Steele				See Top of the World (1)

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Storm King #5 claim Summit	Sec. 2, T2S, R12E, SBM.	Seeley W. Mudd and Philip Wiseman (1938)	Free gold in steeply dipping quartz vein striking N. 20° E. along andesite porphyry-quartz monzonite contact.	This is part of holdings which lie in both Riverside and San Bernardino Counties (see O.K. Mine: Wright, 1953, p. 50). Vein explored to depth of 800 ft. by inclined shaft and extensive level workings. (Cloudman, 1919, p. 802; Eric, 1948, p. 313; Tucker, 1930, p. 246; 1931, p. 306; Wright, 1953, p. 50). [illegible]

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Sunny Boy (claim)	Sec. 6, T2S, R9E, SBM.	Undetermined		Was not identified in the field but may now be part of the Desert Queen mine (see herein). (Tucker, 1945, pl. 35).

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Sunnyside mine	T6 or 7S, R14 or 15E, SBM.	Undetermined	Quartz vein carrying argentiferous lead ores with gold.	Shaft. (Orcutt, 1910, p. 901; Merrill, 1919, p. 539; Tucker, 1929, p. 488).
	Sunrise				Zulu [illegible]
	Sunset				[illegible]
	Sunset				[illegible]
	Thelma				[illegible]

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Thurman (claims)	Secs. 19 and 26, T6S, R3W, SBM.	J. G. Thurman, Elsinore (1929)	A porphyritic dike 4 ft. wide in schist strikes N. 20° W., and dips 70° E. Reported to run $4 per ton in gold.	One small open cut. Mr. Thurman had other claims which see herein under Lake View prospect. (Tucker, 1929, p. 488; 1945, pl. 35).

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Tyler's diggings	Sec. 10, T6S, R4W, SBM, about 2½ miles east of Elsinore.	Undetermined		Reported active in 1876. (Merrill, 1919, p. 527; Engel, 1959, p. 120).

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
28	~~Prospect (Name~~ undetermined)	SW¼SE¼ sec. 4, T5S, R5W, SBM. In the Gavilan Hills, 1 mile southeast of Estelle Mtn.	Undetermined	Irregular shaped body of Jurrasic quartz latite porphyry about 1,500 feet long, 500 feet wide and surrounded by Cretaceous granodiorite. At granodiorite contact the east margin of the quartz latite porphyry contains iron oxides and thin quartz stringers which strike N.60°W., dip 45°SW.	Quartz stringers explored by means of a side hill cut 15 feet deep and 20 feet wide and several other shallow cuts. Apparently long idle.

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
280	~~Prospect (Name~~ undetermined	NW¼NE¼ sec. 4, T5S, R5W, SBM. In the Gavilan Hills north of Estelle Mtn. Road, 1 mile east of Estelle Mtn.	Undetermined	Shear zone in altered volcanic rock is 1-1½ feet wide, strikes N.60°W., dips 83°SW. at surface, vertical at depth. In porphyritic andesite tuff or breccia (Jurassic Santiago Peak Volcanics). Volcanics are stained red-brown or purple-gray and contain thin, black, manganese seams.	Shear zone explored by means of a vertical shaft, estimated to be about 100 feet deep. A small open cut 10 feet deep and 15 feet long is just west of the shaft. In January 1963 no equipment remained on the property which apparently has been long idle. 153

Gold

Riverside County

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Undetermined ~~Unidentified prospects~~	W½ sec. 23, T5S, R4W, SBM, about 4½ miles northeast of Elsinore.	Undetermined	Schist and slate cut by northeast-trending faults and northwest-trending aplitic and alaskitic bodies. Quartz in shear zone.	Trenches in a linear series nearly ¼ mile long. (Engel, 1959, p. 120-121).

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Undetermined ~~Unidentified prospect~~	N½ sec. 14, T5S, R4W, SBM, about 7 miles northeast of Elsinore.	Undetermined	Glassy quartz vein 3 ft. wide strikes north, dips 70°-80° W. in bedding plane of slate. Septum of decomposed granitic rock divides vein.	Gold sought in vertical shaft on vein 50 ft. or more deep. (Engel, 1959, p. 121).

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Undetermined ~~Unidentified prospect~~	SE¼ sec. 15, T5S, R5W, SBM, about 1/3 mile northeast of Alberhill.	Undetermined	West-trending fault zone in metavolcanic rocks.	Prospected by a 10-ft. adit. (Engel, 1959, p. 121).

Gold

Riverside County

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Undetermined ~~Unidentified prospect~~	NE¼ sec. 22, T5S, R5W, SBM, about 3/4 of a mile east of Alberhill.	Undetermined.	Sheared, weathered shale, and slate strike N. 30° W., dip 60° NE.	Prospected by 185-ft. crosscut adit. (Engel, 1959, p. 121).
	Victor				See Top of the World (L)
	Virginia Shay				See Virginia (L)
	Walker				See Lucky Boy (L)

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Waterloo	Sec. 25, T3S, R14E, SBM, on the east slope of the Eagle Mts.	Sold to the State of California in 1918	Undetermined	Patent survey no. 4872 listed as Gray Eagle, tied to U.S. Mineral Monument no. 141 (Saul 1962, p. 7).

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Waters Placer White Owl	17 miles northeast of Sidewinder Well, probably on the west slope of the Palen Mountains near Palen Pass.	Undetermined		Reported to have yielded "some" gold. (Tucker, 1929, p. 489). See [illegible]

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	White Star (~~claim~~	Sec. 12, T2S, R10E, (proj.), SBM.	Undetermined		(Tucker, 1945, pl. 35).
	White Wing				See Red Cloud ( )

Gold

Riverside County

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Willow (mine)	T6S, R15E, SBM, 5 miles northwest of Corn Springs.	Undetermined	Quartz and calcite vein from 6 inches to 4 feet wide strikes west and dips 30° south.	Developed through 30-ft. inclined shaft and open cuts along outcrop through a distance of 750 ft. (Tucker, 1929, p. 489).

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Gold

Riverside County

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Winchester Placer	SW¼SE¼ sec. 29, T6S, R4E, SBM., about 2 miles east-southeast of Ken-worthy Guard Station.	Raymond E. and Ceba E. Noble, 209 Taylor Ave., Montebello (1958)		(Forest Service records; county records).

Gold

Riverside County

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Wrench (prospect)	S½ sec. 34, T5S, R4W, SBM, about 2½ miles northwest of Elsinore.	J. H. Wrench, Elsinore (1937)	Quartz stringers strike N. 70° W., and dip 45° NE. roughly parallel with the fracture of quartzite and slate in a zone 3-4 ft. wide.	Worked through open cut 10 ft. wide, 20 ft. long, now caved to average depth of about 5 ft. Dump suggests concealed underground workings. (Engel, 1959, p. 120).

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Gold

Riverside County

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Yucca Buttes	Sec. 10, T5S, R11E (proj.), SBM.	Undetermined		(Tucker, 1945, pl. 35).

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Barth (Prizer) Capitol Dome	Undetermined: Reported (Ver Planck, 1952, p. 124) location in sec. 2, T4S, R7W, SBM, doubtful	Undetermined	Area covered by alluvium.	Location may have been for a grinding or storage area; gypsum probably obtained from Eagle Canyon-Tin Mine Canyon gypsite belt in nearby Santa Ana Mountains. Operation by H. A. Prizer in 1909 and W. C. Barth in 1914. Reported small production of agricultural gypsite in 1909, 1914, and 1919. (Merrill, 1919 (1917), p. 597; Ver Planck, 1952, p. 124-125; Gray, 1961, p. 115). See Main Street Canyon (L) 165

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	El Cerrito Ranch	Undetermined	Undetermined		A small tonnage of gypsite reported produced in period 1915-1917 for private agricultural use. Probably mined from Eagle Canyon-Tin Mine Canyon gypsite belt about 3 miles south and southwest of Corona in Santa Ana Mountains. (Merrill, 1917 (1919) p. 579; Ver Planck, 1952, p. 135; Gray, 1961, p. 115).
	Frazer				See Eagle Canyon (t)
	Freeman-Nonhof				See White Gypsum and Big Chief
	Garbutt and Orcutt				See Maria Mountains
	Garland				See Maria Mountains
	Gypsum Canyon				See Main Street Canyon
	Langdon				See Maria Mountains

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Omei (claim)	S½ sec. 9, T4S, R7W, SBM, northeastern flank of Santa Ana Mountains 3½ miles southwest of Corona	Mrs. B. I. Markwell, 1001 N. Lowell St. Santa Ana (1957)	See White gypsum group	(Gray, 1961, p. 116).
	Parkford				See Riverside Mountains deposit (t)
	Prizer				See Barth (t)
	Red Bull				See Hagador Canyon (t)
	Savage				See Maria Mountains (t)
	Ware				See White Gypsum and Big Chief (t)

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Iron

Riverside Co.

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Iron	Secs.? T3S, R14E, SBM, in the Eagle Mts.	Kaiser Steel Corporation	Undetermined	Claims named Iron Nos. 1,2,3,5,7,8,10,13, 14,16,17,18,20,22,23,25,26,27, and 33; Rodger Nos. 1,2,4,5,8, and 9 lodes; patent survey no. 3902, completed in 1901, tied to U.S. Mineral Monuments 85 and 86 (Saul 1962, p. 7).
	Laing				See Sulphide Pr... (t)
					168

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Little Maria (Randolph & Hamilton?) Maria Mountain Iron deposit	W½ sec. 29 (proj.), T3S, R20E, SBM, in Little Maria Mountains about 5 miles north of the Arlington Black Jack manganese mine.	Undetermined	A body of magnetite of undetermined but probably relatively small dimensions, is exposed in an area largely underlain by carbonate-rich rocks of the Maria Formation.	This deposit has probably been known for many years, but the only report which might be supposed to allude to it is about a copper claim, the Randolph and Hamilton. (Merrill, 1917, p. 525). See Iron Cap claims (L) 169

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Lead King	Sec.?, T6S, R16E, SBM in Chuckwalla Mtns.	P. E. Gates, Los Angeles (1949)	Undetermined	Small shipment to Wickenberg in 1949; smelter recovery 24.8% lead and 7 ounces of silver per ton (Goodwin, 1967, p. 603).

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	MacLeish	Sec.?, T5S, R20E, SBM., appears to be in central McCoy Mtns. area.	Undetermined	Undetermined	Ore shipped in 1918 showed a smelter recovery of 54.6% lead; 85 ounces of silver, 0.111 ounces of gold, per ton and recoverable copper. (Eric, 1948, p. 293; Goodwin, 1957, p. 604). 171

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	McConkey	Sec.?, T2S, R12E, SBM.	Undetermined	Undetermined	Ore shipped from Dale district in 1941 contained 6.25% lead, 1.15% copper; 2.25 ounces of silver, and 0.25 ounce of gold per ton. (Eric, 1948, p. 293; Goodwin 1957, p. 604).

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Mecca Neal	Sec.?, T4S, R11E, SBM.	Undetermined	Undetermined	Pinion district, 47 miles from Mecca. Inclined shaft 250 feet deep; about 1000 feet of drifts. Between 1923 and 1928, about 1050 tons of complex sulfide ore was mined and shipped. Smelters recovery averaged 25% lead, 2.86% copper; 14.76 ounces of silver, and 0.452 ounce of gold per ton. (Eric, 1948, p. 293; Goodwin 1957 p. 604-605). See Bald Eagle (+) 173

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Oro Mega	Sec.?, T3S, R12E, SBM, 20 miles south-east of Twentynine Palms at the base of the east slope of Pinto Mts., at edge of Joshua Tree National Monument.	F. E. Grover, 1223 West Bay Ave. Newport Beach (1950)	Undetermined	Development consists of 2 open cuts 60 feet by 600 feet by 3 feet, and 2 adits. Concentrates representing about 7% of the bulk ore were shipped to Selby in 1949-1950. Recoverable metal in the bulk ore has averaged about 2.88% lead; 0.92 ounce of silver, 0.08 ounce of gold per ton, and recoverable copper. Ore was milled at the Ivanhoe mill. (Goodwin, 1957, p. 606).

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Palisade	Sec.?, T5S, R20E, SBM.	Undetermined	Undetermined	Shipped ore in 1919; smelter recovery was 13.48% lead, 6.10% copper; 6.73 ounces of silver and some gold. (Eric 1948, p. 294; Goodwin 1957, p. 606).

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Palisades Group	SE¼ sec. 4, T6S, R4W, SBM, about 2 miles east of Elsinore.	George Peterson Elsinore (1929)	Sheeted, fractured zone, 2-3 ft. wide, strikes N.60°E., dips 50°SE° in deeply weathered diorite and gabbro. Associated with iron-stained dioritic dike and dark green diabasic and lamprophyric dikes. Limonite and secondary calcite occur in fractures. Ore minerals not visible, although unspecifice quantities of silver, lead, copper, and gold reported in 1929.	Workings disposed for several hundred yards in a northeasterly direction, include inaccessible 30-ft. inclined shaft on sheeted zone and several shallow pits. Nearly ¼ mile northeast are several caved pits 4-7 ft. deep, and one 35-ft. adit in similar rocks. Production, if any, undetermined but small. (Eric 1948, p. 294, map; Tucker, 1929, p. 491; 1945, p. 148, pl. 35; Engel, 1959, p. 123).

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Scott Lode No. 1	Sec.?, T5S, R20E, SBM, 14 miles south of Rice. Seems to be an uncertain location. Distance from rice suggests that it is same as Bald Eagle (see herein).	Undetermined	Undetermined	Developed by a 350-foot inclined shaft, 300-foot tunnel, and 120 feet of drifts. Shipped complex ore in 1924; smelter recovery was 24.82% lead, 5.72% copper; 16 ounces of silver, and 0.52 ounce of gold per ton. In 1934 2,100 tons of gold ore yielded 128.08 ounces of gold, 50 ounces of silver, 239 pounds of copper, and 1,108 pounds of lead. (Eric 1948, p. 295; Goodwin 1957, p. 607; U.S. Bureau of Mines records).

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Winfield No. 2	Sec.?, T4S, R10E, SBM, Eagle Mt. district, 55 miles northeast of Indio.	W. E. Covey, S.B. Mosher, Box 1135, Indio (1952) Operators: Scott & Lindsay, Box 154, Indio (1952)	Undetermined	Small shipment of complex ore sent to Selby in 1952; smelter recovery approximately 2.62% lead, 5.20% copper; 6.50 ounces of silver, 0.05 ounces of gold per ton, and some zinc. (Goodwin 1957, p. 608).

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Big Hill	Sec. 6, T7S, R5E, SBM. Not confirmed (1963)			See Nightingale limestone in text. (Tucker and Sampson, 1945, pl. 35, no. 233; Logan, 1947, p. 272, pl. 37, no. 12).
	Bautista Canyon Deposits				See [illegible] San Jacinto Rock [illegible] Company [illegible]
					179

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
320	Blue Diamond and Eagle	NW¼ sec. 17, NE¼ sec. 18, T4S, R1E SBM. San Jacinto Mountains about 2 miles northeast of Sobaba Hot Springs.	Harold V. Sims, P.O. Box 16, San Jacinto (1958)	Lenses of pre-Cretaceous gray to white crystalline limestone. Beds strike north to northwest.	In 1958 Mr. Sims held two unpatented claims in the NW¼ sec. 17, Blue Diamond No. 1 and Eagle No. 1. By 1958 these deposits were undeveloped and were accessible by foot only.

Limestone
Riverside County

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Blythe Cement nos. 1 to 5	Published location (Logan, 1947, p. 270) appears to be in error; probably located in sec. 25, T3S, R19E, and sec. 30, T3S, R20E (proj.), SBM, on the south slope of the Little Maria Mts. about 4 miles north of the Arlington Black Jack mine.	Undetermined. (1963) Last reported owners W. V. and G. M. Neuman, B. F. and J. E. Rockhold, Martha B. and E. E. Schellenger, Mrs. Lulla Stearns and D. R. Hall, Blythe (1947)	Deposit in an area underlain by intensely folded and sheared carbon-ate rich rocks of the Paleozoic(?) Maria Formation. The central part of sec. 25 is underlain by a mass about ½ mile wide of crystalline limestone with zones of siliceous dolomite and quartzite. This mass extends north into sec. 24 which is almost wholly underlain by these strata.	Five 160-acre association placer claims were located in 1928-29. Apparently the deposits are undeveloped. (Logan, 1947, p. 270).

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Cameron Marble Co.	E½ sec. 14, T5S, R5E, SBM., 1 mile west of Rancho Mirage; and W½ sec. 30, T5S, R6E, SBM., 1 mile southwest of Palm Desert. Not confirmed, 1963.	Undetermined	Pre-Cretaceous crystalline limestone with biotite schist and gneiss. Dibblee (1945, plate 2) mapped a large body of undifferentiated Triassic and/or Paleozoic metasedimentary rocks (including limestone) in this area. In sec. 14 a bed of "marble" was reported to strike east, dip 25° S., to be 30 ft. thick, and to crop out for 2,500 ft. In sec. 30 a bed of "marble" 30 ft. wide was reported to strike N. 65° E., dip 23° S., and to crop out for 850 ft. This "marble" was reported to be creamy white with black and gray mottling, (Div. Mines Field Rept. 72, Riverside Co.).	In 1914 the Cameron Marble Co., 1022 California Bldg., Los Angeles, was reported to hold "marble" deposits at these locations. By 1914 only assessment work had been done and apparently the deposits have not been mined. (Dibblee, 1954, pl. 2; Div. Mines Field Rept. 72, Riverside Co.). 182

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Carbonate Blanket (4 placer claims)	Probably on N. slope of Little Maria Mts. about one to 1½ miles NW. of Midland.	Undetermined (1963). Might be held, all or in part, by U.S. Gypsum Co. Last reported owners W. V. and G. M. Neuman, B. F. and J. E. Rockhold, Martha B. and E.E. Schellinger, Mrs. Lulla Stearns and D. R. Hall. Blythe, (1947)	Deposit on or near the north margin of a structurally-complex exposure of mixed carbonate, gypsiferous, calcsilicate, and schistose rocks of the Paleozoic(?) Maria Formation. About 1½ miles northwest of Midland is a metamorphic rock mass as much as 3/4 mile wide and several miles long composed mostly of siliceous dolomite with quartzite, but also with zones of crystalline limestone.	Four association placer claims were located in 1928-29. Apparently the carbonate rocks are undeveloped. (Logan, 1947, p. 270).

Limesto[ne]
Riverside County

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
322	Chino Canyon Deposits	E½ sec. 6, W½ sec. 5, T3S, R4E, SBM. Along the north side of Chino Canyon near the west boundary of the City of Palm Springs.	Sec. 6 is within the Agua Caliente Indian Reservation; sec. 5 is owned by the Southern Pacific Co., 65 Market St., San Francisco 5.	Interbedded pre-Cretaceous schist and carbonate rocks intruded by granitic rocks. Numerous beds of crystalline limestone strike north to northwest and dip about 50° east. Major carbonate-bearing zones range from 500 to 1,500 ft. in length and are as much as 100 ft. wide.	Deposits have not been developed. The small size of individual limestone bodies and the nearness of Palm Springs probably precludes commercial development.

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
323	Eden Hot Springs Limestone Deposit Fremont Hill Quarry	$NW\frac{1}{4}NW\frac{1}{4}$ sec. 25, T3S, R2W, SBM. About 9 miles northwest of San Jacinto, 3/4 mile southeast of Eden Hot Springs at the base of the steep west face of Mt. Eden.	Thos. D. McTavish, Route 1, Box 82, Camarillo (1945). Undetermined (1963)	Pre-Cretaceous limestone, the northwestern extension of a sequence of metamorphic rocks mapped by Fraser (1931, plate facing p. 540) as Paleozoic or older. White to gray, medium to coarsely crystalline limestone mass strikes northwest, dips about 40° NE. Limestone mass is probably more than 1,000 ft. long and 200 to 300 ft. wide.	In 1929 the deposit, which is on private land, was owned by Eden Hot Springs, Inc. The deposit appears to be high-grade white limestone. Previous reports state that the $CaCO_3$ was reported to be 98%. Apparently this deposit has not been mined as no evidence of development work was observed in July, 1963. (Tucker and Sampson, 1929, p. 515; Tucker and Sampson, 1932, p. 6, pl. 1; Tucker and Sampson, 1945, p. 172; Logan, 1947, p. 271). See Old City [illegible] [illegible] and [illegible]

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
321	Fingal Deposit	Sec. 17, T3S, R3E, SBM. North-trending spur at the north margin of the San Jacinto Mtns., one mile southeast of Fingal.	Undetermined	Pre-Cretaceous limestone interbedded with mica schist and granitic gneiss. Band composed mostly of limestone, about 2,500 ft. long and 100 ft. wide, strikes northwest, dips 65° NE.	Narrow band of limestone cuts across a spur just south of the center sec. 17, mostly in the NE¼SW¼ sec. 17. Apparently undeveloped.

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Harris	Sec. 9, T7S, R5E, SBM. Not confirmed (1963)			See Nightingale limestone in text. (Tucker and Sampson, 1945, pl. 35, no. 236; Logan, 1947, p. 271).

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
327	Hubbard Limestone Deposit	S½ sec. 24, T4S, R1W, SBM. About 3/4 mile northwest of Soboba Hot Springs, on the steep west face of the San Jacinto Mountains, northeast side of State Highway 79.	W. F. Rohland and Mary Heinsen, Gilman Hot Springs, (1945) Undetermined (1963)	Pre-Cretaceous, medium to coarse crystalline white limestone lens in a large mass of Pre-Cretaceous metamorphic rocks, which are mostly schist and quartzite. Limestone strikes N. 40° W., dips 18° NE. One of a number of limestone lenses in the large metamorphic rock mass that extends about 8 miles northwest from Soboba Hot Springs to just beyond Lamb Canyon.	Limestone was mined from an open cut 75 ft. long with face 20 ft. high, located at the head of a steep, narrow ravine about 1,000 ft. above Highway 79. Property was owned and operated by the Snowflake Lime Company, probably about 1900, and supplied limestone to a steel-shell limekiln which still stands near Highway 79. Tucker and Sampson (1945, p. 173) report that the limestone was blasted and allowed to roll down the canyon to the kiln. Early day residents, however, state that the limestone was lowered to the kiln by means of a cableway tram, but no trace of such an installation remained in 1963. The lime is said to have been used extensively for building mortar throughout southern California. By 1929 the quarry was owned by Omar H. Hubbard, Long Beach, but had been idle for some years and has not since been operated. (Tucker and Sampson, 1929, p. 516; Tucker and Sampson, 1932, p. 7; pl.1 Tucker and Sampson, 1945, p. 271; Logan, 1947, p. 172-173)

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Mammoth 7 Limestone Claim Mira Loma	Undetermined	Louis Steck, 443 North 7th Street, Colton (1947), Undetermined (1963)		According to Logan (1947, p. 272) Louis Steck held 80 acres within one mile of the Palm Springs Station. Apparently this location was in the vicinity of the Novelle, Guiberson, and Southern Pacific limestone deposits (see herein). Mr. Steck is reported to have shipped a few carloads of limestone to Los Angeles in the early 1940's, and to have made several exploratory cuts. (Logan, 1947, p. 272). See Glen Avon Limestone deposit (?) 189

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
332	Mt. Edna Deposit North Hill Quarry	SW¼ sec. 28, T3S, R1E, SBM. 4 miles south of Banning, on the southwest face of Mt. Edna at the Colorado River Aqueduct, north side of the old Banning-Idyllwild Road.	Undetermined	Limestone body occurs with pre-Cretaceous mica schist, a pendant in bouldery granite. Gray to white, medium to coarse crystalline limestone strikes northwest, appears to dip northeast. Limestone mass is about 2,500 ft. long, 250 to 500 ft. wide.	West edge of deposit has been explored by a road-like dozer cut about 500 ft. long. Apparently no production and no recent activity. See Old City Quarry under Rock Product (Banning Crushed Stone) t 190

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
336	Novelle Limestone Deposit	NW¼NW¼ sec. 26; NE¼, NE¼ sec. 27, T3S, R3E, SBM. Steep northern margin of San Jacinto Mtns., about one mile south of Palms Springs Station, in the City of Palm Springs.	George A. Novelle, Monrovia (1932) Undetermined (1963)	Series of interbedded pre-Cretaceous schist and carbonate rocks intruded by granitic rock strikes N. 50° W., dips 55° NE. In the northwest corner of sec. 26 and the northeast corner of sec. 27 is a mass of blue to gray coarse crystalline limestone about 1,500 ft. long and 900 ft. wide, but also contains some dolomite and interbedded schist. In addition thin limestone beds in mica schist crop out at several places in the northern half of sec. 26.	In the late 1920's George Novelle held all of sec. 26. By 1945 the property was reported to have reverted to the public domain. Apparently this deposit has not been mined; the nearness of Palm Springs probably precludes its exploitation. (Tucker and Sampson, 1929, p. 516-517; Tucker and Sampson, 1932, p. 8, pl. 1; Tucker and Sampson, 1945, p. 173; Logan, 1947, p. 272).

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Old City Quarry (Fairmount Hill Quarry, North Hill Quarry)				See under Rock Products, Broken and Crushed Stone.

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Palm Springs Canyon	Secs. 25, 36, T5S, R4E, SBM. In Palm Springs Canyon, about 9 miles south of Palm Springs. Not confirmed (1963).	Undetermined	A large mass of pre-Cretaceous metamorphic rock crops out along the east side of Palm Springs Canyon. The sequence strikes north and dips 35° E. The metamorphic series is mostly mica schist, but contains minor amounts of limestone and quartzite (Fraser, 1931, plate facing p. 540).	In 1945 Tucker and Sampson (no. 243, plate 35) listed a limestone deposit at this location. Apparently it is undeveloped. (Fraser, 1931, plate facing p. 540; Tucker and Sampson, 1945, plate 35). 193

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Palo Verde Dam Quarries				See in text under Rock Products, Broken and Crushed Stone.

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Pinyon Flat	Secs. 5, 6, T7S, R5E, SBM. Not confirmed (1963)			See Nightingale limestone in text. (Merrill, 1917, /1919/, p. 551, fig. 4; Logan 1947, p.272, pl. 37, no. 12).

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
337	Potrero Creek Deposit	W½ sec. 34, T3S, R1W, SBM. 4½ miles due south of Beaumont and 1 mile west of San Jacinto Nuevo y Potrero	Riverside Cement Company, Division of American Cement Corporation, mill office, P.O. Box 832, Riverside (1962)	At least 5 limestone bodies occur in a mass of pre-Cretaceous metamorphic rock (mostly schist and quartzite) which crops out as an irregularly shaped mass in the central part of sec. 34. This metamorphic rock mass is about 1 mile long and ranges from ¼ to 3/4 mile in width. Gray to white, medium to coarse crystalline limestone bodies strike northwest and dip 50°-60° NE. The two largest limestone bodies, about ½ mile apart, appear to be from 1,000 to 1,500 ft. long and 250 to 500 ft. wide.	Local residents report that limestone was transported from this deposit about 1900-1915 by pack mules and presumably was burned locally for building lime. The principal limestone bodies have been explored or mined from a number of small cuts. About 1960 the Riverside Cement Company explored the property and did some drilling, but in 1963 the deposit remained idle.

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Schellinger (Schellenger)	Sec. 22, T3S (proj.) R21E, SBM, on the north slope of the Big Maria Mts., about 2½ miles NE. of Styx	Undetermined (1963). Reported probably to have reverted to public domain (1945).	Deposit part of an east-west trending belt about 1 mile long and ½ mile wide of mixed carbonate-rich rocks. White to gray, coarsely crystalline limestone of the Paleozoic(?) Maria Formation. Reported (Tucker and Sampson, 1945, p. 174) to be 200 feet thick and to have shown, by analyses, to be 98.45 percent calcium carbonate and 0.25 percent "magnesia".	Apparently undeveloped. (Tucker and Sampson, 1929, p. 520-521; Tucker and Sampson, 1945, p. 174, pl. 35).
	Snyder deposit				See Lamb Canyon [illegible]

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
343	Southern Pacific Deposits	S½SW¼ sec. 23, T3S, R3E, SBM. North margin of the San Jacinto Mtns., 3/4 mile south of Palm Springs Station; and SE¼NW¼, SE¼SE¼, sec. 25, T3S, R3E, SBM. on each side of the mouth of Blaisdell Canyon, about 1 mile south of Windy Point.	Southern Pacific Company, 65 Market Street, San Francisco 5, owns all of sec. 25 and all of sec. 23 except the NW¼SW¼.	Series of pre-Cretaceous mica schist, granitic gneiss, and limestone. The limestone is white to gray and medium to coarsely crystalline. Part of the limestone is massive and uncontaminated with other sediments, but in places it is contaminated by granitic dikes, dolomite, and schist. A metamorphic mass in sec. 23 consisting mostly of limestone strikes about N. 50° W., dips 65° NE., and has maximum dimensions of 2,750 ft. by 1,250 ft. This mass is the southeast extension of the Guiberson deposit (see herein). The principal limestone-bearing sequence in sec. 25 lies in the SE¼ NW¼ and has maximum dimensions of 1,500 ft. by 900 ft. The beds strike N. 10-15° W., dip 65° NE. Three limestone beds in the SE¼SE¼ sec. 25 range from 1,250 ft. to 1,750 ft. in length and are 200-250 ft. wide, separated by 250 to 400 ft. of schist.	Apparently no production from these deposits. The nearness of Palm Springs probably precludes their commercial exploitation. (Tucker and Sampson, 1929, p. 521; Tucker and Sampson, 1932, p. 8, pl. 1; Tucker and Sampson, 1945, p. 174; Logan, 1947, p. 273-274).

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Whitecap Limestone No. 1 and No. 2	SW¼ sec. 29, W½ sec. 31, sec. 32 (proj.) T3S, R21E, SBM, one to two miles NE. of Midland in the Big Maria Mts.	Undetermined (1963). Probably held at least in part by U.S. Gypsum. Last reported owners W. V. and G. M. Neuman, B. F. and J. E. Rockhold, Martha B. and E. E. Schellenger, Mrs. Lulla Stearns, and D. R. Hall, Blythe (1947).	Deposit part of an east-west trending belt of mixed, carbonate-rich rocks of the Paleozoic(?) Maria Formation. 160-acre placer locations reported (Logan, 1947, p. 274) to be on high calcium limestone. The SW¼ of sec. 31 (proj.) is underlain by crystalline limestone.	Two 160-acre placer locations made in 1928. Apparently the limestone deposits are undeveloped. (Logan, 1947, p. 274).

Limestone

Riverside County

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Whitewater Deposit				See Guiberson deposit.
	Nichols				Magnesite See Hewitt Magnesite [illegible]

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Black Bird Black Eagle & Newport Black Horse group	Sec. 24(?), T4S, R19E, SBM. Four claims just west of Black Jack mine.	Undetermined	Mn oxides in narrow veins in rhyolite (granite porphyry).	~~See Arlington - Blackjack (t)~~ See Beal - McClellan (t) Probably in part the same as the Manganese Canyon group (see herein). (Bradley, 1918, p. 56; Tucker, 1929, p. 492).
	Black Jack				See Arlington - Black Jack (t)

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Box Canyon Manganese deposit	Sec. 24, T6S, R10E, SBM. 1/8 mile west of Shavers Well.	Leland Noblitt, Brawley (1945)	Manganese oxides and quartz in irregular bodies in schist.	This deposit probably similar to the Big Bullett claims (see herein). Developed by shallow, open cut. (Tucker 1945, p. 150, pl. 35; Trask, 1950, p. 182).

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Bray (mine)	Sec. 19 (proj.), T4S, R20E, SBM, about 1000 ft. south of Black Jack group.	Undetermined	Probably similar to Black Strike (see herein).	Reportedly yielded 44 percent Mn ore in 1918. May be same or near Black Strike (see herein). (Bradley, 1918, p. 56; Tucker 1929, p. 493; Trask 1950, p. 178).
	Brumand Newport				See Beal-McClure (?)

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Clark and Losekamp prospect	SW part of T5S, R1W, SBM, 4 miles southeast Winchester.	Undetermined	Manganese oxides in bedded rocks.	(Trask, 1950, p. 182).
	Dixie [illegible] M[illegible]				See L[illegible] ( )
	Elsinore				See B[illegible]-McG[illegible]
	Giant Chief				See Yellow S[illegible] ( )

Manganese

Riverside County

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Groce (mine)	Sec. 19 (proj.), T4S, R20E, SBM.	Undetermined	4-8 inches of high-grade Mn oxides in faulted granite porphyry.	Probably the same property as Black Strike (see herein). Ore reported shipped from this property in 1918. (Tucker, 1929, p. 493; Trask, 1950, p. 174-179).
	Grouse				(See Black Strike (?))
	Mabey & Brown				(See Langdon (?))

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Noblett Manganese (claim) Paddy Fault (?)	Sec. 23, T6S, R10E, SBM.	Probably Leland Noblett, Brawley (1945)	Probably similar to Big Bullett claims (see herein).	(Tucker 1945, pl. 35). See Lucky Boy

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Palen Mountains deposit)	T4S, R18E(?) SBM.	Undetermined		(Bradley, 1918, p. 59; Trask, 1950, p. 185).

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Palo Verde Region	8 mi. NW.(?) of Palo Verde.	Undetermined		Claims reported in 1918 as belonging to Lugo and Justice Smith of Palo Verde appear to be mislocated and probably lie in Imperial Co. southwest rather than northwest of Palo Verde. May be the Lugo (Lost Donkey, Palo Verde) claims. (Bradley, 1918, p. 59; Tucker 1929, p. 494; Trask, 1950, p. 76-77).

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Parsons (mine)	Sec. 19 (proj.), T4S, R20E, SBM, probably just south of the Black Strike (see herein).	Undetermined	Manganese oxide vein as wide as 2.5 feet in fault-breccia zone in granite porphyry.	Developed through 100-foot shaft with drifts on three levels. By 1918 property had yielded 500 tons of ore. (Trask, 1950, p. 179).

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Pinkham (prospect)	T6S, R9E, SBM, 10 miles east of Mecca.	Undetermined		Apparently little more than a prospect, reported in 1916 as "indications of ore are said to be blocks of float of manganese oxide". (Trask, 1950, p. 185).

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Robinhood No. 4	NE¼ sec. 33, T5S, R4W, SBM, about 1½ miles southeast of highway 74 and about 2 miles northeast of Elsinore.	Giles D. and Eunice M. Robbins, 2754½ Nebraska Avenue, South Gate (1942)	Triassic ~~Santa Ana~~ (Bedford Canyon) chloritic shaly slate contains 3-ft. wide manganiferous siliceous layer along bedding. Manganese oxide replacement of rhodonite and black stained quartz. Manganiferous layer massive except 6 in. of parallel banding on each border suggests layering, possibly of chert beds.	Exposures limited to 10-ft. trench with 7-ft. face; 3-ft. pit 50 ft. southeast on same lense, and 10-ft. long outcrop of similar material 30 ft. to southwest and 100 ft. south of trench. No production. (Engel, 1959, p. 124-125).

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Undetermined ~~Unnamed prospect~~	NW¼ sec. 34, T5S, R4W, SBM, 2 miles southeast of Highway 74 and 2 1/8 miles northeast of Elsinore.	Undetermined	Manganese oxides in siliceous bed 4½ ft. thick with quartz and a little rhodonite.	Manganese-bearing bed exposed along 20-ft. trench with 5-ft. race; offset segment of similar zone exposed in shallow pit just southeast. (Engel, 1959, p. 125).
	Lucky Day Lucky Lay				Mica See Pine Knot [illegible]

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Agua Caliente Spring				See Palm Springs.

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Bundy Hot Springs (Bundy's Elsinore Hot Springs)				See Lake Elsinore Hotel

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
365	City of Elsinore Wells	SE¼ sec. 6, T6S, R4W, SBM.	City of Elsinore, (C. O. Soots, Supt. of Public Works, City Hall, Elsinore) (1955)		Two wells in Elsinore: No. 1 in City Maintenance yard, west of north end of Langstaff Street; No. 2 well 500 ft. southwest of No. 1, between Langstaff and Riley Streets, north of Flint Street. (Engel, 1959, p. 104-105, 139).

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
366	Creswell Baths	Cor. secs. 5,6,7,8, T6S, R4W, SBM.	Noritatsu and Mitsuyo Nakai, Spring and Franklin Streets, Elsinore (1955)		(Engel, 1959, p. 105, 139).

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
367	Desert Hot Springs	E½ sec. 30, T2S, R5E, SBM.	L. W. Coffee, 257 S. Spring St., Los Angeles (1945)	Hot-water wells in the San Andreas fault zone.	Well, sunk in 1940, in the San Andreas fault encountered hot water at a depth of 300 ft. As of 1945 eight wells were developed with a combined capacity of 1500 gals. per minute in temperatures ranging from 112° to 116°. Water used in bath house and swimming pool. (Tucker 1945, p. 175-176).

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
368	Eden Hot Springs	E½ sec. 23, T3S, R2W, SBM.	M. Greenberg (1945)	Eight small springs in the San Jacinto fault zone.	Maximum temperature of water about 110°F. Bathhouse and swimming pool. (Waring, 1915, p.37; Tucker 1929, p. 523; 1945, p. 176).

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Elsinore Springs				See Lake Elsinore Hotel and Lakeview Inn hot springs.

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Elsinore Hot Springs				See Lakeview Inn hot springs.

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
369	Gilman Hot Springs (Relief Hot Springs, San Jacinto Hot Springs).	SE¼ sec. 9, T4S, R1W, SBM, 3 miles north of San Jacinto on State Highway 79.	Gilman Hot Springs, Mrs. Joe Gilman, proprietor and Wm. Gilman, mgr. (1945)	About 6 springs in the San Jacinto fault zone near the base of the San Jacinto Mtns.	Hot spring, motor hotel and golf resort. Reported in 1945, as equipped with hotel, cottages and cabins, a large garage. Roman tub baths, mud baths and swimming pool. (Waring, 1915, p. 38; Tucker, 1929, p. 521-523; Sampson, 1931, p. 8, pl. 1; Tucker, 1945, p. 176-177).

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
370	Glen Ivy Hot Springs	Sec. 10, T5S, R6W, SBM, at base of Santa Ana Mtns. in Temescal Canyon, 10 miles south of Corona.	Axel Springborg and wife (1945)	Small springs having a reported temperature as high as 110°F. issue from the Elsinore fault zone through fractured granitic and porphyritic rocks.	Reported in 1945 to be equipped with a bathhouse, swimming pool and accommodations for guests. (Waring, 1915, p. 42; Tucker, 1929, p. 521; 1945, p. 178).

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
371	Highland Springs	W½ sec. 25, T2S, R1W, SBM, about 3 miles northeast of Beaumont.	F. S. and W. W. Hirsh, 646 E. 8th Street, Los Angeles (1945)	Springs issuing from the San Andreas fault zone at the base of the south slope of the San Bernardino Mtns. Water temperature 112°F.	Described in 1945 as comprising a bathhouse and large swimming pool. (Tucker, 1945, p. 178-179).

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
372	Lake Elsinore Hotel (Bundy's Elsinore Hot Springs, Bundy Springs, Bundy Hot Springs, Elsinore Springs Elsinore Hot Springs, Wreden, (Wrenden))	Cor. secs. 5,6,7,8, T6S, R4W, SBM (proj.), Main at Franklin Streets, Elsinore.	Dr. Wm. E. Schwartz, 605 North Sierra Drive, Beverly Hills. Leased to George Lewis, Murray Finberg and M. L. Herbener, Box 236, Elsinore (1955).	In 1915, Waring reported: "Many small hot springs formerly issued along the northeast side of Elsinore Lake. In the early nineties, however, a canal was cut and the water of the lake was conducted northward for irrigation, and since that time most of the springs have ceased to flow. Hot sulphurated water is still obtained, however, from shallow wells." (Waring, 1915, p. 42).	A resort comprising a hotel and bathhouse (1945). (Waring, 1915, p. 43, 387; Merrill, 1919, p. 58, 581; Tucker, 1929, p. 523; 1945, p. 181, pl. 35; Larsen 1948, p. 128; 1951, p. 45; Engel, 1959, p. 105, 139).

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
373	Lakeview Inn Hot Springs (Elsinore Springs, Elsinore Hot Spring)	NE¼ sec. 7, T6S, R4W, SBM (proj.), Graham at Riley Streets, Elsinore.			(Waring, 1915, p. 42-43, 387; Merrill, 1919, p. 580; Tucker, 1929, p. 521-523; 1945, p. 179, pl. 35; Engel, 1959, p. 106, 140).

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
374	Murrieta Hot Springs	SW¼ sec. 13, SE¼ sec. 14 (proj.), T7S, R3W, SBM, on Webster Avenue about 4 miles east of Murrieta.	Guenther's Murrieta Hot Springs, Murrieta Hot Springs Road	Hot springs issuing from the Elsinore fault zone at base of a gravel bluff. Three springs with a maximum temperature of about 136°.	Hotel, bath-house, cottages and bungalows, and landing field for aircraft. (Waring, 1915, p. 44; Tucker, 1929, p. 523; 1945, p. 179-180, pl. 35).

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
375	Nichols Warm Springs	SE¼, sec. 36, T6S, R21E, SBM, 7½ miles west of Blythe on U.S. 60-70.	Nicholls Warm Springs, A. E. Nicholls, President.	Undisturbed alluvial deposits underlying the Palo Verde Mesa.	A cased, 14-inch well, 638 feet deep drilled in May, 1946. Well does not reach bed rock. Static water level was 138 feet. Temperature of water coming out of well 92°. Average analysis ppm Total solids ----------------1811.6 Total Chloride (NaCl) ------ 852.2 Total Sulphate (Na_2SO_4) ---- 810.5 Total Alkalinity ($CaCO_3$) --- 111.0

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
376	Palm Springs	SW Cor. sec. 14, T4S, R4E, SBM, at the corner of Indian Avenue and Taquitz Drive in the city of Palm Springs.	Undetermined	Probably issues from a fault along the base of the mountains.	(Waring, 1915, p. 338; Merrill, 1919, p. 581; Tucker, 1929, p. 523; Sampson, 1931, p. 9, pl. 1; Tucker, 1945, p. 180, pl. 35).

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Relief Hot Springs				See Gilman Hot Springs.

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	San Jacinto Hot Springs				See Gilman Hot Springs.

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
377	Soboba Hot Springs	NW¼ sec. 30, T4S, R1E, SBM, near Highway 79 about 1 mile northeast of San Jacinto	John G. Althouse, San Jacinto	Six springs issue from the San Jacinto fault. Water temperature ranged from 70° to 118° F. in 1945 (Tucker, p. 180).	Equipped with bath house, separate dwellings, and a swimming pool (1945). (Waring, 1915, p. 39; Tucker, 1929, p. 23; Sampson, 1931, p. 10, pl. 1; Tucker, 1945, p. 180-181).

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Wreden (Wrenden)				See Lake Elsinore Hotel. 232

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Aurora No. 1 mine	Sec. 26, T6S, R14E, (proj.), SBM.	Tyler Bennett and A. H. Hummel, N. Hollywood (1956)	Unidentified radioactive mineral in copper-stained quartz vein in granite.	May be an old gold prospect. (Walker, 1956, p. 12,26).

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Big Cat	SW¼SW¼ sec. 17, T7S, R4E, SBM. 4¼ miles east of Anza.	J. W. and R. F. Barnes 230 E. Bennett St., Compton (1962)	Sheared and faulted granitic rock in the San Jacinto fault ~~trace~~ zone.	Property located by this owner May 6, 1957. Developed by single, 20-foot shaft. Anomalous radioactivity~~, possibly due to radon gas,~~ reported by owner~~, to be confined to shaft.~~ No uranium mineral yet identified (1962).

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Northeast No. 1 claim	$E\frac{1}{2}W\frac{1}{4}$ sec. 19, T6S, R21E, SBM, about 2 miles north of U.S. 66-70 and 12 miles west of Blythe on the south slope of the McCoy Mtns.	Joseph and Charles Safrnek, 4219 Lennox Blvd., Lennox	Property lies on east slope of narrow, north-northwest-trending ridge of sheared, metasedimentary rocks. Secondary, yellow, radioactive mineral resembling carnotite unevenly distributed along shear zones in which it has impregnated porous material and formed thin crusts and fissure fillings. Deposit exposed in area several hundred feet long and about 100 feet wide. Full extent not determined.	Radioactive area opened by several bulldozer cuts (Butler, 1962).

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Ironwood No. 1 Prospect	NW¼ sec. 20, T3S, R23E, (proj.), SBM, about 20 miles north of Blythe and 3 miles west of Quien Sabe Point.	Undetermined	Fine to-medium-grained hornblend granite cut by thin pegmatite dikes. No unusual mineralization or radioactivity found.	Located in 1956 by Guy Waite and Cyrus H. Ferguson, Box 29, Parker Star Rt., Blythe. Development comprises a 9-foot burrow in east bank of wash, and road work.

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
452	Berdoo Adit Aggregate	SW¼ sec. 10, T4S, R8E, SBM, in Berdoo Canyon 3½ miles northeast of the intersection of Berdoo Canyon and Dillon Road.	Metropolitan Water District of Southern California, 306 West Third St., Los Angeles	Terrace deposits and/or older alluvium along north side of Berdoo Canyon. Material semi-consolidated, massive, poorly sorted sand, gravel, and boulder conglomerate. Deposits about 3 miles long and average of a quarter of a mile in width. Thickness undetermined.	Sand and gravel used in concrete aggregate taken from deposit during construction of Colorado River Aqueduct, 1932-41. Since inactive. Open pits and cuts.

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
453	Corona Rock Company	W½ sec. 32, T3S, R6W, SBM, northwest end of Temescal Wash, 2 miles southeast of Corona, along the east side of the city dump.	Riverside County Flood Control District (1957).	Quaternary alluvium in Temescal Wash; dirty, silty sand with sparse gravel.	About 1937, a small sand and gravel plant known as the Corona Rock Company was erected and operated by Bill Flynn. Dismantled after several years operation. Several small, shallow pits 10-15 feet deep.

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
454	Desert Hot Springs Ready Mix, Inc. (deposit)	SE¼ sec. 13, T2S, R4E, SBM, about 1½ miles NW. of Desert Hot Springs	Desert Hot Springs Ready Mix, Inc. Box 286, Desert Hot Springs	Dry wash extends south for about ½ mile from head of canyon. Width ranges from 100-300; up to 50 deep on bed rock. About 70 percent gravel, interstratified layers of sand and gravel up to 1' thick. No overburden or replenishment. Few percent plus 4" gravel. Occasional 2' boulders.	Excavated with dragline scraper and bulldozer to depths of about 50'. Feed empties over primary jaw which crushes plus 4" gravel. From jaw, feed conveyed to trommel screen from which plus 1½" goes to secondary jaw crusher. Wash over standard vibrating screens, twin sand drag. Capacity 60 tons/hr. concrete sand and gravel.

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
455	Fan Hill Canyon deposit	SW¼SE¼ sec. 20, T3S, R7E, SBM, south edge of Little San Bernardino Mts., 9 miles northeast of Thousand Palms, at west margin of Fan Hill Canyon.	Undetermined	Quaternary alluvium, mostly a sandy, pebble and cobble conglomerate with few boulders. Clasts of metamorphic and granitic rock found in Little San Bernardino Mts.	Probably used in construction of Colorado River aqueduct, 1932-41. Roughly circular pit 400 feet in diameter and 10 to 25 feet deep.

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
456	Fargo Canyon Talus ~~deposit~~	Sec. 10, T5S, R8E, SBM, north side of Fargo Canyon Road, 4½ miles northeast of Indio.	Undetermined.	Quaternary alluvial fan. Sandy conglomerate with cobbles and boulders of granitic and metamorphic rocks.	Material tested for all American Canal in 1949 by U.S.Bureau of Reclamation (Report No. C-440). The sample submitted contained a 1½ inch maximum size aggregate and is suitable for use as concrete aggregate, provided the sand is washed to remove silt and an air-entraining agent used in the concrete. No report of use in Government construction. Small pit 150 feet long, 50 feet wide and 20 feet deep. (Dickey and Porter, 1952, p. 9).

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
457	Flat Top Mountain deposit	SW¼ sec. 33, T3S, R5E, SBM, southeast end of Indio Hills 5 miles northwest of Thousand Palms on the south side of Flat Top Mountain.	Undetermined	Dune sand.	Shallow pit on hillslope, about 500 feet wide and 750 feet long. Probably used in local highway construction.

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
458	Hicks-Allred Indio Hills (deposit)	SW¼ sec. 5, T4S, R6E, SBM. Approx. 2½ miles north of Thousand Palms.	Hicks-Allred, 36711 Cathedral Canyon Drive, Cathedral City	(See Yaeger)	Excavate with tractor bull-dozer that pushes material to plant. Crush over-size in two jaw crushers. Wash over standard vibratory screens, sand rake. Capacity 130 tons/hr. Products - concrete sand and gravel.

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
459	Industrial Asphalt (Kuster and Waterbury, Transit Mixed Concrete Co.) Corona plant	SE¼ sec. 30, west margin SW¼ sec. 29, (proj.), T3S, R6W, SBM. At Porphyry station, 1 mile east of Corona in lower Temescal Wash.	Industrial Asphalt of California, Inc., 1027 Quarry, Corona (main office, Santa Fe Springs). (1963)	Quaternary stream deposit of silty sand and gravel.	Medium sized plant for concrete sand and gravel operated for many years by Kuster and Waterbury before 1942; from 1942 to the late 1950's by Transit Mixed Concrete Co., who built a new small plant. The most recent operator was Industrial Asphalt. Plant closed down in 1961, apparently because economic depth limit of deposit was reached. Most of the mining was from 2 adjacent pits east of the plant; one pit is about 1,000 ft. by 750ft. and 40 ft. deep; the other pit is about 750 ft. by 500 ft. and 30 ft. deep. Total production undetermined, probably a few hundreds of thousand of tons of washed sand and gravel. (Gray, 1957, p. 96, 119). 244

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Kuster and Waterbury				See: Industrial Asphalt, Corona plant.

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
460	Massey Indian Ave. (deposit)	$W\frac{1}{2}SW\frac{1}{4}$ sec. 23, T3S, R4E, SBM on Indian Ave. 3 miles south of Garnet	Massey Sand and Rock Co., 43-850 Monroe St., Indio	Whitewater wash. Interbedded gravelly layers up to 1', and sand layers from 1-3' thick. Deposit at least 50' deep, extends north for several miles from intersection with U.S. 60 and to the east of its confluence with San Gorgonio River, for about 5 miles. Width of deposit ranges from 0.25 mile at head to about 1.0 mile south of Garnet. No overburden. Slight replenishment. Abundant cobbles and boulders up to 3'; 18" max. size gravel near Whitewater dimishes to 4" max. near Garnet where few percent plus 4" gravel and occasional 3' boulders present. Gravel content 65 percent near Whitewater dimishes to 25 percent near Garnet.	Excavate from pit approx. 1000' in diameter to depths of 50' with bulldozer (which pushes material to a conveyor). Convey about 300' to plant. Scalp oversize off top deck double vibrating screen. Sand goes to Wemco sandscrew. Crush oversize in two jaw crushers. Wash over standard vibrating screens, sand drag. Capacity of 2200 tons/day. Material used for concrete and bituminous sand and gravel, plaster sand.

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
461	Massey Indio Hills (deposit)	NE¼ sec. 3, T5S, R7E, SBM, about 3 miles north of Indio	Massey Sand and Rock Co., P.O. Box 487, Indio	Alluvial fan deposit on southwest flanks of Indio Hills. Developed area covers about ½ sq. mile. Deposit contains about 35 percent gravel. At least 60' deep. Interbedded sand and conglomerate layers range from 1 to 3' in thickness. No overburden or replenishment. Abundant plus 3" gravel, av. max. size 18"; some 2' boulders. Max. size dimishes to west and north.	Excavate with shovel from pit with working face about 30' high. Haul about 2000' in end dump trucks to plant. Discharge over grizzly into primary jaw crusher. Crush plus 3" in secondary cone. Wash over standard vibrating screens; sand wheel. Bucket elevator and conveyors load bunkers. Capacity 2500 tons/9 hrs. Products - concrete and bituminous sand and gravel, road base, plaster sand. Have hot mix on premises. Truck to ready mix plant in Indio.

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
462	Massey Whitewater (deposit)	NE¼ sec. 11, T3S, R3E, SBM, ¼ mile north of Whitewater	Massey Sand and Rock Co., 43-850 Monroe St., Indio	See Massey Indian Ave. deposit	Excavate with shovel from pit in dry wash. Haul by truck to nearby plant. Depth of deposit 50'. Abundant boulders. Pit run dumped over grizzly into reciprocating feeder. Crush in primary and secondary jaw, tertiary cone and roll crushers. Dry screen over standard vibrating screens. Capacity of 450 tons/hr. Concrete and bituminous sand and gravel, road base.

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
463	Mission Creek (deposit)	$S\frac{1}{2}$ sec. 16, T2S, R4E, SBM, 4 miles northwest of Desert Hot Springs in Mission Creek just east of Twentynine Palms highway.	Undetermined	Alluvium of unknown depth covers large area. Apparently material in Mission Creek-Dry Morongo Wash area has more favorable sand-gravel-reject fines ratio than does the material adjacent to the wash.	The deposit was opened in 1957 and operated from June 1957, to February 1958 by the Gunther-Shirley-Lane Co. Aggregate for concrete was supplied to the nearby semi-portable plant of the American Pipe Construction Co. where precast pipe was made for use in the Colorado River Aqueduct expansion in the area. Inactive since 1958. Large open-pit quarries. Semiportable plant produced washed sand and gravel. International TD24 Tractor dozer fed hopper directly from pits. (Proctor, 1958, p. 143).

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
464	Murrieta Borrow Pit	SW corner of Webster and Jefferson Aves. in the Murrieta portion of the Temecula Rancho, one mile southeast of Murrieta	Riverside County	Coarse fanglomerate with interbedded sand and silt (Quaternary Pauba Formation of Mann, 1955, plate 1).	Used as a source of road metal by Riverside County since 1950. Mine intermittently from an open pit.

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Corona South quad. ng m. 56

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
465	Pomona Ready Mix Concrete	NE¼NE¼ sec. 5, T4S, R6W, SBM. East side of Temescal Wash, 3 miles southeast of Corona.	Minnesota Mining and Manufacturing Co., 900 Bush Ave., St. Paul, Minn. owns a large tract of land. Pomona Ready Mix Concrete, Upland, owns and operates the plant.	Recent stream-deposited sand in Temescal Wash.	Ready Mix concrete batch plant erected early in 1963. Plant utilizes quarry waste from Temescal Rock Quarry for concrete gravel and sand from Temescal Wash adjacent to the plant. Sand is mined by front end tractor loader from small pit about 50 feet by 100 feet and 10 feet deep.

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
466	Riverside County Gravel Pit	$E\frac{1}{2}NW\frac{1}{4}$, $W\frac{1}{2}NE\frac{1}{4}$ sec. 29, T6S, R7E, SBM.	Riverside County	Quaternary alluvial fan deposit of sand and gravel.	Owned by Riverside County since 1947. Development undetermined.

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
467	Riverside County Gravel Pit	SE¼NE¼NE¼ sec. 20, T7S, R3E, SBM. west side of Bahrman Rd., ¼ mile south of Coahuila Rd.	Riverside County	Quaternary stream deposit.	Owned by Riverside County since 1946. Development undetermined, probably a local source of fill and road metal.

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
468	Riverside Sand Company	NE¼SW¼ sec. 25, T2S, R6W, SBM. North bank of Santa Ana River ¼ mile east of Van Buren Blvd. (Pedley Road).	Riverside Sand Company 7626 Arlington Ave. Riverside	Quaternary sand deposit along margin of Santa Ana River channel. Deposit contains minor proportion of gravel with a few cobbles.	Circular pit about 200 feet in diameter filled to surface with water. Pit 35 feet deep. Plant erected in 1960 and placed in operation September 1962. Mine with 2 cu. yd. slack line drag which feeds a bin. Raw material goes by belt conveyor to shaker screens, washing; rock is scalped off and sent to one pile, coarse sand to another pile, finer sand to a third pile. Silt and mud fines are rejected by a twin sand drag and returned to river bank area. Plant capacity is 65 tons per hour; 100 tons per hour with a larger drag. Products include: Plaster sand, concrete sand, 3/4-inch rock, and pea gravel. 254

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
469	San Gorgonio Rock Products (deposit)	NW¼ sec. 3, T3S, R1E, SBM, about ¼ mile N. of Banning.	San Gorgonio Rock Products, P.O. Box 1414, Banning	Dry wash deposit extends from north of Banning to confluence with Whitewater River, a distance of about 15 miles. Width of deposit ranges from 250' at head to 1000' farther east; at least 60' deep. Slight overburden. No replenishment. Average maximum gravel 6", with boulders up to 2' present. About 65 percent gravel content. Abundant plus 1½" gravel.	Excavate from pit 1000' long x 300' wide x 60' deep, with shovel. Haul in end dump truck several hundred feet to plant. Work in 25' benches. Crush oversize in primary jaw and secondary cone crushers. Wash over standard vibrating screens; sand screw and sand drag. Capacity 250 tons/hr. Concrete and bituminous sand and gravel, road base, plaster sand.

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
470	Service Rock (The Service Gravel) Company	SE¼ sec. 3, E½ sec. 10 (proj.) T2S, R5W, SBM. West side of Santa Ana River, 2½ miles northwest of Riverside.	Undetermined	River terrace deposit along west side of Santa Ana River. Overburden in the area mined averaged about 5 feet of silt and soil; sand and gravel layer was 15-20 feet thick and bottomed in a silt layer which is underlain by coarse, buff, sand with no gravel. Deposit averaged about 60 percent sand and 10 percent silt waste. Most of the gravel was less than 2-inch with a few cobbles. This material was tested by the U.S. Bureau of Reclamation in 1945 (Report No. C-275) and found to be suitable for concrete aggregate.	Area totaling about a quarter section was mined from some 8 pits in secs. 3 and 10 from 1920 to 1955. Early operations started before 1920 in the SE¼ sec. 10 where The Service Gravel Co. erected its first plant. During the late 1920's and early 1930's the plant and several pits were in the SE¼ sec. 3. A third and final plant was completed in 1936 at C Street and Crestmore Road and was active until 1955 when the available gravel deposits were worked out. In 1941 the operation became the Service Rock Co. From 1936 to 1955 mining was from several pits in the E½ sec. 10. The plant produced 85 tons per hour of washed sand and gravel products including plaster, concrete, and engine sand; and gravel up to 1½ inch. Total production from the area is unknown, but probably was about 2,000,000 tons. (Dickey and Porter, 1952, p. 3). 256

V.F.1, #13

Sand and Gravel

Riverside County

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
471	Shepwells Big Maria (deposit)	Pit: SE¼ sec. 27, T5S, R23E, SBM, about 6 miles north of Blythe. Road base from County pit SE¼ sec. 25, T5S, R22E, SBM. Plant on Riverside Ave. in Blythe.	Shepwells Inc., P.O. Box 87, Blythe	Dry wash deposit extends for about 1 mile north of intersection with Highway 95. About 500' wide and at least 50' deep. No overburden or replenishment. Max. size gravel 8", some 12' boulders. About 60 percent gravel content.	Excavate from pit approx. 300' wide x 250' long x 50' deep. Haul about 6 miles to plant. Crush in primary jaw and secondary cone crusher; wash over vibrating screens. Capacity 300 yds/day. Products - concrete and bituminous sand and gravel.

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
472	Thermal Canyon Wash (deposit)	SE¼ sec. 18, T6S, R9E, SBM, west edge of Mecca Hills at the end of Ave. 56, 3½ miles east of Thermal.	Undetermined. Co-Val Concrete Pipe Co., Coachella operator (?) (1959)	Alluvium, mostly sandy, pebble and cobble conglomerate with few boulders. Clasts of metamorphic and granitic rocks.	Sample of sand and gravel from sec. 18, 2½ miles east of Thermal tested for All American Canal in 1949 (Report No. C-440) contained 1½-inch maximum size aggregate; is of inferior quality but suitable for use in mild climate if sand washed free of silt and air entraining agent used in mix. Pit 300 feet long, 50 to 150 feet wide and 25 feet deep. Largely dismantled plant (crusher, screens, loading bin) apparently produced unwashed aggregate. No report of use in government construction. (Dickey and Porter, 1952, p. 9).

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Transit Mixed Concrete Company, Corona plant				See: Industrial Asphalt, Corona plant.

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
473	Triangle Rock Products, Inc. Mira Loma Plant	NE¼ sec. 6, T2S, R6W, SBM, in lower Day Creek at Mira Loma. 10 miles west of Riverside at Wineville Road and U.S. Highway 60.	Triangle Rock Products, Inc. 2400 West Highland P.O. Box 2083 San Bernardino	Dry wash and/or old alluvial fan from south flank of San Gabriel Mountains. Deposit opened over an area about 2,000 feet long and 1,000 feet wide. Mined to depths of 40-50 feet where deposit bottoms in silt. Ten to 20 feet reddish-brown dirty silt overburden. No replenishment. Maximum size of gravel 6" to 8" with very few up to 1 foot, mostly 3" to 4". About 50 percent gravel. Pit shows mostly well mixed sand and gravel; in places layers of sand 1 to 1½ feet thick and gravel 2 to 4 feet thick. Layers horizontal, material soft, nonindurated. Gravel mostly mica schist and granitic debris.	Excavate with Link Belt 1-yd. dipper shovel from pit with working face about 40' high. Haul about 2,000' to plant in KW 17-ton end dump trucks. Discharge over grizzly into primary jaw crusher. Crush oversize in secondary Symons Cone and Traylor 3-foot cone. Discharge to 5' x 10' inclined shaker screen. Wash over standard vibrating screens. Conveyors load bunkers. Pit area covers about 60 acres. Products include concrete and plaster sand, unwashed sand, and concrete gravel up to 2½ inches. Capacity 300 tons per hour.

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
474	~~Pit (name~~ undetermined)	NW¼SE¼ sec. 8, T3S, R2W, SBM. Dry wash north side of State Highway 79, about 13 miles northwest of San Jacinto.	Undetermined	Quaternary stream and/or alluvial fan with some gravel. Most clasts are cobbles or smaller of granitic rock, some metamorphic and volcanic clasts.	Utilized during World War II as a source of sub-base and/or aggregate for construction at March Air Force Base. Large open pit, not well defined but about 1,000 ft. long, 500 ft. wide, and 50 ft. deep. Apparently long idle.

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
475	~~Pit (name~~ undetermined)	SW¼SE¼ sec. 8, T3S, R2W, SBM. Edge of dry wash, south side of State Highwas 79, about 13 miles northwest of San Jacinto.	Undetermined	Quaternary stream and/or alluvial fan deposit of sand with some gravel. Most clasts are cobbles or smaller of granitic rock, some metamorphic and volcanic clasts.	Pit about 300 ft. long, 150 ft. wide, 25 ft. deep. Material used as a source of sub-base and/or aggregate for construction at March Air Force Base about 1953; apparently since idle.

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
476	~~Pit (name~~ undetermined)	SW¼SW¼ sec. 14, T4S, R1W, SBM. 2¼ miles due north of San Jacinto, on the northeast side of State Highway 79.	Undetermined	Quaternary alluvial fan deposit. Dirty gravel, mixed with considerable decomposed granitic material.	Circular pit 150 ft. diameter, 40 ft. maximum depth. Apparently a local source of sand and gravel for fill or highway construction. Pit opened before 1953, idle in 1963.

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
477	Undetermined (Unidentified) (~~gravel pit~~)	SW¼ sec. 32, T4S, R8E, SBM, in the valley between the Indio Hills and Little San Bernardino Mts., east of Dillon Road 1 3/4 miles south of the Berdoo Canyon road intersection.	Undetermined	Alluvial fan material. A "dirty" unsorted, cobble, sand, and boulder fanglomerate with little gravel.	Open-pit about 350 feet x 100 feet x 25 feet deep.

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
478	Undetermined ~~Unidentified~~ (~~gravel pit~~)	SW¼SW¼ sec. 6, T4S, R6E, SBM, south margin of the Indio Hills, 2 miles north of Thousand Palms	Undetermined	Sandy conglomerate	Pit about 200 feet x 100 feet x 25 feet deep.

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
479	~~Unidentified deposit~~ Undetermined	SE¼ sec. 28, T4S, R6W, SBM, Temescal Valley, 7 miles southeast of Corona, in lower Brown Canyon.	Mrs. R. Boyd & W. Heinlein, 3265 Floresto Ave., Los Angeles own patented ranch land (1957); 50 acres leased to Temescal Rock Products Company, P.O. Box 364, Corona, (1957)	Stream gravels said to be 80 percent rock with average thickness of 40 feet.	Undeveloped (Gray, 1961, p. 119).

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
480	Valley Rock and Sand Corp.	Plant and deposit: E½SE¼ sec. 22, T3S, R2W, SBM. At Jackrabbit trail and State Highway 79, about 10 miles northwest of San Jacinto.	Valley Rock and Sand Corp., 24161 State St. (P.O. Box 926) San Jacinto	Quaternary stream deposit. Narrow dry wash, maximum width 750 ft., extends for several miles along the west side of Jackrabbit Trail. Deposit opened over an area about 1,000 ft. long and 400 ft. wide. Mined to depths of 10 to 40 ft. where deposit bottoms in silt or in places schist. No replenishment. Sandy silt overburden 3-4 ft. Horizontal layers of non indurated rather well mixed sand and gravel. Very few clasts more than 1-ft. diameter, most are cobbles or smaller. About 75% sand, 5% rock, 20% silt. Most clasts are hard granitic rock, some metamorphic and volcanic clasts.	Plant in operation since 1944. Excavate with northwest 3/4-yd. dipper shovel from pit with working face about 40 ft. high. Haul about 1,500 ft. to plant in 10-yd. Reo end-dump trucks. Discharge over grizzly into hopper which feeds a 3-deck vibrating screen. Oversize (+3/4-in.) goes to jaw crusher. Crusher product returns to the 3-deck screen. Material is washed on 2 bottom decks by water spray bars. Sand size from bottom screen goes through a drag washer, then a wheel washer, and to stockpile. Rock from upper screens goes to loading bins for storage. Products include concrete and plaster sand, concrete gravel and pea rock (3/8-in. to 3/4-in.), and road gravel (1/8-in. to 3/8-in.). Capacity is 150 tons per hour, operate at about 80 tons per hour.

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
481	Valley Transit Cement Co. (deposit)	~~NE~~ W¼ sec. 3~~0~~2, T8S, R9E, SBM, about 2 miles south of Oasis	Valley Transit Cement Co., Inc., P.O. Box 1489, El Centro	Broad alluvial plain on flanks of Santa Rosa Mts. encompasses several square miles. Developed area covers several acres. Sparse sand interbeds. About 65 percent gravel. Material coarser at depth. Gravel reported present to depths of about 75'. Water table at 70'. No overburden. No replenishment. Dry, abundant plus 3" gravel, 10", some 2' boulders present.	Excavate and feed plant with bulldozer tractor, work to about 10' depth. Pit run goes to primary jaw crusher, wash over standard vibrating screens. Plus 3" crushed in secondary cone. Wash sand in screw type classifier. Capacity 140 tons/hr. Concrete sand and gravel. Have batch plant and own ready mix trucks. 268

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
482	Yeager Indio Hills Deposit	SW¼ sec. 5, T4S, R6E, SBM, approx. 2½ miles north of Thousand Palms.	E. L. Yeager Co., P.O. Box 87, Riverside.	Deposit at head of alluvial fan in dry wash. Approx. 300' wide x 1000' long x at least 35' deep. Abundant sand -- approx. 35-50 percent of deposit. No overburden or replenishment. Average max. size gravel 9", abundant plus 3", occasional 3' boulders present.	Excavate with tractor that pushes material to plant. Crush in primary jaw and secondary cone crushers; standard vibrating screens. Capacity 200 tons/hr. Bituminous sand and gravel produced.

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Rock Products

Specialty (~~Foundry~~) Sand

Riverside County

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
486	Jurupa (Riverside) Molding Sand Deposit	SW¼ sec. 29, T2S, R5W, SBM. Along the south bank of Santa Ana River at the north end of Fremont St., 3½ miles southwest of Riverside.	Undetermined	Sand occurs as a reddish layer on the surface of a Quaternary terrace. According to Wright (1948, p. 57) at the Jurupa deposit this layer is 6 to 8 feet thick and is underlain in part by light-gray silty sediments. Granitic rock (Bonsall Tonalite?) is reported to occur beneath part of the excavation. Overburden consists of clay-poor sand that averages 1 foot in thickness. The molding-sand layer is unstratified, poorly consolidated, and contains many minute sponge-like pores. Small igneous pebbles are sparsely scattered throughout the layer. Within the limits of the excavation, the sand is both vertically and laterally uniform. Similar material occurs as a thin, residual mantle on nearby granitic hills.	Riverside molding sand, also known as "V3" or "Pedley sand" was mined intermittently west of Riverside in the vicinity of the Santa Ana River channel from the 1920's until the 1950's. The Jurupa deposit, on the south bank of the river, was opened in 1923 by Harry E. Blood who shipped 6-8 cars per month. During the 1940's this deposit was operated by Miller Brothers, Huntington Park. An excavation on the north bank was operated by Westlake and Sons, Los Angeles, at some period prior to 1947. Riverside sand was found most suitable for light gray iron, brass, and bronze castings. A smooth finish was produced. When the area was visited in January 1963, the sites of former excavations could not be definitely determined. Apparently molding sand has not been mined in this area for many years. (Tucker, 1924, p. 46; Wright, 1948, p. 57-58).

Weisel

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
394	Bernasconi Quarry Blue Diamond Materials Co.	SW¼NE¼ sec. 11, T4S, R3W, SBM. In the Bernasconi Hills at the west side of Bernasconi Pass, south side of Martin Street.	James Minor, San Jacinto (1961)	Light to very dark gray, coarse-grained granodiorite (mapped as Granodiorite west of Lakeview by Larsen, 1951, plate 1). Contains abundant dark, flat, elongated, oriented inclusions concentrated in parallel streaks. Rock in quarry face is well fractured. Overburden ranges from 0 to 5 feet of decomposed granodiorite.	Quarry opened in July, 1961, to furnish rubble and riprap for the San Jacinto River levee project. Operated by Hugh Seeger, Whittier. Quarry is sidehill cut on one main bench level about 300 feet long, 175 feet wide with face 40 feet high. Rock was crushed and sized at the quarry for the levee project which was completed late in 1961. Quarry apparently has since been idle. A considerable tonnage of large boulders remain below the quarry bench, where they were apparently pushed aside as waste. (See Temescal Rock Co. under Roofing Granules)

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
396	Box Springs Quarry	SW¼NE¼ sec. 33, T2S, R4W, SBM. Along the east side of the railroad, in Box Springs Canyon ½ mile northwest of Box Springs.	Santa Fe Railway System, 121 East Sixth St., Los Angeles 14.	Light to dark gray, medium grained, quartz diorite (Cretaceous Bonsall Tonalite). Bouldery surface, no overburden. Rock is somewhat fractured.	Santa Fe Railway has intermittently quarried rock for use as rubble and track ballast since at least 1940. Quarry is side-hill cut on one level along the track, about 1,250 ft. long and 50 to 100 ft. wide. Face is 30 to 60 ft. high. Idle in July 1963.

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
397	Casa Blanca Quarries	S½ sec. 10, T3S, R5W, SBM. 1 mile southeast of Casa Blanca. Two quarries, the larger on the south edge of Quarry Hill on the northwest corner of Madison St. and Lenox Ave.; the other quarry is about 1/3 mile to the south, northeast of the intersection of Dufferin Ave. and Grace St.	Undetermined	Dark gray, medium grained granitic rock (Cretaceous Bonsall Tonalite). Contains dark inclusions ranging from a fraction of an inch to several inches in diameter. Rock is jointed and breaks to regular even surfaces along lines of fracture.	In 1905 the quarries were owned by the Southern Pacific Railroad Co., and operated by the California Construction Co. who were shipping stone for use as rubble in construction of the San Pedro breakwater. In 1905 the north quarry had an opening about 100 feet square with a face of from 50 to 60 feet; the south quarry was 100 feet long, 30 feet wide, with a face of from 30 to 40 feet. By 1914 these quarries were reported as long idle. In January 1963, both quarries were being utilized as dump sites; their dimensions appeared to have been only slightly enlarged from those of 1905. (Aubury, 1906, p. 44-46; Merrill, 1917 /1919/ p. 584).

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Christopher Mines, Inc. (claim)	SW¼ sec. 36, T2S, R3E, SBM, between Super Creek mine and Painted Hill Quarry (see herein).	Last reported: Christopher Mines, Inc. c/o E. O. McFall, Box 341, Glendale	Like Painted Hill Quarry (see herein).	(Proctor, ~~unpublished thesis~~ 1968, p. 33).

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Desert Sunset	NW$\frac{1}{4}$ NE$\frac{1}{4}$, Sec. 21, T3S, R21E, SBM, on a small foothill at the northwest end of the Big Maria Mountains.	U. S. Minerals Development Corp.	Quartzite in a formation of undescribed extent, probably the Paleozoic (?) Maria formation widely exposed in the area. Quarried rock cleaves into tabular fragments colored by iron and manganese oxides, stains, and coatings.	Quartzite sold under the name of "rosado stone" for decorative stone work (published decision; U.S. Department of the Interior, Bureau of Land Management, July 22, 1963).
	Glen Garnet				Se Stone Supplies (?)

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
400	Hole Ranch Quarry	NW¼NW¼ sec. 22 (proj.) T3S, R6W, SBM. Low isolated hill just north of the west end of Buchanan St., 1½ miles southwest of La Sierra.	Undetermined	Light gray, medium grained granodiorite (Cretaceous Mt. Hole Granodiorite). Surface deeply weathered with large hard boulders remaining.	Two small sidehill quarries. The larger quarry, on the east side of the hill, is about 50 feet by 25 feet and 25 feet deep; the other quarry, on the west side of the hill, is about 40 feet in diameter and 15 feet deep. Tests on two samples from the Hole Ranch quarry made about 1939 by the District Laboratory, Corps of Engineers, U.S. Army, showed the following:

Specific Gravity	L.A. Rattler, % loss at 500 revs. Average	maximum	minimum
2.71	35.5	38.0	33.0

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
402	Juaro Canyon Quarry Long Quarry Matich Brothers rock Sand Company	SW¼SW¼ sec. 20, T4S, R1E, SBM. West side of upper Juaro Canyon, 1 mile east of Soboba Hot Springs.	Hawley Rock Inc. 5277 North Vincent Ave., Azusa, (P.O. Box 7, Irwindale)	Coarse grained, light colored granite. Rock exposed in quarry face is well fractured and apparently has good breakage qualities. No overburden. Mapped by Fraser (1931, plate facing p. 540) as Jurassic(?) granite.	Side-hill quarry on one level about 200 ft. long, 100 ft. wide, face 40 ft. high. Quarry was opened and operated by Hawley Rock Inc. in 1961 to furnish rock for the San Jacinto River levee project. Total production undetermined, probably a few tens of thousands of tons. Idle since late 1961. See Storm Sulfide (?) & Tomcat Canyon rock quarry (?)

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	New City Quarry				See under limestone in text.

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
403	Old City Quarry (Fairmount Hill Quarry, North Hill Quarry).	SW¼ sec. 14 (proj.) T2S, R5W, SBM. South of and above Fairmont Park in a hill area bounded by Locust St. on the east, Redwood Dr. on the west, Houghton Ave. on the south, and Banks St. on the north.	City of Riverside	Dark gray weathered quartz diorite (Cretaceous Bonsall Tonalite?) has intruded a sequence of marble and schist over an area about 1,000 feet long and 300 feet wide. The metamorphic rocks strike nearly east-west and are steeply dipping. The marble beds range from less than 2 feet to about 12 feet in width and the longest exposed strike length of marble is about 220 feet. A number of minerals have been reported from this quarry area (see Murdoch and Webb, 1956).	In 1914 the City of Riverside was operating a crusher on the site to provide crushed stone for macadam and concrete. Apparently both the diorite and metamorphic rocks were utilized. At least 5 separate quarries are identifiable in the area with the largest about 100 feet wide, 150 feet long, and face 50 feet high. Most of the rock mined apparently was quartz diorite but the metamorphic sequence is also present in the quarries. Apparently the limestone was never utilized other than for aggregate. These quarries have been idle for about 50 years, except for furnishing occasional small amounts of decomposed material for local use. (Aubury, 1906, p. 320).

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Super Creek	SW$\frac{1}{4}$ sec. 36, T 2 S, R 3 E, SBM, on the southeast flank of Painted Hill	Reported to be held by a man named Grossman (1958)	Same as Painted Hill Quarry (herein).	Activity confined to assessment work in the form of roads and open cuts (1959). (Proctor, ~~unpublished thesis.~~ 1968, p. 39)

Rock Products

Broken and Crushed Stone

Granite
Riverside County

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	~~Quarry (Name~~ undetermined	SE¼SE¼ sec. 2, T3S, R6W, SBM. Low hill east of Tyler St., and between Gramercy Pl. and Hedrick Ave.	Undetermined	Blocky, hard, blue gray granitic rock (Cretaceous San Marcos Gabbro?).	Small shallow quarry with a few quarried blocks scattered about the area. Apparently was once a minor source of building stone, but long inactive. In January 1963, the area was almost completely residential.

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	~~Quarry (name undetermined)~~	$NW\frac{1}{4}$ sec. 3, T2S, R6W, SBM. North edge of the Jurupa Mountains.	Riverside County	Cretaceous Woodson Mountain Granodiorite. Light gray, hard, fine-grained, inclusion-free granodiorite.	Apparently quarried on a small scale at some unknown time for building purposes. In 1950 the quarry was about 50 feet long, 20 feet wide, and 15 feet high. Idle in 1950. By 1963 the quarry was nearly filled with debris and was being utilized as a Riverside County disposal area. (Mackevett, 1951, p. 13). 282

Stone, Metasandstone

Riverside County

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Undetermined ~~Unidentified quarry~~	E½ sec. 14, T5S, R4W, SBM. Low hills about ¼ of a mile northeast of San Jacinto River; about 6 miles northeast of Elsinore.	Undetermined		(Engel, 1959, p. 101).

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Stone, (Metasandstone)

Riverside County

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Undetermined ~~Unidentified road material pit~~	SE¼ sec. 19, T5S, R4W, SBM, at southern tip of hills 3 miles due north of Elsinore.	Undetermined		Road material pit. (Engel, 1959, p. 102).

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Undetermined ~~Unidentified road material pit~~	NE¼ sec. 24, T5S, R5W, SBM, southeastern end of hills about 4 miles northwest of Elsinore.	Undetermined		Road material pit. (Engel, 1959, p. 102).
	Whitewater Sericite Schist deposit				(See Pruitt Hills quarry (?))

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Rock Products

Stone — Decomposed Granite

Riverside County

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
412	Arnold Heights Pit	W½ sec. 27, T3S, R4W, SBM. Low hills about 1 mile west of Alessandro, south of Van Buren Blvd.	U.S. Air Force	Weathered granitic rock (Cretaceous Bonsall Tonalite).	Several pits in this area have been mined by the U.S. Air Force since the 1940's as a source of road metal for March Air Force Base and adjacent installations. Mining has been from an irregular area about 1,000 ft. by 500 ft. with pits from 10 to 20 ft. deep. In 1963 two pits were active. Equipment includes bulldozers, rippers, scrapers, front-end loaders.

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Rockwood ...
Rock Products

Decomposed Granite

Riverside Co.

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
413	Brokar Pit	SW¼SW¼ sec. 20, T2S, R5W, SBM. Along the east side of a small wash on the east side of 54th Street; southeastern Pedley Hills south of Limonite Ave.	Cleo E. Brokar 6401 54th Street Riverside	Weathered Cretaceous granitic rock (Bonsall Tonalite).	Irregular pit area about 300 feet long, 100 feet wide, with maximum depth of 40 feet, has been mined from about 6 small pockets at different levels. Soil is loosened and piled by small dozer and ripper equipped Cletrac. Material is loaded by Ford Ferguson front end loader on small dump tracks directly at the face for transport to market. A small, local source of "decomposed granite".

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
414	Coplin Pit	SE¼NW¼ sec. 29 (proj.), T3S, R6W, SBM. North-trending low hill north side of Sampson St. and the Santa Fe R.R., 1 3/4 miles east of Corona.	Corona Dee Gee Company, 609 Corona, Corona	Weathered granitic rock (Cretaceous Woodson Mountain Granodiorite).	Decomposed granite has been quarried from this area for many years for local use as road metal. In 1963 the Corona Dee Gee Co. was operating a rather large somewhat U-shaped sidehill cut about 1,500 ft. long, 500 ft. wide, with maximum depth of about 50 ft. Mining is done by a Caterpillar D-8 with bulldozer and ripper. Loosened material is pushed into a hopper from which trucks are belt-loaded. Front-end loader is also used. Present mining started in the late 1950's, apparently reactivating an old pit. About 1,000 ft. to the southwest, just north of the railroad, is a small pit, apparently long idle.

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
415	Fontana Paving, Inc.	NE¼NE¼ sec. 5, T4S, 46W, SBM. East side Temescal Wash, 3 miles southeast of Corona.	Minnesota Mining and Manufacturing Co., 900 Bush Ave., St. Paul, Minn. owns a large tract of land. Fontana Paving, Inc., 8747 Lime St., Fontana owns and operates the plant.	Weathered Cajalco Quartz Monzonite and older alluvium.	Modern plant to make asphalt paving was erected early in 1963 by Fontana Paving. This plant utilizes weathered quartz monzonite and alluvium mined from shallow pits east of the plant, and quarry waste from the Temescal Rock Quarry. The Corona Clay Co. also intermittently mines "decomposed granite" from the same pit area used by Fontana Paving. This material is sold locally for road surfacing.

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
416	Nason Street Pit	S½NW¼ sec. 3, T3S, R3W, SBM. 3 miles east of Sunnymead at the northeast corner of the intersection of U.S. Highway 60 and Nason Street.	Undetermined	Weathered granitic rock (Cretaceous Bonsall Tonalite).	Irregular area about 1,000 ft. by 500 ft. was mined to depths of 10-15 ft. Irregular hard zones were left as "islands". Pit was operated in 1942 by the Service Rock Company, Riverside. Material was used as sub-base in runway construction and as road metal at March Air Force Base. Production of several tens of thousands of tons. Apparently idle since 1942, and in 1963 construction of the Nason Street Overcrossing on the freeway obliterated most of the pit area.

Decomposed Granite

Riverside County

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
417	Nuevo Road Decomposed Granite quarry	SE¼SE¼ sec. 24, T4S, R4W, SBM, near the west end of Nuevo Road	Land owner undetermined. Site leased by E. L. Yager Co. (1959)	Deeply weathered "Perris Quartz-Diorite" (Dudley, 1935, p. 501)	When visited quarry was a bull-dozed area about 500 ft. long and 200 ft. wide. The weathered diorite (DG) was being mixed, at the quarry, as follows: 67 percent DG 33 percent 1½"-3/8" crushed rock and an additional 2½ percent cement 8½ percent water This mixture was trucked to the nearby construction site of U.S. Highway 395 to be used as "cement treated sub base". The DG was run through 1½ screen without crushing. As much as 2,000 tons per day of mixed road base taken from site (see Photo ___/).

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Rock Products

Decomposed Granite

Riverside County

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
418	Riley Materials Company	NE¼SW¼ sec. 25, T2S, R6W, SBM. North bank of Santa Ana River, east side of Van Buren Blvd. (Pedley Road).	Riley Materials Co. 6740 Doolittle St. Riverside	Light gray, weathered, granitic rock with hard, dark black, inclusions (Cretaceous Bonsall Tonalite).	Mine with small bulldozer from pit 150 feet long, 75-100 feet wide, and face 20 feet high. In addition to decomposed granite this company markets fill sand and silt obtained from the adjacent dry margin of the Santa Ana River.

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
419	Riverside County Gravel Pit	SE¼NW¼SW¼ sec. 2, T4S, R4W, SBM. Low hills ¼ mile south of Markham Street and 1¼ miles west of Highway 395.	Riverside County owns 10 acres	Weathered granitic rock (Cretaceous Bonsall Tonalite).	Development not determined.

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
420	Riverside County Gravel Pit	NW¼SW¼ sec. 4, T3S, R6W, SBM. Southeast of intersection of Arlington Ave. and 6th Street, 2 miles east of Norco.	Riverside County	Weathered granitic rock (Cretaceous Woodson Mountain Granodiorite).	Owned by Riverside County since 1949. Development undetermined.

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
421	Riverside County Gravel Pit	W½SE¼SE¼ sec. 19, T6S, R2W, SBM. ¼ mile west of the intersection of Leon Road and Keller Road.	Riverside County	Weathered granitic rock (Cretaceous Woodson Mountain Granodiorite).	Owned by Riverside County since 1941. Development undetermined.

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
422	Riverside County Gravel Pit	$N\frac{1}{2}SE\frac{1}{4}NE\frac{1}{4}$ sec. 26, T5S, R3W, SBM. 3 miles southeast of Romoland, northwest of the intersection of Menifee Road and Simpson Road.	Riverside County	Weathered granitic rock (Cretaceous Bonsall Tonalite).	Owned by Riverside County since 1948. Development undetermined.

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
423	Riverside County Gravel Pit	S½NE¼NW¼ and N½SE¼NW¼ sec. 29, T5S, R3W, SBM. 3½ miles southwest of Romoland, ½ mile west of Murrieta Road.	Riverside County	Weathered metamorphic rock (mapped as Triassic Bedford Canyon Formation by Larsen, 1951, plate 1).	Owned by Riverside County since 1950. Development undetermined.

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
424	Riverside County Gravel Pit	SW¼SW¼SW¼ sec. 18, T5S, R3E, SBM.	Riverside County owns about 6 acres	Weathered granitic rock, mapped as Jurassic(?) granite (Fraser, 1931, plate facing p. 540).	Owned by Riverside County since 1948. Development undetermined.

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
425	Riverside County Gravel Pit	E½SE¼SE¼ sec. 19, T5S, R1E, SBM. Southwest intersection of Pleasant and Harrison Aves.	Riverside County	Weathered granitic rock, mapped as Jurassic(?) granite (Fraser, 1931, plate facing p. 540).	Owned by Riverside County since 1946. Development undetermined, apparently used locally for road metal.

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
426	Riverside County Gravel Pit	E½NW¼, W½NE¼ sec. 9, T4S, R3W, SBM. Isolated small hill south of Martin Street at south end of Evans Road.	Riverside County	Weathered granitic rock (mapped as "Granodiorite West of Lakeview" by Larsen, 1951, plate 1).	Owned by Riverside County since 1945. Development undetermined.

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Riverside west quad

Rock Products

Decomposed Granite

Riverside Co.

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
427	Riverside County Pit ~~(name undetermined)~~	$NW\frac{1}{4}SW\frac{1}{4}$ sec. 25, T2S, R6W, SBM. Along the north bluff of Santa Ana River west of Van Buren Blvd. (Pedley Rd.), 3/4 mile SE. of Pedley.	Riverside County	Weathered Cretaceous granitic rock (Bonsall Tonalite).	Pit about 1,000 feet long, 500 feet wide, maximum depth of 25 feet. Mined as a source of road metal by Riverside County since before 1930. Active.

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Rock Products

Decomposed Granite

Riverside Co.

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
428	Riverside County Pit ~~(Name undetermined)~~	NE¼ sec. 12, T3S, R6W, SBM. ¼ mile southwest of the intersection of Van Buren Blvd. and Challen Ave. at the northeast edge of low hills 3/4 mile northwest of Arlington.	Riverside County	Weathered granitic rock (Cretaceous Woodson Mountain Granodiorite).	Pit about 200 feet long, 50 feet wide with maximum height of face 40 feet. Apparently used as a source of road metal by Riverside County Road Dept. from 1916 until recent years. In January 1963 the area was being utilized as a dump site.

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
429	Riverside County Gravel Pit	$N\frac{1}{2}NE\frac{1}{4}SW\frac{1}{4}$ sec. 11, T6S, R4W, SBM. 3 miles east of Elsinore, south side of Railroad Canyon Road.	Riverside County	Weathered granodiorite (Cretaceous Woodson Mountain Granodiorite of Larsen, 1951, plate 1).	Owned by Riverside County since 1949. Development undetermined.

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
430	Riverside County Gravel Pit	SE¼SE¼ sec. 23, T6S, R4W, SBM. West end of Bundy Canyon, north side of Bundy Canyon Road.	Riverside County owns 85.78 acres.	Weathered granitic rock (mapped as Cretaceous San Marcos Gabbro by Larsen, 1951, plate 1).	Owned by Riverside County since 1938. Development undetermined.

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
431	Riverside County Gravel Pit	N½NW¼SW¼ sec. 8, T6S, R4W, SBM. Northeast trending ridge along the south side of Moroni Ave., ¼ mile east of Elsinore City Hall.	Riverside County	Weathered granitic and metamorphic rock (mapped as Cretaceous San Marcos Gabbro and Triassic (?) Bedford Canyon Formation by Larsen, 1951, plate 1).	Owned by Riverside County since 1944. Development undetermined.

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
432	Sugar Loaf Pit	NE¼SE¼SE¼ sec. 17, T2S, R4W, SBM. In the Box Springs Mtns. east of Sugarloaf Mtn. at the north end of Mt. Vernon Ave.	Joe Brennan and Sons, 1869 Service Court, Riverside.	Weathered granitic rock (Cretaceous Bonsall Tonalite).	Mined by present operator since the late 1950's as a source of road metal and fill material. Pit is a somewhat semi-circular side-hill cut with radius about 400 ft. and maximum height of developed face about 40 ft. Standard excavating equipment is used. Small intermittent production each year, total undetermined. Active 1963.

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
433	Undetermined ~~Pit (name undetermined)~~	SE¼SW¼, sec. 30, T4S, R4W, SBM. Just south of Santa Rosa Road.	Undetermined	Weathered blue-gray granitic rock (Cretaceous Bonsall Tonalite).	Pit 50 feet by 100 feet and 20 feet deep. Idle, but apparently active in recent years.

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Rock Products

Decomposed Granite

Riverside County

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
434	Undetermined ~~Pit (name undetermined)~~	$SW\frac{1}{4}$ sec. 2, T2S, R6W, SBM, South edge of the Jurupa Mountains, at the north end of Fleming Street	Undetermined	Decomposed Triassic(?) granitic gneiss.	Small pit 50 by 150 feet and 25 feet maximum depth. No equipment. Idle.

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
435	Undetermined ~~Pit (name undetermined)~~	$E\frac{1}{2}SW\frac{1}{4}$ sec. 17, T3S, R4W, SBM. Low hills east side of Elsinore Road, 3/4 mile south of Alessandro Blvd.	Undetermined	Weathered granitic rock (Cretaceous Bonsall Tonalite). Gray decomposed "granite", about one-foot of red soil overburden.	Irregular, shallow side-hill cut, about 350 ft. by 200 ft., and 10 to 15 ft. deep. For many years a source of decomposed "granite" used locally for road metal. Mined intermittently, inactive June 1963.

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
436	~~Pit (name~~ undetermined	SE¼NE¼NE¼ sec. 32, T2S, R4W, SBM. Isolated hill, south side of lower Box Springs Canyon.	Undetermined	Weathered granitic rock (Cretaceous Bonsall Tonalite).	Side-hill cut about 150 ft. long, 10-15 ft. deep. Apparently a local source of road metal. Apparently long idle.

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
437	~~Pit (name~~ undetermined).	NW¼NW¼ sec. 15, T3S, R4W, SBM. South side Alessandro Blvd., ½ mile west of U.S. Highway 395.	U.S. Air Force	Weathered granitic rock (Cretaceous Bonsall Tonalite).	Irregular shallow pit 10 to 15 ft. deep covers an area about 500 ft. by 350 ft. Has been mined as a source of road metal and sub base fill for March Air Force Base projects. In the early 1950's the Service Rock Co., Riverside, mined a considerable quantity of this material for housing projects at the air base. Idle in 1963.

311

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
138	~~Pit (name~~ unde-termined~~)~~	SW¼SW¼ sec. 10, T3S, R4W, SBM. North side of Al-essandro Blvd., ½ mile west of U.S. Highway 395.	Undetermined	Weathered granitic rock (Cretaceous Bonsall Tonalite).	Side-hill cut about 300 ft. long, 150 ft. wide, and 15 feet deep. In 1942 the Service Rock Co., Riverside, mined a large tonnage of this material for use as sub base in runway construction and for road metal at March Air Force Base. Inactive in 1963, and apparently long idle.

312

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
437	~~Pit (Name~~ undetermined)	NE¼SE¼ sec. 36 (proj.), T3S, R6W, SBM. West side of Taylor Street, 3/4 mile north of Cajalco Dike.	Undetermined	Weathered quartz monzonite (Cretaceous Woodson Mountain Granodiorite).	Side hill circular cut, 75 feet in diameter, 25 feet deep. Apparently a local source of road metal, long idle.

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Riverside West Quad
No. 5

Rock Products

Decomposed Granite

Riverside County

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
440	~~Pit (Name~~ Un-determined)	$NW\frac{1}{4}NW\frac{1}{4}$ sec. 32, T2S, R5W, SBM. Southeast Corner of Mountain View and Fremont Streets, Riverside.	Undetermined. Reported to be operated by E. L. Yeager Construction Co., Riverside, and the City of Riverside.	Light gray, weathered, granitic rock (Cretaceous Bonsall Tonalite).	Area has been a local source of decomposed granite for many years. Shallow pit covers an area about 1,500 feet by 500 feet. Mining has been on several irregular levels, maximum depth about 40 feet. Mining is done by bulldozer, ripper, and skip loaders. Active January, 1963.

314

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
441	~~Pit (name~~ undetermined)	NW¼NE¼ sec. 14, T5S, R2W, SBM. Small isolated hill, ¼ mile west of California Ave., south of Highway 74.	Undetermined	Weathered granitic rock (Cretaceous San Marcos Gabbro).	Side hill cut on west side of hill, apparently active in 1963.

315

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
442	~~Pit (name~~ undetermined~~)~~	NE¼SW¼ sec. 36, T4S, R4W, SBM. 1½ miles southwest of Perris, ¼ mile north of Ellis Ave.	Undetermined	Reddish-brown weathered granitic rock (Cretaceous Bonsall Tonalite).	Decomposed "granite" has been quarried from an irregular pit area about 500 feet by 300 feet and 10 feet deep. Hard, unweathered zones are left as "islands". Mining is done with a Ferguson rubber-tired tractor equipped with front-end loader and fresno. Pit apparently active, but not in operation at time of visit 7/2/63.

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Rock Products
Decomposed Granite
Riverside County

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
443	~~Pit (Name~~ undetermined)	SW¼ sec. 14, T2S, R6W, SBM. on the west side of Felspar St., ¼ mile south of Jurupa Road.	Undetermined (1963)	Weathered mica schist (Triassic? Bedford Canyon Formation) and granitic material.	Semicircular pit, 75 feet wide, 75 feet long, maximum face height 20 feet. Apparently a former source of "decomposed granite", long idle.

317

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
444	~~Pit (Name~~ undetermined)	NE¼NE¼ sec. 22, T2S, R6W, SBM. Low hill on the east side of Cedar Street, between 53rd and 56th Streets.	Undetermined	Weathered mine schist (Triassic?-Jurassic? Bedford Canyon Formation) and granitic material (Cretaceous San Marcos Gabbro).	Shallow working on northwest flank of hill over an area about 150 by 200 feet and 5 feet deep. The south flank of the hill has also been mined over an area about 200 by 80 feet and 15 feet deep. Apparently a source of "decomposed granite". Idle.

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Rock Products

Decomposed Granite

Riverside County

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
445	~~Pit (Name~~ Un-determined	NW¼SW¼ sec. 29, T3S, R5W, SBM. East side of McAllister St.	Undetermined	Weathered granitic rock (Cretaceous Woodson Mountain Granodiorite).	Circular quarry, 100 feet in diameter, maximum height of face 15 feet. One foot of soil overburden. Intermittently active as a local source of decomposed granite. Idle in January 1963. 319

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
446	~~Pit (Name~~ Un-determined	SW¼NW¼ sec. 29, T3S, R5W, SBM. Along the west side of McAllister St.	Undetermined	Weathered granitic rock (Cretaceous Woodson Mountain Granodiorite?)	Narrow pit along road cut, 150 feet long, face 15 feet high. Apparently once used as a local source of road metal. Long idle.

320

Riverside West Quad.
No. 11

Rock Products

Decomposed Granite

Riverside County

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
447	~~Pit (Name~~ Un-determined	SE¼ sec. 25 (proj.) T3S, R6W, SBM. East side of Taylor Ave., 2¼ miles southeast of Magnolia Ave.	Undetermined	Weathered granitic rock (Cretaceous Woodson Mountain Granodiorite).	Shallow circular pit 100 feet in diameter, 15 feet deep. Long idle. In use as a dump in January 1963.

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Rock Products

Decomposed Granite

Riverside County

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
448	~~Pit (~~Name undetermined~~)~~	NE¼ sec. 25 (proj.) T3S, R6W, SBM. West side of Taylor St., 2 miles southeast of Magnolia Ave.	Undetermined	Weathered granitic rock (Cretaceous) Woodson Mountain Granodiorite).	Shallow borrow pit mined by small skip loader, for use in surfacing local roads. Intermittently active.

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
449	~~Pit (name~~ undetermined	SE¼NW¼ sec. 11, T4S, R4W, SBM. Low hills north side of Cajalco Road, 1½ miles west of Highway 395.	Undetermined	Weathered granitic rock (Cretaceous Bonsall Tonalite) with irregular, hard unweathered areas.	Decomposed "granite" has been removed inbetween the hard areas over an irregular area about 50 feet by 100 feet with a maximum depth of 10 feet. Inactive.

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
450	~~Pit (Name~~ Undetermined	NW¼NW¼ sec. 5, T3S, R5W, SBM. Southwest corner of Arlington and Colorado Aves., Riverside.	Undetermined	Weathered Bonsall Tonalite (Cretaceous).	Shallow pit, maximum depth 10 feet. Mined many years ago as a local source of decomposed granite. Long inactive.

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
451	~~Quarry (name~~ undetermined)	NW¼NE¼ sec. 32, T4S, R4W, SBM. South side of Santa Rosa Road, 4½ miles west of Perris.	Undetermined	Weathered blue-gray granitic rock (Cretaceous Bonsall Tonalite?).	Side-hill quarry about 300 feet long, 100 feet wide, 40-foot face. Idle, but apparently has been active in recent years.

Dec., ref Granite

Riverside County

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Undetermined ~~Unidentified~~	NE¼NW¼ sec. 9, T4S, R6W, SBM, northwest of El Cerrito Village and about 3½ miles southeast of Corona.	Minnesota Mining and Manufacturing Company, 900 Bush Ave., St. Paul, Minnesota (P.O. Box 276, Corona)	Light brownish-gray, soft, weathered quartz monzonite with minor hard, light gray blocks.	Two small, nearly connected quarries totaling about 100 feet in length with face from 10 to 25 feet high. Mined by power shovel without blasting. Small intermittent production, probably used locally to surface roads. (Gray, 1961, p. 118).

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Decomposed Granite

Riverside County

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Undetermined ~~Unidentified~~	$SW\frac{1}{4}NE\frac{1}{4}$ sec. 4, T5S, R6W, SBM, about 8 miles southeast of Corona on a ridge between Bixby and Anderson Canyons.	Alfred H. and Sue M. Beazley, 601 Fern Drive, Fullerton, own patented ranch land in area.	Brownish-gray, soft, weathered biotite quartz diorite. Largely altered to clay, breaks into fine-grained material.	Shallow bulldozer cut opened in 1956 in which year a small volume of material removed for local use, probably on roads. (Gray, 1961, p. 118).

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Corona Rock Company				See Mt. Hole Quarries and Sierra Grande Quarries.

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
389	Mt. Hole Quarries	Secs. 8,16,17, T3S, R6W, SBM. In the La Sierra Hills 2 to 3 miles north and northeast of Porphyry Station	Wyle Labs Norco Facility, 1841 Hillside, Norco owns the area in sec. 17 in which the best-developed quarries lie.	Light gray, medium grained, porphyritic granodiorite which weathers into huge light-colored boulders of disintegration (mapped as Mt. Hole Granodiorite by Larsen, 1951, plate 1).	In the early 1900's a number of operators including the Corona Rock Co., Lane Bros., and the Sierra Grande Quarries quarried dimension stone from large boulders of granodiorite in secs. 8,16, and 17. Products included Belgian paving blocks, monumental stone, and rock for concrete, macadam and railway ballast. Numerous split boulders attest to the widespread activity, but in only a few places were regular quarries opened. Three small side hill quarries are located in the N½ of sec. 17. The largest quarry is in the NE. corner of sec. 17 and is about 100 ft. long, 50 ft. wide, with face 40 ft. high. This is the most recently active quarry and was operated by Livingston Rock and Gravel Co., Inc. about 1956-57 as a source of rubble stone. Apparently the other quarries have been idle since about 1925. (Aubury, 1906, p. 46-47; Merrill, 1917 /1919/, p. 584-585; Tucker and Sampson, 1929, p. 508; Tucker and Sampson, 1945, p. 166).

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Quarry (name undetermined)	NW¼ sec. 3, T2S, R6W, SBM. North edge of the Jurupa Mountains.	Riverside County	Cretaceous Woodson Mountain Granodiorite. Light gray, hard, fine-grained, inclusion-free granodiorite.	Apparently quarried on a small scale at some unknown time for building purposes. In 1950 the quarry was about 50 feet long, 20 feet wide, and 15 feet high. Idle in 1950. By 1963 the quarry was nearly filled with debris and was being utilized as a Riverside County disposal area. (Mackevett, 1951, p. 13). 330

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
391	Rubidoux Hill Quarry	NE¼ sec. 22 (proj.), T2S, R5W, SBM. North end of Mount Rubidoux, south side of 8th St. Not verified, 1963.	Undetermined	Pale gray Cretaceous granite. Weathered to a depth of several feet. ~~Fine or coarse gr?~~ Medium grained.	Small quarry active prior to 1905, apparently used for building stone, probably local use for foundations. Owned by Riverside Water Company in 1905. Apparently inactive since before 1905. (Aubury, 1906, p. 47).

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
392	Sierra Grande Quarries	N½SW¼ sec. 29 (proj.), T3S, R6W, SBM. /North end of north-trending hill, just south of Santa Fe RR., ¼ mile east of Porphyry Station.	Undetermined	Pink, indistinctly granular, micro-pegmatite granite. Rock occurs as reddish-brown, sheet-like masses and is well jointed.	Irregular side-hill quarry about 750 feet long, face about 40 feet high. Apparently this is one of a number of quarries operated in the vicinity of Porphyry Station in the early 1900's. All quarries were idle before 1929 and except for the Jameson and Mt. Hole quarries (see herein) have apparently remained idle. Belgian paving blocks, monumental stone, and rock for concrete, macadam, and railway ballast were the chief products. In many places boulders were quarried and no particular quarry site was opened. (Aubury, 1906, p. 46-47; Merrill, 1917, /1919/, p. 584-585; Tucker and Sampson, 1929, p. 508; Tucker and Sampson, 1945, p. 166). 332

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
1 393	Temecula Quarries	E½SE¼ sec. 24, T8S, R3W, SBM. 2 miles south of Temecula along the west side of Highway U.S. 395; NE¼SW¼ sec. 30, T8S, R2W, SBM. South side of Wolf Valley, east of Hwy. 395.	Undetermined	Unweathered large residual boulders of Cretaceous Woodson Mountain Granodiorite. Rock had a very even fracture which resulted in large, regular, smooth surfaces after being split. Fresh rock had a light gray color with a faint rose tint.	A quarry in sec. 24 was active in 1889 and by ~~In~~ 1905 two quarries were active. One operated by Patrick Quinn was in sec. 24, and the other, operated by F. L. Fernald is reported by local residents to have been in Wolf Valley (sec. 30?). The quarries were worked by hand and most of the stone was quarried from boulders. Products included Belgian paving blocks, curbing, flagging, and fence posts. Some of these stone blocks are still in use (in 1963) at Temecula. The quarries were still active in 1915 and were operated by M. Machado and Joseph Winkles. By 1929 the quarries were idle and have since remained idle. (Goodyear, 1890, p. 149; Aubury, 1906, p. 42-43, 47; Merrill, 1917 [1919], p. 586; Tucker and Sampson, 1929, p. 509; Tucker and Sampson, 1945, p. 166; Mann, 1955, p. 19, plate 1).

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Undetermined ~~Unidentified quarry~~	SW¼NW¼ sec. 32, T4S, R4W, SBM, on the west side of a low knoll (see figure 47).	Undetermined	Gray, moderately coarse grained "Perris Quartz Diorite" (Dudley, 1935, p. 501)	Developed through an open cut. Stone appears to have been cut here but tonnage yielded not determined.

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	~~Unidentified quarry~~	NW¼ sec. 17, T5S, R4W, SBM, Arroyo del Toro area about 4 miles north of Elsinore.	Undetermined		Quarry, (Dudley, 1935, p. 506; Engel, 1959, p. 100, 136).

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Unidentified ~~Unidentified quarry~~	SE¼ sec. 18, T5S, R4W, SBM, Arroyo del Toro area, about 3 - 3/4 miles north of Elsinore.	Undetermined.		Quarry, (Dudley, 1935, p. 506; Engel, 1959, p. 100, 136).

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Undetermined ~~Unidentified quarry~~	SW¼ sec. 18, T5S, R4W, SBM, Arroyo del Toro area, about 3½ miles north of Elsinore	Undetermined		Quarry, (Dudley, 1935, p. 506; Engel, 1959, p. 100, 136).

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Rainbow Slate (group)	T5S, R4W, SBM.	Rainbow Mining and Mineral Products Co.		"Three miles north of Elsinore". Probably in area of slate outcrops in Railroad Canyon. Dark, red, yellow, and brown slates in beds 6 to 8 ft. thick quarried prior to 1929 and ground in a 20-ton capacity plant for roofing purposes. Production undetermined. (Tucker 1929, p. 524; Engel, 1959, p. 138).

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Riverside Quarries Company deposit	Sec. 24(?), T5S, R4W, SBM, about 4 miles south of Perris.			Reported explored through open cut 200 ft. long 15 ft. wide and 12 ft. deep. (Tucker, 1929, p. 524; Engel, 1959, p. 103).

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Wrench Slate prospect	S½ sec. 34, T5S, R4W, SBM.	J. H. Wrench, Elsinore (1937)	Fissile slate strikes N. 60°W. and dips 65° NE.	See Wrench prospect under gold. About 200 ft. east of the gold prospect, an open pit with face 20 ft. long and 5 ft. high. Curvature of slaty cleavage planes, abundant cross fractures, and tendency of slate to fray on weathered edges limit commercial possibilities. (Engel, 1959, p. 138).

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Unidentified ~~Unidentified~~ ~~slate quarry~~	S½ sec. 23, T5S, R4W, SBM, west side of Railroad Canyon, about ¼ mi. from stream, about 4 mi. NE. Elsinore.	Undetermined		Quarry. (Dudley, 1935, p. 494; Larsen, 1948, p. 129; 1951, p. 45; Engel, 1959, p. 138). 341

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Undetermined ~~Unidentified slate quarry~~	N½ sec. 26, T5S, R4W, SBM, west side of Railroad Canyon, about ¼ mi. from stream, about 4 mi. NE. Elsinore.	Undetermined		Quarry, (Dudley, 1935, p. 494; Larsen, 1948, p. 129; 1951, p. 45; Engel, 1959, p. 138).

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
1	Bloom (claim)	Secs. 15, 21, T7S, R13E, SBM.	Undetermined	This material is probably of an age and origin similar to that mined at the Bertram deposit a few miles to the southwest near the Salton Sea in Imperial County. See the following references (Tucker, 1924, p. 87-91; 1926, p. 281-283; Sampson, 1942, p. 140-143).	(Tucker, 1945, pl. 35).
	... Black Tu...				Tin See ... Black Rock (t)

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
1	Beauty Mountain claim	Sec. 36, T8S, R2E, SBM.	Undetermined		(Tucker, 1945, pl. 35).

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Blue Bird and Eagle (claims)	Sec. 29, T3S, R1E, SBM.	Undetermined		(Tucker, 1945, pl. 35).

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Blue Boy and Black Mt. group	Sec. 3, T4S, R1E, SBM, 8 miles south of Banning, 1 mile west of Twin Pines Ranch.	J. O. Mayall, Santa Ana (1945)	Garnet-epidote tactite and schist with scheelite, reported to carry 1 to 6 percent, WO_3 in zone 2-4 feet wide.	Developed through 10-ft. shaft and open cuts. Twelve tons high-grade ore reported removed (1945). (Tucker, 1941, p. 582; 1945, p. 154, pl. 35). [illegible] (1) [illegible] Aztec claim (?)

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Dumbbell #1 and #2; G. S. #3, #4, #5 (claims)	Sec. 18, T7S, R5E, SBM, on north slope of Santa Rosa Mtns.	Gerhardt A. Steffen, 3603 Helms Ave., Culver City (1958)	Probably tactite in igneous-metamorphic rocks.	(Personal communication, A. S. Gerhardt, July 31, 1958).

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Magnesium Canyon Tungsten (mine) (Cottonwood #1 - #3)	Sec. 22, T5S, R5E, SBM, 15 miles west of Indio.	Mr. and Mrs. Milton L. Knapp, P.O. Box 365, Arlington (1958) Under lease and option to T. J. Young, Los Angeles 1941-1943	A zone of scheelite-bearing quartz, epidote, garnet tactite bodies in igneous-metamorphic rocks. Tactite bodies 3 to 60 ft. in thickness and 100 to 300 ft. in exposed lateral extent. Assays report 0.8 to 1.5 percent WO_3.	Developed by 7 trenches and a 25-ft. shaft (Tucker, 1941, p. 582-583; 1945, p. 155, pl. 35).

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Matilda group	Sec. 28(?), T7S, R15E (proj.) SBM, on southwest slope of Chuckwalla Mts.	E. G. Sweeney, 355 Norton St., Long Beach (1945)	Scheelite in quartz-epidote-garnet zones at and near contact of dio-rite dikes and schist.	Extent of development not determined; shipments, reported made to Metal Reserve Company's stockpile at Parker, Ariz. said to average 2 percent + WO_3. (Tucker, 1945, p. 155-156, pl. 35).

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Miller Ranch [illegible]	Sec. 2, T8S, R6E, SBM, 24 mi. southwest of Indio.	George A. Glover, Box 1187, Palm Springs (1955).	Tactite-bearing carbonate in igneous-metamorphic rocks. Reported to assay 1 percent WO_3 in ore body 2 to 7 feet wide.	Developed through 56-ft. adit and 20-ft. shaft. (Tucker, 1941, p. 583; 1945, p. 156, pl. 35). (See Pinon mine (?)) 352

MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Phoenix Tungsten (Maynard) prospects	Sec. 9, T5S, R4E., SBM, approx. 7 miles southeast Palm Springs.	Andreas Canyon Club Inc., Palm Springs, 640 acres pat'd. land (1945)	Scheelite-bearing tactite in metamorphosed carbonate rocks in ridge between Andreas and Murray Canyons. Zones as much as 18 feet wide form about eight bodies exposed through horizontal distance of about 900 feet.	Developed through open cut. (Tucker, 1945, p. 156-157, pl. 35).

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
1	Pigeon Creek Tungsten mine	Sec. 11, T7S, R5E, SBM, ½ mile south of Pinion Flat.	Jack Harris and Associates, Los Angeles (1945)	Scheelite in tactite at granite-limestone contact in zone 10 to 20 ft. wide.	Developed through open cut. (Tucker, 1945, p. 157, pl. 35).

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
1	Ribbonwood Tungsten, Inc. claims)	Sec. 26, T7S, R5E, SBM, northeast slope Santa Rosa Mts.	Ray Galenor and George Stallman, Walter P. Story Bldg., Los Angeles (1945)	Scheelite in garnet-epidote-quartz tactite along granite-schist contacts. Some ore reported 2 percent + WO_3.	Developed through 40-ft. adit. Few tons of ore shipped to Parker stockpile. (Tucker, 1945, p. 157-,58, pl. 35).

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Asbestos King (claim)	About 15 miles southeast of Indio.	Undetermined		(Wright, 1950, p. 184; 1957, p. 359; Murdoch, 1959, p. 29).

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME; ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
503	Good Fairy	SW¼ sec. 10 (proj.), NW¼ sec. 15 (proj.), T8S, R17E, SBM, on the north slope of Chuckwalla Mtns. about 1 mile north-northeast of Chuckwalla Spring.	Undetermined	A shear zone as much as 12 feet wide in gneissic diorite strikes N. to N.15°E., dips 65°E.; is exposed through about 500 feet. A quartz vein 3 to 8 feet thick lies along footwall. Vein fractured and stained by secondary iron minerals, resembles gold ore of nearby mines. Local claim holder (Ben I. Brewer) identified this as a tungsten prospect. Presence of tungsten minerals not verified.	Shear zone explored through 4 shallow prospect pits.

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MAP NO.	NAME OF CLAIM, MINE, OR GROUP	LOCATION	OWNER (NAME, ADDRESS)	GEOLOGY	REMARKS AND REFERENCES
	Indian Tungsten mine	Sec. 28, T7S, R5E, SBM, 6 miles south of Pinon Flat.	Elmer E. Dunn, Pinyon Flat (1945)	Scheelite in garnet-epidote tactite body 60 feet wide and 600 feet in length.	Developed by 150-foot crosscut adit. (Tucker 1945, p. 155, pl. 35).

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Field Trip No. 4

GEOLOGY OF THE NORTHERN PENINSULAR RANGES, SOUTHERN CALIFORNIA: GEOLOGIC GUIDE AND ROAD LOG

by

D.M. Morton and C.H. Gray, Jr.
California Division of Mines and Geology
Los Angeles, California

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INTRODUCTION AND ACKNOWLEDGMENTS

This guide covers the north-central part of the Peninsular Ranges, principally in western Riverside County, southern California. Commencing and terminating at the University of California, Riverside campus, the route of travel is a loop of 124 miles, with one short side trip (Fig. 1). The route affords ready access to a variety of geologic features: prebatholithic rocks, rocks of the southern California batholith, Upper Cretaceous to Pleistocene sedimentary rocks, Holocene alluvial deposits, recent fault features, and various geomorphic features. A considerably longer guide, overlapping part of this guide, has been prepared by Jahns (1954a).

The entire Peninsular Range province has been best described in some detail by Jahns (1954b, pp. 29-52) who included a map, and all but the Los Angeles basin part, more briefly by Gray *et al.*, (1971). In 1948 Larsen described the southern California batholith and included a map at a scale of 1:125,000. A number of workers have mapped and described parts of the northern Peninsular Ranges. Published regional reports include the Perris block (Dudley, 1935, 1936), Corona-Elsinore-Murrieta area along the Elsinore fault (Gray, 1954), the Temecula region of the Elsinore fault zone (Mann, 1955) and the Los Angeles basin (Yerkes *et al.*, 1965). For a synthesis of general distribution of major rock units and faults, the reader is referred to Dibblee (1968).

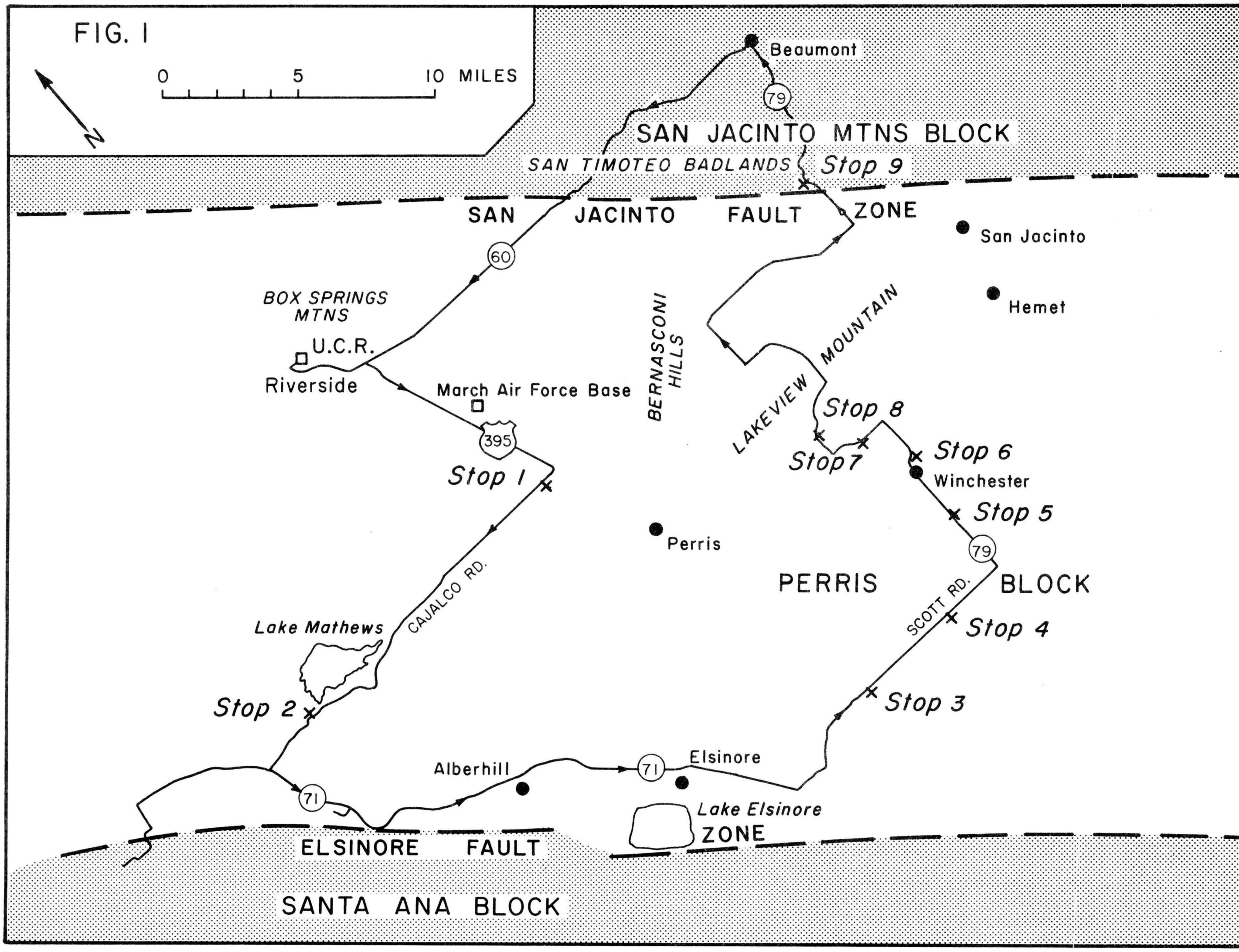
The accompanying generalized geologic map, Figure 2, is after Rogers (1966); modified by the authors. Additional data, mainly structural, were obtained from Engel (1959), English (1953), Gray (1961 and unpublished mapping), Jahns (1954b), Jenney (1968), Larsen, Norman (1962), Menzie (1962), Morton (1969, 1971, and unpublished mapping), and Schwarcz (1969).

A.O. Woodford, Pomona College, kindly made available an unpublished manuscript. Professor Woodford and R.F. Yerkes, U.S. Geological Survey, critically read the geologic synopsis of this guide.

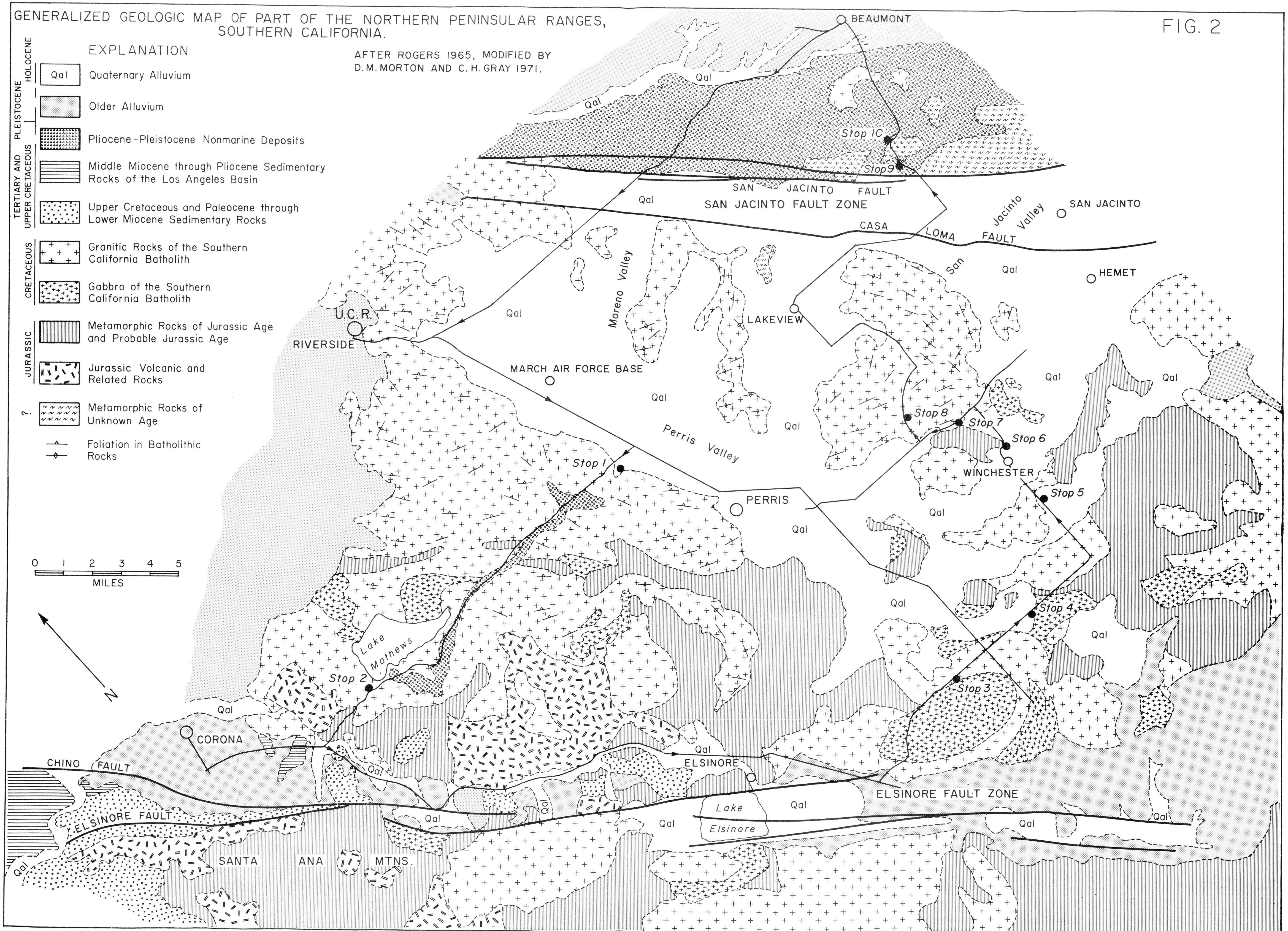
GEOLOGIC SYNOPSIS OF THE NORTHERN PENINSULAR RANGES

An elongate, physiographic domain, the Peninsular Range province extends south-southeast from the latitude of Los Angeles-San Bernardino to the southern tip of Baja California. The western part of the province is submerged, and is part of the area termed the continental borderland (Shepard and Emery, 1941). High prominences of the Peninsular Ranges contintental borderland form the islands of Santa Catalina, Santa Barbara, San Nicolas, and San Clemente off the southern California coast.

Within the province is a general coincidence of both structural and physiographic features—all having a northwest trend (Jahns, 1954b; Larsen, 1948, pp. 119-127). This trend predates the emplacement of the southern California batholith ($\cong$110 m.y.) and has been repeatedly reinforced. Topographically, the province tilts gently westward to depths of about 5,000 feet below sea level over the United States part of the continental borderland. The San Jacinto Mountains along the eastern margin reach elevations in excess of 10,000 feet and drop precipitously to the Salton trough on the east.



INDEX MAP SHOWING MAJOR GEOMORPHIC FEATURES AND ROUTE OF TRAVEL.


GENERALIZED GEOLOGIC MAP OF PART OF THE NORTHERN PENINSULAR RANGES, SOUTHERN CALIFORNIA.
FIG. 2
AFTER ROGERS 1965, MODIFIED BY D.M. MORTON AND C.H. GRAY 1971.
EXPLANATION
HOLOCENE
PLEISTOCENE
TERTIARY AND UPPER CRETACEOUS
CRETACEOUS
JURASSIC
Qal Quaternary Alluvium
Older Alluvium
Pliocene-Pleistocene Nonmarine Deposits
Middle Miocene through Pliocene Sedimentary Rocks of the Los Angeles Basin
Upper Cretaceous and Paleocene through Lower Miocene Sedimentary Rocks
Granitic Rocks of the Southern California Batholith
Gabbro of the Southern California Batholith
Metamorphic Rocks of Jurassic Age and Probable Jurassic Age
Jurassic Volcanic and Related Rocks
Metamorphic Rocks of Unknown Age
Foliation in Batholithic Rocks
0 1 2 3 4 5
MILES
N
BEAUMONT
Stop 10
Stop 9
SAN JACINTO FAULT
SAN JACINTO FAULT ZONE
CASA LOMA FAULT
San Jacinto Valley
SAN JACINTO
HEMET
Moreno Valley
LAKEVIEW
U.C.R.
RIVERSIDE
MARCH AIR FORCE BASE
Perris Valley
PERRIS
Stop 1
Stop 2
Stop 3
Stop 4
Stop 5
Stop 6
Stop 7
Stop 8
WINCHESTER
Lake Mathews
CORONA
CHINO FAULT
ELSINORE FAULT
ELSINORE
ELSINORE FAULT ZONE
Lake Elsinore
SANTA ANA MTNS.
Qal

The landward northern Peninsular Ranges are 60 to 80 miles in width, and divided into three elongate structural blocks separated by major northwest-striking fault zones. From west to east: the Newport-Inglewood zone forms the boundary between the largely submerged continental borderland block to the west and the Santa Ana block to the east; the Elsinore zone and associated Elsinore-Temecula graben separate the Santa Ana block from the Perris block. Eastward, the San Jacinto zone separates the Perris block and San Jacinto Mountains block.

Basement Rocks

The northern Peninsular Ranges consist of pre-Turonian basement rocks separated by a profound unconformity from a superjacent sedimentary sequence of Turonian and younger age. The basement rocks can be divided into two distinctly different complexes: a western complex west of the Newport-Inglewood zone and an eastern complex east of this zone (Woodford, 1960; Yerkes *et al., 1965).*

Western Basement Complex: The western basement complex belongs to the blueschist metamorphic facies characterized by lawsonite and glaucophane. The dominant rock is the Catalina Schist (Catalina metamorphic facies of Woodford, 1924), made up of metamorphosed clastic and volcanic rocks, and serpentinite, which is, in part, intruded by Miocene dacite porphyry and quartz diorite (Forman, 1970; Schoellhamer and Woodford, 1951; Woodford, 1960). Conspicuous by their absence are the granitic rocks that are elsewhere widespread in the Peninsular and Transverse Ranges.

Although the Catalina Schist is of low metamorphic grade, no fossils have been reported. Woodford (1924), on the basis of lithology, correlated this schist with the Franciscan Formation to the north, which is Late Jurassic to early Late Cretaceous in age (Bailey *et al.,* 1964; Irwin, 1967). Forman (1970) reports a K-Ar age of about 100 m.y. for the Catalina Schist.

Eastern Basement Complex: East of the Newport-Inglewood zone the basement consists of granitic rocks, incipiently metamorphosed clastic and volcanic rocks, and locally, marble. Metamorphic grade of the clastic rocks increases progressively eastward, noticeably in the Perris block. Granitic rocks of the southern California batholith have invaded all of these rocks. The eastward increase in regional metamorphic grade is independent of the distribution of individual plutons of the batholith. Local contact metamorphism, however, accompanied the emplacement of the batholith and gave rise to several well-known complex mineral assemblages (e.g., Crestmore—see Burnham, 1959; Murdoch, 1961). Foliation in the metamorphic rocks, which generally strikes northwest, predates emplacement of the batholith (Schwarcz, 1969). Local deviation in the foliation has been produced by the emplacement of some plutons (e.g., Morton, 1969).

In the Santa Ana block the oldest dated rock is a sequence of incipiently metamorphosed, thin-bedded argillite, graywacke, and quartzite, with local pods of marble, termed the Bedford Canyon Formation (Gray, 1961; Larsen, 1948). The

TABLE 1

GENERALIZED GEOLOGIC COLUMN NORTHERN PENINSULAR RANGES (EXCLUDING THE LOS ANGELES BASIN)

Age	Formation	Description	Distribution	Max. Estimated Thickness in Feet
Quaternary	Holocene alluvium; Pleistocene nonmarine; Bautista Beds and Temecula Arkose; Pleistocene marine deposits.	Continental sands, gravels, lake beds. Marine fossiliferous terrace deposits.	Marine terrace deposits along coast. Alluvial fan deposits, lake beds, and valley fill in interior areas.	8,000 (?) in San Jacinto Valley.
Continental Pliocene	San Timoteo and Mt. Eden.	Continental sandstones, silt stones and conglomerate; redbeds. Upper part of San Timoteo is Pleistocene.	West of San Jacinto Mts. along San Jacinto fault.	7,000
Marine Pliocene	Repetto (?)	Thick-bedded white sandstone, conglomerate, silt, and shale. Marine.	Northwest end of Elsinore Trough at Corona on margin of Los Angeles Basin.	2,000 near Corona
Pliocene	Santa Rosa Basalt	Basalt, andesite, and pyroclastics.	Mesa-capping basalt near Murrieta.	Several hundred
Upper Miocene	Puente	Sandy siltstone and shale; minor sandstone, conglomerate and diatomite. Marine.	Northwest end of Elsinore Trough at Corona on margin of Los Angeles Basin.	1,000 (?)
Middle Miocene	San Onofre Breccia	Blocks of glaucophane and similar schists.	Oceanside north on coastal margin of region.	2,500
	Topanga	Buff sandstone, conglomerate, and sandy siltstone. Marine.	Northwest end of Elsinore Trough near Corona.	800
Lower Miocene to Upper Eocene	Vaqueros (Lower Miocene) and Sespe (Upper Eocene-Lower Miocene).	White, buff, red and green sandstone, conglomerate, sandy clay, and siltstone. Interfingering marine and nonmarine.	Northwest end of Elsinore Trough near Corona. West flank of Santa Ana Mts. at Trabuco Canyon.	3,000 combined
Eocene	Santiago	Buff sandstone, siltstone, and conglomerate. Marine.	North and northeastern margins of Santa Ana Mts. near Corona.	600 near Corona
Paleocene	Silverado	Upper part marine sandstone, conglomerate, siltstone, and shale; lower part nonmarine or brackish water sandstone, conglomerate, clay, lignite.	Elsinore Trough from Elsinore to Santa Ana River at northwest tip of Santa Ana Mts.	2,000 (?) at Corona
Upper Cretaceous	Williams and Ladd	Sandy shale or siltstone, arkosic sandstone, boulder conglomerate, Well stratified, fossiliferous. Marine.	Along northern part of coastal strip and around northwest tip of Santa Ana Mts. Underlies younger formations.	5,500
Cretaceous	Trabuco	Red and gray-green boulder conglomerate and sandstone. Nonmarine (?).	In Santa Ana Mts. northerly from Plano Trabuco to Black Star Canyon; southwest of Corona.	1,000; 600 near Corona
	Unconformity			
Cretaceous	Plutonic intrusive rocks of southern California batholith.	Granite, adamellite, granodiorite, quartz diorite, tonalite, diorite, and gabbro.	Basement rocks throughout the region.	
Jurassic	Santiago Peak	Volcanics, metavolcanics and hypabyssal intrusive rocks.	Part of basement rocks along western margin of plutonic basement rocks.	Several thousand
	Bedford Canyon	Argillite, slate, schist, quartzite, and minor marbles.	Roof pendants widely distributed in western part of batholith.	Several thousand
Jurassic (?)	French Valley [may overlie Bedford Canyon Fm.].	Quartzite, schist, and amphibolite.	Central part of Perris block.	13,000
Paleozoic (?)	Unnamed	Schist, gneiss, phyllite, quartzite, and marble.	Roof pendants widely distributed in eastern part of batholith; chiefly in San Jacinto and Santa Rosa Mts.	Several thousand

orientation of sedimentary structures indicates that the Bedford Canyon is highly deformed. Owing to the structural complexity and monotonous nature of this sequence, the overall structure and original thickness are unknown (Gray, 1961). Larsen (1948, p. 22) considered the unit to have a stratigraphic thickness of 20,000 feet; Gray (1961, p. 12) believes this thickness to be excessive.

Prior to 1960 the Bedford Canyon Formation was generally considered to be Triassic (Gray, 1961, pp. 12-13), but Fairbanks (1893, p. 116) originally regarded these rocks as Carboniferous. The Triassic age was based upon a sparse collection of the pelecypod *Daonella sanctaeanae* Smith, the Upper Triassic ammonite genera *Discotropites* and *Juvavites,* and rhynchonellid brachiopods of the Triassic genus *Halorella* (Engel, 1959, p. 20, 23, and 24). Subsequent collections, however, indicate an early Late Jurassic (Callovian) (Imlay, 1963; Silberling *et al.,* 1961) and lower Middle Jurassic (Bajocian) (Imlay, 1964) age for the Bedford Canyon. Brachiopods formerly considered to be *Halorella* are now thought to be a new genus, perhaps transitional between *Halorella* of the Upper Triassic and *Peregrinella* of the Lower Cretaceous (Silberling *et al.,* 1961).

Unconformably overlying the Bedford Canyon Formation is the Santiago Peak Volcanics (Larsen, 1948). Most of the rock is of dacitic to andesitic composition. In the northern Santa Ana Mountains this unit has an apparent maximum thickness of 2,300 feet (Gray, 1961, p. 15). The age of the Santiago Peak Volcanics is considered to be Jurassic (Fife *et al.,* 1967). Shallow, intrusive rocks related to the Santiago Peak Volcanics occur in the Bedford Canyon Formation.

Metamorphic rocks in the western and central parts of the Perris block have been correlated, on the basis of lithology, with the Bedford Canyon Formation and Santiago Peak Volcanics (Gray, 1961; Larsen, 1948; Schwarcz, 1969). They are, however, in general more intensely metamorphosed than the Bedford Canyon in the Santa Ana Mountains. Also widespread in the northwestern part of the block is the Temescal Wash Quartz Latite Porphyry (Dudley, 1935, p. 497). Supposedly of Jurassic age, this porphyry may be related to the Santiago Peak Volcanics.

In the Winchester area (north-central part of the Perris block) rocks correlated with the Bedford Canyon Formation are considered by Schwarcz (1969) to be conformably overlain by a 13,000 foot thick sequence of quartzite, schist, and amphibolite. Schwarcz (1969, p. 19) considered the original sediment of this sequence, which he named the French Valley Formation, "to have been deposited in a marginal basin (Krumbein and Sloss, 1963, p. 418), flanking a cratonic highland and possibly transitional on the west into a eugeosyncline." These rocks earlier were considered to be of Paleozoic age (Larsen, 1948; Webb, 1939), as based on a fossil later believed to have been imported (letter to A.O. Woodford from R.W. Webb, November 20, 1959; ref. in Woodford, 1960). Schwarcz's work clearly shows the incompatibility of the fossil with the rocks in the area of its reported occurrence. Just west of the Winchester area, in rocks apparently equivalent to the French Valley Formation, M.A. Murphy (pers. comm., 1968) collected pelecypods of uncertain age. These pelecypods have been considered to be either Late Triassic or Jurassic in age (Schwarcz, 1969).

The metamorphic grade of French Valley Formation rocks increases abruptly eastward in the Winchester area, passing in map distance of less than two miles from a muscovite zone, through andalusite, sillimanite, and garnet isograds. Based on mineral assemblages (Morton, 1969; Schwarcz, 1969) metamorphism was of the Abukuma (andalusite-sillimanite) type (Winkler, 1965).

At the northern end of the Perris block (e.g., Crestmore, Jurupa Hills, Slover Hill) and southeast of Hemet (Bautista Canyon), the metamorphic rocks commonly contain marble, on the basis of which they may be possibly Paleozoic in age (see Woodford, 1960).

The western San Jacinto Mountains block includes banded gneiss, marble, amphibolite schist, quartzite, and metaconglomerate of the almandine amphibolite facies (Sharp, 1967, p. 717). On the east side of the San Jacinto Mountains and passing southward through the Santa Rosa Mountains is a thick zone of cataclastic rocks as well as abundant marble and dolomite (Sharp, 1967, 1968; Theodore, 1966, 1970). These rocks are of unknown age.

Southern California Batholith

Larsen (1941) gave the name Southern California batholith to a sequence of plutonic rocks that makes up much of the eastern basement complex. Rocks of this composite batholith range in composition from olivine gabbro to granite and form myriad bodies of differing shapes and sizes. The general sequence of emplacement has been basic to silicic (gabbro to granite). Although Dudley (1935) first mapped the northern Perris block, the batholith is best known through the works of Larsen, especially his 1948 Memoir.

In the Santa Ana Mountains batholithic rocks intrude the Jurassic Bedford Canyon Formation and are overlain by the Upper Cretaceous Trabuco Formation, a nonmarine conglomerate that contains clasts of granitic rocks resembling those of the batholith. In northern Baja California, early Upper Cretaceous rocks (upper Cenomanian and Turonian) are intruded by rocks of the batholith and are in turn overlain by late Upper Cretaceous (Senonian) sedimentary rocks (see Woodford and Harris, 1938) which there indicates that the batholith is of middle Late Cretaceous age. Geochronological data from U-Pb isotopes in zircon have yielded dates in the interval 100 to 120 m.y. (e.g., Banks and Silver, 1961). K-Ar dates for batholith rocks give consistently younger ages, clustering in the low 90 m.y. range (Evernden and Kistler, 1970; Morton, 1969).

Lithologically, the batholith is composed of essentially three rock types: gabbro, quartz diorite (tonalite), and granodiorite. In its northwestern part, Larsen (1948, 1951, 1954) found the batholith to consist of 7% gabbro, 63% quartz diorite, and 28% granodiorite, with granite constituting only 2%. Gabbro, generally called San Marcos Gabbro (Larsen, 1948; Miller, 1937, 1938), is typically a hornblende or hornblende-bearing gabbro, but is extremely variable in mineralogy. Rocks called San Marcos Gabbro include allivalite, troctolite, norite, quartz norite, and anorthosite. Quartz diorite (tonalite) is the most abundant rock type and Bonsall Tonalite (Hurlbut, 1935) the most common unit. Typically the quartz diorites are medium- to coarse-grained biotite-hornblende quartz diorites. Most are foliated and commonly contain flattened, discoidal, dark inclusions; some exposures exhibit abundant schlieren. Granodiorite, most of which is termed the Woodson Mountain Granodiorite, is generally a relatively uniform, medium-grained rock, either massive or foliated (Larsen, 1948). Some exposures are essentially inclusion free; others are choked with inclusions. Locally a porphyritic or sub-porphyritic texture is prominent.

A number of discrete plutonic bodies or complexes have been studied in detail. These studies indicate the batholith was emplaced by a variety of processes including magmatic, both forceful (Menzie, 1962; Morton, 1969) and passive (Jenney, 1968; Morton and Baird, 1971), and by replacement (Jahns, 1948). Complex internal structures have been demonstrated for some granitic rocks (Morton, 1969; Osborn, 1939).

An exhaustive chemical investigation of the batholithic rocks has been conducted in the northern Peninsular Ranges. Preliminary results of this study show a marked systematic chemical variation parallel to the structural grain (Baird *et al.,* 1965, 1966, 1970). Two individual plutons have been studied chemically. Both bodies show a chemical variation essentially parallel to their structural configuration. In the Box Springs Mountains complex, Joshi (1969) found the core to be more silicic than the margin and considered the variation to be a function of elevation differences. The Lakeview Mountains pluton has a more basic core than margin, reflecting original magma differences (Baird *et al.,* 1967; Morton *et al.,* 1969).

Superjacent Series Sedimentary rocks and unconsolidated sediments range in age from Upper Cretaceous to Holocene and recent. The northern Santa Ana Mountains and adjacent Elsinore fault zone contain the greatest variety of these units. On the Perris and San Jacinto Mountains blocks the superjacent series is essentially limited to late Tertiary and Quaternary nonmarine deposits.

Santa Ana Block and Elsinore Fault Zone

The northern Santa Ana Mountains and the adjacent Elsinore fault zone are part of the Los Angeles basin, which developed during Miocene time. Thus, the later history of this part of the Peninsular Ranges differs considerably from that to the east. Prior to the inception of the Los Angeles basin, this part of the Peninsular Ranges was the site of discontinuous deposition beginning in Late Cretaceous time. For a summary of the history of the Los Angeles basin, the reader is referred to Yerkes *et al.* (1965).

Upper Cretaceous rocks in the northern Santa Ana Mountains attain a thickness of 5,500 feet (Woodford *et al.,* 1954). Resting unconformably upon basement is the Trabuco Formation (Packard, 1916), a 400- to 700-foot sequence of unfossiliferous conglomerate (Gray, 1961, p. 18-19). Clasts in the conglomerate are primarily Santiago Peak Volcanics and related rocks, with minor, but strikingly ubiquitous, clasts of biotite granodiorite.

Above the Trabuco Formation is an Upper Cretaceous marine sequence of conglomerate, sandstone, siltstone, and shale. Termed the Ladd Formation, it has a stratigraphic thickness of 1,700 feet. In places this formation has been divided into two members: the Baker Canyon Conglomerate Member (with fauna of Turonian age) and overlying Holz Shale Member (Turonian to Campanian) (Gray, 1961; Woodring and Popenoe, 1942). Unconformably overlying the Ladd Formation is the Williams Formation. The lower part (Schulz Ranch Sandstone Member) is an unfossiliferous arkosic sandstone and the upper part (Pleasants Sandstone Member) is a fossiliferous (Campanian), shaly sandstone with intercalated lenses of sandstone (Popenoe, 1937; p. 380).

Paleocene rocks, about 1,400 feet thick in the Santa Ana Mountains (Woodford *et al.*, 1954, p. 69), are called the Silverado Formation (Woodring and Popenoe, 1945). They rest unconformably upon Upper Cretaceous and basement rocks in the Santa Ana Mountains and in the Elsinore fault zone (Gray, 1961). Basal Silverado consists of nonmarine conglomerate and feldspathic sandstone. Locally, the sandstone is extremely rich in biotite and resembles biotite schist (Woodford *et al.*, 1954, p. 69). The upper part of the Silverado is a fossiliferous marine sandstone and siltstone.

The basal part of the formation contains large amounts of high-alumina clay. This clay includes both residual and sedimentary clay, some of which is bauxitic (Gray, 1961, p. 25). The residual clay was derived from *in situ* weathering of a variety of basement rocks (Gray, 1961, p. 63). The clay and local silica sand deposits of the Silverado support a number of mining operations which date back over 80 years, among which are the most productive clay operations in southern California.

The Eocene Santiago Formation apparently conformably overlies the Silverado Formation (Woodring and Popenoe, 1945). Predominantly sandstone, the lower part of the Santiago contains a middle Eocene molluscan fauna; the Santiago has a maximum thickness of approximately 2,700 feet. The upper part of the Santiago at least locally contains nonmarine conglomerate and sandstone and is gradational with the Sespe Formation. Late Eocene to earliest Miocene nonmarine Sespe Formation and the early Miocene marine Vaqueros Formation have been mapped as an undifferentiated unit as much as 3,000 feet thick. They consist of vari-colored (maroon, gray, red, and greenish) sandstone and conglomerate (Gray, 1961). These rocks apparently rest conformably upon the Santiago Formation in the Santa Ana Mountains (Woodford *et al.*, 1954, p. 69) and unconformably upon the Santiago west of Corona (Gray, 1961, p. 30).

Following the deposition of lower Miocene sediments was a period of general emergence and erosion which produced a widespread unconformity throughout much of the Los Angeles basin. During middle Miocene time, a northwest-trending embayment covered the site of the basin, with highlands rising both to the northeast and southwest (Yerkes *et al.*, 1965). During part of this time, the western basement (Catalina Schist) emerged and rapidly shed debris which entered the southwest side of the marine embayment to form the San Onofre Breccia (Woodford, 1925).

Marine middle Miocene rocks crop out in the northwestern Santa Ana Mountains and in limited exposures in the Corona area where they have been assigned to the Topanga Formation. In the Corona area these rocks consist of sandstone and conglomerate which have yielded middle Miocene megafossils and microfossils (Gray, 1961, p. 31).

During upper Miocene to lower Pliocene time, with the main phase of basin development there was essentially continuous subsidence and deposition in the Los Angeles basin (Yerkes *et al.*, 1965, p. 17).

Upper Miocene marine sedimentary rocks, the Puente Formation as much as 13,400 feet thick in the Los Angeles basin, occur in the northernmost Santa Ana Mountains and underlie the Puente-Chino Hills to the north. In the Corona area a few patches of siltstone, sandstone, and conglomerate contain upper Miocene foraminifera and are assigned to the Puente Formation (Gray, 1961, p. 31-35). Immediately east of Corona the apparent eastward limit of deposition of this unit is marked by a cliff-like, buttressed unconformity between granitic rock and fossiliferous sandstone and conglomerate tentatively correlated with the Puente Formation (Gray, unpublished map, 1969).

Lower Pliocene sandstone and siltstone with interbedded conglomerate conformably overlie the upper Miocene rocks in the northeasternmost Santa Ana Mountains and along the margins of the Puente Hills. East of there, these strata have not been named. At the end of the Pliocene, the Puente-Chino Hills and Santa Ana Mountains emerged, which have subsequently not been submerged. During late Pleistocene through Holocene, the Los Angeles basin gradually ceased to be a site of major deposition with a continual westward withdrawal of the sea (Yerkes *et al.,* 1965, p. 19-20).

Alluvial deposits of Pleistocene to Recent age are similar over most of the northern Peninsular Ranges. Stream terrace deposits are widespread along major drainages; most consist of unconsolidated gravels in a poorly sorted, sandy matrix, reddish-brown to tan or buff in color. Clasts are of differing composition, depending upon source area. Older terrace deposits are commonly dissected and have nearly flat upper surfaces. They range in thickness from less than one foot to over 100 feet.

Older alluvium is widespread and occurs generally as dissected alluvial fan deposits. Characteristically, the older alluvium is red-brown and well-indurated. It contains considerable clay, with subangular to rounded small clasts.

Tertiary and Quaternary deposits on the Perris and San Jacinto Mountains Blocks

Nonmarine Pliocene to Pleistocene deposits, other than "older alluvium," are very restricted in the northern Perris block. Two east-trending, largely obscured stream channels cross the northwestern part of the block. During recent construction, a Pliocene mammalian fauna was discovered near Lake Mathews (Proctor and Downs, 1963) in poorly sorted, arkosic sandstone that fills a channel cut in basement rock on the Perris surface, an erosion surface at the 1,700 foot elevation.

A much smaller, somewhat sinuous stream channel occurs on the Lakeview-Gavilan surface, a 2,100-foot erosion surface south of Lake Mathews. Mantled by cobbles, it stands in base relief above a largely bedrock surface (Dudley, 1953). Small patches of gray, poorly bedded sediment of unknown age occur on the Lakeview-Gavilan surface in the Lakeview Mountains (Morton, 1971).

Unconsolidated, buff colored, decomposed arkosic sediment underlies older alluvium in the Canyon Lake area (formerly Railroad Canyon) east of Elsinore. This sediment apparently fills an east-trending depression in the basement.

Nonmarine Pliocene and Pleistocene deposits are widespread in the northern San Jacinto Mountains block; the northern 25 miles of the block is underlain by sedimentary deposits comprising the "San Timoteo Badlands." Sediments overlying basement are generally coarse, arkosic sandstone and conglomerate red beds. Overlying the red beds are buff- to gray- and greenish-gray sandstone, conglomerate beds and lenses, and siltstone. Some conglomerate lenses are monolithologic, composed of quartz diorite clasts as much as 20 feet in diameter (Morton, 1971). The lower part of the sequence is generally termed the Mt. Eden Formation, or Beds, and the higher part, the San Timoteo Formation. The Mt. Eden Formation is probably mainly middle Pliocene in age and the San Timoteo is upper Pliocene in age.

These and similar sediments, east and southeast of Hemet have yielded a mid-Pliocene (Hemphillian), early Pleistocene (Blancan) and later Pleistocene (Irvingtonian) fauna (Frick, 1921; Savage *et al.,* 1954). They have also yielded a mid-Pliocene to early Pleistocene flora (Axelrod, 1937, 1945, 1966).

Faults

The Peninsular Ranges abruptly terminate to the north against the east-trending Transverse Ranges. The Malibu Coast-Santa Monica-Raymond Hill-Sierra Madre-Cucamonga fault complex marks their northern terminus, extending from the Pacific Ocean to the Devore area near Cajon Pass. East of Devore this boundary is apparently offset on the San Jacinto fault approximately 15 miles right laterally to the Redlands area. From this point the boundary is termed the Banning fault, which continues eastward into the San Gorgonio Pass area.

The several blocks of the Peninsular Ranges are separated by northwest-striking faults belonging to the San Andreas fault system (Crowell, 1962). The major fault zones are, from west to east: the Newport-Inglewood, the Elsinore-Whittier, and San Jacinto. The Newport-Inglewood zone is poorly exposed; the other zones consist of a complex of subparallel, en échelon, or anastomosing faults. Individual faults within each zone show evidence of recent displacement as indicated by ephemeral features such as closed depressions and scarps.

The presence of unlike metamorphic rocks on opposite sides of the Newport-Inglewood fault zone suggests considerable displacement and recently it has been considered the "proto-San Andreas" fault in southern California (Suppe, 1970). Pre-late middle Miocene displacement of undetermined amount and sense juxtaposed the Eastern and Western basement complexes and exposed Western basement to erosion. Lower Pliocene strata are separated as much as 5,000 feet in a right lateral sense along faults of the zone. Vertical separation at the basement surface locally attains 4,000 feet across the zone, but that of Pliocene strata commonly does not exceed 1,000 feet and that at the base of the Pleistocene 200 feet. Late movement on the fault has resulted in arching of young sediments to form low hills along the zone (Yerkes *et al.,* 1965, p. 48) and seismic activity (i.e., Long Beach earthquake of 1933) indicates continued movement (Barrows, in press, 1971).

The Elsinore-Whittier fault zone, with a known length of about 135 miles, extends from the Whittier Narrows area, east of Los Angeles, southeast to at least within a few miles of the International Border. Bifurcating at the north end of the Santa Ana Mountains, its west branch is termed the Whittier fault. The east branch, the Chino fault, passes along the east side of the Chino (Puente) Hills northwest of Corona. From the Corona area southward the zone is designated Elsinore.

Along the Whittier fault, local structural data indicate an oblique net slip (right-lateral reverse) of about 15,000 feet since Miocene time; this part of the fault zone may have been active since middle Miocene time (Yerkes *et al.,* 1965, p. 50).

Displacement on the Elsinore fault zone has been considered essentially normal, reverse, as well as lateral by various workers (Gray, 1961, p. 46). Distribution of basement rocks across the faults suggests possible lateral displacement on the order of a few miles. Sag ponds and scarps along faults of this zone indicate recent movement (e.g., Glen Ivy, Willard, and Wildomar).

The San Jacinto is the only fault of the San Andreas system, including the San Andreas, to cross the southern Transverse Ranges without deviating from its general strike or being terminated. On the contrary, the San Jacinto fault appears to offset the southern, east-striking faults of the Transverse Ranges (Allen, 1957, p. 339; Sharp, 1967, p. 726). Based on its straightness, continuity, and seismic history, it appears to be the most active fault of the San Andreas system in southern California (Sharp, 1967). Based on a number of offset basement contacts southeast of Hemet, Sharp (1967) determined a 15-mile right-lateral displacement across the San Jacinto. He also found Pleistocene deposits offset right laterally at least 3.2 miles and stream courses offset half a mile.

In the San Jacinto Valley, a remarkably deep, narrow graben has developed between the San Jacinto and adjacent Casa Loma faults. North of San Jacinto the depth to basement in this alluvial-filled graben is some 8,000 feet beneath the present valley floor (Fett, 1968). It is thought this graben developed and filled since the early Pleistocene. Currently, parts of the graben are undergoing rapid subsidence. Surface expression of this subsidence is widespread (Fett *et al.,* 1966) and includes major surface fissures (Morton, 1971). This active subsidence, which in part may be of tectonic origin, appears to be mainly the result of ground-water withdrawal. A large number of recent surface expressions of faulting occur on the San Jacinto fault (Sharp, 1970).

Seismically, the San Jacinto fault zone has been the most active member of the San Andreas system; many destructive earthquakes having occurred along the zone since the turn of the century (e.g., 1899, 1918, 1923, 1937, and 1954) (Allen *et al.,* 1967).

Geomorphology

A number of low-relief, erosional surfaces occur throughout much of the northern Penisnular Ranges at different elevations. They are best developed, and exposed, on the Perris block. Erosional surfaces are present there at elevations of 1,700; 2,100; and 2,500 feet (Dudley, 1936; Larsen, 1948). There is also a largely buried canyon system. Dudley (1936, pp. 358-387) believed that the Perris block, which is bounded on the southwest by the Temecula-Elsinore trough, had a geomorphic history briefly summarized as follows:

1. A mature surface was developed in the area of the Perris block. Drainage was at that time toward the east.

2. This old topography was partly buried by sediments, and the Perris surface was developed. This surface, cut on crystalline rocks and interrupted here and there by monadnocks, lies at an altitude of about 1,700 feet.
3. Sediments accumulated over a large area, and the Lakeview-Gavilan surface at an altitude of about 2,100 feet was formed.
4. Erosion exhumed the Perris surface, and the San Jacinto River then flowed across this surface and through the Santa Ana Mountains to the sea. The river thus is superimposed where it crosses monadnocks on the Perris surface.
5. The San Jacinto River was captured by Temescal Creek, a tributary of the Santa Ana River. Elsinore Lake is a temporary feature, incidental to recent faulting.

A revised interpretation of the development of these features, and their relations to contemporary tectonism has been proposed by Woodford *et al.* (in press, 1971).

Of particular interest is the San Jacinto River course, which may once have flowed across the present area of the Santa Ana Mountains. Apparently movement of the Elsinore fault zone uplifted the Santa Ana Mountains across its path, disrupting the earlier westward course of the drainage and causing the present northward drainage along the Elsinore fault zone toward present-day Santa Ana Canyon. The canyon itself is probably antecedent, as uplift of the Santa Ana Mountains continued after the initial disruption of the San Jacinto River course. Currently except for periods of extraordinary runoff, such as during 1916-1917, the San Jacinto River runoff terminates at Lake Elsinore, a closed depression marking the northern end of the Temecula-Elsinore graben.

FIELD TRIP ROAD LOG

The starting point of the trip is located on the west flank of a funnel-shaped granitic complex (see Fig. 2). This complex, part of the southern California batholith, and termed the Box Springs body (Menzie, 1962), is elliptical in plan (5 x 8 miles) with its long dimension oriented N.40°W. It consists principally of two parts: an outer zone composed of foliated quartz diorite (tonalite) and granodiorite, with minor quartz monzonite and granite; and an interior or center (2 x 3 miles), of massive quartz diorite. Quartz diorite (Bonsall Tonalite), the most abundant rock in the outer zone, is strongly foliated with common to abundant inclusions most of which are disc-like in shape. The long dimensions of the inclusions, as well as the long dimensions of tabular and platy minerals, define the foliation. Quartz diorite comprising the center contains sparse unoriented inclusions. Menzie considers the complex resulted from mobilization of largely crystallized quartz diorite (which forms the outer zone) and was later intruded by magma which formed the central part of the complex. Movements in the largely crystallized quartz diorite resulted in formation of the foliation and "flattening" of the inclusions (after Menzie, 1962).

0.0 Start trip. Parking Lot, Ramada Inn, Riverside. Proceed east from parking lot to University Avenue and hence onto southbound US 395. Highway proceeds up Box Springs grade passing through exposures of typical Bonsall Tonalite. Note the foliated nature of the rock and the common pancake shaped dark inclusions.

3.6 Highway grade decreases on entering the 1,700+ foot Perris erosional surface.

4.1 Overpass across Santa Fe tracks. Here a thin veneer of gray Pleistocene (?) sediments covers the Bonsall Tonalite.

4.3 Highway branches. Bear to the right on US 395.

4.6 To left (northeast) is the east-striking, north-dipping southern part of the Box Springs complex.

5.5 The valley floor, termed the Paloma surface (Woodford *et al.,* 1971), subtly reaches elevation 100-200 feet below the Perris surface.

6.5 Highway crosses Allesandro Road (traffic light).

7.6 March Air Force Base Depot. Strategic Air Command (SAC) headquarters to left.

8.6 Highway crosses Van Buren Boulevard (traffic light).

8.8 Ahead to the right the low relief hills silhouette the Perris surface rising above the alluviated valley.

11.0 Four miles east are the Bernasconi Hills. These hills are upper parts of a buried stream system which drained towards the highway, where at this point the valley fill is over 800 feet deep (Bean, 1955). The former drainage direction abruptly reversed at the west edge of the Bernasconi Hills and flowed eastward towards the San Jacinto Mountains and emptied into a graben along the San Jacinto fault zone (Woodford *et al.,* 1971).

12.5 Right turn off US 395 onto Cajalco Road.

12.6 Low dump 200 yards south of Cajalco Road is spoilage from the Metropolitan Water District's (MWD) Val Verde Tunnel. This tunnel is part of the elaborate aqueduct that brings water from the Colorado River to the metropolitan areas of southern California. Our route follows the aqueduct for the next ten miles to Lake Mathews, an MWD reservoir.

12.9 Near horizontal skyline to south is the Perris surface developed on Bonsall Tonalite.

13.5 Contact between alluvium and Bonsall Tonalite.

13.8 **Stop 1:** Turn left (south) onto dirt road. Proceed for 0.2 mile to dump from MWD tunnel to view abundant fresh boulders of quartz diorite. This quartz diorite is from the Riverside-Perris pluton (Jenney, 1968), a large elongated (4.9 x 13 miles) body of Bonsall Tonalite of predominantly a biotite-hornblende quartz diorite. To the northeast it merges with the Box Springs Mountain body. Like the outer quartz diorite in the Box Springs Mountains, this rock is strongly foliated with abundant inclusions oriented north-northwest and dipping moderately to the northeast. In general the dip flattens from west to east across the pluton. Jenney (1968) considers the quartz diorite to have been intruded into a tensional environment which allowed permissive entry of the quartz diorite magma (after Jenney, 1968). Return to Cajalco Road.

14.1 Cajalco Road reaches top of the Perris surface.

14.8 Intersection of Cajalco Road and Clark Street. A few hundred feet to the left is a buried Pliocene-Pleistocene stream channel marked by the low rounded hills. Note the lack of rounded boulders which would indicate the presence of granitic rocks.

15.4 Cajalco Road crosses north-trending arm of the channel.

16.3 Exposure of Bonsall Tonalite.

16.5 To the left is dump from MWD Val Verde tunnel. To right is an exposure of hybrid rocks. Folded inclusion-like layers in migmatite are oriented with fold axes striking northwest and plunging to southeast. (Note: As of 12/30/70 road was in process of being straightened. In the future the road will pass through the migmatitic rocks.)

17.5 Intersection with Wood Road. To the north is brown-weathered quartz diorite within typical gray-weathered Bonsall Tonalite.

17.6 Road cut in red older alluvium covering buried Pliocene channel. The buried channel is essentially parallel to, and to the left of, the road.

18.1 Smooth hills to the north and south of road are underlain predominantly by pre-batholithic schist.

18.5 Lazy MC Ranch. To the southwest the upper surface of the flat topped hills is the Lakeview-Gavilan surface (2,100 feet of elevation).

18.7 Riverside County fire station.

19.5 On left are dissected Pleistocene fan deposits of red-brown alluvium overlying the buried channel.

20.9 For next several miles the road continues through dissected Pleistocene alluvium. View to the northeast of the Perris surface.

22.2 Water to north and northwest is MWD reservoir Lake Mathews (Cajalco Reservoir). San Gabriel Mountains on skyline to north.

23.2 Straight ahead on skyline is Santiago Peak, the highest point in the Santa Ana Mountains (5,687 feet) on the west side of the Elsinore fault zone.

23.8 Road veers to northwest leaving the Pliocene channel.

24.5 Altered quartz monzonite. This is the start of an extensive area of rock which has been silicified and tourmalinized.

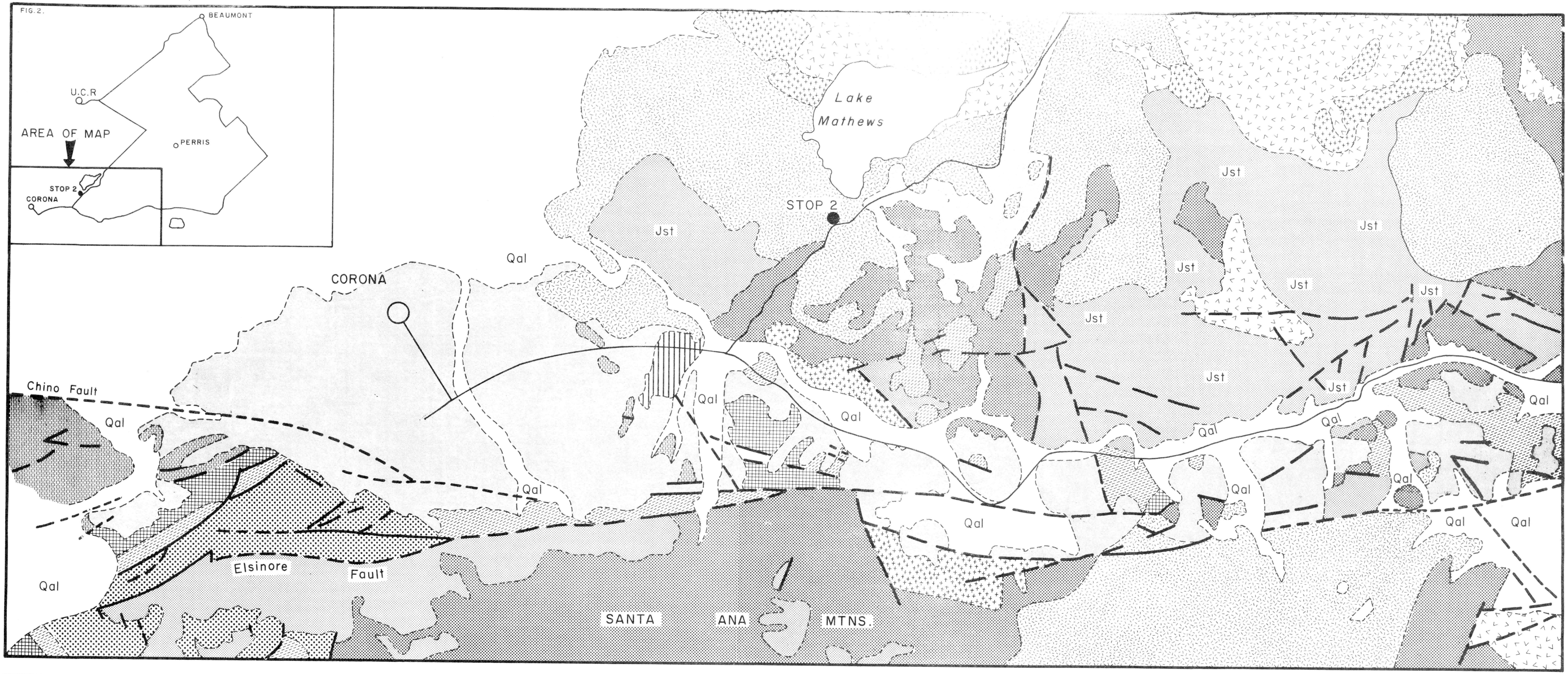
24.8 Small dark outcrops half a mile to the south (left) consist of quartz monzonite completely altered to silica-tourmaline rock termed tourmaline "blowouts." This tourmaline-silica rock is locally tin-bearing.

25.2 To right behind fence is prosptec for tin.

25.4 Dirt road to left leads to site of excavation just south of Cajalco Road that yielded Pliocene mammalian fauna (Proctor and Downs, 1963). At this point the channel turns to the north and extends to the reservoir.

26.0 Intersection of La Sierra Avenue and Cajalco Road; take left branch (Cajalco Road).

26.7 **Stop 2:** Park on shoulder and walk or take dirt road to right to low ridge just north of Cajalco Road (see Fig. 3). Rock is subporphyritic quartz monzonite which contains local "veins" of tourmalinized rock. Lake Mathews dam is to northeast at head of Cajalco Canyon. Numerous prospects to north and northeast explore tourmalinized rock for tin. Low, dark hill to north is Cajalco Hill, site of Cajalco (Temescal) tin mine. Tin was discovered in the area around 1853. The main mining activity was between 1869 and 1892, 1928-29, and 1942. The Cajalco mine, the only producer, had a total production of about 130 long tons of tin (Gray, 1957).



Symbol	Unit
Qal	Alluvium
	Older Alluvium (includes terrace deposits)
	Undifferentiated marine Pliocene and Puente Formation
	Topanga Formation
	Undifferentiated Vaqueros, Sespe and Santiago Formations
	Silverado Formation
	Ladd and Trabuco Formation
	Undifferentiated granitic rocks
	Quartz diorite (primarily Bonsall tonalite, quartz diorite of the Lakeview Mtns. pluton
	Gabbro and diorite
	Santiago Peak volcanics
Jst	Temescal Wash quartz latite porphyry
	Bedford Canyon Formation

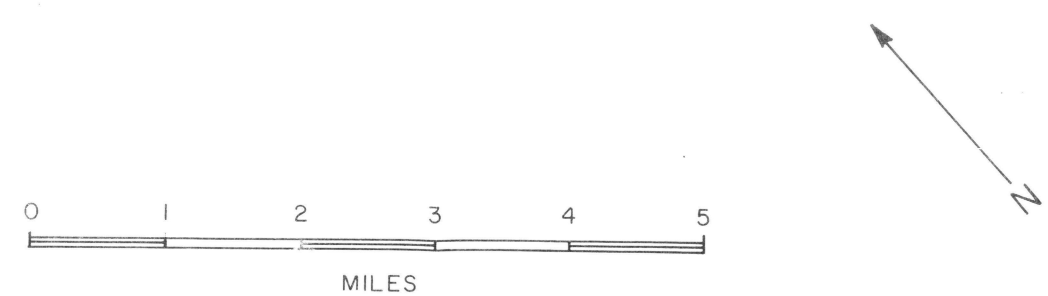


Fig. 3. GEOLOGY OF PART OF THE ELSINORE FAULT ZONE.

by

D. M. MORTON and G. H. GRAY.

1971

27.5 Dark colored tourmalinized rock on left in the road cut is in mixed granitic rock and Bedford Canyon Formation (?).

27.8 Road cut on left is in Bedford Canyon (?) rock. Here it is predominantly siliceous with some phyllite.

28.2 Elsinore trough (fault zone) straight ahead. From here to the trough the predominant rock type is Bedford Canyon Formation (?).

28.6 Quarry in red rock to left is mostly weathered Bedford Canyon Formation (?) with some sediments of the Silverado Formation.

29.0 Road cut in Pleistocene (?) older alluvium.

29.3 Road crosses Santa Fe tracks. Railroad cut to right is in Bedford Canyon Formation (?) overlain by terrace deposit.

29.6 Intersection Cajalco Road and Temescal Canyon Road. Turn right onto Temescal Canyon Road for Corona Skyline Drive side trip. Turn left on Temescal Canyon Road for continuation of trip.

CORONA SKYLINE DRIVE SIDE TRIP

(0.5) International Pipe & Ceramics Corporation, Corona Plant (Interpace) (formerly Gladding, McBean & Company). Produces red-burning heavy clay products (e.g. sewer pipe, drain tile, and conduit). Plant uses local clays and filler clays, mostly from Paleocene Silverado Formation.

(0.6) Brown- to dark-gray, sandy, older alluvium containing angular cobble clasts.

(0.8) El Cerrito Hills. Exposed on both sides of highway is white to buff and brown sandstone of the middle Miocene Topanga Formation. Some of the Topanga is buff and brown siltstone and shale; in places Topanga strata are diatomaceous.

(1.3) Temescal Canyon Road changes to Ontario Avenue. Ahead to right is operation of Minnesota Mining & Manufacturing Company. Large quarry is developed in Temescal Wash Quartz Latite Porphyry of probable Jurassic age. Rock is crushed, screened, and colored with a sub-vitreous, bonded, ceramic-type glaze and used as granules for roofing materials. This operation produces most of the granules used for processed roofing materials on the west coast; shipments are made as far north as Vancouver, British Columbia. This operation has been active since 1948, although the quarry, Temescal Rock Quarry, was opened and produced rock for macadamizing streets in Los Angeles and area in 1888. Quarry operation in the early 1920s was by tunnel or coyote system which brought down 600,000 to 1,500,000 tons of rock in each blast which used 45 to 125 tons of powder (Gray, 1961). Some of these large blasts in more recent years have been used by seismologists for refining seismic travel times (Richter, 1958).

(1.6) On north side of road are outcrops of granitic rocks (quartz monzonite and hornblende granodiorite porphyry).

(2.0) Is small road cut and along north side of highway is undifferentiated Puente Formation of upper Miocene age. In this area the Puente is mostly white to greenish-gray, thin-bedded, diatomaceous siltstone; some buff to gray siltstone and shale, and brown to buff sandstone, with local conglomerate lenses.

(2.2) Road crosses north end of short stretch of the Corona Freeway (State Highway 71) and joins Highway 71 (Ontario Avenue).

(4.4) Intersection with Main Street. Proceed ahead on Ontario Avenue. The nearby citrus acreage and the town of Corona are developed on a surface of Quaternary older alluvium, the Corona compound alluvial fan.

(5.4) Intersection of Ontario Avenue and Lincoln Avenue; turn left onto Lincoln Avenue.

(6.4) Turn right onto Chase Drive. To the west and south the break in slope in Quaternary older alluvium may be the surface expression of the Chino fault. Further southeast anomalous scarplets and benches in the older alluvium, as well as a definite scarp at the contact between Quaternary terrace deposits and older alluvium, apparently mark the trace of the Chino fault.

(6.8) Oak Avenue. Road cut at left in Quaternary older alluvium.

(7.0) Intersection Chase Drive and Skyline Drive; turn left (south) onto Skyline Drive.

(7.2) Cleveland National Forest Boundary sign and end of pavement. To left (east) is Paleocene Silverado Formation capped by flat-topped Quaternary terrace deposits. Terrace deposits here are at two different elevations that are attributed to erosion, rather than faulting.

(7.4) To left (east) Silverado sandstone and conglomerate capped by brown Quaternary terrace deposits along lower Hagador Canyon.

(7.6) Junction of Hagador and Tin Mine Canyons; keep right along Tin Mine Canyon.

(7.8) To right (north) is white to buff sandstone and conglomerate of the Silverado Formation.

(8.0) Northwest-striking fault along bare cliff faces juxtaposes upper Cretaceous Ladd Formation (Baker Canyon Conglomerate Member) and Paleocene Silverado Formation. Just to west is reef-type deposit in the Baker Canyon containing abundant oyster debris. Channel to left (Tin Mine Canyon bottom) contains boulders derived from the Ladd Formation (Baker Canyon Conglomerate Member) a short distance to the northwest on the brush-covered slope. These boulders contain numerous *Actaeonella oviformis* Gabb and are from a highly fossiliferous, generally hard, sandstone layer that crops out discontinuously over about one and a half miles from Tin Mine Canyon northwest to Mabey Canyon. In places this sandstone contains abundant *Trigonarca californica* Packard and other material that indicates a *Glycymeris pacificus* fauna.

(8.1) Draw on skyline to northwest (right) is contact between the Cretaceous Trabuco Formation (red, buff, and grayish-green massive conglomerate, minor sandstone, probably nonmarine) and Ladd Formation (Baker Canyon Conglomerate member).

(8.3) Road leaves canyon bottom and starts upgrade. Cars can be left here and the remaining trip (0.8 mile) made on foot, or there is a more narrow parking area 0.7 mile further on. Rock exposed in road cut is Jurassic Santiago Peak Volcanics—just west of the Elsinore fault.

(8.4) Road crosses the northwest-striking and steeply south-dipping Elsinore fault and passes back from Santiago Peak Volcanics into Trabuco Formation.

(9.1) Switchback. Turn around here (if driving). The switchback is essentially on the Elsinore fault which again separates Santiago Peak Volcanics on the west from Trabuco conglomerate (note clasts of weathered biotite granodiorite). The switchback is in Santiago Peak Volcanics and immediately below and above the switchback, the contact between the Santiago Peak Volcanics and Trabuco conglomerate can be seen. Up the road 0.1 mile, the fault zone is well exposed in the road cut. The switchback turn out provides a vantage point for a sweeping view of the general area to the south and east.

South across Tin Mine Canyon the bare scar high on the brush-covered slope is an old gypsum working (active in the 1920s) in altered Santiago Peak Volcanics. To the southeast (south side of Tin Mine Canyon) the Elsinore fault crosses the low, rounded, brush-covered landslide debris. Here the fault is at the break in slope between nearby flat-topped areas, which developed through landsliding, and Santiago Peak volcanics. The scars along this trace also are old gypsum prospects. Fault crosses the far ridge, with the line of eucalyptus trees, at the break in slope between this flat-topped ridge (Silverado Formation capped by Quaternary terrace deposit) and the abruptly rising, steep, brush-covered hills to the south (Santiago Peak Volcanics and Bedford Canyon Formation). Continuing to the southeast the Elsinore fault is essentially at the break in slope and separates the Silverado Formation from Santiago Peak Volcanics and Bedford Canyon Formation.

Below, in lower Tin Mine Canyon, the bare hill at left is sandstone of the Baker Canyon Conglomerate Member in fault contact with Silverado sandstone and siltstone. Brushy hills north of Skyline Drive and toward the observer are Cretaceous sandstone and conglomerate (Trabuco Formation and Baker Canyon Conglomerate Member).

Retrace route to intersection Cajalco Road and Temescal Road.

29.6 Proceed southeastward on Temescal Canyon Road.

30.0 Butterfield Stage Station Historical marker. Ahead is spoil bank from Owens-Illinois glass sand operation.

30.3 At left, under the two tanks, terrace deposits overlie Silverado Formation. To right is the glass sand pit of Owens-Illinois in essentially flat-lying Silverado. Farther to the right the freeway traffic is essentially along the contact between the Silverado and the overlying undifferentiated Sespe and Vaqueros Formations (upper Eocene to lower Miocene) which is also essentially flat lying. The Elsinore fault is located along the base of the high hills (Santa Ana Mountains) which are underlain predominantly by Jurassic Bedford Canyon Formation.

30.5 Owens-Illinois glass sand plant. This is the oldest continuously operating and principal source of silica sand in southern California. The sand is obtained from a quartz-rich facies of the Silverado. In the quarry some 120 feet of usable sandstone is exposed; well data, however, indicates locally the sandstone is nearly 300 feet thick. Yearly production exceeds 100,000 tons of finished sand, of both flint and amber, with some monthly production more than 20,000 tons. To left are silt-clay waste ponds from Owens-Illinois operations. This material has been used by several companies in the manufacture of clay products.

32.0 At left San Marcos Gabbro and Bedford Canyon Formation form the low part of the hills. Overlying the basement rocks are both residual clay deposits and Silverado Formation.

33.1 Temescal (Harrington and Atlas) clay pits are to the left (east). Both residual and sedimentary clays of the Silverado Formation are mined.

33.5 Stop Sign. Proceed southeastward on Highway 71.

33.7 To right is Mission Clay Products which produces sewer pipe. Hills to left are Quaternary terrace deposits capping clay deposits of residual clay derived from the Bedford Canyon and Silverado Formations.

33.9 Turn right onto Lawson-Hunt Road.

34.1 Terrace deposits on right. Sag pond to left developed on north branch of Glen Ivy fault, part of the Elsinore fault zone. The road follows along the trace of this fault with a southwest facing scarp.

34.6 Light colored sediments in road cut are probably part of the Silverado Formation brought up along the Glen Ivy fault.

34.7 Lawson Road-Hunt Road intersection. To the northwest the trace of the fault is marked by saddles and aligned gullies in several ridges. Retrace route along trace of Glen Ivy fault to Highway 71.

35.5 Rejoin Highway 71 and turn right.

35.7 Dense vegetation at right marks the position of the Glen Ivy fault.

36.0 Entrance to Glen Ivy Resort. The south branch of the Glen Ivy fault goes through the resort but its trace is masked by recent alluvial deposits.

36.5 To the left are Holocene terrace deposits.

37.0 Santa Fe Railroad underpass. Hill straight ahead (Estelle Mountain) underlain by intermediate composition batholith rock and Temescal Wash Quartz Latite Porphyry.

37.3 Steep walled gorge ahead is superposed meander of Temescal Wash. The stream is believed to have cut a cover of sedimentary rocks which formerly filled the valley (Dudley, 1936).

38.0 Highway 71 ascends terrace deposits which cover fossiliferous Silverado Formation. The obvious break in slope paralleling and just to the left of the road is a modified fault scarp. Rock on the east side of fault is the Temescal Wash Quartz Latite Porphyry.

38.6 Highway 71 crosses fault separating Silverado Formation from Temescal Wash Quartz Latite Porphyry.

38.9 Upper end of the superposed drainage.

39.0 South end of Lee Lake, a reservoir for Temescal Water Company. This is a good vantage point from which to view the steep walled gorge. To the southwest terrace deposits cap Silverado Formation beyond the railroad tracks.

39.4 Dissected alluvial fan deposits capping Silverado Formation.

41.0 Alberhill turnoff.

41.7 Santiago Peak volcanics (Jurassic age) are exposed in road cut on left. To the right is the operation of Pacific Clay Products and the community of Alberhill which developed around the clay mining industry. The clay deposits in the Alberhill area are of both residual and sedimentary origin and are restricted to a zone within (or just below) the Paleocene Silverado Formation. Residual clay deposits, which attain a thickness of 130 feet, have been developed from the Bedford Canyon Formation, Santiago Peak Volcanics, Temescal Wash Quartz Latite Porphyry and dioritic-gabbroic rocks. The sedimentary clay is the product of local erosion of the clay which developed on the weathered basement. Sedimentary clay averages 80 feet in thickness with a maximum of about 150 feet. Two main types of clay products are produced: red burning clay is used to make heavy clay products (e.g., brick, sewer pipe and tile); white burning clay is used to produce refractory clay products (e.g., firebrick and flue lining material). In the early 1880s both coal and clay were mined at Alberhill. Mining at the time was by underground methods. The coal, lignite, was of low grade and soon constituted only a nuisance to clay mining. Between 1895 and 1955 almost six million tons of clay had been mined in the Alberhill area. By 1955 as much as 800 tons of clay was being mined each day (Engel *et al.,* 1959, pp. 77-97).

42.7 Hill to right is Bedford Canyon Formation overlain by Silverado Formation which is in turn covered by Quaternary terrace deposits and dumps from the clay mining. The road follows Walker Canyon which is apparently a superposed drainage.

45.2 Elsinore City limits.

45.3 Exposures of Bedford Canyon Formation.

45.8 Closed depression to right of highway. At this site earlier (1926) was a fissure at least an eighth of a mile in length which later formed a trench in places more than ten feet deep and averaging two or three feet in width. According to local residents this feature developed at the time of the 1918 San Jacinto earthquake (Engel, 1959, p. 52).

46.1 State Park turnoff. The broad valley to the right is underlain by Silverado Formation.

46.9 Junction with Highway 74. Low hills ahead and to left are underlain mostly by rocks presumed to be equivalent to Bedford Canyon Formation. To the right on the west side of the low hills is trace of the Glen Ivy fault.

48.1 Turnoff to downtown Elsinore and San Juan Capistrano.

48.4 Boulders of dioritic rock to left.

48.8 Hills straight ahead on skyline are at the northern end of the Paloma Valley ring-complex.

50.0 Railroad Canyon Road. At this point the San Jacinto River enters the Elsinore

Valley (trough) from the Perris block. The Elsinore trough here constitutes a closed depression and is filled by ephemeral Lake Elsinore. In historic times only during a few prolonged periods of wet years, the last being 1916-17, has the lake overflowed entering Temescal Wash which drains northward to Santa Ana Canyon and ultimately the Pacific Ocean. A recent gravity investigation indicates the valley to be underlain by four to 8,000 feet of sediments (Ghaeni, 1967).

51.0 Road cuts in old dissected alluvial fan.

51.8 To the right in the Elsinore trough is a low hill, Rome Hill, which is bounded on both sides by faults of the Elsinore fault zone. The fault on the north is generally termed the Wildomar fault, the fault to the west, the Willard fault, the frontal fault of the Santa Ana Range in this area.

53.1 Turn left onto Bundy Canyon Road. On the skyline to the northeast is a contact between San Marcos Gabbro to the right, which constitutes the interior rock of the Paloma Valley ring-complex, and granodiorite to the left, which is the outer part of the Paloma Valley ring-complex. Immediate hills on both sides of the road are granodiorite of the Paloma Valley ring-complex which contain blocks of gabbro. This composite ring-complex consists of an older, singular ring-dike, with two subsidiary shorter-arc inner dikes; and a younger set of thin, shorter-arced dikes, largely inside the older ring-dike. The older ring-dike is granodiorite (Woodson Mountain Granodiorite of Larsen, 1948), has nearly vertical walls, and is elliptical in plan with its long axis (nine miles) oriented west-northwest. This dike was emplaced in, and contains numerous inclusions of, gabbro. Largely within the older ring-dike are more than 200 younger, shorter-arced dikes, half a foot to three feet thick. These dikes, of granitic composition, define a ring-structure which cuts older-dike rock as well as gabbro. The structure is of a classical form with moderately- to steeply-dipping margins and a horizontal center. Spatially associated with the younger dikes are a number of bodies of fine-grained granophyre. The older ring-dike appears to have resulted from vertical ring-fracturing and emplacement by magmatic stopping. Granitic magma was emplaced along a younger set of domal ring-fractures. Granophyre resulted from "pressure quenching" of part of the magma which formed the younger ring-dike (after Morton and Baird, 1971).

53.7 Decomposed granite quarry with gabbro blocks within granodiorite.

54.0 Contact of the inner side of the ring-dike (granodiorite to gabbro).

54.5 Hills ahead and to right are underlain by gabbro which is intruded by granitic dikes which form an annular pattern.

55.0 Bundy Canyon Road reaches the Perris surface. The red-brown soil is characteristic of decomposed gabbro.

55.5 Granitic dikes of the ring-dike in gabbro.

55.8 To the north is the contact between gabbro and older ring-dike rock.

56.0 To the north (left) is an exposure of a finger of metamorphic rock which interrupts the otherwise continuous outer ring-dike. Note that the metamorphic rock weathers similarly to the gabbro giving rise to smooth slopes devoid of prominent outcrops.

56.6 Road cut in San Marcos Gabbro.

57.3 At this point contact between gabbro and outer ring-dike rock is just north of the road.

57.5 Intersection with Murietta Road. Exposed in road cut to left is migmatitic rock consisting of gabbro partly digested by ring-dike rock. This is essentially at the contact of the gabbro and ring-dike.

57.8 Bundy Canyon Road crosses back into the ring-dike (granodiorite) which here strikes northwest. Hill on skyline to the south (right) is at the structural center of the ring-dike complex. Top of hill is a body of granophyre.

58.1 **Stop 3:** Road cut in weathered San Marcos Gabbro with kernels of fresh rock.

59.8 Intersection with US 395. Continue straight across and continue east on Scott Road.

59.9 Boulders of ring-dike rock protrude above valley floor (Paloma surface of Woodford *et al.*, 1971).

60.6 Northeast end of Paloma ring-dike complex.

61.8 **Stop 4:** Intersection of Scott Road and Briggs Road. The road cut is in phyllitic quartz-rich metamorphic rock correlated with Bedford Canyon Formation. Hills to the left, underlain by phyllite and slate, contain a few gold-bearing quartz veins. Small building at the base of the hill is the Leon gold mine.

62.3 Hills to right are underlain by San Marcos Gabbro.

63.0 Road crosses contact between San Marcos Gabbro and granodiorite of the Domenigoni Valley pluton. The discontinuously exposed Domenigoni Valley pluton is elliptical in plan (4 x 8 miles) and oriented slightly west of north; similar rock occurs west of the pluton. The pluton invades country rock of the Bedford Canyon and French Valley Formations. The pluton, partly discordant and partly concordant, is composed of homogeneous appearing granodiorite-quartz diorite. In all but its southernmost part the plutonic rock is massive,and contains abundant unoriented inclusions. In its southernmost part the pluton is faintly foliated and contains inclusions parallel to the margin of the pluton. Two relatively consistent, steeply-dipping joint sets are present; one strikes northeast, the other northwest. A dike swarm, principally of quartz latite composition, occurs in the northwest-striking joint set. Most of the dike rock is porphyritic with a foliated structure and with a lineation produced by micaceous streaks and oriented hornblende and plagioclase crystals, on S-surfaces of the foliated rock. This lineation is strikingly consistent in orientation; it trends southeast and plunges at moderate angles to the southeast. Field evidence suggests most of the pluton was passively emplaced. Movement within quartz latite dikes after they were largely crystallized produced cataclastic texture (after Morton, unpublished mapping, 1970).

64.4 To the left is outcrop of resistant foliated quartz latite dike rock in granodiorite.

64.8 Hills on skyline to east are underlain by metasedimentary rocks of the French Valley Formation (Schwarcz, 1969).

65.0 Intersection with Winchester Road. Turn left.

65.8 Skyline to west and north is underlain by Domenigoni Valley pluton rock cut by abundant foliated quartz latite dikes.

67.0 Ahead and to left are wall-like masses of resistant quartz latite.

67.6 **Stop 5:** Road cut affords excellent exposure of granodiorite cut by foliated quartz latite dikes.

67.8 To right at base of low hills is seen the contact between the pluton and the French Valley Formation.

68.4 Road cut shows typical rock of the pluton with abundant unoriented equidimensional dark inclusions.

68.6 To the east on the far hillside is the open pit working of the old Winchester magnesite mine developed in a metaserpentine body.

68.8 Hills on skyline ahead are underlain by French Valley Formation and cut by granitic dikes. To the northwest is the contact between the Domenigoni pluton to the west, and French Valley Formation rocks to the east.

69.6 Downtown Winchester.

70.3 **Stop 6:** Cordierite-bearing biotite schist of the French Valley Formation.

71.1 Hills to right are underlain by San Marcos Gabbro which is here primarily olivine gabbro. Bouldery hills straight ahead are part of the Lakeview Mountains pluton.

71.8 Low hills to right are quartz diorite and migmatitic quartz dioritic rock that surround the Lakeview Mountains pluton.

72.2 Intersection with Highway 74. Turn left.

72.6 Workings on hill to right are feldspar-quartz prospects in pegmatite dikes in the Lakeview Mountains pluton.

73.0 Road cuts in foliated quartz dioritic rock.

73.5 **Stop 7:** Exposures of foliated quartz dioritic and migmatitic rock.

74.5 Turn right onto Juniper Flats Road.

75.1 Cross contact between foliated quartz dioritic rock and Lakeview Mountains pluton.

75.6 **Stop 8:** Outcrops to left contain abundant schlieren which are characteristic of rock of the Lakeview Mountains pluton. This pluton is a steep-walled body tear-shaped in ground plan, exposed discontinuously over an area of 60-80 square miles. Located at an abrupt local deflection of the northwest-striking regional grain, it is concordant with the enclosing rocks, which consist of varied granitic and mixed granitic-metamorphic rocks. The pluton is almost entirely coarse-grained hornblende-biotite-quartz diorite that lacks potassium feldspar. Schlieren are ubiquitous, as are lenticular inclusions, which parallel the schlieren. Schlieren, which impart to the rock an extreme small-scale mineralogic heterogeneity, geometrically fall into three orientation groups with the most pronounced concordant to the outline of the body. The other two groups, which are discordant, strike northwest and northeast. Granitic pegmatite dikes, hypersthene gabbro masses, and both mafic and leucocratic quartz diorite are concentrated in the geometrically and structurally deduced center of the pluton. It is believed the pluton was emplaced forcefully producing the deflection in the regional grain. The pegmatite dikes represent the fugitive constituents of the pluton-forming magma and their concentation in the center of the pluton marks the last part of the pluton to crystallize. An extensive chemical study shows the pluton is highly homogeneous on a large scale and extremely heterogeneous on a small scale. However, a weak, but consistent, zonational chemical pattern parallels the walls of the pluton. This zonation shows the pluton has a relatively basic and dense core and implies the last rock to crystallize was more basic than rock formed earlier (after Morton, 1969; Morton *et al.,* 1969).

75.9 Quarry in partly decomposed quartz diorite. Note the numerous schlieren.

76.5 Road reaches the 2,100 ft. Lakeview-Gavilan surface.

76.9 Thin veneer of gray bedded sediments on Lakeview-Gavilan surface.

77.8 Turn left.

78.0 Flat skyline to west and east are remnants of a 2,500 foot surface (Magee surface of Woodford *et al.,* 1971). To the north is seen a continuation of the Lakeview-Gavilan surface.

78.2 Road cut in typical rock of the pluton with abundant schlieren. Northward towards the center of the pluton granitic pegmatite dikes become common to abundant.

79.3 To the northeast is a good view of the Lakeview-Gavilan surface.

80.1 Road cut in old red alluvium.

81.4 Low hills on skyline straight ahead are the northwest part of the Lakeview Mountains pluton. Higher hills, Bernasconi Hills, are underlain by a variety of granitic rock and schist.

81.9 Turn right onto Hansen Avenue.

84.0 Community of Lakeview. Turn right onto Ramona Expressway.

84.2 Hill to the left is schist of unknown age intruded by quartz diorite. Straight ahead the higher hills are mostly metamorphic rock and the lower hills, the San Timoteo Badlands, Pliocene-Pleistocene sediments. The San Jacinto fault bounds these hills on the southwest.

86.7 In the small canyon to the south is located the contact between the Lakeview Mountains pluton to the west and foliated granitic rocks to the east.

88.0 Line of cottonwood trees to the left marks the Casa Loma fault. An 8,000-foot deep sediment-filled graben is located between the Casa Loma fault and the San Jacinto fault (Fett, 1968).

89.0 Low hill to the left, Casa Loma Hill, is a tectonically produced feature along the Casa Loma fault (Proctor, 1962).

89.5 Road crosses Casa Loma fault scarp.

89.8 West side of the high hills ahead is the modified fault scarp of the San Jacinto fault. These hills are covered by extensive landslide deposits.

91.2 Turn left onto Sanderson Avenue.

92.1 San Jacinto River.

92.9 Road crosses San Jacinto fault. Note fault scarp which produced southwest-facing break-in-slope in alluvium to northwest.

93.1 The road crosses the Gilman Springs Road. Continue straight ahead on Highway 79 (Lamb Canyon Road) entering the Badlands.

93.2 Road cut in coarse clastic red beds of Pliocene age.

93.9 **Stop 9:** Road cut affords excellent view of a minor reverse fault. Here schist of unknown age has been thrust over Pliocene red beds.

94.0 Depositional contact of red beds over gneiss. The road for a short distance to the north skirts this depositional contact.

94.3 Road cut in schist.

94.7 **Stop 10:** To the right is schist and marble of unknown age. Just north of the road is a depositional contact between these rocks and Pliocene sediments. The Pliocene sediments contain lenticular beds of monolithologic conglomerate with clasts of quartz diorite as much as 20 feet in diameter.

95.1 To left are beds of boulder conglomerate.

95.4 Prominent red bed to the left is the approximate top of the red beds in this sequence. Above this marker unit gray to tan, finer grained clastic rocks predominate.

97.0 Bouldery hill to the north is quartz diorite. Lithologically it is the same as the clasts in the conglomerate to the south and may have been the source for the clasts.

97.7 Contact between sediments and quartz diorite.

97.9 Contact between quartz diorite and sediments.

98.4 Contact between Pliocene-Pleistocene sediments and Pleistocene red alluvium.

98.8 Road cut in red alluvium. Straight ahead on the skyline is San Gorgonio Peak—high point of the San Bernardino Mountains, 11,502 feet.

99.7 Southern Pacific Railroad and the town of Beaumont.

99.9 Left turn onto Interstate Highway 10 towards Los Angeles. Enter left lanes to take Highway 60 to Riverside.

100.7 Take Highway 60 west towards Riverside.

102.3 Road cuts in red alluvium.

103.1 Road crosses contact back into Pleistocene sediments.

103.4 Jack Rabbit Trail turnoff.

103.8 Terrace deposits to the right are of old red alluvium.

104.5 Recent terraces to the right have been cut by San Timoteo stream.

105.2 Re-enter San Timoteo Badlands. Highway is essentially normal to the length of the Badlands and predominant structure which, in a gross form, is a northwest-trending anticline.

106.2 Eastward-dipping coarse clastic Pliocene-Pleistocene sediments.

107.7 Westward-dipping Pliocene-Pleistocene sediments on the south flank of the anticline.

109.4 Hemet—San Jacinto turnoff.

110.1 Highway crosses San Jacinto fault.

110.4 Smooth-topped hills to the northwest are underlain by quartz diorite and separated from the Badlands to the east by the San Jacinto fault.

115.0 To the northeast is Pigeon Pass Valley. Exposed on both sides are rocks of the Box Springs complex. Note the eastward dip of the rocks on the west side of the valley and the westward dip of the rocks on the east side.

119.2 San Diego turnoff onto US 395.

119.5 Junction with US 395.

122.6 University Avenue turnoff. Bear to the right to return to Ramada Inn.

123.8 Parking Lot, Ramada Inn, Riverside. End of trip.

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Prado Dam
Santa Ana River near Junction of State Highways 71 and 91
Corona Vicinity
Riverside County
California

HAER No. CA-178

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

Historic American Engineering Record
National Park Service
Western Region
Department of the Interior
San Francisco, California 94107

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HISTORIC AMERICAN ENGINEERING RECORD

PRADO DAM

HAER No. CA-178

Location: North of Santa Ana River, northeast of the Junction of State Highways 71 and 91
Corona Vicinity
Riverside County, California

U.S.G.S. 7.5. minute Prado Dam, California, quadrangle
Universal Transverse Mercator coordinates: 3749880 441760

Date of Construction: 1938-1941

Engineer: Major Theodore Wyman, Jr., U. S. District Engineer
U. S. Army Corps of Engineers

Builder: W. E. Callahan Construction Company, Los Angeles, California

Present Owner: U. S. Army Corps of Engineers, Los Angeles District

Present Use: Flood control, water conservation, recreation

Significance: The construction of Prado Dam was a significant event in the history of flood control in southern California and specifically Orange County. The Dam has played a vital role in the economies and development of Orange, Riverside, and San Bernardino counties. Prado Dam is a distinctive and recognizable representative of its type, period, and method of construction, of worthy design and retaining unusual integrity. At the time of its construction it was the largest earthen dam in the United States. The attention to architectural detail, particularly the control house and control tower, demonstrates that government structures can be aesthetically pleasing and simple at the same time.

Report Prepared by: Roger Hatheway, Mark Swanson, Dana Slawson
Greenwood and Associates
725 Jacon Way
Pacific Palisades, California 90272

David DeVries
Mesa Technical
2630 Hilgard
Berkeley, California 94709-1002

Date: June 1996

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1. INTRODUCTION

Prado Dam is an integral part of one of the largest flood-control projects in southern California. Begun under the auspices of the Orange County Flood Control District in the late 1930s, the dam was finished by the U.S. Army Corps of Engineers, Los Angeles District, which has maintained and operated the structure since its construction. Prado Dam is located on the Santa Ana River in the southwest corner of Riverside County, about three miles north of the Orange County line.

Behind the dam the flood basin, which includes all lands below the present 556-foot above sea level taking line, covers 9741 acres of prime agricultural land in Riverside and San Bernardino counties. Sixty-eight percent of this land is now owned directly by the Federal government; most of the remainder is currently owned by the Orange County Water District, which manages the land solely for water conservation in Orange County (U. S. Army Corps of Engineers [CoE] 1988a).

Following decades of discussion, controversies about its location and primary purpose, and spurred finally by the flood of 1938, Prado Dam was completed in 1941, on schedule and without untoward incident. Since its dedication, it has served its objective of flood control, thereby contributing to the rapid development and urbanization of Orange County. The dam was the largest single component in the flood control system for Orange County, and remains the second largest earthen dam in southern California. It has served its purpose well, even though modifications will be needed. The statement that the design and engineering were essentially simple should not be taken as a critical assessment. It is, perhaps, the major reason why the existing facility has performed so well over the years and remains in good to excellent operating condition, as well as demonstrating architectural integrity.

The facilities maintain their architectural integrity and are well maintained, without modification or intrusion. Even the operating mechanisms are original; the generator has been replaced, but all of the other equipment is otherwise original, even down to the hand-lettered signs on the control panel inside the control tower. Even though the design is relatively simple, there were explicit efforts made to achieve a pleasing architectural result. The most unique element is the concrete tower and control house. The tower was designed in an unusual open-frame style, with a self-contained control house above. The band of recessed dentation below the roof subtly repeats the arches between the concrete pillars, and is interrupted only by the simple, embossed letters which identify the facility. The pillars taper toward the top, embellished with corner recesses which contribute to the shadow pattern. What might otherwise present a rather stark elevation is relieved by these design details created with incised and cast concrete, and the recessed entrance and windows.

There is little visible change other than the removal of the caretaker's house and addition of maintenance roads, both away from the dam or its immediate setting. The closing of the conduits in 1971 marked only a change in function and operations, in that the flow of water is now regulated at gate level, reflecting a secondary role in water conservation.

The construction of Prado Dam was a landmark event in the history of flood control in Orange County and southern California. The original design was well planned and executed, even if not particularly innovative. Construction was completed in a timely and orderly manner, and all difficulties or contingencies were addressed by Change Orders managed by the CoE and implemented by the contractors. What was prophetic for the future was the realization of the need for broad, regional planning (i.e., that problems like flood control or water conservation could no longer be addressed only within - or by - a politically or geographically defined unit such as a single county). As exemplified by Prado Dam, the major benefits were to Orange County, although the natural resource originated outside its borders. As a result, the solution was constructed in Riverside County, Orange County became an important landowner and holder of water rights in San Bernardino, and the functioning of the dam became of increasing concern throughout the region. It has played a pivotal role not only in downstream development but in the economy of all three counties. The construction displaced a whole town (Rincon/Prado) and many other rural residents in the basin; affected the dairy industry, ranching, and agriculture; caused the relocation of highways and a railroad; and contributed to biotic changes as a result of the higher water table behind the dam. Losses to the local tax base have been partially offset by leasing and recreational opportunities for the public.

Prado Dam is a significant cultural resource eligible to the National Register of Historic Places. There is no question that it possesses integrity of location, design, setting, materials, workmanship, feeling, and association. It meets Criterion A, association with events which have contributed to broad patterns of history, in its direct effects on the lives and economies of three counties and as an early example of regional planning for flood control and water conservation which has influenced subsequent projects. No claim is made that the engineers, politicians, landowners, or others directly associated with the dam are individually significant (Criterion B), although each played an important role in facilitating the construction. Under Criterion C, the structure is a distinctive and recognizable representative of its type, period, and method of construction, of worthy design and retaining unusual integrity. The attention to architectural detail demonstrates that government structures can be aesthetically pleasing and simple at the same time. The research conducted has already yielded a wealth of historical information (Criterion D); it is possible that additional data may exist below the surface in the areas occupied by construction yards, shops, or workers' housing.

The only "flaw" in the design of Prado Dam was probably unavoidable: the planners did not foresee the incredible rate of growth and development that was to take place in southern California from the end of World War II to the present. And, largely as a result of this, the dam has been put to a use (water conservation) for which it was not originally designed. The managers of Prado Dam are not alone in having to cope with unanticipated development pressures, but are joined with countless planners, engineers, public agencies, developers, and scientists in adapting or modifying older technologies to newer needs. With the improvements being contemplated, Prado Dam can again fulfill its authorized function of flood control, protecting life and property in Orange County, and add the more contemporary objective of water conservation, to the benefits of all southern California.

This document summarizes the beginnings of flood control along the Santa Ana River, and outlines the various plans and proposals for dam construction along the Santa Ana - plans that eventually led to the construction of the present Prado Dam and the reservoir area behind it. With its promise of comprehensive flood control, Prado Dam has in effect permitted the phenomenal growth of Orange County, first as a center of the citrus industry and finally as an urban conglomerate spread across the Santa Ana River floodplain.

Flood control, however, is only part of the story. Even in the planning stage, Prado Dam was the focus of an on-going controversy between the often conflicting interests of flood control and water conservation, a controversy that has become more, not less, acute since the dam was constructed. Officially built solely for flood control, the dam was quickly embroiled in long-standing controversies over water rights and water use along the Santa Ana. Prado Dam, situated between Orange County downstream and Riverside and San Bernardino counties upstream, has been the fulcrum in a see-saw war between two areas increasingly desperate for water.

Sources of Information

Research was conducted by Swanson and Hatheway (1989) and Dana N. Slawson at the following major repositories of information:

Federal Records Center, Laguna Niguel
University of California at Los Angeles, University Research Library
University of Southern Califomia, Watt Library
Santa Ana Public Library
U. S. Army Corps of Engineers, Real Property Records and Map Room
Sleeper Collection (private papers and newspaper files).

Of these, the Federal Records Center provided the most critical infonnation about the design and construction of the dam. The archives included a copy of the original Invitation to Bid, the various Change Orders issued by the District Engineer during construction, miscellaneous correspondence, and a series of photographs in the quarterly reports documenting the progress.

The next most important technical resource was the *Southwest Builder and Contractor*, a trade journal which carried all construction and building news in southem Califomia from the late nineteenth century to the mid 1960s. This series is available in hard copy at the Watt Architectural Library and on microfilm at UCLA.

The Santa Ana Public Library contains a large collection of general information regarding flood control in Orange County. The CoE's Real Property Records, plans, and other files were consulted to check for any details not available at Laguna Nigel. Finally, Jim Sleeper, Orange County historian, provided access to his extensive clippings and files as a consultant.

The information gathered at these repositories, added to more general sources, provided sufficient data to compile a chronological and history of the planning of the Prado Dam, a detailed account of the bidding and construction process, and a description of the operations and architecture of the structures.

Project Setting

The Prado Dam was built to contain major floods along the Santa Ana River and its tributaries, which drain a watershed of almost 2500 square miles in San Bemardino, Riverside, and Orange counties (Prado Dam 1971:1; Scott 1982:15). The Santa Ana is the longest and largest river in southern California, and has its origin in the San Bernardino Mountains in the run-off from slopes which rise more than 11,000 feet (Figure 1.1). From this point, the river courses 100 miles in a southwesterly direction on its way to the Pacific Ocean (Post 1928:31).

En route to the sea, the river passes through two constrictions, both named Santa Ana Canyon. The Upper Santa Ana Canyon is located between the high mountain valleys where the river begins, and the plain far below formed by the San Bernardino Valley. The Lower Santa Ana Canyon is located about 30 miles from the sea and is formed by the Puente Hills to the northwest and the Santa Ana Mountains to the southeast (Figure 1.1). Unless otherwise identified, the Santa Ana Canyon in this report will refer to the lower of the two constrictions.

FIGURE NOT AVAILABLE

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Figure 1.1. Santa Ana River Watershed. After Post 1928: Plate 1.

The Lower Santa Ana Canyon is a gorge approximately 12 miles long, divided between Riverside County to the northeast and Orange County to the southwest (Bailey 1940:3). Just before reaching this constriction, the river is joined by all of its major tributaries -- Temescal Wash, Cucamonga Creek, San Antonio Creek, Mill Creek, and Chino Creek. It is this confluence that forms the Prado Basin.

After the river leaves the basin and the canyon, it enters the coastal plain for its final 21-mile run to the river's mouth, now permanently channeled between Huntington Beach and Newport Beach. Before being stabilized, the river channel on the coastal plain was often poorly defined and the potential for flooding was high.

The Santa Ana River floodplain in Orange County covers at least 170 square miles, and encompasses the communities of Anaheim, Orange, Fullerton, Buena Park, La Palma, Cypress, Stanton, Garden Grove, Westminster, Santa Ana, Fountain Valley, Los Alamitos, Costa Mesa, Huntington Beach, and Seal Beach (Prado Dam 1971:1). These communities constitute the very heart of Orange County, and as they have grown, county authorities have left no stone untumed in securing adequate flood protection. Orange County has always been in the forefront of the struggle to control and harness the Santa Ana. It is thus ironic that the most feasible place to control the river flood is in the Prado Basin, at the upstream end of the Lower Santa Ana Canyon, located in Riverside County.

Prado Basin owes its existence to an active fault line. The Lower Santa Ana Canyon is formed by the Puente Hills and the Santa Ana Mountains. Both ridges are part of a single uplift along the Chino-Elsinore Fault that occurred at the close of the Tertiary and beginning of the Quatemary periods (Figure 1.2). The Santa Ana River, an "antecedent stream," was not displaced as the land rose because it was able to cut through the uplift (Post 1928:242-47). Both the Puente Hills and the Santa Ana Mountains consist of generally water-tight sandstones and shales of Tertiary age. From a base of around 500 feet above sea level, the Puente Hills rise to a height to 1800 feet; the Santa Ana Mountains are much higher, rising to over 5000 feet. The Chino-Elsinore fault line runs along the northeast edge of these mountains, almost directly under the Temescal Wash and Chino Creek. Upthrust and fault lines have helped define the Prado Basin, an extensive low-lying area drained by the Santa Ana and its tributaries before the river passes through the Lower Santa Ana Canyon (CoE 1938c:13-15; Means 1942:10-12).

Prado Basin consists of gently sloping river hottom land, approximately two miles square, bordered by the Puente Hills to the west and the Santa Ana Mountains to the south. To the north and east, the boundaries of the basin are less well-defined, but are generally formed by an irregular rim rising between 30 and 60 feet above the basin, often broken by spring-fed recessions along the edge of the rim. The basin itself is lined with sandy deposits that range in depth between 50 and 100 feet below surface, resting on a water-impervious base of sandstone or shale (Means 1942:10-12).

Local Hydrology

The Santa Ana is a river of extremes, flowing full after winter rains and running almost dry in summer. The seasonal flow is directly related to the semi-arid climate of southern California, with its winter rainy season and virtual drought at other times of the year (Scott 1982:16). The winter rains, which fall anytime between November and March, account for at least 75 percent of the total rainfall in the Santa Ana drainage (U. S. Department of Agriculture 1938). Precipitation is particularly heavy in the San Bernardino Mountains, where the Santa Ana originates in the pine forests of the intemontaine valleys. There, rainfall can average as much as 40 inches per year. In the San Bernardino Valley below, rainfall is much less, averaging about 12 inches per year.

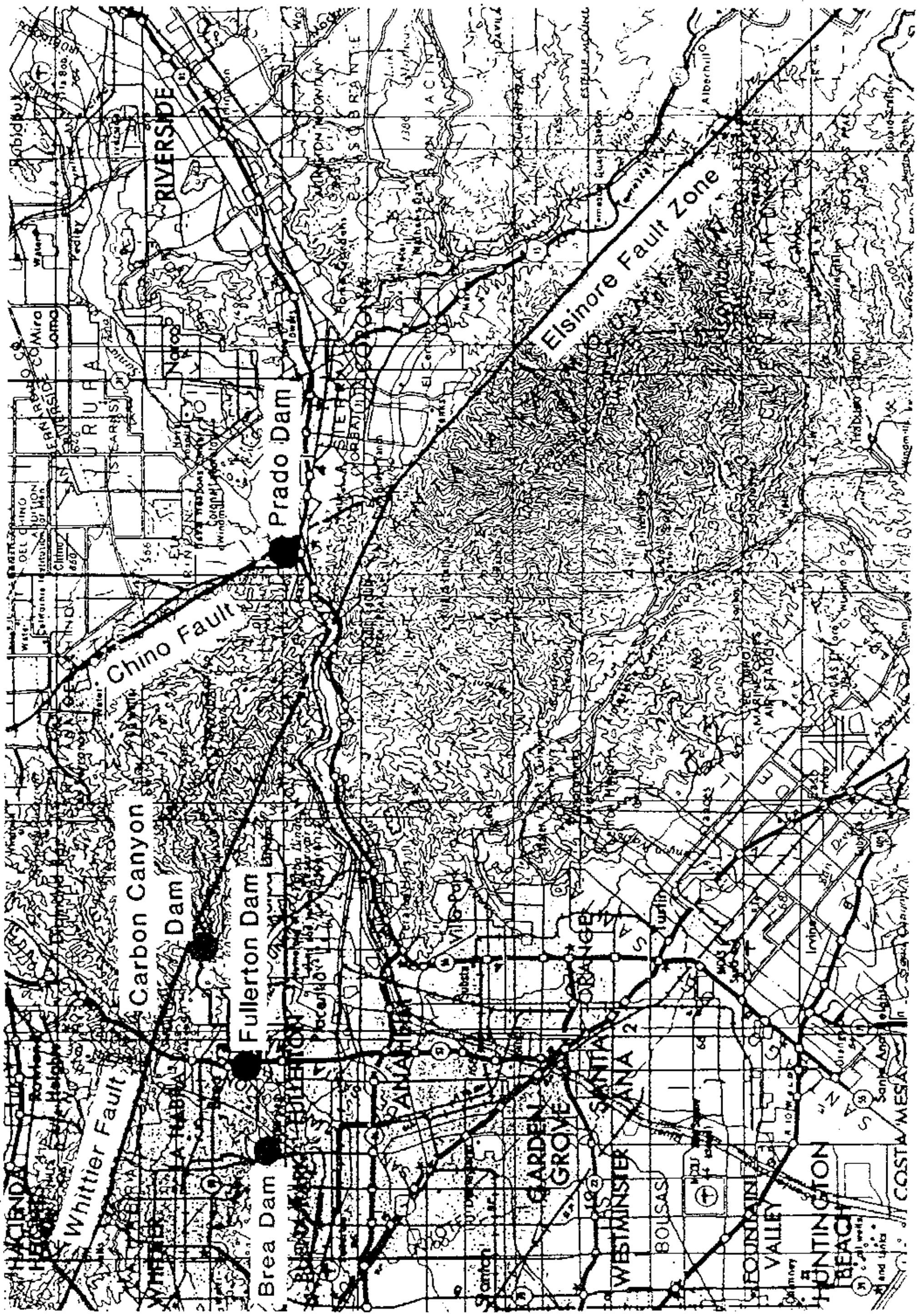

Figure 1.2. Active Fault Lines in Prado Basin (After Analysis of Design 1938: Plate 5)

The low level of precipitation and lack of summer rain limits the vegetation that can grow in much of the project area. The chaparral found below the mountain valleys is not capable of soaking up much water. Even this cover is often reduced by summer fires that leave the ground denuded. Historically, the Santa Ana did not even flow to the sea in summer, losing all of its water to evaporation, plant transpiration along the river banks, and percolation through the soil (Blaney et al. 1930:19). As a result, the river channel on the coastal plain has always been vague and subject to braided flow. Particularly heavy rainfall under these conditions often resulted in a flood, characterized by a wall of water in the mountain canyons, and widespread inundation in the low areas. At such times, the coastal plain, from Newport Beach to the mouth of the San Gabriel River, was subject to flooding (U. S. Department of Agriculture 1938).

The watershed of the Prado Basin, located above the Lower Santa Ana Canyon, contains the upper two-thirds of the Santa Ana watershed, an area of about 1460 square miles. About half of this area is located in the mountains, where water percolation tends to be limited. The other half is on the main valley floor, which consists of vast deposits of sand and gravel. The percolation potential of the valley floor is great (Post 1928:31). This area stores most of the water that eventually forms the Santa Ana River in the Prado Basin.

All moisture that falls on the San Bernardino Mountains or in the upper Santa Ana River valley has to escape to the sea through the Prado Basin and the Lower Santa Ana Canyon, either in the Santa Ana River itself or as part of the underground flow that percolates through the pervious sand and gravel deposits above the shale and sandstone bedrock. Because of this constriction, underground water flow in the San Bernardino Valley, especially from the sandy Cucamonga basin (also known as the Chino Basin; Conkling 1930a:10), is forced close to the surface as it enters the Prado Basin. This augments the surface flow of the Santa Ana River as everything squeezes through the lower canyon (Elliott et al. 1931:34).

As a result of this accumulation, the Prado Basin is far wetter than most areas either upstream or below. The increased moisture can support a luxuriant plant community of willows, tules, brush, trees, and grasses. This underground flow is generally found between 3 and 8 feet below the surface of the basin, with depth depending on distance from the nearest stream and the time of year (Elliott et al. 1931:37). The underground flow from the Cucamonga basin is actually sufficient to create a stream, Mill Creek, which is constantly fed by springs just north of Prado Basin. In 1931, it was noted that Mill Creek was backed up by an earthen dam between 4 and 6 feet high at a point where the stream left the bluff line to enter the basin. The stream flow behind the dam was sufficient to flood a 40-acre area (Elliott et al. 1931:37).

All of this water, forced together at the canyon, is of vital importance to the groundwater supply of the coastal plain. Here, the local rainfall, averaging less than 12 inches a year, is not sufficient to percolate to the water table, or even create viable streams on the south slopes of the Puente Hills and the Santa Ana Mountains (Blaney et al. 1930:21). The Santa Ana River, with its wide sandy bed, is absolutely essential for recharging the groundwater aquifer of the coastal plain (Elliott et al. 1931:9). As agricultural interests began to pump this ground water in the late nineteenth century, and as urban development began to deplete it in the twentieth, the falling water table has been a paramount worry for coastal plain residents, who keep a jealous guard on the Santa Ana River. With the creation of Orange County on the coastal plain in 1889, this proprietary attitude toward the Santa Ana quickly became a driving concern of Orange County officials, who have attacked the twin problems of flood control and water conservation with a single-minded zeal not often found at the county level.

2. PHYSICAL DESCRIPTION - PRADO DAM, RIVERSIDE COUNTY, CALIFORNIA

Dam Embankment

Prado Dam is an earthen structure, the axis of which runs east-west across the Santa Ana River at the upstream end of Lower Santa Ana Canyon (Figure 2.1). The dam abuts the sandstone canyon walls at either end. It measures approximately 2280 ft from abutment to abutment at the crest, and extends approximately 830 ft at mid-dam from the toe of the upstream slope to the downstream toe. A band of spoil material deposited at the base of the downstream slope to prevent scouring adds an additional 250 ft to the lateral dimension of the structure. The dam rises to a height of 106 ft above the stream bed, with the crest at 566 ft above mean sea level (Figure 2.2).

In cross-section, the slope of the upper portion of the dam is symmetrical. The upstream slope maintains a consistent gradient to the toe, while the downstream slope becomes more gradual and is extended farther from the central axis. The crest of the dam is graded level and is crossed by a 20-ft wide asphalt paved roadway flanked by 5-ft wide shoulders on either side. The uppermost portion of the dam is sloped at a 1:2.5 gradient on both the upstream and downstream sides, with the slope lessening to 1:3 at a distance of 90 ft from the central axis. Horizontal berms 20 ft wide running the length of the embankment occur on both upstream and downstream slopes. Two berms exist in the downstream slope while the upstream incline is broken by only one berm. The upper berm in the downstream slope occurs roughly 125 ft south of the centerline, at an elevation of 525 feet. Below the berm the slope changes to a 1:5 ratio until it reaches the second berm, approximately 295 ft from the axis, below which the slope decreases to a 1:6 incline to the toe. The berm across the upstream slope is located approximately 170 ft north of the central axis at the 510 ft elevation level. The 1:3 slope gradient is continued below the berm to the toe.

The composition of the dam embankment is described in detail in Chapter 4. It was constructed with a central core of impervious material approximately 155 ft wide at the base, with random material of graded permeability (least permeable next to core, most permeable material farthest from core) used adjacent to the core on the upstream slope, overlain by a layer of pervious material. For the downstream slope, only pervious material was used. A concrete key wall was set into the underlying foundation material along longitudinal axis of the dam for its entire length, and continuing eastward to intersect the axis of the spillway ogee.

The upstream slope of the dam embankment is paved with a layer of "one man stone" roughly 12-in thick laid on a 6 in layer of spall material. Paving stones used are generally rectangular in section, rough dressed, and hand placed, forming a fairly even pavement over which additional spall material was spread, filling gaps between stones and creating a regular surface. The rock paving immediately adjacent to the control structure is grouted with concrete. The grouted paving is continued below the toe in the intake approach channel which extends to the northeast of the intake structure. The downstream slope of the dam embankment is covered by a 12 in blanket of coarse gravel and cobbles laid directly on the pervious fill material. At the base of the downstream slope a rock toe 30 ft wide and roughly 10 ft thick was constructed using "toe rock"- rocks weighing up to 1000 pounds. Toe rock was also used at the toe of the upstream slope and along the border of the upstream berm. The downstream toe and the lower portion of the slope are covered by a substantial layer of spoil material, roughly 250 ft in breadth and up to 25 ft thick, that is graded nearly level and acts as

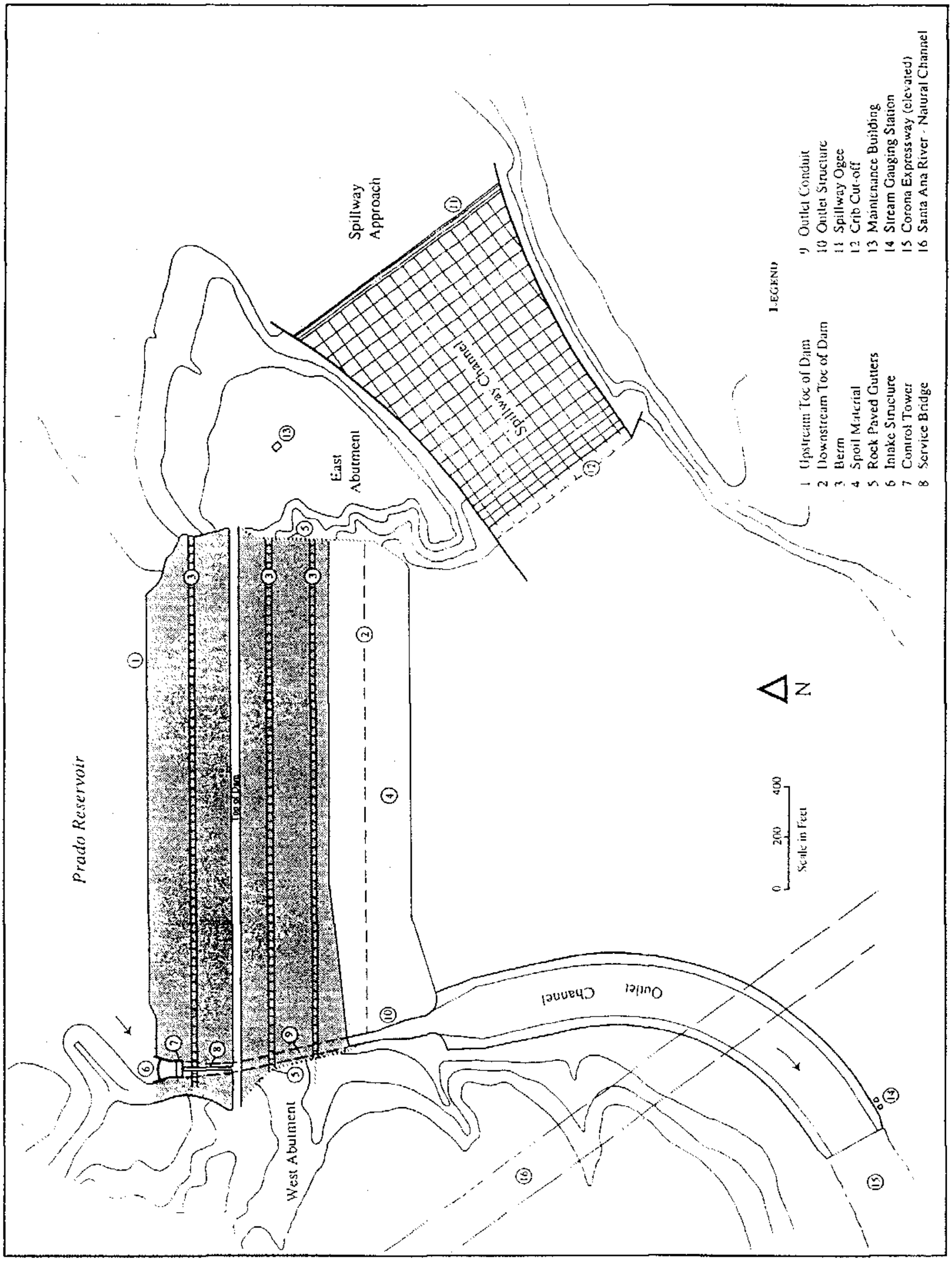

Figure 2.1. Schematic of General Plan of Prado Dam.

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Figure 2.2. Overall Upstream View of Dam. (Photograph by Wayne Rowe)

scour protection for the base of the slope at times when water is discharged from the spillway. The downstream terminus of the spoil layer is paved with 12 in rip-rap. The surface of the layer is regularly graded to keep it free of vegetation.

The downstream dam slope is crossed by a system of grouted rock paved gutters, placed to collect and drain away surface run-off. Constructed of rough-dressed stone, the gutters are approximately 4 ft across and 1.5 ft deep, with flat bottoms and sloped sides. Two gutters run the length of the embankment along the northern edge of each berm. These drain into four gutters that run downslope, perpendicular to the dam's axis, along either embankment/abutment interface, and at two locations in the central portion of the dam. The two outer gutters begin at the dam crest and angle inward toward the center of the dam initially, then run straight down slope. The west gutter drains into the outlet structure and the east empties below the rip-rap toe of the spoil berm. The outer gutters are open; the central gutters, and also along the berms, are covered by the 12 in blanket of gravel which protects the downstream slope and are not apparent on the surface. The inner gutters likewise drain into the depressed basin below the rip-rap toe.

At the base of the upstream embankment, beginning immediately west of the intake structure, a raised berm (or levee) with a level crest 20 ft wide and sloped, grouted rock sides extends to the northeast roughly 400 ft into the reservoir (CA-178-B-2). The berm forms the west bank of the intake approach channel and also serves to direct water emptying from a small drainage in the slope forming the dam's west abutment away from the intake and into the reservoir, thereby preventing the accumulation of silt in the approach area. The outermost portion of the berm is surfaced with ungrouted stone paving. A boom of linked planks extends across the intake approach channel from the end of the berm southeasterly to the dam embankment, preventing debris from reaching the intake trash racks.

From the paved access road which enters the Prado Dam site from Route 71 to the west and crosses the dam crest, an unpaved roadway branches at the west end of the upstream slope adjacent to the abutment, allowing maintenance vehicles to access the intake structure, base of the control tower, and berm during period of normal water level. Another unpaved access road also descends from the dam crest to the basin below the dam and spillway along the east abutment/embankment interface. The outlet structure, outlet channel, earthquake monitoring stations, and stream gauging station may be reached from this roadway.

Two small metal clad sheds on concrete slab foundations are located along the south edge of the dam crest at the center of the embankment and at the dam's east end. A similar 5 ft 4 in square structure exists to the south of the dam, below the rip-rap toe of the spoil area. These structures house celographs, strong motion indicators, which record seismic activity of a magnitude of 3.5 and above on the Richter scale.

Outlet Works

The flow of water from the Prado Reservoir is controlled by the outlet works. Located at the west end of the embankment, they comprise the intake structure situated at the base of the upstream (north) embankment slope, concrete outlet conduits which carry waters beneath the embankments, and the outlet structure itself, consisting of an open conduit and stilling basin, from which discharged waters continue their downstream course along the outlet channel. The intake structure functions as a base for the control tower which rises to the level of the top of the dam and is surmounted by the control house - architecturally the most intriguing elements of the Prado Dam complex. A service bridge which extends from the top of the dam embankment provides access to the control house.

Intake Structure

The intake portion of the outlet works channels in-flowing reservoir water into the outlet conduits. It contains the control gates which regulate the flow of water through outlet works and acts as a base for the control tower (CA-178-B-4). Constructed of cast-in-place concrete, the intake structure is essentially rectangular in plan, with gravity-type side walls flaring outward and extended into the intake approach channel at the north end (Figure 2.3). The intake portal bay, which comprises the upstream portion of the structure, has a semicircular north face defined by seven rounded piers. The piers carry horizontal members that radiate out spoke-like from the deck covering the outlet conduits. The intake structure serves to funnel waters into six concrete conduits which are rectangular in section and arranged in line; these, in turn, contain the control gates. The piers and roof beams of the intake entrance bay essentially act as framing for metal "trash racks" spanning the piers: These grills fit into vertical slots in the piers and prevent large pieces of debris from flowing into the conduits and control gates. A metal frame above the trash racks carries a track mounted mobile maintenance winch used in cleaning the rack. Steel trash racks cover the open top of the intake structure as well, allowing overflow to enter from top and front during periods of high water. The openness and perceived lightness of the intake enhances the overall sense of permeability and weightless quality of the outlet structure and tower when viewed from the north. The total height of the intake structure is 40 ft, measured from the invert (floor of channel), and it is approximately 94 ft across at the entrance.

The inlets to two 66-inch unrestricted bypass pipes, which allowed continuous drainage of water from the reservoir, exist in the side walls of the intake chamber. They were later sealed when water conservation became a function of the dam's operation, in addition to flood control, in the 1950s and 1960s. A concrete encased 60-inch steel infiltration pipe which extends upstream to collect water passes beneath the intake structure invert.

The control gates are seated at the very base of the outlet conduits. The 7 x 12 ft, 11 ton, riveted steel gates move within cast iron frames with steel roller races. Broome caterpillar-type gates manufactured by Philips and Davies, Inc. of Kenton, Ohio were selected for use as their roller hearing movement made them more durable and less likely to jam due to water pressure or silt than simple slide gates. Each gate is individually raised and lowered by means of a series of six 1-in diameter steel cables attached to a sheave at the top of the gate and a drum hoist in the control house above. The control cables descend through an aperture in the top of the control structure base (CA-178-B-9). Removable steel plates in the deck of the control structure allow access to the gate well for maintenance or removal of the gate assemblies.

Immediately south of the control gates, the six outlet conduits are merged in a 90-foot section referred to as the conduit transition into a double conduit.

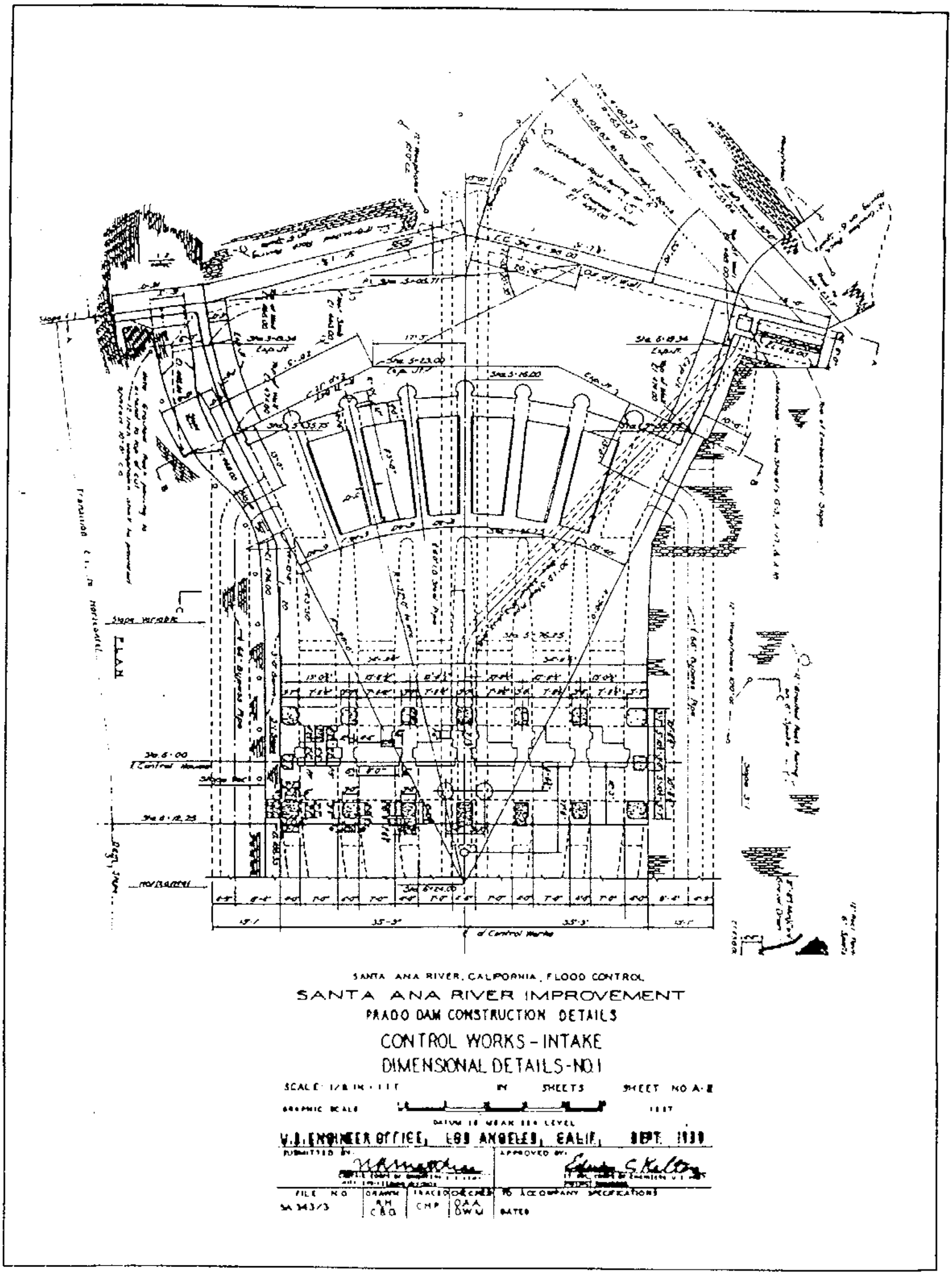

Figure 2.3. Control Works - Intake Plan View

Control Tower

The control tower is an open, rigid frame design incorporating concrete columns and horizontal struts formed of cast-in-place reinforced concrete (Figure 2.4). The three tier tower is surmounted by a monolithic single story control house. The open frame of the tower creates a lightness which is balanced by the solidity of the mass of the control house. The tower rises from the southern end of the intake structure and its upright members bear on the substantial walls of the outlet conduits below. Its total height to the top of the control room is approximately 84 feet. The tower is six structural bays wide by one deep, though the ends have an

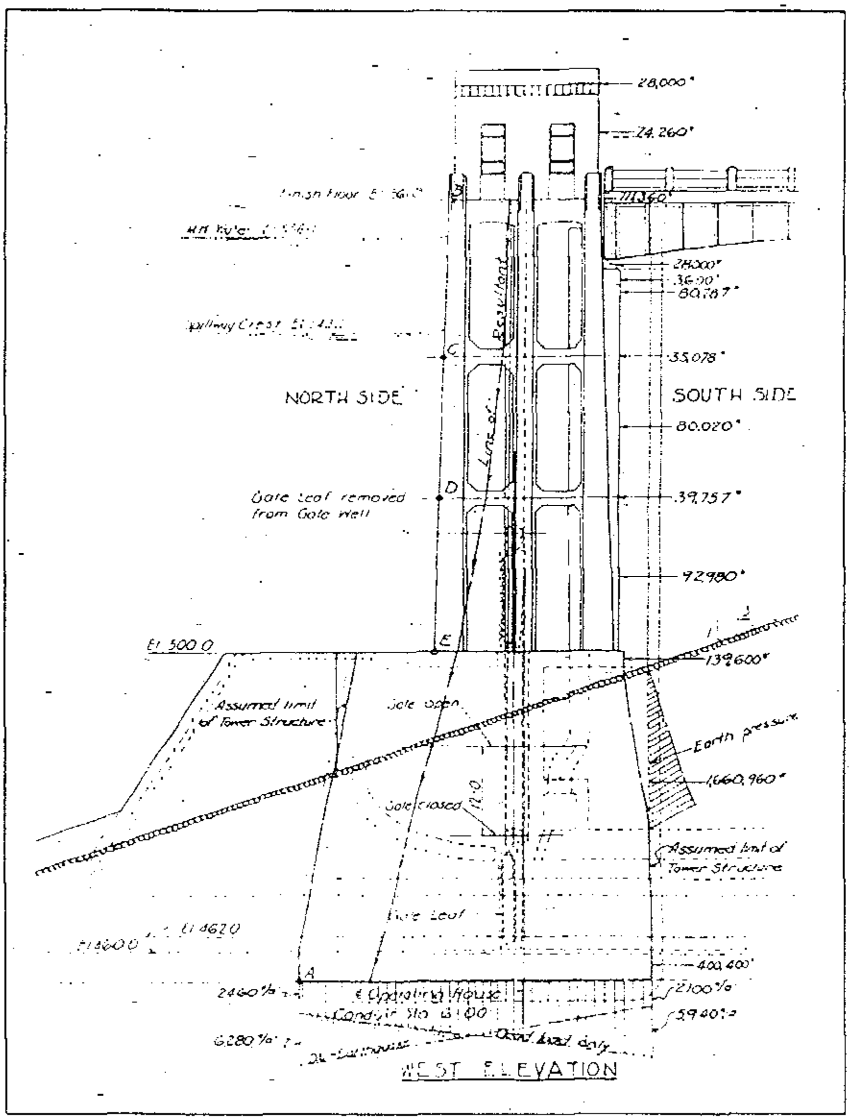

Figure 2.4. Control Tower and House

intermediate column. In a manner typical of the Art Deco style, the scale of the tower is exaggerated somewhat by the slight attenuation or "battering" of the outer surfaces of the columns. At 70.5 x 22 ft, the base is somewhat more than 2 ft wider than the top of the structure. The outer comers of the rectangular section columns display a chamfered reveal, which also serves to diminish the perceived mass of the members. The tapering of the vertical elements is continued as the columns are extended up the face of the control house in the form of reduced pilasters with stepped heads which terminate at the window sill level. The horizontal members spanning between columns are rectangular in section, with slightly beveled edges, and are flared at the ends, dumbbell-shaped. The three central columns on the south side are deeper, and carry an additional cross member on which the north end of the control tower service bridge is supported. The uppermost horizontal members are segmentally arched and form the base of the control house. Immediately north of the central vertical member on the south side, two large diameter steel air vent pipes rise from the intake structure, terminating immediately below the control house. The vent pipes are attached to a gallery with ducts into the conduits immediately behind the gates.

The Control House

The control house is a symmetrical rectangular structure, one story in height with a parapeted flat roof. The cast-in-place concrete walls are smooth finished, and the heavy horizontal impressions of the narrow board forms used on the tower structure and base are not apparent here. Its fenestration is regularly placed, with two windows in the east and west elevations, six windows in the north elevation, and two windows on either side of the central entrance in the south elevation. The single entrance is accessed by way of a service bridge which extends from the top of the dam embankment. Beyond the tapered pilasters which occur in the lower wall, an 18 inch reeded frieze band at ceiling height is the only decorative embellishment of the control house. The frieze band is interrupted at the center of the south elevation and "PRADO DAM" in simple block capital letters the height of the frieze is inset in the wall above the entrance (Figure 2.5). The streamlined typographic style is typical of the era. The entrance is without elaboration, consisting of double, vertical folding, hollow metal doors with a narrow molded metal frame. Each leaf is hinged in the center, with one elongated molded recessed panel in the upper portion of each section leaf. The panels were originally glazed, each containing three wire glass lights. The original wall mounted lamp which hung above the door has been replaced with a halogen flood light. A metal date plaque mounted on the exterior wall immediately east of the door bears the inscription: "Constructed by the U.S. Army Corps of Engineers 1941."

The three light steel casement windows also had wire glazing which has been replaced with metal panels. The lower and central sash are operable hopper and awning-type casements, the lower sash opening inward, and the upper sash, outward from the top. The windows have simple steel frames set in openings with beveled edges. Recessed panels below the windows extend from sill to base of the control house.

The interior of the control house is a single large room dominated by the six 60-ton drum hoists used to raise and lower the control gates (Figure 2.6). A small frame office enclosure has been added in the southwest corner. The hoists are arranged linearly and numbered 1-6 moving west to east. The walls and ceiling of the control house are of unfinished concrete. The floor has a grey painted finish, as do the infilled windows and door. Exposed concrete roof beams are trapezoidal in section and run north-south, spaced 2 ft 7 in apart. The north and south wall planes are interrupted by engaged columns corresponding in location with pilasters on the exterior of the building. The columns are rectangular in section. They protrude from the walls 1 foot, terminate approximately 1 foot above the level of the window heads, and carry steel I-beams on which the tracks for a traveling crane are mounted. Lighting in the control house consists of suspended industrial fixtures with metal shades.

FIGURE NOT AVAILABLE

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Figure 2.5 Detail of Control House. (Photograph by Wayne Rowe)

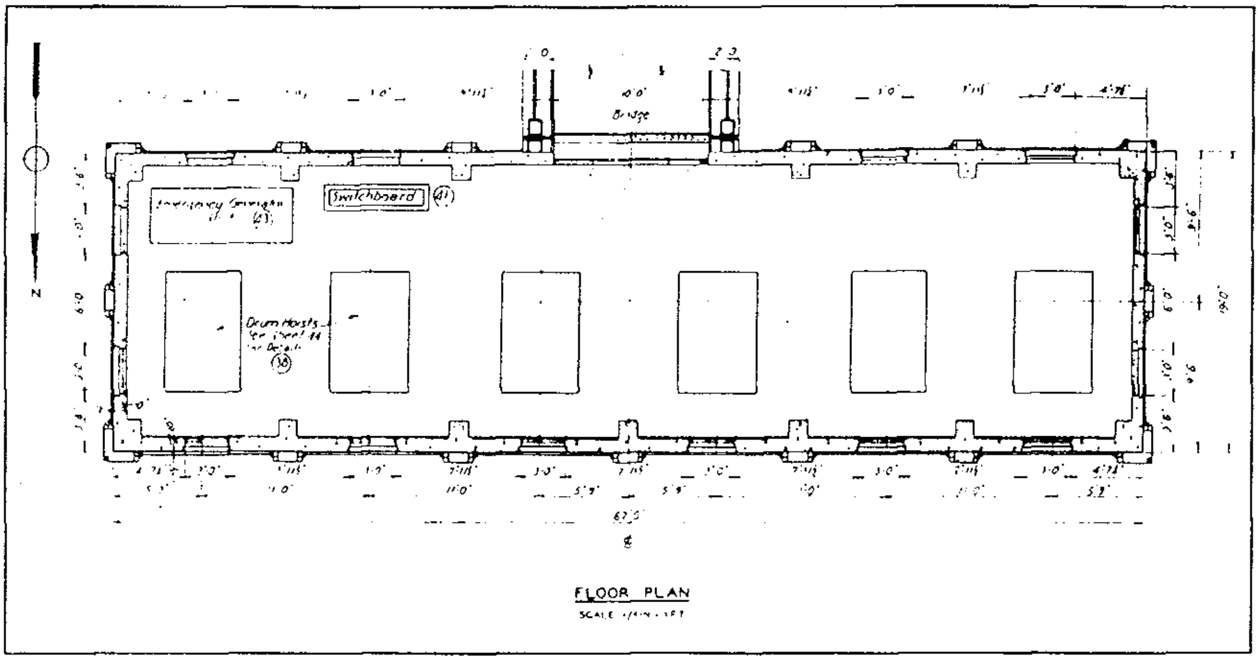

Figure 2.6. Control House Floor Plan

The frame enclosure in the southwest corner of the control house functions as the dam keeper's office. Added to the control house in the late 1950s, the enclosure measures 6 x 8 ft and is 8 ft 2 in in height with an open ceiling. The painted plywood enclosure has a wood hollow core door and currently houses computer equipment linked to the regional flood control telemetry system.

The drum hoists used to raise and lower the control gates were manufactured and installed by Philips and Davies, Inc., of Kenton, Ohio (CA-178-B-14). Each 60-ton capacity hoist is mounted on a 5 x 8 ft riveted steel I-beam base and is powered by a 6.25 horsepower, 13/26 amp, 440 volt, 50 cycle electric induction motor manufactured by General Electric. The motor turns a series of massive gears, and ultimately the cable hoist drum mounted at the north end of the unit. The hoist is controlled by a four position magnetic switch located at the southeast corner of the unit. A gate leaf position indicator with a large circular dial attached to the hoist drum indicates the height of the "gate opening in feet." These indicators provide readings based on the amount of cable fed out, but do not necessarily give a true reading of the position of the gate, e.g., in the instance of a jammed gate. For this reason, a second set of linear gate height recorders, which are connected directly to the gates via conduits on the south wall/columns, was later installed along the north wall of the structure. An electric gate height recorder box mounted below each gauge keeps a permanent record of gate heights. Six, 1 in diameter steel cables which descend through 4 ft rectangular openings in the floor of the control house connect the drum hoists to pulleys or "sheaves" at the top of the control gates. The hoists are capable of raising or lowering the gates at a rate of one foot per minute. They may be turned by hand in an emergency, at 600 rotations per foot of height.

Immediately northeast of the control house entrance is a free-standing electrical switchboard from which power to the drum hoists, traveling crane, and lights is controlled. Electrical service is supplied to the switchboard via a conduit run from the top of the dam and across the service bridge. From the switchboard, the power supply to the gates may be transferred from the utility grid to the backup generator within the control house, or to an alternate backup generator which would be brought to the site in an emergency situation. The switchboard has a steel case mounted on a concrete base and is 6 ft 4 in high by 5 ft 4 in wide. In addition to fused switches for each piece of machinery, the switchboard also includes ammeters and voltmeters to monitor performance and test blocks and plugs for equipment testing. A circuit panel for lights on the interior and exterior of the control house is mounted on the east wall.

The original gasoline powered backup electrical generator located in the southeast corner of the control house was replaced with the present diesel powered generator in the mid-1960s (Riggle, personal communication 1996). The present CAT Electric Set D320 Series A generator is capable of producing 75 kilowatts and utilizes the original mounting platform. An exhaust stack exits through the roof of the building.

The control room is equipped with a three-ton, electrically powered traveling crane capable of moving the drum hoists or other equipment for maintenance or replacement. The crane moves the length of the building on I-beam mounted tracks atop the pilasters along the north and south walls. A single steel I-beam cross-rail allows the hoist mechanism to traverse the building. The crane was manufactured by Wright and is original to the building.

Telemetry equipment use to monitor water depths in the outlet channel is also housed in the control room. A water surface recorder (float gage recorder) manufactured by Leapold & Stevens Instruments, Inc. is mounted on the south wall, immediately east of the entrance. The mechanism uses clock and counterweight operation rather than electricity. The float mechanism descends from the recorder to the outlet works through a "well" - a 20-in diameter steel pipe - located at the north end of the service bridge and tied to the central control tower support.

Service Bridge

The service bridge provides access to the control house from the roadway at the top of the dam embankment. The bridge is riveted steel plate girder below-deck structure consisting of two spans with a total length of 190 ft 2 in (CA-178-B-43). The south end of the structure is supported on a gravity-type concrete abutment with reinforced concrete wing walls which give the bridge an overall length of 218 feet. The north end of the bridge bears on built-out sections of the three central columns on the south side of the control tower. The spans are also supported by a monolithic concrete central pier. The pier is rectangular in section and attenuated, being 12 ft wide at top and flaring to 39 ft below embankment slope. The pier extends through the dam embankment to bear on the outlet conduit. Connections at the abutments and at the central pier are pinned, with rocker supports at both the north and south ends. Riveted steel plate girders with arched lower chords which would compliment the arches of the control tower were originally planned for the service bridge. Plans were later revised to employ straight girders. The bridge girders are 6 ft ½ in deep, placed 8 ft apart, and braced internally with diagonal struts and regularly placed cross-members. An 8-in reinforced concrete slab forms the bridge deck, with a 10 ft wide vehicle lane and 2 ft wide concrete curbs on either side. Railings placed atop the curbs consist of square concrete posts 3.5 ft in height and 8 ft apart spanned by three pipe railings with flanged connections. Set in the center of the north end of the bridge deck is a hinged steel plate door providing access to the float gage recorder box and float gage recorder well - an 18-in pipe which descends to the outlet conduit from this point. The well is attached to the central column of the control tower with three steel brackets. A steel pipe rail gate placed at the joint of the south span and the bridge abutment prevents unauthorized access of the bridge and control house.

Outlet

Upon passing through the control gates, released waters immediately enter the conduit transition, a 90 ft section in which the six outlet conduits merge into two adjoining closed outlet conduits, each measuring 13.5 ft square, constructed of reinforced concrete 4 ft thick. At regular intervals along the exterior of the conduit structure are concrete "cut-off collars" - baffles which prevent the seepage of water along the outside of the conduit (CA-178-B-24). The alignment of the conduit bends gently to the southeast along its 684 ft length before released waters exit the outlet portal and are discharged into the outlet structure.

The outlet structure consists of an open conduit the same width as the closed conduit 126 ft long with vertical concrete walls, and the stilling basin (CA-178-B-17). Upon entering the basin, the floor (or invert) of the channel slopes 20 ft and the outlet widens from 31 to 70 feet. Over the 200 ft length of the stilling basin, discharged waters flow over a series of three rows of baffle piers - stepped piers 5 ft in height which act to slow the speed of the effluent and, finally, a full width stepped baffle curb located at the downstream end of the basin. Waters in the basin are contained by vertical concrete gravity-type walls and channel floor slabs 5 to 6 ft thick. Immediately downstream of the baffle curb the outlet walls curve sharply outward, becoming perpendicular to the channel and extending to a total width of 223 feet. At this point, waters enter the outlet channel.

The channel has side walls or banks sloped at a 1:2 gradient which extend outward to the ends of the flared concrete outlet walls. The banks and channel bed are paved with three feet of grouted rock derrick stone for the first 50 ft, then 12 in grouted rock paving. Beyond the outlet structure the outlet channel gradually widens to a maximum width of 272 ft and becomes shallower, 12 ft from the bed to top of bank. Upon attaining its ultimate depth and width, the grouted rock paving of the outlet channel bed is discontinued and uncompacted backfill is used for the remainder of the channel's length. The grouted rock banks extend to the end of the outlet channel, with 12 in of rock on 6 in of spalls, and a 7 ft thickness of "two man" stone deposited at the toe of the slope. The outlet channel continues southward and curves to the west, passing beneath the Corona Expressway and ultimately terminating 1850 linear feet southwest of the outlet structure. The improved outlet channel terminates with a sheet steel piling cut-off wall extending across the width of the channel, the top driven flush with the channel floor. Immediately downstream of the cut-off wall, the channel bed is again paved with three feet of grouted rock paving, which drops gradually over 50 ft to the level of the natural channel of the Santa Ana River. Large boulders and pieces of concrete have been placed in the river channel downstream of the improved channel to prevent scouring as the flow reenters the unmodified waterway.

Spillway

The spillway is a secondary control structure which functions during periods of high water levels in the Prado Reservoir. Trapezoidal in plan, the spillway is approximately 1147 ft in length, slightly over 1000 ft wide at the upstream end, and 660 ft at its outlet (Figure 2.7). Elements of the structure include the ogee, a broad barrier which allows water to spill from the reservoir evenly across its entire width, the spillway channel, a broad, tapering channel with a concrete floor and walls, the drop structure or "lip," and the cut-off crib or "bucket." The spillway is located east-southeast of the dam embankment. Its axis is rotated 37 degrees counter-clockwise from the east-west axis of the dam: the ogee runs northwest-southeast. The structures are separated by the elevated area which serves as the east dam abutment and the northwest boundary of the spillway, and are approximately 325 ft apart at their closest point. The spillway's southeast wall is also bounded by an elevated bluff.

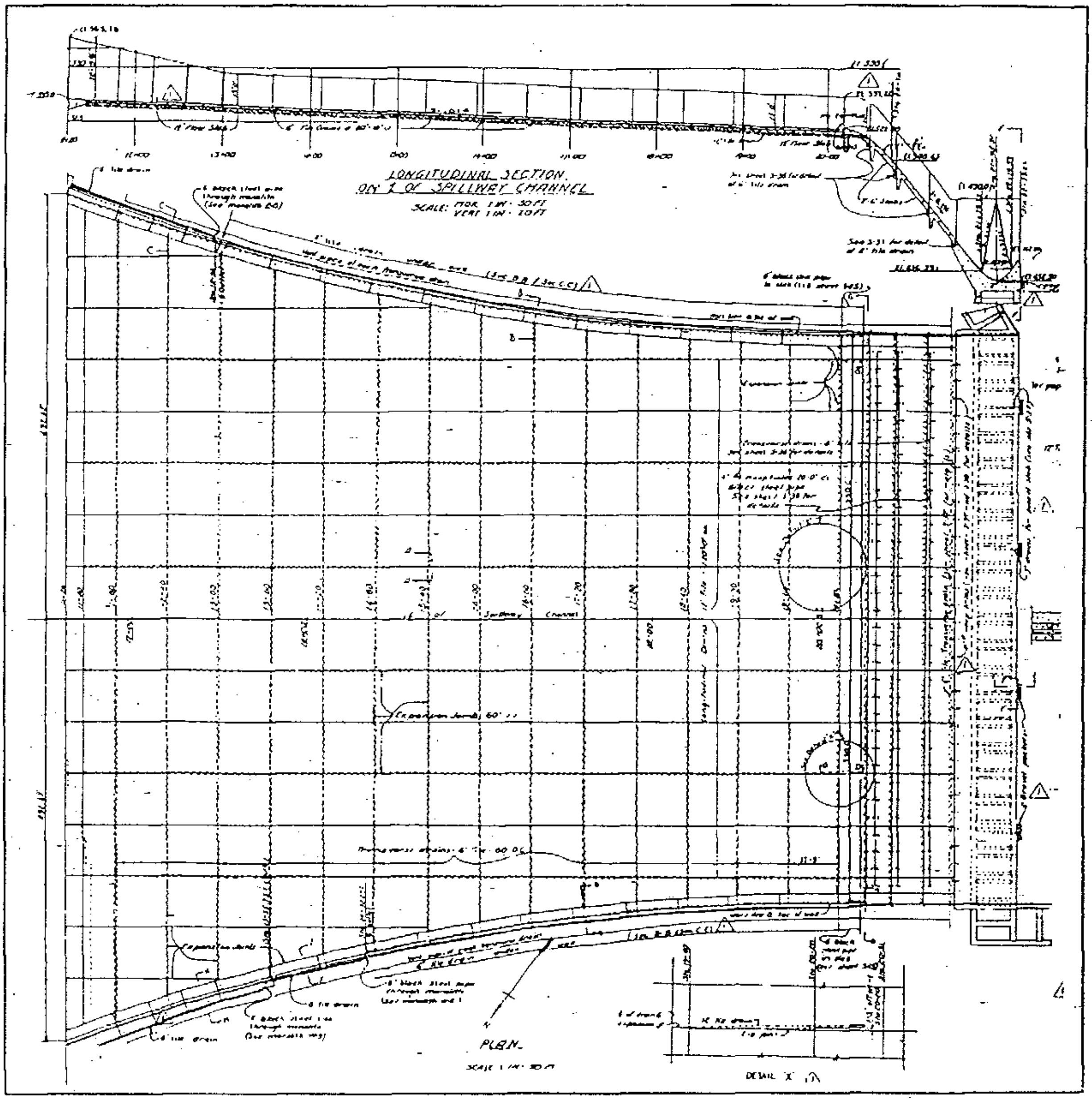

Figure 2.7. Plan View of Spillway Channel.

The spillway ogee is formed of reinforced concrete and is supported on gravity-type foundations (CA-178-C-2). The northeast face of the structure is a straight, vertical wall which rises to a height approximately 12 ft above the approach channel to the northeast. A 20-ft wide concrete slab apron runs the length of the base of the ogee. At the top of the vertical face, the ogee curves upward slightly before recurving and sloping gently downward over roughly 50 ft to meet the plane of the spillway channel. The superstructure resembles the top half of an airfoil with a blunt leading edge in cross-section. The elevation at the crest of the ogee is 543 ft above sea level, which is 13 ft below the maximum high water level of the dam, and 23 ft below the dam's crest.

The spillway channel is at an elevation of 535 ft above mean sea level where it meets the base of the ogee. Perfectly horizontal in transverse section, the floor of the channel drops 13 ft over its length before reaching the lip at its southwest end. The spillway channel is composed of reinforced concrete slabs measuring 60 x 60 ft and 12 in thick. Each expansion joint between slabs in the transverse direction is underlain by 6 in drain tile. Twelve-inch collecting tiles underlie every other joint (120 ft apart) running the length of the channel and draining through the face of the spillway lip. The outermost slabs, which support the gravity and cantilevered side walls, are heavier, measuring 2 ft 8 in to 3 ft thick, with keyed connections to the interior slabs. At its southwest end, in the section referred to as the spillway "lip," the spillway channel slopes steeply, dropping approximately 55 ft to the cut-off crib or "bucket." The cut-off crib is a long trough-like structure designed to break the fall of exiting waters and prevent erosion of the underlying strata. Leaving the cut-off crib, the discharged water reenters the natural flood plain of the Santa Ana River. The cut-off crib is a heavily reinforced structure formed of concrete up to 11 ft thick which is supported on coffer-type foundations 62 ft deep. The spillway lip is constructed of 2 ft 6 in thick slabs supported along the north and south edges by foundation walls 7.5 ft deep. Four rows of 4-in weep holes along the face of the spillway lip allow ground water to escape. The spillway bucket was back filled after construction to the 470 ft elevation level - completely concealing the structure.

A combination of gravity and cantilevered reinforced concrete walls, poured in 60 ft long monolithic segments, was used to construct the side walls of the spillway channel. Cantilevered wall segments - inclined walls which rest on the outer edge of the channel floor slabs and bear in part on the sandstone walls of the abutments - were used in the central portions of the channel walls where structural forces exerted by discharged water would be the least (Figure 2.8). In areas at the north and south sections of the channel, gravity walls were employed. The self-supporting gravity walls bear completely on the outer edge of the channel slabs. The outer face of the gravity walls is vertical, while the inside wall plane is sloped at a ratio of 4:1. This degree of slope holds true for all channel wall sections, including the cantilevered sections. Also, both cantilevered and gravity wall sections have keyed joints with the channel slabs, which prevent horizontal movement. Cantilevered wall sections are uniformly 1.5 ft thick and 15 ft high. Gravity-type wall sections are also uniformly 1.5 ft thick at the top, but their thickness at the base varies relative to the wall height (Figure 2.9). Fifteen feet is the minimum wall height for the spillway, and at this height, the basal dimension of the gravity wall is 5 ft 3 in, while at a point adjacent to the ogee crest where the wall rises to a height of approximately 29 ft, the base of the wall is 10 ft 3/4 inches. In the area adjacent to the ogee, the spillway side walls are higher. Their height begins to increase in a regular slope 180 ft south of the ogee, reaching a maximum height of 30 ft at the ogee axis (17 feet higher than the top of the ogee). In this area the length of the monolithic segments is reduced to approximately 42 ft, and an additional 3-ft deep footing is added to the base of the supporting slab. The side walls are extended beyond northeast face of the ogee for a distance of approximately 85 ft, decreasing abruptly with distance to near grade level. In the spillway approach area, the side slopes behind these wall extensions are covered with rock paving.

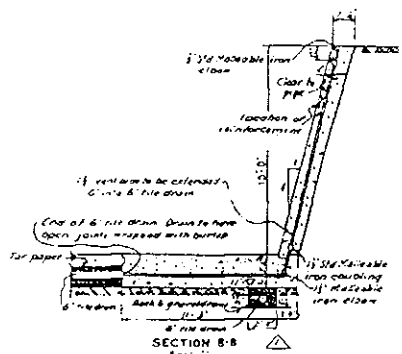

Figure 2.8. Cantilevered Reinforced Concrete Wall.

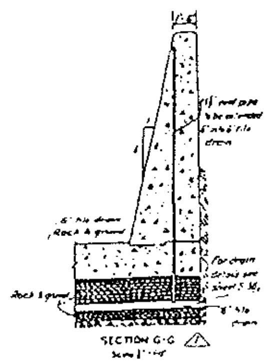

Figure 2.9. Gravity Reinforced Concrete Wall

The side walls are also elevated in the area at the ends of the spillway hucket, where they rise to a height of 37.5 ft above the base of the bucket. On the west, the cut-off wall is extended 206 ft beyond the end of the bucket, in line with the side wall. The wall extension directs the flow of discharged water to the southwest, away from the dam embankment and east abutment, and toward the natural Santa Ana River channel. At the east end of the spillway bucket, the side wall turns sharply to the east at the end of the bucket, extending an additional 115 ft to embed itself in the rock sideslope. The cut-off wall extensions on both the east and west sides are partially freestanding and are supported by deep coffer-type foundations 50 ft wide. Soil was backfilled along the outer face of the east and west sidewalls to the top of the walls, with a horizontal berm 20 ft wide left between the wall and the side slope on either side. The sidewalls are surmounted by chain link security fences. Run-off from the side slopes is collected in a single rock-paved gutter on either side, which empties into the spillway near its north end. Ground water is drained through weep holes in the side walls. The broad approach to the spillway, and the spillway outlet have been graded level and planted with grass which is maintained and kept free of trees and brush.

Maintenance Building

A small structure used for storage of equipment used in dam maintenance is located on the elevated piece of land between the east dam abutment and the spillway (CA-178-D-1). Built in 1941, the building was originally associated with the dam caretaker's residence, now demolished, which stood immediately west of the structure. The maintenance building is a one story, wood frame, stucco clad structure with a low-pitched hipped roof. It is rectangular in plan with a low, shed roof addition on the northeast side. The addition is also of wood frame construction, with asbestos shingle cladding applied over the original clapboards.

The maintenance building rests on a concrete slab. The north elevation is dominated by a full-width vertical metal panel, tilt-up garage door - an alteration of the original design. Personnel doors are located in the southwest and southeast sides. The southwest door is a single panel wood door centered in the elevation, with a two-over-two double-hung sash window with horizontal lights placed southeast of the door. A one-over-one sash window occurs in the southeast wall, and the second personnel entrance is located in the southeast side of the shed-addition. It is a wood hollow core door with a small two light casement window placed immediately to the northeast. An identical window exists around the corner on the northeast wall and both windows relate to a bathroom in the east corner of the shed. A large window on the northeast elevation has been infilled. All of the windows and doors of the garage have been covered with metal security bars. The maintenance structure is unfinished on the interior, with exposed frame and wall cladding, except for the rear third of the building which was used as an office area at one time and is finished with painted plywood. The bathroom is in the east corner of the shed addition, with the remainder of the wing providing additional equipment storage space. The structure's roof is covered with composition shingles. Concrete slabs exist on the northwest and southwest sides, with concrete walks along the other two sides as well. A small metal clad portable shed stands off the west corner of the structure, and the entire maintenance building and surrounding concrete apron are enclosed by a chain link fence.

Approximately 100 ft southwest of the maintenance building, a second fenced enclosure contains three cylindrical metal storage tanks and a small wood framed shed. The tanks and the shed rest on concrete slabs. The largest tank is an upright galvanized corrugated steel tank with a conical roof used for water storage. The two other tanks are used for chlorine mixing and pressurization. The shed is clad with horizontal drop siding with a roof composed of corrugated sheet metal (no roof framing). A one panel wood door is present in the south wall of the structure and a fixed, multi-light window in the north wall has heen covered. The shed houses a pump and water controls.

Stream Gauging Station

Approximately 2100 ft downstream from the dam outlet, near the southern terminus of the modified portion of the outlet channel, immediately adjacent to the east bank of the channel, are two small utilitarian structures which house stream gauging equipment. Both buildings were built and maintained by the United States Geological Survey (USGS); they are a single story in height and square in plan. The eastern structure is of relatively recent construction, built of concrete block with a flat roof. It has no openings beyond a steel slab-type door in the south elevation and it is supported on a concrete slab foundation. An antenna is attached to the building's west side and a steel pipe extends from the base of the north wall into the river channel.

The western building is constructed of cast-in-place concrete and is contemporaneous with the dam. Although a modest utilitarian structure, the stream gauging shed displays several Art Deco stylistic elements, design flourishes which are noteworthy in a building of its scale and function (Figure 2.10). Constructed of cast-in-place concrete and set on a concrete slab, the structure is covered by a low-pitched pyramidal hipped roof which is also of cast concrete. Corners of the building are expressed with chamfered squared corner pilasters that terminate in stepped back heads. Narrow vertical windows are centered in both the east and west wall. The openings have beveled edges and are infilled with metal panels through which electrical conduits now protrude. Small rectangular screened vents also occur at the lower right corner of the west wall and the upper left corner of the north wall. Entrance to the building is by way of a steel industrial type slab door in the south elevation. A galvanized steel cabinet is attached to the north wall of the structure, and a grated opening and plate steel access door exist in the grouted stone bank of the outlet channel immediately below the structure to the north. A large diameter steel pipe supporting an antenna stands immediately west of the building.

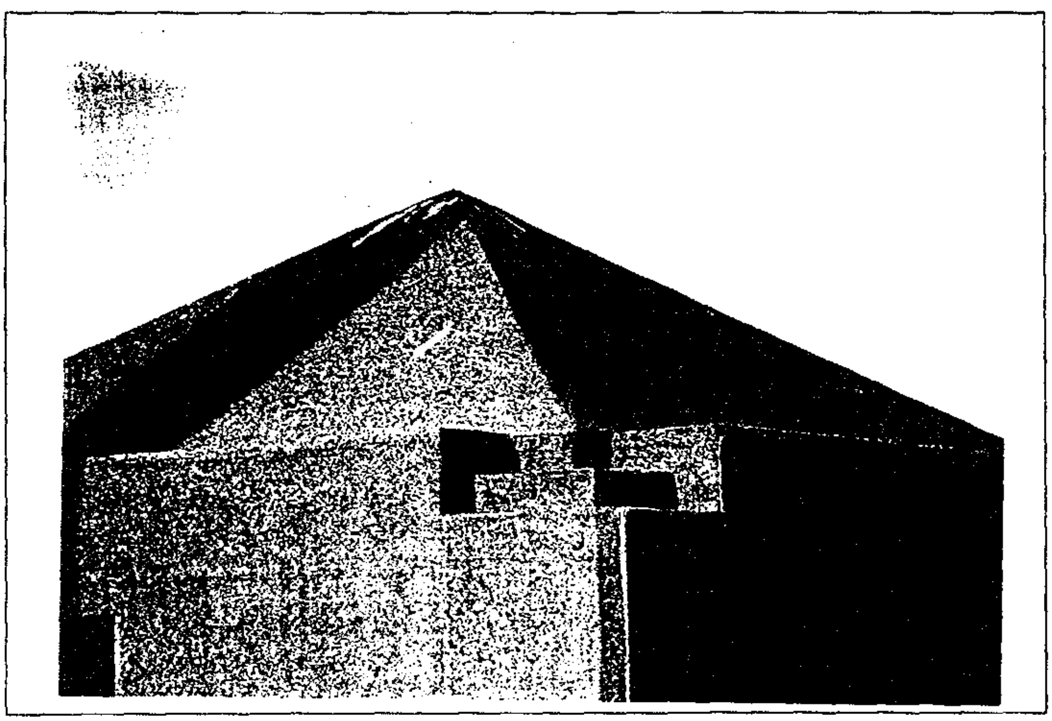

Figure 2.10. Detail of Stream Gauging Station (Photograph by Dana N. Slawson)

3. EARLY PLANNING CONCEPTS

Floods and Water Rights

Vernon C. Heil, former president of the Orange County Farm Bureau and chairman of the Orange County Water District, once said that, "there are only two times when people are vitally interested in the supply of water; when there is too much of it,... or when there is too little" (*Farm Bureau News* 1944). One or the other problem has always confronted Orange County, and the solutions to both have proven increasingly difficult with the subsequent development of the coastal plain. Unlike San Bernardino and Riverside counties, Orange County does not have direct access to the mountain run-off that naturally recharges the underground water table and supplies the Santa Ana River with its water. Orange County, limited to the coast, is dependent on the Santa Ana itself for both surface water and the water needed to recharge the water table. For this reason, the Santa Ana has always been of vital interest to Orange County residents and their elected officials.

At the time Orange County was separated from Los Angeles County in 1889, water conservation was not yet a major concern because the demand on the water table was still low. When this problem finally came to the attention of Orange County water interests around the turn of the century, they were quick to buy land and water rights in the Prado Basin to secure a reliable flow of water in the river downstream. The major water interests involved in this operation were the Anaheim Union Water Company, the Santa Ana Valley Irrigation Company, and the Santa Ana River Development Company (Orange County Water District 1948). The latter bought the huge Durkee Ranch in the center of the Prado Basin around 1900 for the sole purpose of acquiring water rights to the Durkee Ditch, so that its water could be returned to the Santa Ana. This action also stopped most ditch use for crop cultivation (Scott 1977:92). By the terms of an agreement dated to 1907, the Santa Ana River Development Company allowed the waters from the Durkee Ranch to flow down the Santa Ana, where the water rights were bought by Anaheim Union and Santa Ana Valley Irrigation (Conveyance 1907).

From this beginning, the Santa Ana River Development Company continued its expansion in the Prado Basin. By 1930, the company had bought up much of the land and water rights around the Santa Ana River, to ensure the supply of water into Orange County (Scott 1977:89).

The initial expansion of Orange County water interests into the Prado Basin helped lead to the creation of the Tri-County Water Conservation Association in 1909 (Hinckley 1944). The association, formed by representatives of San Bernardino, Riverside, and Orange counties, agreed to reduce river evaporation by allowing water to percolate into the gravel and debris cones in the river beds immediately below the mountains. For a while, this helped recharge the underground aquifers around San Bernardino with enough water left over to contribute to the flow of the Santa Ana at Prado Basin. As agricultural development in San Bernardino and Riverside counties increased rapidly in the early twentieth century, the upstream counties drew off more water, affecting water conservation in the Prado Basin. Orange County became dissatisfied and finally withdrew from the association altogether in 1932 (Bookman and Baker 1949:13-14).

In many ways, the 1916 flood was the turning point in the brief era of tri-county cooperation. Most of the Santa Ana River floodplain below the canyon was inundated as the river left its banks and washed over northwest Orange County (Figure 3.1; Orange County Flood Control District [OCFCD] 1931). Orange County, with the most to gain from both flood control and river water conservation, began to consider taming the Santa Ana and regulating its flow. After 1916, Orange County became more acutely aware of its own

FIGURE NOT AVAILABLE

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Figure 3.1 Extent of 1916 Flood in Orange County (After Elliott et al. 1931: frontispiece).

interests in this matter. As its need for flood control and water increased, the county's water interests began to diverge from those of Riverside and San Bernardino counties. Orange County began to act on its own.

The first action of Orange County was to begin monitoring the complex pattern of water flow in the Prado Basin, an operation that became comprehensive after about 1930. Soon it was noted that the artesian wells of Chino, covering a 23 square mile area in 1900, became progressively weaker until they finally ceased to flow unaided by around 1940 (Elliott et al. 1931:37; Means 1942:17). This development was attributed to the increase in groundwater pumping in the Pomona and Ontario areas (Means 1942:17). In the Prado Basin itself, the increase in irrigation water drawn from wells along Mill Creek and Chino Creek began to lower ground water levels and decrease the flow of water in the Durkee Ditch, which only averaged five second-feet (i.e., cubic feet per second) in 1931 (Elliott et al. 1931:37-39). By this time, about half of the land within the Prado Basin was irrigated, mostly from wells and springs adjoining Chino Creek. Although the use of irrigation water in the Prado Basin, computed to be 1.25 acre-feet per acre, was consistent with other areas of southern California (Elliott et al. 1931:45-46), the continued development of the area could only pose a threat to Orange County, which was solely interested in getting basin water downstream as quickly as possible.

To monitor the flow of the river as it entered the Santa Ana Canyon, Orange County officials took measurements of the river's mean monthly discharges, starting at least as early as 1919. January was found to be the month of the greatest mean flows, ranging from about 100 to 170 second-feet; August had the smallest, ranging from about 30 to 70. It was noted that the annual river discharge had a tendency to shrink from year to year, an omen viewed with the utmost concern (Means 1942:22). Orange County officials could read the handwriting on the wall: while everyone admitted that something had to be done about flood control, Orange County knew that something had to be done about water conservation as well.

The First Studies

Water conservation was a perennial issue, but it seemed that only floods got immediate results. The idea of a dam on the Santa Ana to control floods and effect water conservation was seriously entertained only after the 1916 flood. The first engineering investigation for a dam site within the Prado Basin was conducted in 1918 by a body of consulting engineers - John H. Quinton, F.H. Olmstead, A.L. Sonderegger, and W.K. Barnard - retained by the boards of supervisors of Orange, Riverside, and San Bernardino counties. Little is known about this study, except that later investigators found it general in nature. This report apparently identified the need for both flood control and water conservation (Bookman and Baker 1949:4), and recommended additional study and a continuation of water-spreading in the cone areas south of the mountains (Lippincott 1925:24,38).

The second dam study was sponsored by Orange County alone. It was conducted in 1925 by J.B. Lippincott, an hydraulic engineer from Los Angeles retained by the Orange County Board of Supervisors. Lippincott's report went into great detail about the phenomenal growth of Orange County, both urban and agricultural, and the increase in groundwater pumping associated with this growth. It was noted that Orange County's 1890 population of 13,589, had jumped to 61,375 by 1920. Almost half of that growth had occurred in a single decade (Lippincott 1925:1). With this phenomenal growth in mind, Lippincott took a hard look at the flood control and water conservation associations to which Orange County was then committed.

According to Lippincott's report, Orange County was then a member of a tri-county Flood Control Association, as well as the Tri-County Water Conservation Association that was mentioned earlier. The Flood Control

Association was financed by appropriations from the three counties within the watershed, each of which had contributed $3000 a year for the past three years into a common fund that contained $27,000 in 1925. This association apparently concentrated its water-spreading in the Barton Flat area in the high intermontaine valley near the source of the river (Lippincott 1925:43).

The Tri-County Water Conservation Association conducted most of its work in the debris cones at the base of the mountains. The association had been constructing contour ditches and rock dams in these areas since at least 1911. By agreement with Orange County, the association promised not to spread water in the cones until there was river flow at the Chapman Street bridge in Orange County (Lippincott 1925:45).

After reviewing the work of these associations, Lippincott concluded that Orange County did not really benefit from the water-spreading conducted by the tri-county Flood Control Association in the mountains. It seems likely that Orange County dropped out of this association shortly after this report was filed, since nothing more is ever heard about it in the Orange County records. Lippincott was more favorably inclined toward the Tri-County Water Conservation Association, which had been formed in 1909 and began water-spreading at the cone areas by 1911. He warned, however, that in the future this connection might not be beneficial to Orange County (Lippincott 1925:52).

After documenting current efforts in the upper watershed, Lippincott made his most pressing recommendation for a large dam in the Lower Santa Ana Canyon, a construction that would be closer to Orange County and more easily subject to its control. He suggested two locations for the dam: Sculley's Point, at elevation 410 feet ASL; and the location of the Santa Fe Railroad bridge over the Santa Ana at the head of the Canyon, elevation 460 feet. Sculley's Point, two miles downstream from the canyon's head, was considered the better location from a geological point of view, but the bridge site was considered more economical, since there would be less of the railroad to relocate if the dam were built at the canyon's head. Although the reservoir site, which included most of the Prado Basin, was surveyed by the Orange County Engineer Office from Sculley's Point (410 feet) to elevation 530 feet, Lippincott appears to have made calculations for the hypothetical "Rincon or Prado" reservoir based on a dam at the bridge location (Lippincott 1925:55-56).

Lippincott's "Rincon or Prado" reservoir would have been created by a dam about 70 feet high, behind which would have been a reservoir capable of containing 174,000 acre-feet of water. The lower 81,500 acre-feet would have been devoted to water storage for Orange County, with the upper 92,500 allotted for flood control (Lippincott 1925: General Summary, 56). Although the actual plans for Lippincott's dam do not appear to have survived, he briefly described its operation under flood conditions. The dam was to have three syphons, each capable of discharging 1000 second-feet of water. The first syphon would begin operating when flood waters reached the 510 foot elevation; the second, at 515; the third, at 520. At this point, the dam syphons could discharge a total of 3000 second-feet. At the 525 foot elevation, five feet from the crest of the dam, the overflow spillway would be activated (Lippincott 1925:62-68).

Due to the poor condition of the rock of the canyon walls, Lippincott recommended that the dam itself be constructed of hydraulic fill, the cost of which he estimated at $1,770,000. The "Prado Dam," however, was only a part of the entire flood control package Lippincott recommended to the Orange County Board of Supervisors. Additional dams on tributaries and main stem river channel enlargements were also suggested. The whole plan came to an estimated 5 million dollars (Lippincott 1925:62-68).

One of the greatest problems Lippincott foresaw in the operation of a dam at Prado was the inevitable siltation of the reservoir basin, a problem he discussed at some length in his report (Lippincott 1925:59-61). He calculated that siltation would be such a problem that the dam would have to be raised 10 feet every 78 years to accommodate 174,000 acre feet in the reservoir (Lippincott 1925:General Summary). For Lippincott, this problem was hypothetical, since he suggested that any dam in the Lower Canyon would be too costly to build with local funds (Lippincott 1925:55). Lippincott's report, although not implemented, paved the way for state involvement in both flood control and water conservation in the Santa Ana watershed.

In conjunction with the Lippincott report, Orange County made a study of property in the Prado Basin to identify the owners who would have to be compensated in case of actual dam and reservoir construction. This resulted in the first known map of property tracts and owners in the Prado Basin, and the first assignment of tract numbers for each parcel (OCFCD 1926: Tract Map). There is no record that any property appraisals were made at this time.

The objectives of this survey work were never realized, since the voters of Orange County turned down the Lippincott plan after it was presented to them in 1925 (*Orange County Register* 1938a). County officials, however, continued to agitate in the state legislature for flood control money. The first state-funded study of flood control on the Santa Ana was finally authorized by the California legislature in 1925. Chapter 476 of that year's budget provided $50,000 for a survey of flood control possibilities throughout the entire watershed, with the proviso that an equal amount of money would have to be raised by local agencies (Post 1928:6).

Chapter 476 inaugurated the Santa Ana River Cooperative Investigations. Each of the three counties involved- Orange, Riverside, and San Bernardino- appointed an engineer to consult with the State Engineer, who was then Edward Hyatt. Appointed for San Bernardino County was George S. Hinckley; for Riverside County, A.L. Sonderegger; and for Orange County, J.B. Lippincott (Post 1928:9). This cooperative investigation must not have proved very productive, for little more is heard about it. Edward Hyatt was soon replaced as State Engineer by Paul Bailey, who apparently maintained close ties with Orange County.

The flood of 1927, though not nearly as extensive as the 1916 flood (Post 1928:Map 3), again spurred Orange County residents to seek some additional means of regulating the Santa Ana. In 1927, Orange County officials were instrumental in passing an act through the California legislature that created the Orange County Flood Control District (OCFCD). The importance Orange County attached to this district cannot be overestimated. The district borders were the same as those of Orange County, and the county board of supervisors doubled as the district board of supervisors. As established by the state legislature, the purpose of the district was to control all flood waters that might affect Orange County, including sources both inside and outside the county itself. The OCFCD was empowered:

> to provide for the control of the flood and storm waters of aid district and flood and storm waters of streams that have their sources outside of said district, but which flow into said district, and to conserve such waters for beneficial and useful purposes by spreading, storing, retaining, and causing to percolate into the soil of said district (Beard 1941).

This language made it possible for Orange County to effect flood control measures and water conservation on the Santa Ana River, even in areas outside the county (Elliott et al. 1931:5). It also granted Orange County a vested interest in any measures that might be enacted.

In August of 1927, shortly after the OCFCD was established, Paul Bailey resigned as State Engineer of California and was immediately appointed chief engineer of the Orange County Flood Control District by the OCFCD board (Bailey 1928:8; Bookman and Baker 1949:5). Bailey's interest in reservoirs as a means of flood control along the Santa Ana had already attracted the interest of Orange County officials; his last state publication on the subject had to be completed by his associate (Bailey 1928). Under the auspices of the OCFCD, Bailey was commissioned to prepare a comprehensive plan for both flood control and water conservation. The investigations he supervised took two years to complete, and when he finally filed his report in April of 1929, he had selected an altogether different location for the proposed dam site than the one chosen earlier by Lippincott (Elliott et al. 1931:5).

The 1927-1929 Plan

After his appointment as chief engineer of the Orange County Flood Control District in 1927, Paul Bailey investigated possible dam sites in and worked closely with state officials commissioned to study the possibility of creating a large reservoir on the Santa Ana itself. By far the most comprehensive of these studies was the 1928 work conducted by William S. Post-- work that was later amplified by Orange County's own consulting geologist, E.K. Soper.

Drawing on monies allocated by the California legislature in 1927 and apparently matched by local agencies, Post gathered a tremendous amount of geological data on the watershed, all of which was published for public perusal. He also developed a complete plan for flood control on the Santa Ana River. The construction of 50 possible structures was considered in a lengthy report he prepared with the assistance of Paul Bailey in Orange County, A.L. Sonderegger in Riverside County, and George Hinckley in San Bernardino County (Post 1928:Acknowledgements). Post adopted the premise that any flood control system erected within the watershed would also address the need for water conservation. In fact, he wanted to capture flood waters for later water conservation use, and never assumed that one task precluded the other. The report stated that only dams in the mountainous portion of the watershed should be true flood control dams, equipped with permanently opened gates (Post 1928:29).

The central feature of Post's watershed study was the examination of 12 possible dam sites within the Lower Santa Ana Canyon, one of which would have to be the basic flood control structure along the main stem of the Santa Ana River. These 12 sites, located where the local topography was conducive to dam construction, were judged on their geological merits. As Post was careful to point out, all of the possible sites had serious drawbacks, such as proximity to fault lines and the poor quality of the rock, which was generally soft and folded. The middle sites in the canyon, Nos. 1 through 4, were summarily dismissed because they either crossed or were too close to the Whittier fault. With Sites 1 through 4 eliminated, the remaining options were dam sites at either the upper or lower ends of the canyon. Both of these areas, separated by four miles, had significant deposits of blue shale, which was considered the best locally-available bedrock support for a large dam.

The locations at the upper end of the canyon, Nos. 5 through 7, were considered less desirable than those at the lower end (Nos. 8 through 12) because the upper end sites were dangerously close to the Chino fault. The Prado site (No. 7) in particular was ruled out for this reason. Even though the Chester site (Nos. 5 and 6), located about 2000 feet below it, had the best dark blue-gray shale deposits in the area, Post also considered it too close to the Chino fault. By Post's first reckoning, the best dam sites within the canyon were the lower three, Nos. 10 through 12 (Post 1928:252-61).

In a supplemental report dated to December 1928, Post altered his opinion somewhat by providing a series of options for dam sites. He rechecked three of the 12 dam sites, Nos. 6 (Chester), 7 (Prado), and 12. Out of these, Post identified the two best options as Nos. 6 and 12, located at opposite ends of the canyon. Finally, he made his choice for the best, which was No. 12, located at the lower end of the canyon (Post 1928:265).

The alternative locations discussed by Post soon came to be known by a confusing array of terms. Post himself identified many of them by names that he borrowed from the closest rail siding along the Atchison, Topeka & Santa Fe line that hugged the course of the river through the canyon. Site No. 7, at the upper extreme of the canyon, thus became known as the Prado site, since it was close to the small community of that name; Site Nos. 5/6 were identified as the Chester site (Figure 3.2). At the lower extreme of the canyon, Site No. 12 was referred to by Post as the "Oil Well Site" (Post 1928:60-61), but this name did not stick. It soon became known as the Esperanza site, after the closest rail siding of the same name (Figure 3.3).

To confuse matters more, the dam and reservoir proposed for any of the locations within the canyon were often referred to as "Prado" in Post's geological report and the reports that followed. With the popularization of the Chester and Esperanza sites, these two locations became known as the Upper and Lower Prado sites, respectively (Post 1928:20). To complicate matters further, the "Upper Prado Reservoir" could refer to either the Prado site itself (No. 7) or the Chester site (Nos. 5/6) immediately below it (Post 1928:74).

The costs of building a dam at either the Chester or Esperanza site were explored by Post, who favored these two sites because they had blue shale across the canyon floor. It was estimated that a Chester site dam would have to be 93 feet high to hold back a flood capacity of 180,000 acre feet. The cost of this dam, including land purchases and transportation artery relocation, was computed to be $7,600,000. A dam at the Esperanza or "Oil Well" site would have to be both longer and higher (155 feet high) to contain the same quantity of water. The cost was comparably greater: $11,800,000 (Post 1928:60-61). With the danger of earthquakes so prominent, it was assumed that a dam at either location would have to be earthen.

After exploring the different dam site options of the canyon, Post made his final selection for Site No. 12, which soon became known as the Esperanza or Lower Santa Ana Canyon site. In addition to this large structure on the main stem of the river, he also recommended a series of reservoirs along the upper Santa Ana and on Mill Creek in San Bernardino County, channel improvements around the city of San Bernardino, and channel improvements from Prado Dam to the sea (Post 1928:18).

Post included within the report all the information he could gather on the hydrology of the Santa Ana River system. His calculation of the canyon water underflow beneath the river and above the bedrock, as registered at the Prado USGS gauging station, was 1.4 second-feet (Post 1928:181). Little was made of this fact in the Post report, but it would later play a crucial role in the controversy between flood control and water conservation.

As a result of Post's study, only the Chester and the Esperanza dam sites were seriously considered by Bailey and his staff in their 1929 report. The OCFCD consulting engineer, E.K. Soper, obviously had access to Post's report, since he used Post's nomenclature in identifying possible dam sites. Sites 6 and 7 in the upper canyon were considered good, as were Sites 10 through 12 in the lower canyon. Finally, in a supplemental report, Soper re-examined the rock beds of what he considered the three best sites: No. 6 (Chester), No. 7 (Prado), and No. 12 (Esperanza). Of these three, Soper determined that the best two were 12 and 6; and the best single location was No. 12 (Soper 1928).

FIGURE NOT AVAILABLE

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Figure 3.2. Location of the Prado Dam and Chester Dam Sites (After Post 1928: Map 1)

FIGURE NOT AVAILABLE

This item has been removed from the formal documentation for this structure because:

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Items protected by current copyright law may include--but are not limited to--photographs, prints, drawings, letters, maps, unpublished manuscripts, photo albums, theses, dissertations, books, and periodicals.

Figure 3.3 The Esperanza Dam Site or Dam Site No. 12 (After Post 1928: Map 1)

In addition to the Post and Soper reports, Bailey helped coordinate other pertinent studies at both the county and state level. Ground water studies in the canyon, conducted in 1928 by the State Department of Public Works, Division of Engineering and Irrigation, reported that no outlet could be found for groundwater in the Prado Basin other than the channel of the Santa Ana through the canyon. These studies concluded that dam sites at either the upper or lower canyon locations were adequately impervious to water and were capable of holding back a flood of approximately 180,000 acre-feet, as specified in the OCFCD flood control plan. These studies, however, did not specify which of the sites might be the best (Bookman and Baker 1949:6; Elliott et al. 1931:37).

All of this discussion led to some controversy over which of the two preferred sites should be chosen. The advantages and disadvantages to both were aired in the months before the Bailey report was published. Following the lead of the two previous geological studies, Bailey chose the Esperanza site in his final report. Nonetheless, he was concerned enough about the controversy to defend his selection with another paper submitted to the OCFCD on the same day he filed his official report, April 30, 1929 (Bailey 1929c).

The final criterion of site selection was the issue of costs. The Chester dam site would require a structure just 93 feet high to contain a reservoir of 180,000 acre feet, whereas the Esperanza site would require a more expensive dam 155 feet high (Elliott et al. 1931:35). Alternatively, the Esperanza dam site was located in Orange County, which would significantly reduce the tax complications expected from a dam site in the Prado Basin, located in Riverside and San Bernardino Counties (Bailey 1929b).

The Bailey report, which has been preserved in its draft and final versions (Bailey 1929a; 1929b), was an exhaustive treatment of flood control and water conservation problems in the watershed. Bailey proposed the construction of eight small dams along the river's tributaries, as well as the purchase of land along the river channel from Esperanza to the sea so that the reservoir outlet channel could be widened (Bailey 1929b). He noted that the existing channel could only hold a maximum flow of 6000 second-feet without some form of enlargement (Bookman and Baker 1949:5).

The major feature of the report were the plans for a dam in the Lower Santa Ana Canyon. Bailey apparently omitted the totally undesirable sites and renumbered the rest; the Prado site was now called No. 1, the Chester site, No. 2, and what would later be known as the Esperanza site, was simply referred to as the "Lower" site (OCFCD 1928, 1929a). In order to store a capacity of 180,000 acre feet, the Esperanza dam would have to be 155 feet high and 950 feet thick at the base. The stability section of the dam could be formed with the sand and gravel from the local stream bed. The upstream side of the stability was then to be reinforced with a concrete core wall, which would in turn be covered by another layer of sand and gravel. The upstream face of the dam would then be paved with hard rock to resist any wave action in the reservoir. To allow for flood outlets during construction, 25-foot diameter tunnels lined with concrete would be excavated through the north abutment (Bailey 1929b:61).

The reservoir created by a dam at the Esperanza site would effectively fill the Santa Ana Canyon, with the headwaters of the reservoir located just above the head of the canyon (OCFCD 1929b). Even though no water was to be permanently stored behind the dam, it was proposed that the OCFCD would purchase all the land within the canyon. The Santa Ana River channel downstream from the dam was also slated for acquisition, so that it could be diked and baffled for groundwater recharge and flood control. Bailey estimated that a dam at the "Lower" site would cost $11,802,300, with the total watershed project estimated at $16,500,000 (Bailey 1929a).

The selection of the Esperanza dam site was controversial, and certainly had its detractors, who noted that a dam at the Chester site would cost less money to build (Elliott et al. 1931:35). Bailey justified his selection of the Esperanza site by arguing that a dam at Chester would periodically flood the Prado Basin itself and thus lead to basin siltation. This, it was feared, might clog the Cucamonga basin springs that fed the Santa Ana in the summertime, adversely affecting the total volume of water that would reach Orange County. The Bailey report also noted that if Prado Basin flood waters were backed up at the Chester dam site, reservoir water might percolate through some yet undiscovered outlet through the Puente Hills or the Santa Ana Mountains. There was also the vague fear that the Chester dam, located in Riverside County, would somehow fall under Riverside County control through taxation (Elliott et al. 1931:11, 35-36).

The Bailey Plan, consisting of a river dam at Esperanza and eight smaller constructions on adjacent tributaries, was put before the voters of Orange County in June of 1929. The total cost of the package was $16,500,000, which was to be raised by authorizing a bonded debt. The controversy over the dam site and the proposed cost of the project had its effect upon the voters. The proposal was rejected by a narrow margin in the election of June 25 (Bookman and Baker 1949:6; Elliott et al. 1931:5; *Orange County Register* 1938a). With the defeat of his plan, Paul Bailey was ousted from his post of OCFCD chief engineer (Bookman and Baker 1949:8), and county officials began working almost immediately on another proposal.

The 1931-1935 Plan

Orange County officials realized that every year they postponed a decision on the dam, their options would become both fewer and more expensive. Since the last major flood, in 1916, the population of the county had more than doubled. Most of the new inhabitants had no personal knowledge of the areas susceptible to flooding, and citrus groves continued to expand into low-lying areas adjacent to the river banks. The river was even being encroached by urban development, its channel narrowed by levees and bridges. The lower channel was reduced to a width of 300 feet, with a carrying capacity of only 6000 second-feet. Since the 1916 flood carried an estimated load of 44,000 to 45,000 second-feet, this discrepancy was the spur for a new plan (Elliott et al. 1931:8; Post 1928:18).

Paradoxically, as development began to encroach on the river, hemming the channel, there was an increased need for a wider channel to aid the spread and percolation of water entering the county from Prado Basin. Far more water was being pumped out of the ground than was being put back in; the water table, about 23 feet below surface in 1898, had dropped to about 116 feet in 1930 (Elliott et al. 1931:9). There was an urgent need for both flood control and water conservation, and the first step had to be the construction of a dam.

After the rebuff of the Bailey Plan, OCFCD laid the groundwork for a new proposal carefully, beginning with a new geological study of the Santa Ana Canyon dam sites. George D. Louderback, professor of geology at the University of California at Berkeley, was commissioned to re-investigate these sites and make recommendations for another dam. By this time, the dam sites had been re-numbered so that the Prado site was now Site No. 1, and the Chester site, No. 2.

Louderback determined that any proposed dam, especially if it was to be a rigid dam, would have to rest on a foundation of Tertiary sediments, especially shales; the lower Santa Ana Canyon, while suitable for an earthen dam, was not bordered by rocks that would be suitable for a rigid dam. The rocks of the Esperanza site were too folded and potentially too porous. Louderback determined that the best dam sites were located in the upper portion of the canyon, and he designated the Chester site, with its bed of shale, as the best of all

(OCFCD 1929a; Louderback 1930). He also examined the Prado site (Site No. 1), just 2000 feet north of the Chester site and now the location of the present Prado Dam. He did not consider this location as suitable as the Chester site, primarily because of the variability of the rock layers in the canyon walls and the possibility of abutment slump and seepage around and under the dam.

Armed with a geological report that clearly recommended the Chester site, the OCFCD appointed a board of engineers in 1930 to work up a new plan. This engineering board was comprised of G.A. Elliott, B.A. Etcheverry, and Thomas H. Means, all from San Francisco (Bookman and Baker 1949:7). Their first task was to gather new information on the flow of the Santa Ana and the flood of 1916 so as to design a dam that would contain a similarly destructive force (Elliott et al. 1931:5-6). After compiling pertinent information on the river flow, Elliott, Etcheverry, and Thomas declared their preference for the Chester site, as recommended by Louderback. The engineers felt that underground flow into the Prado Basin would not be affected by flood siltation. They also suggested a close cooperative arrangement between the OCFCD and the local Orange County irrigation companies that already had a vested interest in the basin (Elliott et al. 1931:47; OCFCD 1931a).

Etcheverry finished the preliminary plans for the Chester site dam by 1931 (Etcheverry 1931). The dam was to be an embankment construction, anchored to a solid foundation of shale along the abutments and 60 feet below the river bed. The plans called for an underground water cut-off wall consisting of concrete sheet piling extending 60 feet through a matrix of sand and gravel to a solid base of shale below. This concrete sheet piling would be pressure-grouted to ensure water-proofing (OCFCD 1931d). It was not considered essential that the pilings be water-proof all the way to the rock foundation below the dam, although plans were made to ensure that the dam was impervious at the abutments (Elliott et al. 1931:18).

The dam itself was to attain a height of 92 feet above the stream bed (Elliott et al. 1931:18), or 547 feet above sea level. It would have a sand and gravel base, reinforced by a concrete core wall, with impervious material adjacent to the core wall. This would be followed by another layer of sand and gravel, followed by a cement-grouted rock rip-rap facing the reservoir (OCFCD 1931d). To replace the natural flow of the Santa Ana River, a permanently opened outlet was proposed at river grade level. Identified as the "conservation outlet," this outlet was designed with maximum discharge of about 2000 second-feet when the water reached a level of 503.5 feet (Elliott et al. 1931:14).

The highwater mark of this projected reservoir was to be 532 feet above sea level (OCFCD 1931d). At 503.5 feet, a siphon flood control outlet north of the dam on the west side would begin to flush water through a series of conduits under the dam to the Santa Ana channel downstream. This siphon had a projected maximum capacity of 3350 second-feet when the reservoir height reached 532 feet. Combined with the water released from the open outlet at the base of the dam, a total of 4400 second-feet could be discharged if the water level was at 503.5 feet. A total of 5790 second-feet would be discharged at level 532 feet (Elliott et al. 1931:14,18-19). It was felt that this series of releases could handle almost any flood, and still not overtax the estimated 6000 second-feet carrying capacities of the channel downstream from the dam.

In the case of an extraordinarily large flood, the 1931 plan called for an emergency spillway that would be opened when the level of the flood waters reached a point about five feet below the crest of the dam. At that time, the emergency spillway was to carry a maximum capacity of 100,000 second-feet. This emergency feature was to be combined with an emergency bottom gate with a maximum capacity of 10,000 second-feet (Elliott et al. 1931:14).

The dam proposed by the 1931 plan would have a holding capacity of 180,000 acre-feet, with allowances for siltation up to 12,000 acre-feet. It was believed at the time that this reservoir would contain the greatest flood that could realistically be expected, a flood that would be two and one-half times greater than the 1916 disaster. It was designed so that, failing a flood of extraordinary proportions, the release rate of flood water would not exceed the rate of absorption in the channel below. Elliott, Etcheverry, and Means estimated that the dam itself, the purchase of reservoir lands, and the relocation of transportation arteries, would cost an estimated $7,215,397 (Elliott et al. 1931:14-19), a significant savings over the proposed cost of the 1929 dam and reservoir.

The engineers made a number of other recommendations in their 1931 report. They suggested acquisition of a channel 500 feet wide, from the proposed dam to the Yorba bridge. The following segment of the channel, between the Yorba bridge and the north line of the Newbert District, would also be bought and the surface prepared for maximum water spreading and percolation. The remainder of the channel to the sea, unessential to percolation, was to be bought to ensure the unimpeded flow of excess flood waters. The document also made provisions for other, much smaller reservoirs to complement flood control on the Santa Ana. Dams were planned for a number of small tributaries within Orange County itself: the Santiago, San Juan, Carbon, and Brea Creeks, and the Fullerton Drainage (Elliott et al. 1931:20-33).

The 1931 plan was comprehensive. In addition to plans for the dam, there were provisions for the acquisition of the reservoir basin itself. Plans were drawn for the relocation of various transportation arteries within the basin, such as the Atchison, Topeka & Santa Fe Railroad, the Santa Ana Canyon Road, the Aubumdale Bridge, and the Chino Creek Bridge (OCFCD 1931c). The whole basin was mapped, highlighting the Durkee Ditch and local land use (OCFCD 1931c).

Plans were also drawn up for the acquisition of the land tracts within the proposed Prado reservoir basin. A master map was compiled of the 203 affected land tracts, each of which was numbered from "1" in the northwest comer of the proposed reservoir basin, to "203" in the vicinity of the proposed dam at the Chester site (OCFCD 1931b). This numbering system was almost identical to that used by Orange County officials in their first study of land tracts in the Prado Basin in 1925.

On the basis of information compiled for the Prado Basin, the OCFCD apparently dispatched appraisers to assess the property value, both land and buildings, of each tract. Unfortunately, no record of these appraisals has survived, but they are alluded to in some of the later correspondence between property owners and the U.S. Army Corps of Engineers (CoE). As one property owner later complained, the first OCFCD assessments, conducted by local land appraisers, were much higher than the later 1936 appraisals (Lillibridge 1938). Although an exact year for the first series of appraisals has not been discovered, it probably dates to this time.

Even at the 1931 planning stage, OCFCD was anticipating the changes they would make to the Prado Basin in order to maximize the recovery of ground water. Long-range objectives of the OCFCD were to eliminate unnecessary brush from the basin to reduce water loss to plant transpiration, and discourage agricultural activities in the basin to reduce water loss from evaporation. Maps were drawn up identifying the brushy areas of the basin and irrigation lands (OCFCD 1931c). At that time, the major brush areas within the basin were located at the headwaters of Mill Creek, some of the smaller tributaries of Chino Creek, and a large area along the Santa Ana River itself; irrigated lands clustered adjacent to Mill Creek, between the Pomona-Rincon Road and Chino Creek, in the vicinity of the old Durkee Ranch, and in a large area south of the Santa Ana.

The OCFCD plans for the reservoir led to some tension between Prado Basin residents and Orange County water interests. The tension remained muted, since very little work was actually undertaken; the new plans had not yet been approved by the voters of Orange County, who would have to pay for the project. It appears that the only work actually conducted at the Chester dam site was a series of test holes dug along the axis of the proposed dam (OCFCD 1931d).

In the meantime, friction from other sources increased between Orange County and upstream water interests, and it was probably these tensions that postponed resolution of the 1931 plan for four years. In 1932, Orange County finally pulled out of the Tri-County Water Conservation Association, which was a prelude to the "Irvine Case," a suit filed by the Irvine Company of Orange County against the old Tri-County Water Conservation Association at the end of 1932. This suit, which dragged out for 10 years, was later enjoined by the OCFCD. The case eventually led to the creation of all of the present water associations within the three-county area: the Orange County Water District, the Riverside County Flood Control and Water Conservation District, and the San Bernardino Valley Water Conservation District. The story of how this case developed is recounted briefly below.

One of the largest landowners in Orange County, the Irvine Company, headed by James Irvine, had long been concerned about the loss of water to spreading and percolation at the stream cones at the base of the San Bernardino Mountains. This concern was brought to a head in 1931, when the California legislature apportioned money to increase the extent of the spreading. Irvine commissioned his own engineer, C. Roy Browning, to conduct a study of the practice and its impact on Orange County water interests. About the same time, the OCFCD also became concerned. In 1931, the district commissioned their consulting engineer, G.A. Elliott, to recommend what Orange County should do about the matter (Hinckley 1944). Elliott's report in June of 1932 recommended that Orange County should:

> not only not participate in the proposed spreading plan in the Upper Basin, but should prevent, if possible, any further conservation above the lower [Santa Ana] canyon until equitable agreement has been agreed to by all parties in interest (Hinckley 1944).

Based on these recommendations, Orange County withdrew from the Tri-County Water Conservation Association in the summer of 1932. This was followed, in November 1932, with a suit filed by the Irvine Company against the Association in the federal court in Los Angeles, both on its own behalf and in the interest of groundwater recharge in Orange County (Hinckley 1944; Scott 1977:222). On this basis, the suit was later assumed by the OCFCD.

In response to all this, the Orange County Water District was created in June of 1933 by act of the California legislature to manage groundwater conservation in the county and protect Orange County's water rights (Hinckley 1944). Paul Bailey was appointed the first chief engineer. Orange County Water District coordinated the work of recharging the county's groundwater, which has since been its primary function (Banks and Halatyn 1971:7,11; Bookman and Baker 1949:8). The District has gradually assumed greater control over this task from the various Orange County-based water companies that preceded it (Nick Richardson, personal communication 1989). Historically, the Orange County Water District has only been interested in water conservation or recharge. It has not participated in flood control (Richard Runge, personal communication 1989).

Probably because of the complications created by the Irvine Case, the 1931 Plan, based on the recommendations made by Elliott, Etcheverry, and Means, was not put before the voters of Orange County until 1935. In its final form, the plan called for 11 different projects-- nine dams and two conduits-- for a total estimated cost of $11,600,000. The Santa Ana dam at the Chester site comprised most of this amount-- just over 7 million dollars (OCFCD 1935). On October 21, an election was held on a bond issue to raise this sum of money. The plan was defeated. On December 19, another bond issue for 6 million dollars was voted on to finance various flood control projects in connection with the Federal Work Relief Program, and this measure failed as well (Bookman and Baker 1949:8).

The 1931 Plan failed because Orange County's water interests still feared that a dam at the Chester site and a reservoir in the Prado Basin would adversely affect their surface water rights below the dam. In 1935, they were less concerned about siltation in the basin itself, than about groundwater flow below the dam. The 1931 Plan did not address underground water flow at the dam site, or what would be done about it if the dam were built with concrete sheet pilings that would make the ground beneath the dam largely impervious. This was something of a problem, since it had previously been estimated that the groundwater flow passing the dam site was an estimated 1.4 second feet (Bookman and Baker 1949:8; Post 1928:181). In 1935, it would appear that water conservation had successfully blocked flood control.

The 1936 Flood Control Act and a New Plan

Just one month after the Elliott, Etcheverry, and Means Plan was voted down in Orange County, the Orange County Board of Supervisors, in their capacity as directors of the OCFCD, made a formal and unprecedented visit to a meeting of the Riverside County Board of Supervisors in November 1935. There they filed application for the construction of a flood retarding basin in the Prado Basin. The visit, they said, was not considered a legal necessity, but was rather a courtesy call to state their intentions. The Riverside County Board approved the application, which was based on the "Elliott Plan" of 1931 for flood control. Years later, officials in Riverside County would insist that the project's more controversial water conservation measures were not discussed at this meeting, which concentrated mostly on the problems of relocating roads and highways (Bookman and Baker 1949:11). Whatever was discussed, it was clear that Orange County had every intention of pushing through yet another flood control and water conservation plan for dealing with the Santa Ana River. This time, they would go to the federal level for assistance.

Orange County officials, through their Congressmen in Washington, were instrumental in including the proposed Santa Ana dam and reservoir in the 1936 Flood Control Act, which allotted over $300 million to 270 flood control projects in 31 states (U.S. Army Corps of Engineers [CoE]1939:9). This Act of June 22, 1936 (Public No. 738, 74th Congress, Title 33, USCA, Section 701 et seq.) declared that flood control was, "the proper activity of the Federal government, in cooperation with the states, their political subdivisions, and localities thereof." As pertained to the Prado Basin, the act specified that local work was to be for, "Santa Ana River, California, construction of reservoirs and related flood control works for the protection of metropolitan areas in Orange County" (USA 1946:4). The act specified money for flood control work along the Santa Ana, but no direct provision was made for water conservation (Bookman and Baker 1949:9).

The 1936 Flood Control Act, while declaring the Federal government's intention to involve itself in local flood control, fell far short of assuming the full responsibility for the project. According to the terms of the act, no federal money was to be spent on construction until either state or local agencies fulfilled three prerequisites. The first was to provide, without cost to the federal government, all lands, easements, and rights-of-way needed for both the dam site and the reservoir. The second was to hold the United States exempt from all damages that might result from any construction work. The third was a commitment by state or local agencies to maintain and operate all flood control works after their construction (Beard 1941).

After reviewing the implications, the Orange County Board of Supervisors resolved on October 6, 1936, to fulfill its responsibilities as outlined in the act (Beard 1941). A month before, the first $50,000 had been allocated to the U.S. Army Corps of Engineers, Los Angeles District, for the preparation of plans for what would later be Prado Dam (Bookman and Baker 1949:9). With the passage of the 1936 Flood Control Act and the Orange County response, there commenced a period of close cooperation between the OCFCD and the CoE, whose task it was to construct the dam. A December 22, 1936 resolution of the OCFCD empowered M.N. Thompson, OCFCD flood control engineer, to begin work on a report detailing the project costs to be borne by Federal government and the OCFCD.

Before the conclusion of 1936, this new effort resulted in a series of maps detailing land tracts within the Prado Basin. The numbering system used in 1925 and again in 1931 was completely revised. From a comparison of the two systems, it would appear that the OCFCD planned to acquire the lower basin before even identifying and numbering the tracts that might be impacted in the upper portion of the reservoir. Preliminary plans were also made for the relocation of Prado basin highways and railroads (OCFCD 1936).

The CoE published the first preliminary plans of the Santa Ana River dam on April 15, 1937. The report stated that the, "Prado Retarding Basin is primarily for flood control, with water conservation secondary" (Bookman and Baker 1949:9). The reservoir proposed for the dam would contain a total of 180,000 acre-feet: 54,000 for conservation and 126,000 for flood control, which included 12,000 for siltation. The initial plans called for one 4-by-8 foot ungated opening at river level, which would be used to release reservoir water for Orange County water conservation (Bookman and Baker 1949:9). In spite of these initial plans, two ungated openings, each 66 inches in diameter, were actually constructed.

Shortly after the CoE issued its preliminary report, M.N. Thompson filed his report with the OCFCD, on June 7, 1937. The Thompson report was a scaled-down version of the "Elliott Plan" and covered the land acquisition and highway and railway relocation costs of eight different projects that were to be coordinated with the CoE. The cost to be borne by the federal government was calculated at $12,748,000, while the costs to Orange County were put at $2,500,000 (Thompson 1937). Orange County money allocated for the Prado Reservoir was an estimated $961,300. The bond issue to raise the full $2.5 million was quickly brought before the voters of Orange County and passed on July 27, 1937 (Beard 1941; Thompson 1937), the first time a massive flood control measure had been approved by a county-wide vote.

By the terms of this 1937 bond issue, the site of the dam on the Santa Ana River was left to the discretion of the CoE (*Orange County Register* 1938). Even before this, however, available records indicate that the CoE (and possibly the OCFCD before them) had lost interest in the Chester site. It would appear from the re-drafted OCFCD maps of the Prado Basin dated 1936, that the Chester site had already been abandoned in favor of "Damsite No. 1," also known as the Prado site, located 2000 feet north of Chester. It is important to note that the OCFCD did not relinquish all interest in the details of dam construction. The OCFCD continued to work up plans for particular parts of the dam until the final plans were approved in 1938. The County was often able to get the CoE to modify small details of the dam in favor of some increase in water conservation (OCFCD 1938).

The 1938 Flood and Flood Control Act

By far the greatest spur to flood control along the Santa Ana, one that temporarily ended all debate between flood control and water conservation, was the massive flood of 1938. In a series of storms that buffeted southern California between February 26 and March 3, unusually high precipitation fell during a period of unusually warm weather in the mountains. A tremendous amount of debris washed down by the rain clogged up the mountain reservoirs, forcing a great volume of water over dams like that at Big Bear Lake (Scott 1982:3). A wall of water washed down the Santa Ana River Canyon in the San Bernardino Mountains, flooding over the river banks in San Bernardino and Riverside counties. The Prado Basin was extensively inundated as water backed up before surging through the Santa Ana Canyon. Orange County was widely flooded as the Santa Ana flood waters quickly overflowed the river levees and found their own way to the sea.

By the end of March, at least 74 people were known to have died in the flood, 20 were missing, and at least 116 were injured. There was major damage to the local highways, roads, powerhouses in the upper Santa Ana Canyon, and railroads. The losses to the local citrus groves was massive, with residual damage caused by the scouring of the top soil and deposition of poorer eroded materials (U.S. Department of Agriculture 1938; Rogers 1941). The 1938 flood was thoroughly documented by the CoE, which compiled several notebooks of photographs showing flood damage throughout southern California. The destruction left by the Santa Ana River, from San Bernardino to Orange County, was also recorded. Aerial views of the Prado Basin taken shortly after the flood graphically illustrated the level of destruction (CoE Miscellaneous 1938a, 1938b).

In the aftermath of the flood, Orange County was galvanized into pressing Congress for greater speed in addressing the urgency of flood control. So was Riverside County. On May 3, the Riverside City Council petitioned the CoE for flood control measures along the Santa Ana River. Flood control was also strongly supported by local Congressman Harry R. Sheppard (Scott 1982:12).

All of this clamor contributed to the 1938 Flood Control Act, which was an umbrella for another series of flood control projects in 19 states, and preliminary studies for work in another 345 localities. The Act passed on June 28, 1938 (Public No. 761, 75th Congress, Third Session, Ch. 795, Title 33, USCA, Sections 701 a-l et seq.), and was budgeted to cost $375 million. The Act authorized the federal government to acquire any lands needed for the completion of construction projects authorized by the 1936 Act. The United States was to assume this responsibility from the local agencies previously entrusted with this task. For any costs already outlaid, the local agencies were to be reimbursed only for direct costs, not indirect or speculative damages. The United States was also authorized to pay for any highway relocation (CoE 1939:9; USA 1946). The reimbursement provision of the 1938 Flood Control Act caught the OCFCD by surprise, for the district had already begun to purchase the Prado Basin tracts needed for the dam reservoir.

OCFCD Land Appraisal and Acquisition, 1936-1939

Within a month of the passage of the 1936 Flood Control Act, the OCFCD had appointed a board of appraisers to determine the value of every tract of land in the Prado Basin so that the OCFCD could forecast with some accuracy the amount of the bond issue needed in 1937. Comprising the board were three Federal Land Bank appraisers from Berkeley: W.P. Stanton, G.F. Meredith, and J.N. Tate. They began work in the Prado Basin on July 16, 1936, and filed their report with the OCFCD on December 8, 1936 (Beard 1941).

All of 1937 was taken up with preliminary studies, bond issue votes, the arrangements that detailed how the CoE would construct the dam, and the final approval of the appraisal reports (Beard 1941). By February 1, 1938, the OCFCD was ready to begin land acquisition on the basis of the 1936 appraisals. In February, Charles H. Chapman, a respected businessman from Santa Ana, was appointed the right-of-way agent charged with buying land and obtaining easements for the Prado Basin. His salary was $300 a month (*Orange County Register* 1939e). Chapman was not authorized to offer landowners more money than the appraisal figure without the prior consent of the OCFCD board of supervisors (Beard 1941). Thus commenced a roughly two-year period in which the OCFCD acted as land agent for the CoE, purchasing the dam site and the reservoir lands.

Land acquisition had hardly begun when the 1938 flood devastated the basin at the end of February and beginning of March. Much of the physical plant in the basin was damaged and a great deal of property was ruined. Despite the damage, the OCFCD promised to pay landowners on the basis of the 1936 assessments (Beard 1941). The flood made some of the landowners more willing to sell.

The general procedure practiced by the OCFCD in the acquisition of lands was to purchase an option to buy within a certain period of time, and then exercise that option before it expired. This was a more gradual method of acquiring the land, one that raised fewer objections among the residents of the Prado Basin and spread the expenditures over a longer period. Some property owners, of course, were not satisfied with the 1936 appraisal figures. When purchase negotiations broke down, condemnation was the next step. The OCFCD avoided this process as much as possible because it was soon discovered that Riverside County juries generally awarded landowners more money than allowed by the 1936 appraisals (*Orange County Register* 1940).

Among the first lands to be obtained, by both purchase and condemnation, were those that covered the dam site itself. Part of this 500-acre area was purchased by the OCFCD on July 19, 1938. The grantor in this case was the Santa Ana River Development Company, which had a history of cooperation with the OCFCD (Grant Deed 1938). The balance of the land, Tract 335, was 82 acres that belonged to E. Penprase and Isabella Chavez. Tract 335 had to be condemned in September of 1938 (OCFCD 1938). This action made it possible to begin preliminary work on the dam as early as the fall of 1938, when much of the basin had still not been purchased or otherwise obtained.

This haste caused some problems with landowners in the Prado Basin. The OCFCD had made it clear that it would purchase land piecemeal, as the opportunity arose and prices fell within their range. In the meantime, the district would continue to conduct tests and preliminary work at the dam site. The district did not feel committed to buy all the basin lands before starting work on the dam (Johnson 1938). This procedure caused many basin landowners to complain to the CoE, and it led directly to the formation of the Rincon Basin Protection Association in 1938, established solely for protection against the OCFCD (Johnson 1938; Lillibridge 1938).

The progress of the OCFCD in acquiring the basin land can be inferred from a series of colored maps adapted from the official 1936 base map (OCFCD 1936). These maps, unaccompanied by any text, were found in the Third Floor Blueprint Room and Flood Design of the Orange County Environmental Agency, Santa Ana. They provided some insight into the status of land acquisition in the basin in late 1938 and early 1939. From these maps, it would appear that by the end of 1938, most of the basin was already optioned, obtained, or under contest. Properties falling under these three categories will be discussed briefly below.

A large block of land, comprised of the old Durkee Ranch and adjoining properties, was covered by an option agreement made on July 5, 1938. The owner of the Durkee Ranch, the Santa Ana River Development Company, entered into a complex settlement with the OCFCD, whereby the district had a nine-month option on the property, with the right to an extension (Kelton 1940e). It was understood at the time that the Santa Ana River Development Company, a major Orange County water interest, was working in some sort of collusion with the OCFCD (*Orange County Register* 1939e). Option agreements appeared to have been entered into only in instances where it was generally understood that both parties had similar interests: flood control and perhaps even water conservation.

Outright purchases of land were most common along Chino Creek. Here, the standard procedure of purchasing an option to buy, and then buying, seemed to have worked without major hitches. Perhaps the particularly small size of many of the tracts in this area made it more difficult for individual landowners to fight what they saw as inevitable. The fact that many of the owners were absentee landlords was probably a factor in their willingness to sell. Condemnation proceedings seem to have been required for much of the property in Riverside County south of the Santa Ana River, including the townsite of Prado immediately east of the dam site. By April of 1939, condemnation suits were in place against most of the tracts in this area (CoE Miscellaneous n.d.).

Whether the reservoir lands were covered by option, direct purchase, or condemnation, the CoE made it clear to the OCFCD that all lands had to be cleared of human habitation below the taking line. This meant not only the relocation of the local residents, but the physical removal of most of the structures within the basin. In 1938 and 1939, the OCFCD began auctioning the houses and barns left by departing residents. Five-room houses sold for anywhere from $140 to $550; one seven-room house sold for $830 (*Orange County Register* 1939d). More important structures, or structures with a unique past, were identified by name in the local newspaper accounts that covered these events. Among these were the Pioneer School, established in the nineteenth century, the Ashcroft Ranch, the Serrano adobe, the Moreno Ranch, the Pine Ranch, and the Bandini-Cota adobe (Orange County Register 1939b).

The Pioneer School, and especially the fate of its bell, attracted considerable attention. This school, believed to have been built originally on the Mayhew property in the early 1880s, was moved to an acre of ground on the Pate Ranch in 1887. The school was sold at an OCFCD auction in 1940 (*Orange County Register* 1940a), and its subsequent fate attracted enough local attention that OCFCD engineer M.N. Thompson finally arranged for the structure to be sold to a Corona nursing home, where it could be reconstructed (*Orange County Register* 1941). The Prado School was purchased by the Callahan Construction Company of Los Angeles for $500 (*Santa Ana Register* 1938d). Orange County agents bought the abandoned Santa Fe bridge as part of the cost for relocation of the railroad right-of-way; the seven 90-foot spans weighing more than 561 tons were sold as scrap to the Pennsylvania Iron & Steel Company for $3925, on condition that the buyer dismantle and remove the structure by May 15, 1939 (*Santa Ana Register* 1939d). The 500 acres condemned for the dam, including 27 parcels and the entire townsite of Rincon/Prado, was appraised for $47,464, and distributed among 200 defendants (*Santa Ana Register* 1938h).

Mention was also made of even older cultural resources. It was noted that burials probably existed near or even under the Prado Dam, then in the beginning stages of construction. It was believed that a Civil War soldier and an undetermined number of "Indians and Mexicans" were buried in the vicinity of the dam, "at the edge of a mesa on a small knoll near the village of Prado." The Indians and Mexicans were said to have been laborers employed over the years by Raymundo Yorba. All of these graves were unmarked and had been farmed over for many years (*Orange County Register* 1939a).

The Taking-Line Controversy, 1937-1939

OCFCD Engineer M.N. Thompson's report on the Prado Reservoir costs, filed with the OCFCD on June 7, 1937, provided the first discussion of the land acquisition costs in the Prado Basin, based on the results of the 1936 appraisals. In this report, Thompson specified that, at least temporarily, the taking-line of the reservoir should not be higher than the 520-foot elevation line, as indicated on the official acquisition maps dated to December 1936 (OCFCD 1936). Thompson suggested that the OCFCD begin land acquisition below this taking-line (Beard 1941).

It is not clear now whether this 520-foot line was just a temporary measure, or whether the OCFCD really thought they could make some other sort of arrangement to clear the property above the 520-foot line. Since OCFCD land acquisition did not really start until after the 1938 flood, the whole issue lay dormant for about a year, until local landowners began to complain to the CoE about the land acquisition practices of the OCFCD. In a letter dated June 28, 1938, the commanding officer of the CoE Los Angeles District, Major Theodore Wyman, Jr., complained to the OCFCD that he and his superiors in Washington were receiving complaints from residents in the basin about land acquisition that stopped short of the 543-foot elevation of the dam's proposed spillway. Specifically, residents between 520 and 543 feet complained that the OCFCD appeared to be content to flowage rights only, leaving the land itself in private hands. To quell this unrest, Wyman informed the OCFCD that all areas below the 543-foot line had to be obtained in fee (Beard 1941).

Four months later, on October 25, 1938, Wyman advised the OCFCD through Thompson that Prado Basin lands now had to be purchased up to the 556-foot elevation of the dam itself. Apparently it was generally understood that there could be no human habitation below this line, although this policy does not appear to have been etched in stone until 1939 (Beard 1941; Johnson 1939). The CoE and the OCFCD both reaffirmed their commitment to the 556-foot taking-line in a letter to a U.S. Attorney in December 29, 1938 (Morgan 1939).

Then, on March 7, 1939, Major Wyman informed the OCFCD that, for the time being, the district was only to obtain in fee the lands below the elevation of the spillway (543 feet) until the actual taking-line had been determined by the CoE. On March 16th, however, Wyman explained to a confused Thompson and OCFCD that the 556-foot acquisition line was not superseded by the March 7 letter (Beard 1941). Five days later, on March 21, the OCFCD announced that it would take steps toward final land acquisition only for the lands below 520 feet, reserving the lands above 520 feet for another series of actions, to be held in abeyance until the Corps determined what the final taking-line would be. The U.S. Attorney, apparently contacted by the local residents on this matter, complained to the U.S. Attorney General that this confusing situation was unjust to the local landowners (Harrison 1939).

The March 21 decision by the OCFCD, to return the 520-foot taking-line, caused a storm of protest by local landowners in the Prado Basin in the late spring of 1939. Landowners claimed that if they did not bring suit against the government in this matter, the dam would be built above their heads to a height of 556 feet, after which the government would only have to pay damages in case of flood, and not buy the land, as they had promised to do (Morgan 1939). The controversy reached such a pitch that Major Wyman informed Thompson on May 26, 1939, that the OCFCD should now make it policy to buy lands up to the 556-foot line (Beard 1941).

Policy changed again in June. On the 14th, the CoE sent additional instructions to Flood Control Engineer Thompson that the OCFCD was now to purchase all lands below 520 feet in fee, whereas lands between 520 and 543 feet could be obtained in fee or secured through floodage easements. If properties were situated on both sides of the 543-foot line, fee or easement would have to be obtained for the entire property, up to a point not beyond the 556-foot line. It was made explicit policy that no human habitation would be allowed below 556 feet (Beard 1941; Wyman 1939).

By this time, both the CoE and the OCFCD probably felt as though they were working at cross-purposes. The CoE's Los Angeles District and the Chief of Engineers in Washington, D.C., were discussing the possibility of the CoE taking over land acquisition directly from the OCFCD as early as July 1939 (Johnson 1939). The OCFCD, in turn, felt like the middle man with all of the responsibilities and none of the power. To simplify relations with the CoE, on August 8 the OCFCD designated M.N. Thompson as the official negotiator for the OCFCD in all business with the CoE, even though it would appear that he had already filled this position for quite some time (OCFCD 1939).

The issue of the final taking-line was not resolved until September 21, 1939, when the OCFCD was informed that the Secretary of War himself had established the 556-foot elevation as the taking-line, and had outlined the following stipulations for land acquisition in the basin: all lands below 520 feet were to be obtained in fee simple, and all lands between 520 and 556 feet were to be secured through either title in fee or flowage easements (Beard 1941).

The issue may have been settled for the CoE and the OCFCD, but the matter had not been laid to rest for the basin landowners located between 520 and 556 feet, who still felt that the OCFCD had reneged on its promise to purchase all lands below 556 feet. The taking-line controversy did not abate in the months that followed, and the bad feeling that resulted only made it more difficult for Charles Chapman, the OCFCD right-of-way agent, to complete his assignment. Soon it looked more and more likely that the CoE would simply take over the responsibility of land acquisition in the Prado Basin.

Transition to the CoE

On December 15, 1939, Lt. Col. Edwin C. Kelton, who had replaced Wyman as District Engineer in September, informed the OCFCD that the U.S. Engineer Department was, "considering taking over direct acquisition of land, easements, and rights-of-way at Prado Dam and within the reservoir area created thereby under provisions of Flood Control Act, Public No. 761, 75th Congress, approved June 28, 1938" (Beard 1941). As Kelton told the OCFCD, the 1938 Flood Control Act, then over a year old, permitted the federal government to purchase lands needed for flood reservoirs. More pressing matters had kept the CoE from exercising this option before.

Four days later, the OCFCD ordered its employees to cease all land acquisition activities, with the exception of work already underway and three condemnation proceedings already scheduled to come to court in Riverside County (Beard 1941). Charles Chapman, the OCFCD right-of-way agent, had his employment terminated, as did many others -- appraisers, soil technologists, and engineers (Kelton 1940a; *Orange County Register* 1939e). On January 15, 1940, Kelton asked the OCFCD to remove its largest case, No. 754-M-Civil, from the court calendar so that all data for the trial could be turned over to the U.S. Attorney for adjudication in the federal courts (Kelton 1940a). The matter was a condemnation proceeding against most of the larger basin owners in Riverside County, who were named defendants in the case (Kelton 1940b).

This case, or some spin-off from it, apparently dragged out until 1941, and the OCFCD still had some involvement in the matter (Papers 1941). In all other respects, however, the OCFCD had long disassociated itself from the problems of land acquisition in the Prado Basin. After December of 1939, all remaining problems became the property of the CoE.

CoE Land Acquisitions, 1940-1942

The U. S. Army Corps of Engineers took over land acquisition from the OCFCD at the end of 1939. This simplified the process by eliminating the OCFCD as middleman. It was probably done, too, to placate irate Riverside County residents who frequently complained of irregularities in OCFCD land acquisition. Certainly one of the published reasons for the take-over was to protect the government against future financial problems with irregular OCFCD expenditures and requests for reimbursements. Some of the reimbursements had already been questioned by the government, which complained of the "overhead expenditures" reported by the OCFCD (*Orange County Register* 1939e).

By the time the OCFCD ceased land acquisition in December of 1939, the district had already purchased 80 parcels, or a total of 3205.59 acres, within the basin. Most of these properties had heen purchased at 1936 prices, with the exception of 10 tracts that were bought at slightly greater prices in order to avoid litigation or condemnation proceedings (Beard 1941). Land acquisition was so far along that the OCFCD had already authorized, or was considering the authorization of, land leases on 2200 acres of purchased property, often to the original owners (*Orange County Register* 1939d).

Most of this activity was not seriously inconvenienced when the United States assumed land acquisition. In December of 1939 and January of 1940, the OCFCD flood control engineer M.N. Thompson was directed to turn over all pertinent land acquisition data to CoE engineers. At the insistence of Orange County authorities, the CoE agreed to preserve the existing water rights of the Santa Ana River Development Company, so long as these did not interfere with flood control needs. The CoE also agreed to authorize or guarantee the continuing lease of lands to those original owners who still wanted to use the land for agricultural purposes. The CoE, however, remained adamant that no human habitation could be allowed below the 556-foot line after the dam was completed. The first leases allowed by the CoE were for one year, to be paid in advance; if a leasee's crops were destroyed by flood, then the rent the following year would only be one dollar (*Orange County Register* 1939e). There would be no direct reimbursement for crop damage.

Federal lawyers quickly took over the OCFCD case that had been brought against most of the Riverside County landowners in the Prado Basin. Now identified as "U.S.A. vs the Anaheim Sugar Company, et al.," this case was filed on January 13, 1940 in the District Court of the United States, Southern District of California, Central Division. The defendants were required to file a response to the government's action within 20 days or obtain an extension. Negotiations on this issue were to be conducted through Mr. H.E. Spickard, Chief of the Right-of-Way Subdivision of the Los Angeles District (Kelton 1940b).

Apparently this case resulted in a condemnation, for soon the CoE was contemplating the blanket use of eminent domain to condemn the remaining properties in question and thus prod the other landowners into a negotiated sale. This action was contemplated as early as March of 1940 (Kelton 1940c). H.L. Thompson, special attorney for the OCFCD, urged the CoE to pursue this matter, not only because condemnation speeded up the process, but because it tended to prevent further prosecution by the local landowners against the OCFCD (Harrison 1940).

By May of 1940, 69 tracts had been singled out for condemnation. On the 25th of that month, Lt. Col. Kelton made a formal request to the Chief of Engineers in Washington, D.C., for permission to use condemnation by right of eminent domain to wrap up land acquisition in the Prado Basin. Kelton pointed out that the dam itself was already 60 percent complete, and that land acquisition had to be accelerated. Kelton proposed to sue for all the remaining lands in fee simple, hut if the landowners between 520 and 556 feet would agree to selling flowage easements, that the CoE would settle for that (Kelton 1940e).

It would appear that condemnation proceedings took up the remainder of 1940, and that the government obtained most of the lands that it wanted. Little documentation has been found pertinent to this period. By the time Prado Basin land status reported again, it would appear that the government was in control of the basin. According to a series of untitled articles that appeared in the *Orange County Register* in January 1941, the government was selling more houses and barns in the Prado Basin (Jim Sleeper Collection). By the following month, most of the land had been bought and most of the houses moved, for the CoE warned the few remaining residents of the basin that they had to leave the flood basin in February (*Orange County Register* 1941).

Eight months after the basin had been abandoned by permanent habitation, the OCFCD began to turn land titles over to the CoE. Apparently the first to be submitted were the properties along Chino Creek, which were handed over in October of 1941 (Status 1941). This transfer of title occurred throughout the fall of 1941 and winter and spring of 1942 (Tabulation 1942). Much like the OCFCD before it, the CoE did not bother to obtain title to the extensive lands of the Santa Ana River Development Company in the heart of the basin, since the aims of the company were not incompatible with the flood control measures proposed by the CoE. For this land, the CoE simply obtained a permanent easement and a guarantee that there would be no human habitation within the flood control basin (Kelton 1942).

The arrangement with the Santa Ana River Development Company highlighted the general feeling in Orange County that county interests should retain control over at least some of the lands within the Prado Basin, in order to influence how the area was managed. This was considered essential for the county's water conservation needs, since the CoE was mainly concerned about flood control. At least one engineer with the OCFCD even urged Orange County not to give the government any of the titles of its purchases, since it was believed that the CoE would allow unrestricted plant growth in the basin and so double the water loss to transpiration, estimated at 16,000 acre feet in 1939 (*Orange County Register* 1939c).

One provision of the 1938 Flood Control Act provided federal reimbursement to local agencies for direct expenses involved in land purchases for flood basins. For the Prado Basin work, the government began to reimburse the OCFCD for their expenses in relocating the Santa Fe Railroad, local highways, and public utility lines, at least as early as November of 1939 (*Orange County Register* 1939c). After the CoE informed the OCFCD that the government would take over land acquisition in December, the OCFCD began pressing for payment of all the reimbursements owed to the district. Apparently the OCFCD was told that the district would be paid for these expenses after July 1, 1940 (Kelton 1940e). This apparently was not done, since late 1940 still found U.S. government auditors working over each account the OCFCD had submitted for reimbursement (Beard 1941).

Apparently, so many irregularities were found that in the summer of 1941, the government re-appraised the properties bought by the OCFCD back in 1938 and 1939, to determine what in fact should be paid back to the OCFCD. These appraisals found that the extensive damage left by the 1938 flood had still not been repaired in most cases. Most of the lands examined were abandoned or occupied by tenants under lease to the OCFCD or the United States. The OCFCD complained that the re-appraisals were too low, lower in some cases than what the OCFCD paid to the original owners (Beard 1941). Details are not clear, but the matter was finally settled and the government apparently paid most of the reimbursements to the OCFCD by the end of 1941 (Status of Land 1941). While the reservoir lands were being bought, condemned, or otherwise acquired, the dam itself had been completed.

4. THE CONSTRUCTION OF PRADO DAM

Design Analysis

Hydraulic and Structural Criteria

The design of Prado Dam was regarded as a critical component in the protection of metropolitan areas in Orange County (CA-178-7). The site was ultimately chosen for two major reasons. First, the costs of relocation of highways and the railroad would have been prohibitive for any location at the lower end of Santa Ana Canyon in Orange County. Second, hydrological studies made by the United States Engineer Office determined that the siphon-type spillway required at the lower location would not provide adequate protection. As a result, the dam site was moved upstream to the present location, which allowed the use of an emergency spillway, and posed fewer problems with regard to relocating transportation facilities.

Prado Dam and the Prado Flood Control Basin were designed in accordance with a theoretical computed "design" flood, as outlined in a report titled "Hydrology of the Santa Ana River and Adjacent Coastal Basins." This hypothetical flood was based on a four-day storm in which the maximum rainfall occurred on the fourth day. The precipitation on the fourth day varied from a minimum of four inches to a maximum of 18 inches over a 2264 square mile area. The rainfall on the first three days was 15 percent, 32 percent, and 57 percent, respectively, of the fourth day. The design flood had a peak discharge of 193,000 cubic feet per second with a volume runoff of 275,000 acre feet.

It was determined that the gross flood control capacity at Prado Dam, to meet the stipulated design characteristics, was approximately 224,500 acre feet at the spillway crest. It was intended that the reservoir would be empty and that it would function as a flood control basin only during periods of heavy rain. Apart from the rainy season, the gates would remain open, and the level or pool of water would automatically regulate itself through open conduits during acceptable periods and levels of precipitation. Flood control during early flood stages would also be automatic, in that the size and shape of the basin itself, by allowing the waters to spread within basin perimeters, would provide ample time for the operators to determine the actual flood threat. If it was concluded that flooding posed a serious threat, they would then be able to operate the gates and control the outflow of water.

No special consideration was provided for earthquakes in the design of the hydrology of the dam. The possibility of an earthquake was not unknown, since the major faults in the vicinity were already identified, and the possibility of a seismic event was considered. However, in the opinion of the designers, the possibility of an earthquake occurring when the flood control basin was near its maximum capacity was considered so remote that no special provisions regarding earthquakes were made in the design of the dam.

Foundation Design

The overburden at the foundation site was thought to range from 20 to 40 feet deep (later found to be much deeper), and to consist of numerous layers of sandstone with some strata of shale. The overburden is inclined steeply to the upstream slope, and generally becomes more coarse with depth. The face of the left abutment along the dam axis is sandstone, and the abutment has an overlying layer of sand and gravel. The right abutment has a superficial layer of fine sand, formed by the decomposition of the underlying sandstone. An extensive series of tests was conducted prior to development and issuance of the contract. The evaluation included mechanical analysis of the foundation overburden, shear tests of foundation material, and permeability studies. The permeability tests concluded that as long as a cut-off wall extended through the foundation overburden to the foundation (see Change Orders), no problem would exist. No water solubility tests were conducted. In general, it was determined that no lateral flow or appreciable settlement of the foundation would occur.

Embankment Design

The embankment was to be composed of pervious and impervious areas or zones (Figure 4.1). Much of the latter material was to be obtained from borrow pits, although some was to be stored and reused from the excavation of the spillway. Most of the pervious material was to be obtained from the spillway excavations. Shear tests were run on the impervious borrow pit material, to assess the safety factor regarding the sliding of an upstream portion of the dam. The tests were conducted in accordance with guidelines developed in 1929 by Dr. Charles Terzagi for public roads construction. It was determined that most of the settlement of the embankment would take place during construction, and that little danger with regard to stability was likely. Compaction tests were made "in accordance with methods outlined by Proctor in the August and September, 1933 issue of *Engineering News-Record*" (U. S. Army Corps of Engineers [CoE] 1938c:210).

Some consideration for earthquakes was incorporated in the design of the embankment. In general, recommendations were made with reference to the slope of the embankment and the careful selection and placement of materials to be used in its impervious core.

Hydraulic Design of Spillway and Outlet Works

The spillway consists of an approach channel, an ogee control section, and a discharge channel (Figure 2.2). The discharge channel is sloped to the topography to reduce erosion below the concrete-lined section. The emergency spillway had a designed pond elevation of 556 feet, and a capacity of 180,000 cubic feet per second. The approach channel of the outlet works consisted of an intake with racks, six 7-foot by 12-foot gates, two bypasses, a 90-foot transition section connecting three gates to one conduit, two conduits approximately 590 feet long, a 126-foot long rectangular channel extending from the outlet portal to the stilling basin, a stilling basin, an outlet channel, and a control weir.

Structural Design of Spillway

The spillway is trapezoidal in shape (Figure 2.2). It is approximately 1135 feet long, and ranges from 1000 feet wide at the upper end to 660 feet wide at the lower end. It is detached from the embankment, and is located in a bluff which forms the east (left) abutment. The control section of the spillway is a gravity ogee. On either side of the ogee weir, the channel sides are cantilevered, built on rock, and drained by weep holes. The lower end of the spillway consists of a drop structure designed to direct the flow of water to the streambed below. At the lower end of the drop structure, a crib cut-off was designed to prevent erosion. In effect, the spillway is divided into the following components:

(1) Spillway Ogee
(2) Gravity Side Walls
(3) Cantilever Side Walls
(4) Slabs
(5) Concrete Cut-off Crib.

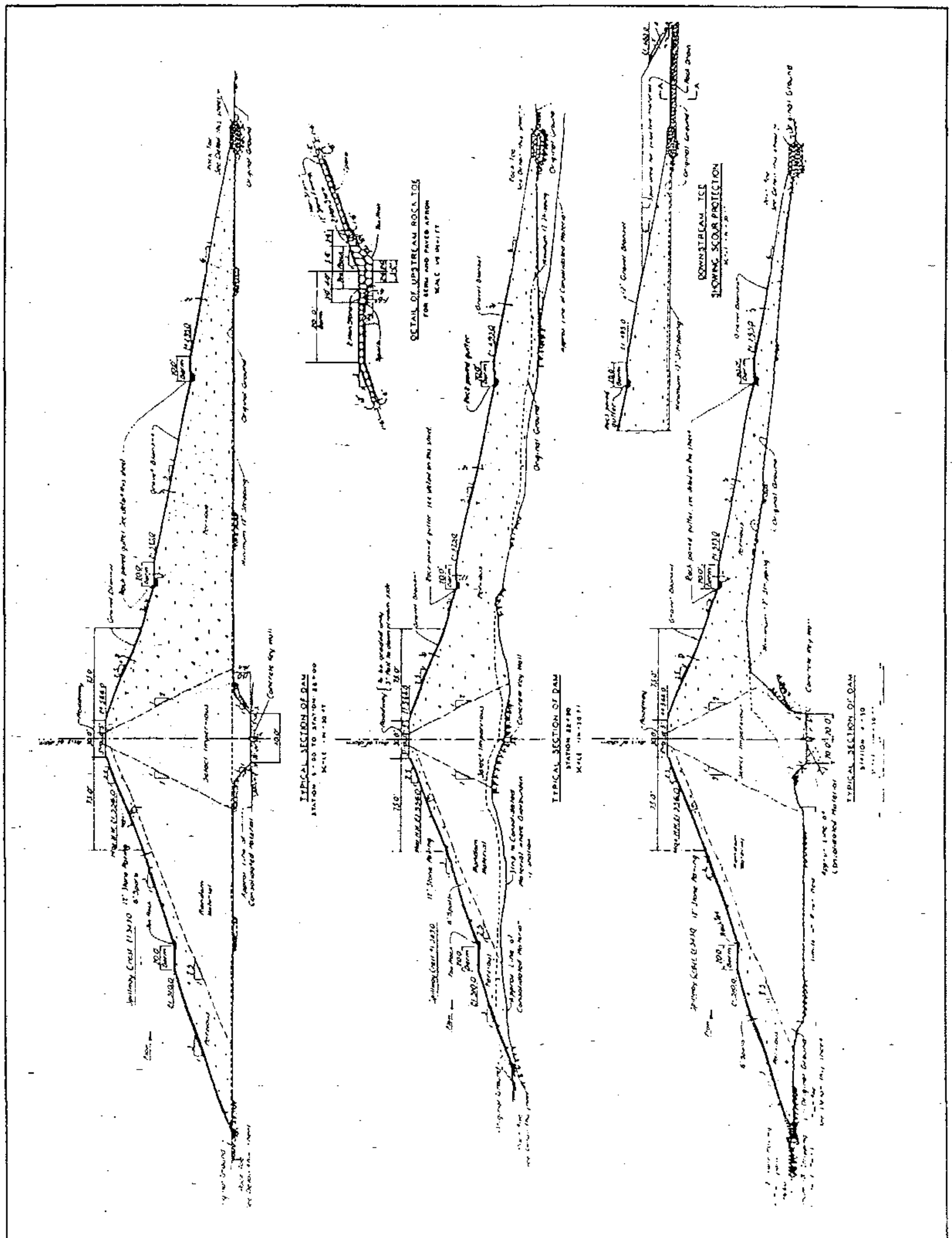

Figure 4.1. Typical Embankment Sections.

Structural Design of Outlet Works

The outlet works are located in the west (right) abutment. They consist of the following elements:

(1) Intake Structure
(2) Control House
(3) Control Tower
(4) Gates and Operating Equipment
(5) Conduit Transition
(6) Outlet Conduit
(7) Outlet Structure
(8) Outlet Channel
(9) Discharge Line for Gallery System
(10) Service Bridge.

The intake structure consists of two gravity-type entrance walls, with invert slab and piers. The sides of this structure contain the uncontrolled conduits and the supports for the trash racks.

The control house, as a part of the control tower, is built of concrete. The roof was designed for a "live" load of 20 pounds per square foot, whereas the floor was designed for a load of 200 pounds per square foot and the weight of the gates as operated under maximum load. Engineering provided for a wind load (vertical) of 20 pounds per square foot, and an earthquake (horizontal) or seismic coefficient of 0.2. The design of the control house was based on a bulletin published by the Portland Cement Association called *Analysis of Small Monolithic Concrete Buildings for Earthquake Forces.*

The control tower was designed of rigid frame construction with concrete columns and horizontal members (Figure 2.4). The tower was planned to carry all of the loads from operation of the control house, and to withstand a comparable earthquake. Included in these computations were the weight and horizontal force of the service bridge during an earthquake.

The gates and operating equipment, including six 7-by-12-foot caterpillar gates, were designed as manually operated with motor-driven drum hoists located in the control room (Figure 4.2). Much consideration was given to the type of gate utilized. Ultimately, it was determined that slide gates would not be readily operahle due to massive hydrostatic pressures, and caterpillar gates were selected as the preferred alternative. These gates had a relatively low friction coefficient, and had the added advantage of being closed by gravity. They also required no recess in the tunnel floor and therefore would not impede the flow of water. The hoists were rated at 55 tons, and were designed for a gate speed of one foot per minute. A manually-operated automatic electric brake was installed to hold the gate in any desired position, and gate indicator lights told the operator the position of each gate. The control station was designed with individual push buttons for each hoist. Electricity was to be provided by power company lines, with a standby gasoline engine generator in reserve.

The outlet channel was designed as an earth channel with a trapezoidal section. The purpose of this unit was to return the controlled or diverted water to the river channel. Included in the plans were a weir (a sill across the channel with retaining walls) and downstream sheet pile cut-offs to eliminate undermining of the weir.

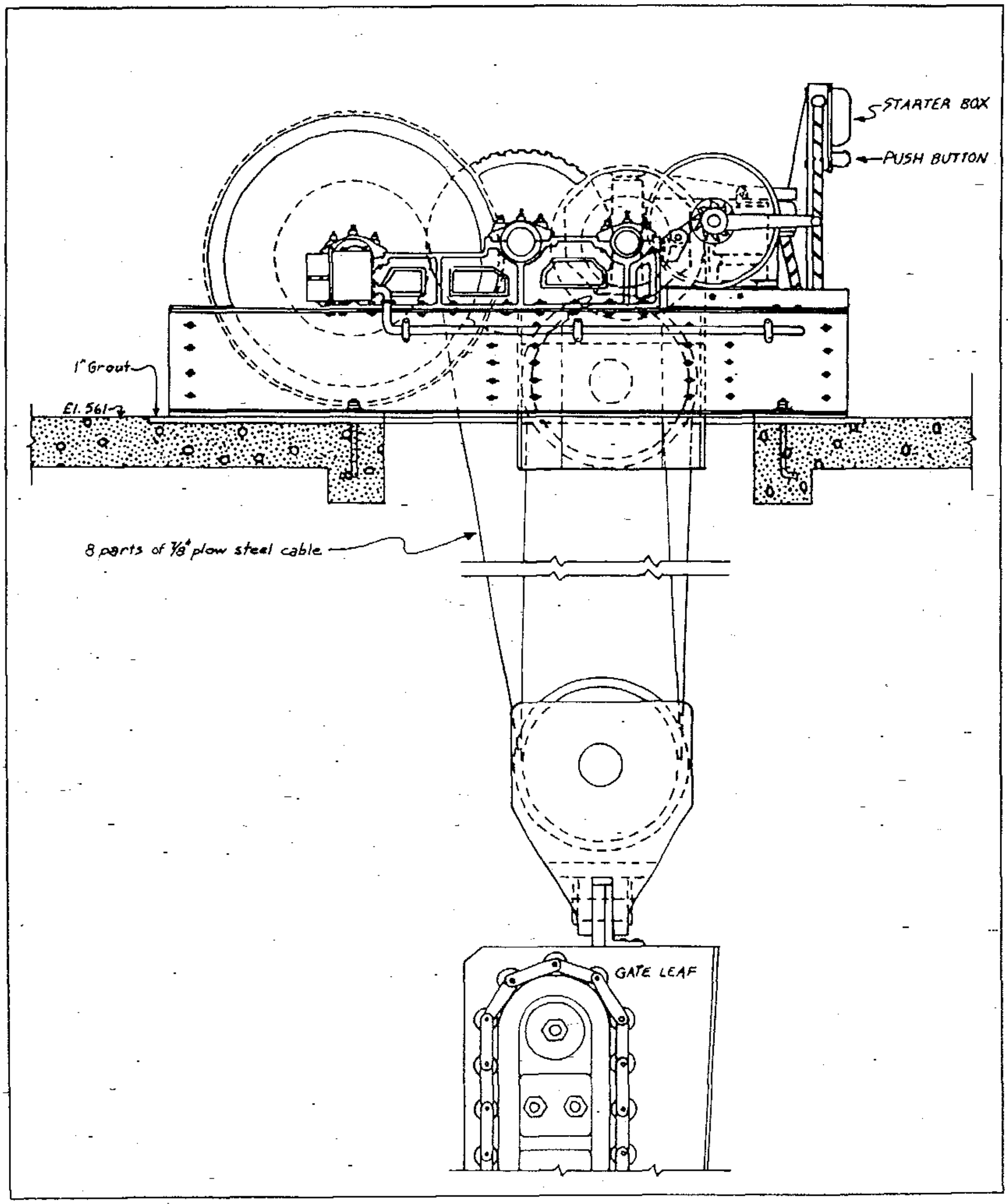

Figure 4.2. Drum Hoist Assembly.

At the request of the Orange County Flood Control District, the plans of a Discharge Line for Infiltration and Gallery System included a 60-inch steel pipe encased in concrete beneath the conduit. The pipe was to be enclosed at both ends until it was needed. It would later prove to be the subject of considerable controversy.

The purpose of the design of the service bridge was to "furnish a structure that would be architecturally pleasing," inexpensive, and earthquake resistant. To serve these objectives, structural steel was used in the construction because it weighed less than concrete. No provision was made for pedestrian walkways since it was anticipated that there would be only limited traffic on the bridge.

Discussion of the Design

The design of Prado Dam is of interest for several major reasons. These are:

Overall Simplicity of Design

This was possible largely as a result of the fact that the dam was to be used only to control the river during flooding episodes. The machinery and technology utilized were not complex, and the plan followed the general design criteria employed in other earth fill dams. The outlet works were, for example, designed to function like those of the Hansen Flood Control Dam on Tujunga Wash, and the spillway discharge channel was much like that of the Conewingo Dam.

The Concrete Outlet Tower and Control House

This is the outstanding and most architecturally and technologically unique feature of Prado Dam. The tower was designed in an unusual open-frame manner, with a self-contained control house above. It was also designed to resist relatively heavy horizontal earthquake effects, and special effort was made to achieve a "pleasing" architectural result.

Use of Design Guidelines

Despite the relatively simple design of the dam itself, considerable attention was given to a justification of the plan with regard to prevailing state-of-the-art technical literature. The War Department, United States Engineer Office, very carefully analyzed the design in a May, 1938 paper titled *Analysis of Design Prado Dam*. Numerous reference sources were cited in this document. The citations are incomplete as they appeared in the text and the sources are not available for reference, but the following were used in the analysis:

(a) *Hydrology of the Santa Ana River and Adjacent Coastal Basin*, dated April 22, 1938.

(b) Local interest group investigations, such as those prepared by the Orange County Flood Control District.

(c) Engineering Bulletin No. 7, 1937.

(d) Eckis, R., *South Coastal Basin Investigation*, California Division of Water Resources, Bulletin No. 45, 1934 et seq.

(e) Freeman, J. R., *Earthquake Damage and Earthquake Insurance.* McGraw Hill Co., 1932:615.

(f) *Bases for Design, Santa Ana River Improvement, Definite Project*, dated April 30, 1938.

(g) Charles Terzagi, *Public Roads*, issue of December 1929.

(h) Proctor article in *Engineering News-Record*, issue of August-September 1933.

(I) Conewingo Dam design in *Engineering News-Record*, January 1932:127.

(j) *Hydroelectric Handbook* by Creager and Justin.

(k) Mannings formula.

(l) Portland Cement Association, *Analysis of Small Monolithic Buildings for Earthquake Forces.*

These sources were consulted and cited in justifying and developing the contract to be issued. By today's standards, these references appear to be remarkably few and lack details. They are, however, reflections of both the overall simplicity of design, and of the relative level of design sophistication and analysis employed at the time of construction.

Model Testing

The comments presented above with regard to the evaluation and analysis of Prado Dam do not imply any contextual shortcomings in the design of the dam itself. Extensive model tests were completed prior to issuance of the contract and final preparation of the plans. For example, a model of the embankment was completed by February 1938. It was built in the U. S. Engineer District Office, Los Angeles, with all materials collected from the dam site. Additional and quite detailed tests, with models, were made for the spillway and to determine the proper rolled fill earth section required. These tests actually continued until well after the Invitation to Bid was issued, and they were subsequently responsible for several change orders in the procurement.

In summary, the design of Prado Dam is best viewed as a relatively straightforward process. Unlike the political arena with associated special interest group lobbying, the economic considerations which influenced the ultimate site selection, and the controversy over the social impacts of construction, the actual design of the dam is comparatively uncomplicated. And with relatively few exceptions, the bidding, award of contract, and actual construction of the dam were to be equally well thought out and brought to a cost-effective and timely conclusion.

The Bidding and Award of Contract

On August 26, 1938, *The Southwest Builder and Contractor* (SBC) announced that construction bids for the "Prado Flood Control Dam Notable for Unusual Design Features" would be received until noon on September 19, at the U. S. Engineer Office in Los Angeles. A notice of bids, along with a detailed list of quantities, had been published in this journal on August 19, and potential bidders were advised that a complete list of specifications was on file at the SBC offices at 168 South Hill Street. The bids were solicited under Invitation No. 509-39-90, dated August 20, 1938.

The SBC article further noted that the original Orange County flood control program was being executed under federal authorization. The original plan had been developed by M. N. Thompson, chief engineer of the flood control district. By 1938, however, jurisdiction had passed to the U. S. Army Corps of Engineers (COE), under the direction of Major Theodore Wyman, Jr., U. S. District Engineer. Captain N. A. Matthias was Military Assistant and Chief of the Engineering Division. G. B. Archibald was his assistant, and preparation of plans for Prado Dam and other flood control projects was under the direction of Deming W. Morrison, Senior Engineer. Captain G. W. Withers was Military Assistant and Chief of the Operations Division.

The SBC carried weekly listings of the contractors who had obtained plans for submittal of bids to Major Wyman. These notices were published on August 26, September 2, September 9, and September 16. By the 16th, nearly 70 firms had obtained the bid package, or reviewed plans at the SBC offices. Ultimately, 87 sets of specifications would be distributed. Although two-thirds of the prospective bidders were from Los Angeles or the immediate vicinity, widespread interest was generated by the opportunity. Two firms from San Diego requested bidding information, and nine firms from northern California, including six from San Francisco, two from Oakland, and one from Sacramento, expressed interest. Two East Coast companies, located in New York and Pennsylvania, obtained plans, and a number of Midwest firms, from Illinois, Nebraska, Colorado, Iowa, and Minnesota, also requested the bid package.

Two sealed bids were requested. The invitation also stipulated a guarantee bid bond, and a performance bond with surety or sureties sufficient to protect the government. Strict wage and labor conditions were made explicit, and each bidder had to document previous or current experience in work similar to that of the proposed project. Each bid was also to contain a statement of the proposed work plant with drawings, charts, and the location of all material yards and plant layout. A chart, in the form of plotted curves, was to detail time in days to complete work, and the percentage completion of each project task in time. Bidders were also to visit the site to acquaint themselves with conditions there, and were further invited to review samples taken from the borings and test pits.

Two modifications were made by the District Engineer to Invitation No. 509-39-90 prior to the final submittal of bids. Addendum No. 1, signed by L. Rosenberg, Executive Officer in the absence of the District Engineer, contained two alterations to the listed specifications, and four revisions to the drawings. Changes to the specifications were minor, but the drawings made several significant revisions including an extension of the limits of the contractor work area and a new, deeper thickness of the spillway tunnel (COE Miscellaneous Letters, Sept. 1, 1938). Addendum No. 2 was less complex, noting only that "all sand rock encountered in excavation of trenches will be classified as rock regardless of method of excavation" (COE Miscellaneous Letters, Sept. 14, 1938). It was requested that each prospective bidder acknowledge receipt of each addendum.

Several hundred people attended the opening of bids for the construction of Prado Dam, at the offices of the U. S. District Engineer, Los Angeles, at noon on September 19. The attendance at this meeting is understandable for two major reasons. For one, the Prado project was the largest undertaking in the Orange County flood control program, and was second only to the Hansen flood control dam in Los Angeles County. Second, it had been stated previously that the District Engineer would likely award the contract to the lowest qualified bidder. Clearly, the interest and attendance at the September 19 meeting was a product of these two variables.

Major Theodore Wyman, Jr., District Engineer, read the bids. Seven offers were submitted, ranging in cost up to $5,474,170. The lowest cost proposal was in the sum of $3,640,795, submitted by a group composed of the Guthrie-Marsch-Peterson Company, Chicago; George W. Condon Company, Omaha; and J. P. Shirley and W. E. Callahan Construction Company of Los Angeles. The second lowest bid was submitted by California Constructors, Inc., consisting of Jahn & Bressi and Elliot Stroud Seabrook of Los Angeles, and R. G. Clifford, San Francisco. The bid by this group was $3,837,600. The third lowest bid was $3,873,015, submitted by the Winston Bros. Co., Los Angeles. The four remaining bids were those of the Bates and Rogers Construction Company, Chicago, for $4,048,275; the Utah Construction Company and Griffith Company, Los Angeles, $4,368,500; the J. F. Shea Company, Inc., Los Angeles, $4,889,265; and the Atkinson-Kier-Dennis Co., San Francisco, at $5,474,170.

There was only a difference of approximately 5 percent between the lowest and second-lowest offers. In addition, each member of the consortium which submitted the low bid was associated with construction on the All-American Canal. It was duly noted that all were virtually finished with their All-American work at the time when the bids were opened (SBC 1938a). The District Engineer's estimate for completion of the Prado Dam flood control project was $4,570,074; all but the two highest bids, therefore, were less than the Engineer's estimate.

Events proceeded quickly. On September 30, 1938, the SBC reported that "Major Theodore Wyman...has forwarded to Washington his recommendation that the contract for Prado Dam be awarded to the low bidder at $3,640,975" (SBC 1938k:28). One week later, the "contract for Prado Dam...has been approved by Col. Warren T. Hannum, Div Eng, U S Army Engr., San Francisco, and has been mailed to the successful bidder" (SBC 1938l:36). The offices of the W. E. Callahan Construction Company were located at 206 South Spring Street. Throughout most of the contract period, this company would serve as the primary contact between the District Engineer and the other contractors, although the contractors subsequently incorporated as Prado Constructors, Inc., in order to execute the contract. The official contract reference was W-509-Eng.-749, dated September 23, 1938.

Plans and Specifications

The plans and specifications within Contract No. W-509-Eng.-749 filled 102 single-spaced pages of text. In addition, 49 prints and drawings had accompanied the invitation to bid, comprising virtually the entire set of working drawings for the project. Work was authorized by the Flood Control Act approved June 22, 1936, and amended May 15, 1937. Funding was provided under the War Department Civil Appropriations Act, as approved on June 11, 1938.

The contractor was to provide all labor and materials (with the exception of materials supplied by the government) for constructing Prado Dam and all appurtenances. The major structural items or operations required in the performance of the work were:

(1) Care of water, river, and drainage during construction.
(2) Clearing of existing structures, debris, grubbing, and stripping.
(3) Excavation in borrow pits and excavations for structures.
(4) Drilling and grouting anchors.
(5) Concrete work for structures.
(6) Installation of gates and accessories.

(7) Structure backfilling.
(8) Construction of earth dam and fills.
(9) Placement of fill, paving, filters, and drains.
(10) Construction of a steel service bridge.
(11) Installation of structural steel.
(12) Miscellaneous metal work.
(13) Installation of electrical and power systems.
(14) Construction of operating house and superstructure.
(15) Cleaning up of debris and needed incidental work.

Fifty-five separate categories were listed for various quantities of material and specific work items. The project was to be initiated within 10 calendar days of the notice to proceed. The outlet works and all dam embankments were to be completed prior to November 1, 1940, and all work was to be completed within 925 calendar days of the award. The contract contained numerous penalty clauses. The only major anticipated reasons for delay were related to the abandonment and relocation of Highway 18 and the Atchison Topeka & Santa Fe railroad tracks. Any delays related to natural events, such as flooding, were to be made up on an equal day-lost to day-added basis. Finally, no work was to be conducted on Sundays or the legal holidays designated by Congress.

Payments were made on monthly estimates of work conducted, with 10 percent retained from each payment until a total of 5 percent of the total contract had been withheld. The contractor was required to perform not less than 50 percent of the estimated work without delegating to subcontractors.

All work was subject to the detailed inspection of the contracting officer. In order to maintain compliance with the strict specifications and limitations of the contract, the contractor was required to maintain various lines, stakes, grades, and templates. Strict stipulations were placed on the use of domestic materials and supplies, with the exception of a specific list of materials which were not produced or manufactured within the United States.

The government agreed to provide the following:

(1) All cement. This was to be delivered to the contractor. Any cement not used within 120 days was to be condemned and charged to the contractor in full.

(2) Service Gates and Accessories. These would be furnished complete with all frames, guides, hoists, operating machinery, mechanisms, and motors. The contractor was to supply all electrical conduit and wiring.

(3) Traveling Crane for Operating House. This was to be delivered f.o.b. to the contractor at the Prado Dam siding.

Wage rates, compensation insurance, and the use of relief labor were also required and strictly regulated by the government. The wage rates were based on costs determined by the Department of Labor; minimum wage was established at $0.625 per hour, and the maximum was $1.375 per hour. The lowest rate applied to ax men, cleaners, flagmen, handymen, unskilled laborers, teamsters, and wagonwinders. The highest rate was paid to trench machine operators, power shovel operators, pile driver operators, and structural iron workers. Wages of $1.00 per hour were paid to blacksmiths, compressor operators, concrete mixers and operators, elevating grader operators, machine erectors, grouting machine operators, machinists, head powdermen, roofers' operators, roofers, tractor operators, and truck drivers. In all, 75 separate classes of laborers and mechanics were listed. The contract further specified that the contractor was to employ as many laborers as possible (both skilled and unskilled) from the Relief Rolls, and that such employees were subject to the same rates paid to other workers for comparable positions.

Final acceptance of all work was subject to a thorough examination of the site, and to the written approval of the Division Engineer, South Pacific Division, San Francisco. Final payment, including all funds retained, was to be made only upon signing of this approval.

Technical Provisions

The contract contained 12 major technical stipulations related to the structural items or activities previously noted. These provisions are important, in that they further detail the engineering and technological features of Prado Dam, and reflect the order of work scheduled by the CoE.

(1) Diversion and Care of the River During Construction

Permanent construction was carried out in areas free of water. In the event that work was required at elevations lower than that of stream or groundwater, cofferdams and levees were to be constructed to keep the water level below all activity. The contractor was allowed to use any type of engineering, as long as the upstream cofferdams provided protection to elevation 475 feet, and the downstream cofferdams provided protection to elevation 472 feet. In some instances, it was anticipated that sheet pile cut-offs might be necessary to safeguard the work.

The first task was therefore construction of the diversion channel, and construction of cofferdams, etc., to divert the stream flow through the new channel, thereby allowing all other work to go forward.

(2) Removal of Existing Structures, Clearing, Grubbing/Stripping

The contractor was required to remove all structures and any other obstructions at the site. This included pavement and other highway improvements in the dam and borrow pit areas, fences, guardrails, posts, test-pit lagging and sheeting, and any other miscellaneous debris. It was noted that many existing buildings would be removed by other agencies prior to construction, but that the contractor would be responsible for the disposal of any buildings or debris left at the site. All utilities were to be removed by other agencies, but the contractor was to dispose of all material in government-designated spoil areas, or burn all flammable materials.

Clearing and grubbing required that the area to be occupied by the dam, including a 10-foot wide strip beyond the slope lines, be cleared of all trees, stumps, brush, and all vegetal matter including roots to a depth of 6 feet. The area to be covered by the dam was also to be stripped, or excavated, to a depth sufficient to ensure that no unsuitable foundation material remained below the new structure. The banks of the stream channel and the slopes of the abutments were also to be stripped. Unsuitable materials to be removed included topsoil, rubbish, material below ground surface not removed by grubbing, and the railroad and highway embankments. This stripped material was to be stockpiled for later use in the new embankments or, if totally unsuitable, placed in designated spoil areas.

(3) Excavation, Backfill, and Sheet Piling

Excavation was described as the removal, hauling, and/or disposal of any class of material encountered after clearing, grubbing, and stripping. Excavation work for rock foundations entailed the removal of all loose rock, and the cleaning of each bed or side wall. Excavated material not suitable for later use in the embankment was to be wasted in spoil areas. Suitable material was stockpiled for future use. Work on the excavation for the spillway was to proceed without stockpiling, with the material to be taken directly from the spillway cut to the embankment.

Borrow pit excavations first required clearing of the pit, and the subsequent removal of unsuitable material through stripping and disposal. It was required that slopes from the borrow pits be no steeper than 1 to 3, and that they blend into the surrounding topography as much as possible. The horrow pits were further graded following completion of the contract to ensure that all surface water would drain from the area. Rock excavation was authorized only when other means were determined to be unsuitable by the Contracting Officer. Heavy blasting was not permitted against rock which was to form the final foundation. Excavation was accomplished instead in such areas by the far more laborious means of barring, wedging, and close drilling. All excavated rock was stored for further use on the downstream slope of the dam.

Structure backfill included the filling of all excavated areas outside the limits of the rolled embankment. Backfill material was to be free of any roots, brush, or other flammable material. Compacted backfill was to be free of any stones larger than 2 inches in diameter.

Guidelines set forth for the actual backfilling operations were detailed. For example, backfill on either side of a concrete structure was to be kept to the same approximate level throughout the operation to equalize the load. Backfilling against concrete could not be completed until the concrete had been in place for at least 21 calendar days. Uncompacted backfill was completed with a raised or crown line, to allow for settlement, and the water content of compacted backfill was carefully regulated to provide for the maximum consolidation of material. Compacted backfill was placed in layers approximately 2 inches thick, and then compacted with power and/or hand tampers.

Steel sheet piling was to be used in place of concrete cut-offs when appropriate. The contractor was required to place a series of test piles to expose the locations of the underlying consolidated (foundation) material. Sheet piling was then driven with single or double-acting hammers (drop hammers not permitted), and driven so as to interlock with the adjoining pieces to form a water-tight diaphragm.

(4) Embankment

The term "embankment" was used to describe all of the earth fill portions of the dam, the outlet levees, and the filling of all trenches, test pits, etc., required to achieve the desired contour. The central core of the embankment was constructed of selected impervious material taken from the various excavations and supplemented with material taken from borrow pits.

The embankment section upstream from the central core was constructed of random unclassified material, although coarser material was dumped near the upstream pervious section, and the finer components dumped nearer the impervious section. In this manner a gradual transition was achieved from the pervious section of the embankment to the impervious section.

Prior to forming the embankment, the area of its foundation was plowed to a depth of 8 inches. All excavations for the keywalls, cut-off, test pits, exploration holes, and stumps were filled with the same materials as used in the embankment. After completion of such preparatory work, the embankment sections were constructed. Throughout the period of construction, the embankment was crowned with a grade not exceeding 2 percent, to allow for proper drainage.

The location of the borrow pits was determined by the government. The contractor was allowed to use Army type of equipment to excavate fill material. Again, all excavated material was to be kept free of roots and stones larger than 4 inches in dimension. Larger stones not acceptable as fill were used for rock paving, gutter paving, or rock fill, on the downstream slopes or else wasted in spoil areas.

Throughout construction of the embankment, the moisture content of the material was carefully regulated. It was anticipated that moisture content of approximately 15 percent was ideal for maintenance prior to compaction. The material was compacted by using a tamper-type roller, with a minimum of eight complete passes. The select impervious material was to be compacted by a roller weighing not less than 1100 pounds per linear foot; on the pervious sections, the weight of the equipment was to be not less than 2400 pounds per linear foot. Each trip of the roller was to overlap the previous path by no less than 2 feet. Additional roller passes were to be made if the Contractor Officer believed they were necessary to fulfill the requirements of the contract, prior to COE approval of the work.

(5) Rock Fills, Paving, and Drains

The materials used in all rock fills, paving, and drains were to be of a quality that would not disintegrate under the action of air, water, or during handling and placement. The paving stone was selected to be close to rectangular in section, with each piece having its greatest dimension no larger than three times its least dimension. "One-man" stone was graded in sizes of no less than 25 pounds and no larger than 150 pounds, with an average weight of 100 pounds. "Two-man" stone was to weigh between 150 and 250 pounds, averaging 225 pounds. Spalls or gravel consisted of broken stone from ledge or crushed rock. All stone or gravel used around drains, etc., was graded under Class "A" concrete specifications. Toe rock consisted of material weighing up to 1000 pounds, and derrick stone was quarry rock up to 2 tons. In general, the upstream slope of the dam embankment, and the approach and outlet channels, were protected by one or more grades of rock paving.

The paving was laid on a 6 inch layer of spalls or gravel. All stone was hand placed to form a flat, compact surface. On gutters and other sections where grouting was to occur, a layer of heavy burlap was laid over the spalls. The stone in these areas was laid with open joints to permit later grouting, with small stones placed in the joints to prevent movement prior to grouting. The connection between the slope paving and the toe rock was laid up with "two-man" stone, with the remainder of the slope covered by "one-man" stone. Weep holes were set in the grouted paving in the approach channel on approximately 10 foot centers. The grouting was composed of a mix of one part Portland cement to three parts sand, mixed in a power batch-type mixer in the same manner as concrete preparation. All grouted surfaces were carefully brushed and cured for a period not less than 14 days.

Toe rock was placed in the upstream and downstream toes of the dam, the toe of the rip-rap, the toe of the berm of the dam, and the rock fill at the edge of the approach apron. Rock fill below the outlet structure consisted of the large derrick stone. The downstream face of the downstream slope of the spoil area was to be laid in rip-rap 2 feet thick, conforming to the general guidelines describing toe rock.

(6) Concrete: Drilling, Grouting, Composition, Classification

The single largest component of the technical provisions section in the contract addressed the specifications for concrete in its various applications. Concrete was defined as a composition of cement, fine aggregate, coarse aggregate, and water. Most of the concrete used was Class "A," except under special applications where Class "B" was required. Fine aggregate was defined as consisting of strong, hard, and durable particles. Coarse aggregate was washed gravel or crushed stone.

The grading and mixing of concrete were carefully regulated with regard to water content, size of aggregate, cement content, mixing time, delivery, and placement. All concrete was to be cured for a period of not less than 14 days by a saturated water covering, water flow, or a system of mechanical sprinklers.

Forms were constructed primarily of wood or steel. Where walls were visible, such as on buildings or in the bridge superstructure, the forms were to be of pressed wood sheets. The objective was to provide a much more aesthetic appearance.

(7) Installation of Government Supplied Equipment

The following equipment items were supplied by the United States to the contractor: gate hoists, steel switchboard, standby unit, traveling crane and hoist, and the service gates. The gates, with all the associated hoists, guides, and frames, were installed under the supervision of the manufacturer. The contractor was to supply the necessary labor, and to ensure that the equipment operated well. The contractor was to install the switchboard and traveling crane in accordance with plans provided, and to test the equipment as installed in the control house. The generator was also to be installed by the contractor, with associated fire protection insulation consisting of magnesia, asbestos, white lead, and oil paint.

(8) Miscellaneous Structural Steel and Metal Work

Other structural steel installations included the trash racks and crane rail beams in the control house, and all associated priming and painting. Miscellaneous metal work included ladder rungs, guard chains, bolts, eyebolts, service bridge scuppers, standby generator exhaust, and a gasoline tank. The contractor was also to furnish all structural steel for the service bridge superstructure, with all bases, pins, and anchor bolts. Finally, all guard fences were to be constructed on top of the spillway channel, on top of the walls of the outlet channel, and along the flume wall.

(9) Conduits, Power and Light Systems, Underground Power

The electrical apparatus was installed in accordance with existing standard requirements of the National Electric Code of the National Board of Underwriters, except as modified by the Electrical Safety Orders of the Industrial Accident Commission of the State of California. All electrical work was subject to inspection and approval by the Electrical Division of the Department of Building and Safety of Riverside County, although the permit for the electrical work was granted by the Orange County Flood Control District.

All electrical conductors were run in rigid steel conduit. Most of the conduit was concealed within walls and floors, set in place during the course of the masonry work rather than by cutting into completed fabric at a later date. All conduit had a round cross section, and was made watertight with white lead. Underground electric power was supplied to the switchboard in the control room, and electric light was supplied from the transformer rack at the east end of the dam to a pull-box at the south end of the service building.

(10) Control House

The contractor was obliged to supply all labor and materials for the control house, with the exception of the cement and special equipment provided by the government. The contract specifications called for special care to be given to the ornamental portions of the walls and roofline. The form for the lettering on the wall consisted of a plaster cast mold, in accordance with details provided by the government. All exposed surfaces of concrete were rubbed, after removal of the forms, with a fine grained carborundum stone to polish the surfaces and achieve a uniform texture and color.

All window sash was of copper-bearing steel. The intermediate sash was to open down and outward, while the bottom sash was designed to open downward and in to the interior. The windows were arranged to be glazed from the inside. The doors and frames for the control house were made of hollow metal, designed to open inward. The active leaf was required to be on the west center side, and all plates and hardware were attached with machine screws.

All painting of metal work began with the application of a single coat of rust-resistant paint and two coats of mineral filler, baked on and rubbed, prior to assembly. Doors and trim then received three additional baked-on coats. A color coat was then added, and a final varnish coat was applied and rubbed to a gloss. Windows were then glazed with clear wire glass, one-quarter of an inch thick.

(11) Miscellaneous Specifications and Workmanship

The quality of workmanship required of the contractor was defined in detail in the contract. In general, the work was to conform to federal specifications, and/or those defined by the American Society for Testing Materials (ASTM). Requirements were set forth for each class of material to be utilized (Table 4.1).

The workmanship was to exemplify a consistently high level of quality. An unworkmanlike finish would constitute cause for immediate rejection. Welding, plugging, and shimming were allowed to correct defects in materials or workmanship, but only at a level which did not affect the strength or function of any object or part. Finally, any patterns, molds, templates, and jigs made as part of the project were to be supplied to the government at the dam site prior to final payment.

(12) Paints and Painting

The federal specifications applied as well to all paint and raw material. For example, all finish paint was to be composed of two pounds of pigment to one gallon of vehicle. The vehicle was to consist of not less than 50 percent non-volatile oil and resin, and the thinner for the vehicle was to be free of toxic hydrocarbons. The pigment was of aluminum powder. All paint was to be mixed on the job site, and only in quantities sufficient for one day's work.

Table 4.1. Quality of Workmanship Requirements

Material	Specification	Designation
Structural steel	Federal	QQ-S-711a
Steel castings	Federal	QQ-S-691a
Iron castings	Federal	QQ-I-651
Malleable castings	Federal	QQ-I-666
Bronze	Federal	QQ-B-746
Brass castings	Federal	QQ-B-601
Brass pipe	Federal	WW-P-351
Brass screws and bolts	Federal	QQ-B-611
Copper sheets	Federal	QQ-C-501
Zinc coatings	Federal	QQ-I-696
Iron, steel sheets	Federal	QQ-I-696
Bolts, screws, washers	Federal	FF-B-571a
Steel pipe	Federal	WW-P-403
Iron fittings	Federal	WW-P-521
Wrought iron fittings	Federal	WW-P-441
Corrugated metal pipe	Federal	QQ-C-806
Wire mesh	ASTM	A-82-34
Wire bars	Federal	QQ-B-71a
Chain	Federal	RR-C-271
Fencing	ASTM	A-171-33
Barbed wire	Federal	RR-F-221
Asphaltic paint	Federal	SS-A-701
Steel conduit	Federal	WW-C-581a

Change Orders

The Invitation to Bid and the resulting contract, as signed by the government and the contractor, were highly structured, setting forth lengthy sets of procedures, technical specifications, and guidelines to be followed during construction. However, it was anticipated by all parties that any project as large and complex as the construction of a dam required the issuance of numerous change orders (large and small) to accommodate unanticipated conditions encountered during construction. Thirteen change orders were added to Prado Dam Contract No. W-509-Eng.-749 between December 21, 1938 and January 23, 1941. These were revisions to the original plans and specifications as issued August 20, 1938, and amended on September 1 and September 14, 1938.

Change Order No. 1

Issued and approved on December 21, 1938, the first change order did not affect the time schedule or provide additional funds to the contractor. It did, however, reflect on the readiness and ability of the contractor to perform the required services. The contractor was directed to receive the government-supplied cement in bulk, rather than in paper sacks as originally stipulated. This is an indication of the equipment already in the possession of the contractor, most likely the same equipment previously used in the construction of the All-American Canal.

Change Order No. 2

The second change order was issued by T. Wyman on December 23, 1938, but not approved by M. C. Tyler, Acting Chief of Engineers, until January 20, 1939, because it involved more than $500. The change in scope was prompted by the need for additional tests to determine the nature of the overburden in relation to the assumed groundwater elevation. The contractor was to construct a test pit from the assumed groundwater level of 456 feet to the rock or foundation level at 406 feet. The amendment added three additional days for completion of the total contract.

Change Order No. 3

This revision was issued by T. Wyman, District Engineer, on January 9, 1939. It did not extend the time for completion, but the results of the recommended testing, at a cost of $484.37 would soon have a major impact. The depth to consolidated material (rock), along the axis of the dam, was much greater than projected on the original contract drawings. The constructor was therefore directed to drive sections of "H" piling to determine the depth of penetration into consolidated material. The change order illustrates that there were errors, however minor, in the scientific data gathered prior to the preparation of the invitation to bid.

Change Order No. 4

Another change order was issued by Wyman on January 11, 1939, and approved by Major General J. L. Schley, Chief of Engineers, on February 15, 1939. Again, this work was required as a result of problems encountered with the nature of the soils along the axis of the dam. Here, the additional testing was to determine "the practicability of driving a deep cut-off of sheet piles along the axis of Prado Dam." One additional day and a sum of $3,000 were approved to conduct this effort.

Denial of Change Request

A request for a schedule change was denied by Wyman on January 13, 1939. It would appear that the contractors had earlier initiated discussions with him about the possibility of completing their work on an advanced schedule. Wyman wrote in response:

> With reference to our recent discussions concerning changing your construction schedule to permit completion of Prado Dam at the earliest possible date, you are advised that information has been received in this office from higher authority which is in part as follows: "The Department does not believe the payment of amount for earlier completion of Prado Dam justified...Authority for issuance of the change order is therefore not approved" [COE Miscellaneous Letters, Jan. 13. 1939].

Wyman's response implies several significant issues were related directly to the construction of the dam. First, the contractor must have believed that the work could have been finished earlier than the schedule set forth in the request for proposals. Second, Wyman must have had some misgivings about the denial as he states that a "higher authority" made the decision. Finally, the decision not to complete the dam "at the earliest possible date" may well have ben based on conditions unrelated to construction (political, social, legal, economic, etc.). It appears that the contractors had requested a bonus or accelerated payments to expedite the work.

Change Order No. 5

The results of testing conducted under Change Orders 2, 3, and 4 prompted this revision. The tests had demonstrated that the material beneath the axis of the dam was "so poorly constructed" that it would both permit and require the driving of a sheet pile cut-off wall to a much greater depth than first anticipated. The contractor was therefore requested to drive an additional wall of approximately 70,000 square feet between the originally engineered line of consolidated material and the actual line as determined by the tests. The additional amount authorized was $144,730. The order was issued by Wyman on February 24, 1939 and approved by J. L. Schley, Chief of Engineers, on March 24, 1939.

Change Order No. 6

The order issued by Wyman on April 12, 1939 was not approved until May 8, 1939 by John Kingman, Acting Chief of Engineers. It became necessary when excavation for the outlet structure uncovered rock which rapidly decomposed when exposed to the atmosphere. As a result, plans were made to cover this rock with a layer of "pneumatically placed concrete" to protect the surfaces. Additional time was not allowed for completion of the contract, but a budget increase of $10,000 was authorized.

Change Order No. 7

An order issued by Wyman on July 12, 1939 was not approved until October 17, 1939 by John Kingman, Acting Chief of Engineers. The schedule was not extended, but an additional amount of $132,615.15 was authorized. The stipulations outlined in this change order were many. They were almost all based on the fact that "unsatisfactory foundation conditions" had been encountered, this time during excavation for the spillway and outlet works. Provisions were made for additional common and rock excavation below the original grade plan, the removal of objectionable foundation material, additional sheet pile cut-off walls, dewatering and the driving of test pipes, the removal of concrete already in place, and the placement of additional backfill.

One reason for the delay in approval was that the Chief Officer of the COE Finance Division, E. E. Gessler, had noted a difference in unit price between Change Orders 7 and 8. He requested that approval be deferred until the question of price was resolved. This change order reflects the level to which each amendment was screened by different divisions within the CoE. Wyman also appears to have been put somewhat on the defense here, for he wrote on August 9, 1939, that "an error was made in laying out the work for the contractor...the error revealed that the work was done in conformity with the established lines and grades, and the contractor was not at fault in this matter."

Change Order No. 8

Issued on August 22, 1939, and approved by John Kingman, Acting Chief of Engineers, on October 17, 1939, the change was prompted by the same problems which had led to Change Order No. 7. Specifically, unsatisfactory foundation conditions required that an additional 180,000 cubic yards of backfill be placed in the dam embankment upon removal of the same amount of unsuitable material. After much discussion and justification, the order was approved on the same day as Change Order No. 7. Theodore Wyman, Jr., was replaced as Division Engineer by Edwin Kelton after this date, and Kelton served in this capacity during the remainder of the construction of Prado Dam.

Change Order No. 9

Kelton's first change order as the new Corps District Engineer addressed the need for additional borrow pit excavations of approximately 700,000 cubic yards over the original 600,000 cubic yards specified in the contract. At $0.17 per cubic yard, the amendment amounted to an increase of about $119,000.

Change Order No. 10

A change order issued by Kelton on June 13, 1940 was approved by J. L. Schley, Chief of Engineers, on July 9, 1940. It was precipitated by yet another discovery of "unsatisfactory subsurface conditions," this time along the west wing of the spillway crib cut-off. Kelton carefully calculated the additional increase, while at the same time reducing the original contract commitment in light of the newly authorized work. The expenditure would be $215,000, minus the reduced work cost of $97,4842.30, for a net augmentation of $117,517.70. No extension of time for completion was approved.

Change Order No. 11

This change order called for the substitution of concrete pipe for the clay tile drains originally specified. The United States apparently had a surplus of 12-inch concrete pipe (probably from another flood control project), and it sought to use this material rather than have the constructor acquire clay pipe. The order was issued by Kelton on July 29, 1940, and approved by John Kingman on September 10, 1940. No additional time was involved, and the total cost was decreased by $1078.

Change Order No. 12

The last change order was dated January 23, 1941. It related primarily to cosmetic work including "filling gullies, smoothing the surface, and placing a gravel blanket on the downstream slopes of Prado Dam."

The entire sequence of change orders provides insight into both the difficulties encountered during the construction of Prado Dam, and the internal process of politics, finances, and review of construction-related activities. It is clear that the major problem arising during construction was the inaccuracy or inadequacy of scientific information regarding the nature of foundation soil and rock beneath the dam. Nine of the 13 change orders were issued as a direct result of this problem. Out of the total increase in contract commitment of approximately $550,000, at least 99 percent was necessitated by the discovery of unsuitable foundation conditions.

No change order greater than $500 could be approved by the District Engineer. Any greater commitment had to be approved by the Chief Engineer, and was subject to review by a variety of other divisions, most notably the Finance Division. This could result in lengthy delays in approval. Change Order No. 7, for example, took more than three months for approval. It would appear that the government took some steps both to limit costs, and to maintain the original schedule without any modification whatsoever. The Denial of Change Order dated January 13, 1939 is notable in that it set forth the government's policy not to consider an early completion of scheduled work. On the other hand, no additional extensions of time for completion were granted to the contractor under subsequent change orders, regardless of the size or complexity of the additional work involved.

In summary, the construction of Prado Dam was a tightly scheduled and well managed undertaking. The authorized increases in cost (approximately $500,000) were large, amounting to about 15 percent of the total original contract figure. However, this was still nearly $400,000 below the District Engineers' original cost estimate prior to the invitation to bid. Considering that severe problems were encountered and carefully corrected with regard to underlying soil conditions, the on-time completion of Prado Dam should be regarded as a tribute to the contractor and the CoE alike.

The Construction Schedule

Assigning a specific date to the first work associated with the construction of Prado Dam is problematic. Property and water rights acquisition had begun far in advance of turning the first shovel of earth by Prado Contractors. Water companies had acquired water rights in the early twentieth century, and the mechanism for purchasing property was established by the Orange County Flood Control District in February 1938. In addition, numerous celebrations, with appropriate speeches and ceremonies, were held throughout the late summer and fall of 1938 to commemorate the inauguration of various activities. On August 15, 1938, the *Santa Ana Register* reported, for example, that a gathering of about "200 leaders in water conservation from Orange, San Bernardino, and Riverside counties attended the celebration over plans for the culmination of more than 20 years of effort to harness the Santa Ana River in the name of flood control." Contractors Pederson and Hollingsworth hosted a barbecue, with Wilber C. Cole, the firm awarded the contract for the relocation (grading and building structures) of the railroad and Highway 18. The completion of the latter was essential to the scheduling of construction for the dam itself. The date for the beginning of construction, therefore, may be regarded as prior to the issuance of the request for bids by the U. S. Engineer Office in Los Angeles.

Actual construction work on the dam itself was begun by Prado Constructors, Inc., on November 1, 1938. The process of debris disposal, grubbing, and stripping was the first task item undertaken. By January 1, 1939, the *Santa Ana Register* reported that 10 tractors and auxiliary equipment were in use at the dam site, and by the end of March, nearly 150 men were at work on the dam including inspectors, surveyors, and engineers (*Santa Ana Register* 1939b). It was anticipated that this number would be greatly increased once the earth fill operations began.

By late spring 1939, work was in progress on the foundation excavation, drains, construction of the keywall, backfilling of the keywall trench, and excavations for the outlet structure. As of May 1, 1939, the following work had been completed in terms of the gross totals of materials used or moved:

(1) Stripping of 367,000 cubic yards out of a total estimated amount needed of 5,000,000 cubic yards.

(2) Common excavation of 520,000 cubic yards out of an estimated total of 1,375,000 cubic yards.

(3) A total of 3500 cubic yards out of an estimated total of 2,125,000 cubic yards of rock excavation.

(4) A total of 73,000 cubic yards out of a total of 2,125,000 cubic yards of rock fill in the dam toes.

(5) A total of 2000 cubic yards of concrete used in the outlet structure out of an estimated total of 168,000 cubic yards needed for all structures.

(6) A total of 31,000 pounds of reinforcing steel placed out of an estimated total requirement of 10,700,000 pounds.

(7) A total of 23,000 square feet of sheet steel pile driven, out of the original estimated amount of 67,000 square feet (later amended by Change Order No. 7).

Work progressed rapidly during the summer of 1939, and the labor force was increased as each new construction phase was initiated. The installation of the 60-inch drain, specifically requested and paid for by Orange County, had been completed by June 29, 1939, and construction of the outlet conduits was in progress. By the end of July, the initial sheet pile cut-off wall was completed, and the embankment material was being backfilled and compacted. Construction of the intake structure had begun, the uncontrolled bypass pipes were in place, the trash racks and frames were heing fabricated, and excavations near the ogee section of the spillway were under way. By the end of August, forms had been erected for the gravity wall sections of the outlet structure, and the baffle piers at the discharge end of the closed conduit near the stilling basin. The forms were also in place for the center pier of the service bridge.

By the end of December 1939, slightly more than a year after construction had begun, the gravity walls had been completed, the intake structure and the pier for the service bridge were finished, the embankment was well under way (including placement and compaction), the baffle piers had been completed, and grading had started on the stilling basin. The base of the control structure was nearly finished, and the slide gates for the control outlet were installed. The ogee section of the spillway was partially completed, and backfilling in progress along portions of it. Work had also begun on the crib cut-off walls.

The new year ushered in the only labor unrest recorded during construction of the dam. On January 24, 1940, the *Santa Ana Register* reported that union truck drivers had walked off the job, and that "a milling crew of pickets" had gathered at a nearby service station (probably at Prado). The strike was ended abruptly when the contractors replaced all the men who had walked off the job with non-union labor. Altogether, the trucks, then used primarily for transporting material to the embankment, were only idle for a period of several hours, and no measurable interruption to the schedule resulted. By the end of the month, the outlet control tower was completed. Construction of the embankment was also beginning to have a discernible impact, and all forms had been stripped from the service bridge pier.

On March 18, 1940, a landmark event in the construction of Prado Dam took place:

> ...the first water poured through the dam at 5:58 p.m., as Prado's rising stream was diverted from its old channel and harnessed to its new master. The diversion was completed at 7:50 p.m. The diversion was completed six weeks ahead of the originally scheduled May 1, 1940 date [*Santa Ana Register* 1940b].

The decision to advance the schedule was made largely as a consequence of the fact that construction was proceeding more rapidly than anticipated. The east abutment of the dam had already been completed to elevation 525 feet, with only 41 feet remaining before the maximum designed height was attained. The COE thus elected to divert the flow of water, in order to clear the way for construction across the old channel.

Work continued throughout the spring and summer of 1940 on the embankment and the embankment's rock paving. The outlet channel had been completed, and excavation continued on the spillway overflow section and apron. These tasks were massively labor intensive, involving both heavy equipment and hand labor to accomplish the tamping, placement of rock, and all associated grouting and finishing.

The fall of 1940 was devoted to finishing the embankment, left abutment, and on the excavation and completion of the spillway and crib cut-off wall. The steel reinforcing for the spillway bucket was in place by September 5, and by the end of September, the bucket was complete except for the wing wall. By mid-November the excavations for the spillway lip and trenches were complete, and pouring of concrete for the spillway slab was in progress. By the end of December, concrete was being poured on the spillway lip, and work was nearing completion on the spillway slab and the crib cut-off wall extension.

The first three months of 1941 were devoted to the various remaining "details," including completion of the service bridge (which could only be built after completion of the embankment), and completion of the spillway and spillway channel. Forms for the service bridge were in place by the beginning of February, and the unit was ready by the end of March. Excavation and grading for the spillway channel were finished, with the exception of the addition of the rock blanket on the downstream slope by March 5, 1941. Work was complete by the end of April, including the finishing, paving, and surfacing of all features.

One new contract was issued by the District Engineer, Los Angeles, early in April. Invitation for Bids No. 509-41-55 called for "Furnishing all labor and materials and performing all work for constructing Caretaker's House and Appurtenances--Prado Dam, located at Prado Dam near Corona, California" (COE Miscellaneous Letters January 3, 1941). The contract was awarded to Carl J. Flagstad and Edward Bock, located at 3517 Alsace Ave., Los Angeles. Contract No. W-509-Eng.-1292, dated January 22, 1941, stipulated that all work was to be conducted in accordance with the plans dated January 3.

Construction of the caretaker's house was delayed by a series of unusually heavy rainstorms during the period from February 23 to March 14, 1941. The site was actually flooded during much of this time, and heavy equipment could not be used to excavate the basement area. As a result, Edwin Kelton issued Change Order No. 1 for this procurement, providing an extension of 21 calendar days for completion of the caretaker's house.

On May 8, 1941, District Engineer Edwin Kelton issued the following brief and formal letter addressed to the W. E. Callahan Construction Company et al.:

> In accordance with paragraph 1-42 of the specifications forming a part of the above-numbered contract for furnishing all labor and materials and performing all work for the construction of Prado Dam and appurtenant work near the City of Corona, California, you are advised that all of the work under the contract was completed as of April 29, 1941; that it has been inspected and found to conform to the provisions of the contract plans and specifications, and that it is hereby finally accepted by the United States [COE Miscellaneous Letters, May 8, 1941].

A single sentence was all that Kelton wrote, bringing to a close several decades of effort and achievement. A similar letter was issued to Flagstad and Bock on June 13, 1941, accepting the work on the caretaker's house which was completed on June 2, 1941.

Prado Dam was complete. The work, begun by Prado Constructors on November 1, 1938, had been carried out in full by April 29, 1941. Despite the numerous change orders prompted by unanticipated subsoil conditions, delay in the approval of some change orders, an aborted strike, and inclement weather, Prado Dam was completed without penalty, and ahead of the May 1941 deadline.

5. THE OPERATION OF PRADO DAM

Operating Plan

Regulations entitled "Dam Caretakers: Rules and Regulations Governing Duties and Responsibilities" were issued by the War Department circa 1941 (U. S. Army Corps of Engineers [CoE] 1941). The directions for operating the dam and its systems were extremely brief, taking up less than two single-spaced pages of text.

In brief, the caretaker was instructed to patrol the grounds to prevent the admission of unauthorized persons, the removal of property without authority, and to maintain a check on the operation of all equipment. Trespass violations on the property were specifically and quite liberally construed, but only authorized persons were to be admitted to the works. The caretaker was responsible for the watering and maintenance of his own premises, and individual directions were issued for the maintenance and repair of equipment. A chart was placed in the control house, "in a prominent location for quick reference," regarding the operation of the gates during flood stages. The caretaker was to make sure that the trash racks were kept clear of debris, and was responsihle for the buming and/or disposal of any debris removed. The caretaker was also to maintain all boats and motors supplied for the removal of debris. During emergencies, declared only by the District Engineer or a higher authority, guards were to be stationed 24 hours per day at the control structure and on the dam itself.

These directions are remarkably brief, given the critical role that Prado Dam played in the protection of metropolitan areas in Orange County. This was not an oversight, however, and should actually be regarded as testimony to the simplicity of design and maintenance required for the operation of Prado Dam. As noted earlier, the design was not complex. It used no new theoretical systems, and employed no new technological features.

Aside from the immediate environs and facilities of the dam, the caretaker had no jurisdiction within the flood control basin itself. Use and maintenance of these lands were the responsibility of CoE representatives in Los Angeles, who controlled the area through the regulation of leases. The low-lying areas of the basin, although frequently flooded, were normally reserved for pasturage; only the higher areas which were rarely inundated were allocated for farming (Means 1942:5). In 1940, prior to any agreements, the CoE was considering a series of five-year leases (Kelton 1940d), but it is not known whether this term was adopted. By the late 1940s, most of Prado Basin was under some sort of lease arrangement. In 1949, there were 48 separate agricultural and grazing leases, many negotiated with the previous landowners who now rented the same lands that they had once owned (Index to Leases 1949).

To review, the dam is approximately 106 feet high (above original streambed), with a base at elevation 460 feet. The spillway crest is at elevation 543, and the top of the embankment is at elevation 506. The top of the emhankment is 30 feet wide and paved with asphaltic concrete. As originally designed, the reservoir had a capacity of approximately 223,000 acre feet, flooding some 6700 acres of the valley when water was at the spillway crest.

Four methods were originally provided for the outflow of water. Besides the spillway itself, there were two uncontrolled circular conduits which were to be kept open at all times, two tunnels controlled by six gates operated from the control structure, and the 60-inch pipe paid for by the Orange County Flood Control District to collect subsurface water drained from the wetlands to the reservoir bottom. One of the open conduits was closed by 1950, as it was discovered that the discharge was more than the river bed could safely absorb. This conduit was apparently reopened for a brief period of time, but plugged again in 1961. The second conduit was plugged in 1970. According to a 1978 inspection report, the second conduit was plugged at the request of the Orange County Flood Control District, which desired to obtain more complete control of the flow of water. This relatively simple act of closing the two conduits had far greater implications than were immediately apparent. In brief, it subverted the original design intent and purpose of Prado Dam.

Until 1971, however, the plan of operation was quite simple. As flooding entered the reservoir the open conduit would discharge water, automatically draining the reservoir, until the flooding stopped. At elevation 514, the inflow of water would exceed the capacity of the conduit(s). At this point approximately 3750 acres of the reservoir bottom would be flooded, and the discharge of water would be about 1240 second-feet of water. As the water rose above elevation 514, the gates would discharge water into the tunnels would gradually be opened to regulate the discharge to a maximum of 9350 second-feet at elevation 518.5. If flooding persisted, the waters would continue to rise to elevation 543, the spillway crest, and any additional downstream flow would be discharged directly into the river below.

After a flooding episode, the process was reversed. When the water fell below the spillway crest, the discharge was regulated by operation of the gates to 9350 second-feet, until elevation 518.5 was reached. At this level the gates would be closed to elevation 514, when the open conduit would again begin to drain the reservoir automatically.

The closing of the uncontrolled conduits (since 1971) has changed the original simple operating design. First, the waters behind the dam are no longer "automatically" drained. Second, all of the control of water has to be regulated at the gate level. This has posed some maintenance problems, since the gates were originally designed to be dry virtually year-round. Rust and sedimentation of the gates, never anticipated in the original engineering, are now major considerations. Finally, the purpose of the design has been altered; the dam now serves a partial water conservation function, whereas it was originally designed and operated only for flood control. This has served to complicate the sedimentation problems, currently under review, in relation to the overall adequacy of the protection which Prado Dam provides to downstream property.

Since completion of the dam in 1941, Prado Dam has performed its designed purpose (i.e., flood control) without incident. The structures and equipment are in good to excellent operating condition, and the dam has provided flood control which has allowed the increased development and urbanization of downstream areas in Orange County. Few alterations have been made in the operating facilities, apart from the closure of the uncontrolled conduits. The dam caretaker's house was removed in the early 1980s, and various unpaved access roads across the property have been added for the maintenance and inspection of the facility.

Operation in the 1940s

In its first year of operation, in the rainy season of 1940-1941, the dam gates were left open rather than risk the accumulation of flood waters that the dam could not yet contain (CoE 1940). In the CoE annual reports for every year after 1941, the dam was listed as 100 percent completed, with funds provided for operation and maintenance (CoE 1949). By 1949, annual upkeep of the dam ran around $16,000, with the budget allocated as follows: routine care, $4000; flood operations, $7000; stream gaging and sedimentation studies, $2000 each; and leases and permits, $1000. Some years required work crews to complete specific maintenance projects, and in those cases there might be $10,000-$14,000 added to the budget to cover the costs of hired labor (Walsh 1949b).

The increasing use of the basin under lease conditions in the 1940s led to some disputes over road and bridge maintenance and electric service. Both Riverside and San Bernardino counties effectively abandoned the area in 1944 and refused to maintain public facilities in the area since the basin was now in the possession of the federal government. Unfortunately, no federal funds were allotted for local roads and bridges, even though both were needed to allow tenants access to their leased lands (Walsh 1949). In a similar vein, Southern California Edison considered pulling down electric lines in the basin after local residents moved out. The CoE urged Edison to stay since tenants would still be using the land and would need electricity (Kelton 1940).

Flood Control vs. Water Conservation

The superimposition of the Prado flood control basin over what had been an established community led to residual service problems for the CoE and its tenants. The dam and its flood control basin also led to problems concerning existing water rights and water use. The dam overlaid a complex series of historical water arrangements extending up and down the river. Most of these rights were held by Orange County water companies, which had vested interests in the water of the Prado Basin. The Prado Dam temporarily upset many old arrangements, and Orange County interests were keen to restore their hegemony. Shortly after the 1938 Flood, the everyday needs of water conservation again rose to the top of the Orange County agenda. As water conservation began to vie with flood control, political decisions and considerations impacted the operation of the dam and reservoir.

Prado Dam and reservoir were originally established as a flood control measure, but this was quickly subverted by the intense pressure placed on the CoE by Orange County to make accommodation for water conservation as well. This was done almost clandestinely at first, until water conservation was finally recognized as a legitimate concern of the Prado Dam and reservoir by Act of Congress in 1968 (Bailey 1971:4).

When final construction plans were approved on August 20, 1938, it was believed at that time that the sand deposits below the dam and above the bedrock were at least 67 feet deep and could sustain appreciable underground water flow (Bailey 1940:10). It was also understood that the steel sheet-piling to be laid under the dam down to bedrock would effectively cut off this supply of water to Orange County, even though the sheeting would be laced by some gaps and bored holes. The sheeting would back up the underflow, raising the water table upstream from the dam, and result in greater water loss to plant transpiration and evaporation (Bailey 1940:20,31).

To forestall this problem, the dam plans were modified to include a 60-inch infiltration pipe 15 feet under the dam to permit the passage of this underground flow. This pipe was duly installed, even though it was capped, pending final approval for its use. This was the first of many water conservation measures pushed by Orange County and accepted by the CoE. The installation of this pipe was preceded by a number of test wells and gauges set up to measure the underground water flow, all of which were paid for and administered by the OCFCD (Bailey 1940; Means 1942:5,7).

The first evidence that the Corps formally recognized the importance of water conservation appeared in a July 1939 report prepared by Major Theodore Wyman, District Engineer in Los Angeles. In this report, Wyman promised to release flood flows out of the reservoir at rates within the absorption capacity of the channel downstream. He also promised to control the accumulation of debris within the basin itself, which might interfere with the smooth delivery of water to Orange County (Bookman and Baker 1949:10). In that same month, plans were drawn for an upstream extension to the 60-inch infiltration pipe to capture Prado Basin water above the area of greatest siltation (Plans on file, Los Angeles District, CoE, Drafting).

This activity did not go unnoticed in Riverside County, which took a dim view of Orange County's water conservation measures. The Riverside County Board of Supervisors was concerned that if the dam and reservoir were used for water conservation, it might lead to Orange County interests claiming an ever greater share of the Santa Ana River water, a development that would intrude on the water rights of Riverside County. By resolution adopted on August 7, 1939, the board addressed its complaint to Theodore Wyman, the District Engineer, requesting from him reassurance that Prado Dam would only be used for flood control and not become an instrument of Orange County water interests. Wyman's reply, dated August 10, 1939, reversed the position he had taken in July. Wyman told the Riverside Board that according to the 1936 Flood Control Act which authorized the dam, the Corps was without the authority to do anything other than flood control (Bookman and Baker 1949:11-12; Wyman 1939a).

This first controversy between flood control and water conservation, or more specifically between Riverside and Orange counties, was not without consequences for the Corps. Major Wyman was replaced as District Engineer at the end of August 1939 by Lt. Col. Kelton (Turhollow 1965:326-327), and there is some indication that Wyman left under a cloud. If so, he may have been a casualty of the water conservation issue, as well as the taking-line controversy discussed earlier. The water conservation controversy had repercussions at the dam itself. The 60-inch pipe placed under the dam remained capped, pending resolution of the dispute between Riverside and Orange counties. In fact, the pipe remained sealed throughout the 1940s, 1950s, and 1960s (Nick Richardson, personal communication 1989).

By March of 1940, after much controversy, the Orange County Cooperative Plan was hammered out between the OCFCD and the Army Corps. By the terms of this agreement, the Corps reaffirmed that water conservation must be subordinate to the needs of flood control, with the implication that there could be no surface reservoir water storage for the benefit of Orange County. The Corps did agree, in theory at least, that the OCFCD could operate the 60-inch pipe under the dam. The Corps also granted to the Santa Ana River Development Company the right to collect and send to Orange County any water on its lands, provided that this collection did not affect the water rights of others. The OCFCD was also allowed to cooperate openly with the Santa Ana River Development Company and other companies in the salvage of Prado Basin water (Shafer 1940).

This first cooperative venture does not seem to have operated effectively, and was at least partially undermined by the final court ruling in the Irvine Case, which was finally decided in 1942, 10 years after the case was first enjoined. By the terms of the ruling, a board of three "Special Masters," one from each of the three counties in the watershed, was appointed to settle on a system of water control based on information that predated construction of Prado Dam (Bookman and Baker 1949:14-15). This threw everything into confusion, and Orange County again began to agitate for more water.

Orange County's Renewed Push for Water Conservation

Floods occur rarely; alternatively, water conservation is an everyday need. This was especially true for Orange County, which was daily faced with the growing problem of groundwater overdraft-- pulling more water out of the ground than could be recharged. As memory of the 1938 Flood receded, Orange County became more concerned about water recharge. Since 80 percent of its recharge comes from the Santa Ana River, the outflow of water from the Prado Dam attracted a great deal of Orange County's attention (Shafter 1949:2).

What Orange County wanted from Prado Dam was a regular water flow, feeding as much water into the coastal plain aquifer as percolation would allow. This meant reducing the flow at Prado Dam when there was too much water in winter, and increasing the flow when water was more scarce in summer. For the Prado Basin, this meant the storage of water in the winter, and the drastic reduction of ponding in the summer. Obviously any winter storage of water would compete with space needed for flood control, and the decision of how to balance the priorities between flood control and water conservation was the very crux of the disagreement between Orange County and Riverside County. Caught squarely in the middle were Prado Dam and the U.S. Army Corps of Engineers.

By 1942, the effects of Prado Dam on river irrigation downstream were widely lamented. In that year, Owen Smith and his two brothers brought suit against the CoE for the disruption of their riparian rights. The Scully Ditch, from which they had irrigated their fields for 75 years, was now largely inactive due to fluctuations in the river level below the dam. The Smith brothers requested the construction of a pipe from the 60-inch sub-dam conduit to the Scully Ditch so their traditional water level could be restored (Schwartz 1942).

The irregularity of the river flow led the Orange County Water District to influence the CoE toward a more lenient water conservation policy. In March of 1943, the Orange County Water District board adopted a resolution denouncing the practice of releasing more water into the Santa Ana channel than could percolate into the ground. The board expressed a desire for more control over the use of reservoir for water conservation (Bailey 1944). Their justification for more water conservation was based on the actual wording of the 1936 and 1938 Flood Control Acts:

> Plans... may be modified to provide additional storage capacity for domestic water supply or other conservation storage, on condition that cost of such increased storage capacity is contributed by local agencies and that the local agencies agree to utilize such additional storage capacities in a manner consistent with Federal uses and purposes (Bailey 1944:2).

The board amplified this request for more control by making a specific recommendation: they wanted to close temporarily one of the two 66-inch diameter ungated openings built through the dam at stream level, and study the result of this closing on channel percolation. Orange County maintained that this action would not impair the dam's ability to contain floods (Bailey 1944:6), and would instead reduce the amount of water discharged through the dam to a level that would match the recharge capabilities of the channel downstream (Bailey 1971:2).

This request to regulate water flow downstream of the dam was developed in 1944 by Paul Bailey's "Report on Change in Ungated Bypasses at Prado to Increase Percolation from Downstream River Channel." According to this report, closure of one of the two ungated openings would save 5000 acre feet of water a year (Shafer 1949:9). The suggestion that one of the openings be closed was quickly adopted by the OCFCD, the Orange County Water District, and the Orange County Farm Bureau. In another document, it was noted that the permission to close one of these openings could be obtained from the Chief Engineer in Washington, D.C., and did not need Congressional approval (*Farm Bureau News* 1944).

The following year, the CoE tentatively acceded to the Orange County request to close one of the two openings, and brushed aside the objections posed by the City of Corona and the Riverside Water Company, neither of which had a vested interest in the Prado Basin water by the terms of the final 1942 ruling in the Irvine Case (Putnam 1945). The Orange County Water District won final permission to close one of the ungated openings in 1946, although it was later denied permission to have this same opening permanently sealed (Bailey 1971:2). By 1947, the ungated opening was finally closed (Nick Richardson, personal communication 1989).

In 1948, 19 separate Orange County water interests combined to form the "Orange County Committee on Additional Water Supply." This committee petitioned the CoE for additional water conservation measures. Under the influence of this kind of pressure, the California State Water Resources Board, headed by Edward Hyatt, the State Engineer, added its weight to the Orange County resolution for more water (CoE 1948). Finally, on October 22, 1948, the Orange County Water District formally petitioned the CoE to designate Prado Dam and Reservoir as a multi-purpose construction (flood control and water conservation) rather than its original single purpose designation (flood control). In other words, Orange County requested that the Corps reverse Major Wyman's promise to the Riverside County Board of Supervisors that Prado would only be used for flood control (Bookman and Baker 1949:21).

In conjunction with this formal petition, Orange County worked on a plan to reduce the amount of Prado Basin water lost to evaporation and plant transpiration, which had been estimated in 1931 as an annual loss of 17,000 acre feet (Shafer 1949:4-5). There were at least three elements to this plan: reduction of the plant life near the main water producing area; the construction of pipe extensions connecting these areas with the sub-dam conduit (which was still unopened), and the purchase of new lands in the basin for the extension of this water system. Orange County had always had an interest in reducing the plant growth near its main water sources. As early as 1944, the OCFCD prepared up maps targeting the timber and brush areas of the basin that needed to be cleared along the Santa Ana River and along Chino and Mill Creeks (OCFCD 1944). It is not known to what extent any clearing actually took place, if any, but the successful implementation of the second element of the plan would at least partly obviate the need for clearance, for it entailed a lowering of the water table below the root line.

The OCFCD and the Santa Ana River Development Company had long advocated lowering the basin's water table below the root zone as a means of saving water from plant transpiration. The Santa Ana River Development Company attempted this by using channels and ditches to drain water-logged areas and hurry water to the dam (CoE 1948). Orange County now proposed an upstream extension on the 60-inch conduit under the dam. In the late 1940s, the county requested a permit to extend the pipe to an underground water collecting system that would be relatively free of silt (Bradley 1947, 1948a, 1948b, 1949; CoE 1948). Such a system, equipped with well and pumps to speed the lowering of the water table in the basin and transport water to the sub-dam conduit, had been proposed since at least 1942 and was even mapped out in 1944 (Figure 5.1.; Means 1942:63; OCFCD 1944). By 1948, the OCFCD had the right-of-way for three pumping stations and water transmission lines in addition to its other drainage ditch arrangements with the Santa Ana River Development Company (Bookman and Baker 1949:18-19). Although the sub-dam conduit was not opened at this time, the upstream extensions were built and may have been used as a means of pumping water downstream (Nick Richardson, personal communication 1989).

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5.1. Proposed Upstream Extension, 1944.

Riverside County Reaction, late 1940s

The construction of the pipe extension and impending opening of sub-dam conduit elicited a strong reaction from Riverside County. Ever since the state legislature had created the Riverside County Flood Control and Water Conservation District in 1945-1946 (Scott 1982:23), the county had an agency capable of countering the demands of the OCFCD and the Orange County Water District. Max Bookman, Chief Engineer of the Riverside County Flood Control and Water Conservation District, was instrumental in fighting the flood of water conservation proposals that issued from the Orange County agencies. He even co-authored a manuscript detailing the whole controversy from a Riverside County perspective (Bookman and Baker 1949).

Riverside County's main complaint against Orange County, and indirectly against the CoE, was that the OCFCD and the Orange County Water District were getting piecemeal and almost clandestinely from the CoE all the water conservation measures they were not allowed to get openly. Going back to the beginning of the controversy, with the laying of the 60-inch conduit below the dam, Riverside County maintained that the five-foot diameter pipe was larger than was needed to accommodate the estimated underground flow beneath the river itself (Bookman and Baker 1949:17B). Further, Orange County had engaged in creeping water conservation, negotiating for new water rights directly with the CoE rather than applying for them with the California State Division of Water Resources, as they were required to do by the terms of the Water Commission Act of December 1914 (Bookman and Baker 1949:26). As for the Orange County request for formal recognition of a multi-purpose dam, the Riverside authorities were flatly opposed. They already resented the fact that up to one-third of the reservoir's capacity was devoted to water conservation (Bookman and Baker 1949:17B-18).

The Riverside County Board of Supervisors also took a dim view of the Orange County proposal for more land in the basin (CoE 1948), and their active opposition probably ensured that the CoE would not grant such a request. Riverside also rejected the further development of the upstream pipe extensions or "galleries" that were to connect with the sub-dam conduit. The enunciation of formal Riverside County opposition to Orange County's plans in the Prado Basin led to a war of words between the two counties. Orange County let it be known that it might consider litigation as a means of settling the matter of water rights in its favor once and for all. Hoping to avoid this step, the Orange County Board of Supervisors appointed a panel commissioned to educate Riverside County residents on the urgent needs of Orange County for more water (Shafer 1949:2).

Development of Recharge Basins in Orange County

Perhaps because the Orange County authorities perceived increasingly greater resistance to their proposals for water conservation in the Prado Basin, they began to entertain other schemes for water conservation within Orange County itself. Specifically, these strategies entailed recharging the Orange County groundwater aquifer in the area of maximum utility-- a six-mile wide band south of the mouth of the Lower Santa Ana Canyon. In 1949, the Orange County Water District began buying Colorado River water to help recharge the aquifer through spreading basins established in the river channel and nearby abandoned gravel pits (Banks and Halatyn 1971:7, 9). Eventually, these gravel pits, like the Crill Basin, were purchased and formally incorporated into the Orange County effort to recharge the water table.

Recreation Use in Prado Basin

To complicate the picture further, the Federal Flood Control Act of 1944 (Public Law 78-534) authorized the CoE to construct, maintain, and operate public parks and recreational facilities at water resource development projects such as Prado Dam and Reservoir. The CoE was also allowed to authorize local interests to establish and maintain such facilities (CoE 1976:1). By 1947, the Los Angeles District of the CoE was raising suggestions for recreational facilities in the Prado Basin (Suggested Recreation ca. 1948). Among the proposals considered by the CoE were a possible nine-acre lake on the Santa Ana River, devoted to boating, fishing, and other water activities, and an 80-acre lake created by a natural check dam on Chino Creek, surrounded by camping areas that would be accessible to the "Kota" adobe (Suggested Recreation ca. 1948). The CoE even went so far as to mark off lands for recreational purposes among the properties it held in fee simple (Orange County Water District 1948).

The CoE's suggestions for recreational facilities in the Prado Basin ran counter to the requirements of both flood control and water conservation, which have to allow for extreme fluctuations in reservoir water levels. For this reason, authorities in neither Orange nor Riverside counties looked with great favor on the early schemes to develop recreational facilities. The Orange County reaction was particularly strong, at least in the beginning. In May of 1948, the Orange County Board of Supervisors generated a series of resolutions protesting the use of Prado water for anything other than percolation into the groundwater aquifer of Orange County. The board, supported by most of the Orange County water interests, specifically opposed any proposed recreation use of the basin water (Memoranda on file, Box 3931, National Archives, Pacific Southwest Region, [NAPSWR]).

This opposition was soon modified, probably for political reasons. Since Orange County was embroiled in the struggle to declare the Prado Dam and reservoir a multi-purpose use area, it was probably perceived that a strong stand against recreation would be prejudicial to their own cause. Nonetheless, Orange County made it clear that recreational use in the basin should only be incidental (CoE 1948), and approved only if recreation did not interfere with other, more important uses (Orange County Water District 1948). By the following year, Orange County had adopted the attitude that recreation could be allowed on lands above the 514 foot elevation assuming the following conditions were met: the water used for recreational purposes could not exceed what had been used earlier for irrigation; and there could be no ponding of water or watering of lawns (Bookman and Baker 1949:2-3).

The reaction to the proposed recreational use of the Prado basin was more mixed in Riverside County. The local flood control district did not want to finance any recreational activities in the basin (CoE 1948), but the Riverside County Planning Commission actually encouraged the CoE to develop more recreation suggestions (Black 1948). Riverside County's more favorable reaction to recreation in the basin was perhaps a reflection of the local popularity of the CoE's suggestions. Similar ideas were even tendered by private citizens, like the suggestion that the basin be set aside as a waterfowl refuge. This suggestion had to be rejected because downstream water interests would object (Moore 1948). However, the demand for recreational use of the Prado Basin would continue to grow. The continued development of both Riverside and San Bernardino counties led to an increasing pressure for park and recreational facilities in the basin itself.

Resolution of the Conflict

The conflict between flood control and water conservation, with the added issue of recreational use, continued on a more subdued level throughout the 1940s, through the 1950s, and even until the end of the 1960s. Only with the passage of the Intergovernmental Cooperation Act of 1968 was the CoE explicitly directed to increase water conservation to the extent that such measures would not adversely affect flood control (CoE 1988a). It was about this time that the Orange County Water District bought the Prado Basin land held previously by the Santa Ana River Development Company (Nick Richardson, personal communication 1989).

The Intergovemmental Cooperation Act led to the Cooperative Agreement of 1969 between the CoE, Orange County Water District, and the California Department of Water Resources. An agreement was reached to determine and develop multiple uses of the Prado Dam and reservoir (Cooperative Agreement 1969). The facility had at last been declared a multi-purpose use area, and Orange County's pre-imminent need for more water was recognized.

Orange County's water needs in the Prado basin were further recognized with the conclusion of a water rights suit between Orange County Water District and the City of Chino, et al., finally decided in 1969. This case, settled in Superior Court, State of California, was essentially decided in favor of Orange County. By the terms of this settlement, the defendants upstream from the dam (City of Chino, Western Municipal Water District [Riverside County], Chino Basin Municipal Water District, and San Bernardino Valley Municipal Water District) agreed not to oppose water conservation of any storm flood in the basin below the 514 foot elevation (Cooperative Agreement 1969; Summaries 1971). Orange County was also awarded the right to an annual base flow of 42,000 acre feet (Bailey 1971:6), and the renewed right to close temporarily one of the two ungated openings, limiting the controlled release of water into Orange County to around 5000 cubic feet per second (Bailey 1971:2). This right was later buttressed by the closing of the second ungated opening around 1970. Henceforth, Orange County was to receive its allotted water through the dam gate, which could be closely regulated (Nick Richardson and Dave Riggle, personal communications 1989).

The controversial 60-inch pipe under the dam was not actually opened until 1972-1973, when it was finally hooked up to two massive sewage lines, one from Corona and the other from Chino. From under the dam, this sewage is now piped all the way to a treatment plant on the coast between the Santa Ana River and Huntington Beach. This operation is conducted under the auspices of the Santa Ana Watershed Project Authority (Nick Richardson, personal communication 1989).

6. THE FUTURE OF PRADO DAM

Plans to Raise Prado Dam

The possibility of modifying the flood control facilities at Prado Dam was first raised in 1964, as part of a review of the Santa Ana River watershed commissioned by resolution made on May 8 by the Public Works Committee of the U.S. House of Representatives. The CoE began this review that same year (Bailey 1971:3).

By November of 1969, the design review of the Prado Dam itself was completed. The dam and reservoir, which had a capacity of 198,220 acre-feet at the spillway discharge level in 1969, was found to be insufficient to contain a projected maximum flood. Such a flood could send 290,000 second-feet of water into the reservoir, with a total flood volume after one week of around 500,000 acre-feet. As a result of arrangements made with Orange County, the dam outflow would be no greater than 5000 second-feet, which would not begin to drain such a flood. When the waters reached the 543 foot elevation, they would begin to crest the spillway, and would continue to do so until there was a waterfall at least 12 feet over the spillway, sending 150,000 second-feet into the river channel below, which could not contain this volume. Flood waters would break free of the river banks, mostly on the north side, and flood about 100,000 acres to a depth of 2.5 to 4 feet. There would be damage to an estimated 200,000 homes and most of the transportation arteries across the river (CoE 1976; Prado Dam 1971:1-2; Prado Dam 1985).

The drastic increase in the potential damage caused by a maximum projected flood had two causes. One was the increase in the siltation of the reservoir as a result of seasonal rains and the minor floods that entered the basin every year since the dam had been completed (Hayward 1979). The other cause was the vast increase in the urbanization of the Santa Ana watershed since the dam had been built. With more housing, more asphalt and concrete, there was more water run-off and less percolation. With every new construction project, the flood potential increased (Hayward 1972; Prado Dam 1971:1-2). The cost of enlarging the dam and reservoir to the point where it would accommodate the run-off from a maximum projected flood was estimated at $400 million (Prado Dam 1971).

Local reaction to the proposed dam raising varied greatly. Orange County strongly supported the idea, but Riverside and San Bemardino counties were less than enthusiastic. Neither of the upstream counties wanted an enlargement of the basin and a reduction of the local settlement, since that meant revenue losses. They also resented having to absorb a tax loss for a project that would only benefit Orange County. There was the general feeling that Orange County should make some sacrifices, too, such as enlarging the Santa Ana River channel below the dam (Prado Dam 1971).

The communities directly threatened by basin enlargement were strongly opposed to the plan. The City of Corona disliked the idea because it would adversely affect the Butterfield Stage Park and the Corona Airport, both adjacent to the reservoir (Eldridge 1972). In both Corona and Chino, the local dairymen feared that an expansion of the reservoir would push them out of the area, forcing them to give up fertile lands for less productive plots (Ritter 1972a and 1972b).

Partly as a result of the local outcry in the upstream counties against raising the dam, the CoE began to float alternatives to test the local reaction. One potential solution was to build a series of smaller dams on the upstream tributaries of the Santa Ana, but this was acknowledged as a costly and not particularly effective alternative. The only upstream dam that was seriously considered was a flood control dam at Mentone, in the debris cone of the Santa Ana River immediately south of the San Bernardino Mountains. This dam remained an option for a number of years. Another alternative to raising the dam was to widen the river channel in Orange County so that it could handle a flood outflow. It was estimated that this action would require the relocation of at least 2500 homes and the rebuilding of 36 bridges (Hayward 1972). As might be expected, Orange County was not pleased with this alternative, and countered that any serious channel enlargement downstream from Prado would deprive the county of revenue from property taxes while costing more than any enlargement of the basin itself (Prado Dam 1971).

Soon it was acknowledged at the Corps that an enlargement of the Prado Dam and reservoir was the most cost-effective solution to the problem of flood control. By 1974, the CoE was back to its original scheme, known then as "Plan F," to raise the dam 34 feet and raise the spillway 23 feet. This conclusion, however, was still did not agreeable to Riverside and San Bernardino counties, and their attempts to modify this solution led to another war of words between Orange County and the upstream counties.

The 1974-1975 Controversy

In 1974, the CoE and Orange County supported the so-called "Plan F," which entailed raising Prado Dam by 34 feet and the spillway by 23 feet. Even though Orange County was committed to paying 98 percent of this projected work, local Riverside and San Bernardino County residents resented any loss of their property for the sake of flood control in Orange County (Hayward 1980b).

The San Bernardino County Board of Supervisors could be induced to support Plan F, but the Riverside County Board was strongly opposed, as was the City of Corona (Eldridge 1974b). Local dairymen were particularly opposed to the plan, since it was widely believed that any enlargement of the reservoir would cause additional land to be withdrawn from dairy production and eventually turned over to the public for recreation (Prado Dam 1971:15). Following their lead, Representative George Brown, Jr., the local Congressman from Colton, went on record as opposing the plan (Eldridge 1974a).

In December of 1974, when it became clear that there would be no Congressional action on raising the dam without an agreement from all three counties, Orange County threatened a law suit against the Riverside County Board of Supervisors for blocking the flood control measure (Eldridge 1974c). In December of 1974 and January 1975, there were numerous meetings, threats, and counter-threats between Orange and Riverside officials. In February of 1975, Orange County began a serious lobbying campaign in Congress through the "Santa Ana Flood Control Agency," designed to counter the effects of adverse publicity circulated by the Cities of Corona and Norco, the Corona and Norco Chambers of Commerce, and the Riverside County Board of Supervisors (Hayward 1975a).

The conflict between Riverside and Orange counties eventually settled into a stalemate, which was only broken by a proposed compromise worked out by the CoE in September of 1975. To placate the Corona residents, the CoE suggested raising the dam 30 feet rather then 34 feet, and the spillway 20 feet rather than 23. This more modest enlargement of the reservoir would affect 125 property owners, rather than 250, and the 125 owners would not necessarily have to vacate their land. Their property would either be bought out when the project began, or they could have the option of flood-proofing their property, or having flood easement bought from them by the Corps (Hayward 1975b).

This compromise was worked out with the assistance of Victor Veysey, Assistant Secretary of the Army in charge of the CoE, and former Congressman from the Corona area. It was through his good offices that Corona and the Riverside County Board were induced to accept the compromise, and a formal agreement between the CoE and the City of Corona was signed in December of 1975 (*Corona Daily Independent* 1975). All parties now agreed that the Prado Dam would be raised 30 feet above the present level and that the reservoir behind the dam would be increased accordingly. As though to symbolize the agreement and the end of the bitter controversy, a large red, white, and blue logo, "200 Years of Freedom, 1776-1976," was painted on the Prado Dam spillway in 1976 by students from the Corona High School (Hayward 1979). Easily visible from Highway 91 just south of the dam, the logo remains today one of the dam's most striking features.

New Proposals, 1975 to Present

Both recreational use and environmental studies came of age in the Prado Basin during the dam-raising controversy. Recreational development in the basin, though hinted at earlier, really began with the development of the Code 710 program, defined by regulation EC 11-2-119, dated May 30, 1975. According to a report developed for this document ("Recreational Development at Completed Projects"), federal funding was to be made available for recreational development at completed CoE projects if local agencies shared one-half of the development costs and assumed the operation and maintenance of the recreational facilities. By 1976, approximately 6500 acres of land within the basin had been leased for recreational use by San Bernardino and Riverside counties and the City of Corona (Recreation Master Plan 1976:1). There was also an increase in fishing within the basin, of both a legal and illegal nature (*Corona Daily Independent* 1983).

Almost in conjunction with the increased recreational use of the basin came the growth of local environmental and archaeological interest. The first Environmental Impact Statement for the Prado Dam and reservoir was compiled in 1975 and approved in 1977. It was followed by two others, one in 1980 and the other in 1988 (Steven Schwartz, personal communication 1989). The first comprehensive report to deal with the local cultural resources, both historical and prehistoric, was compiled by Paul E. Langenwalter II and James Brock in 1985. Since then, broad theoretical overviews of prehistory and history have been prepared, several representative archaeological sites have been tested and evaluated for their significance, and thematic studies have focused on water systems, the dairy industry, landholdings and settlement pattern, etc. Other environmental studies were conducted, such as that for Least Bell's vireo, a migratory bird living in the trees of the Prado Basin (Beeman 1985). The vireo has since been officially listed as endangered, and the Basin has been proposed (but not designated) as Critical Habitat.

Despite this research and planning, the fate of the dam itself was once again thrown into confusion. When it became apparent that the 1975 plans to raise the dam by 30 feet were not going to be acted on immediately, the consensus that had been reached by more than a year of wrangling was allowed to lapse, permitting the old feuds and resentments to resurface. This problem was only exacerbated by a new CoE study of the flood control issue that appeared at the end of the 1976. This study suggested abandoning the Mentone Dam idea and raising Prado Dam by 45 feet, thus negating the 1975 compromise of 30 feet (*Corona Daily Independent* 1977). To compound matters, President Carter's 1977 budget presented a series of funding problems for any proposed work on the dam, so that it became increasingly unclear just what would be done to improve flood control on the Santa Ana, and when any improvements would take place.

By 1980, with no resolution in view, Corona and Orange County were feuding about water impounded behind Prado Dam, which was good for water conservation measures downstream, but bad for Corona's airport runway

(Hayward 1980c). Chino dairy owners were again upset about any potential expansion of the flood control basin and were particularly incensed about the recreational uses proposed for the land. Many even suggested getting royalties for recreational use. Just as in 1975, dairy owners had to be reassured by the CoE that they would not necessarily have to move if the flood basin was enlarged: their property could be flood-proofed or the CoE could simply buy up flood easement rights (Kurtz 1980).

Behind much of this new uncertainty lay the realization that much more local monies would have to be spent on any flood control improvements than had been proposed in 1975. Riverside County was now expected to pay a portion of the costs for any improvements, when in 1975, it was not expected to pay anything at all. In addition to this problem, it was also recognized that any new solutions would be more difficult to implement now, since local authorities had permitted additional residential and commercial development along the peripheries of the basin since 1975 (Hayward 1980a).

The CoE's position on proposed flood control measures was ambivalent largely because of funding problems at the national level and renewed bickering among the local communities. To complicate matters, the CoE raised some resentment by letting it be known that local agencies would be required to pay at least 25 per cent of the cost of any flood-control measures. Even though the CoE still favored the so-called "all-river plan" essentially worked out in 1975, there was now the additional possibility that Prado Dam would be raised 45 feet, which would obviate the need for a Mentone Dam, which was hotly opposed by the local residents in that part of San Bernardino County (Hayward 1980b). One study of the Prado Dam modifications, finished in October of 1981, provided four alternatives for the solution to the flood control problems on the Santa Ana River (Prado Dam 1985).

By 1982, the Army Corps had pretty much settled on a modification of the 1975 compromise: raise Prado Dam by 30 feet; build a dam at Mentone; and conduct some river channeling work in Orange County. It was also proposed that the percentage of state and local money what would be required to complete the work be reduced to 11.5; Federal funds would account for the rest (Gottlieb 1982).

The most controversial portion of this plan was the proposed construction of the Mentone Dam, which was to be built within the extensive debris cone of the Santa Ana River immediately below the Upper Santa Ana Canyon in San Bernardino County. Building this dam would eliminate the need to raise Prado Dam by 45 feet and would save the government a great deal of money. It was estimated that raising Prado Dam by 30 feet would eliminate 158 houses, ranches, and businesses; raising the dam by 45 feet would eliminate 450. If the difference could be made up by a reservoir in the undeveloped debris cone of the river farther upstream, then the government would end up saving money (Gottlieb 1982).

As proposed by the CoE, the Mentone Dam would be 250 feet high, 3.5 miles long, and cost $477 million to construct. The dam, though not particularly controversial in concept, was strenuously opposed by the local residents, who feared that such a construction so close to the San Andreas fault might prove disastrous (Gottlieb 1982). Local opposition to the Mentone Dam was so fierce that Congress actually resolved in the early 1980s that the CoE abandon this portion of the plan (Steven Schwartz, personal communication 1989).

By the terms of the Water Resources Development Act of 1986, the CoE's "Santa Ana River Flood Control Project" had dropped any plans to construct the Mentone Dam and had gone back to the 1975 compromise of raising the dam by 30 feet (566 to 596 feet) and the spillway by 20 feet (543 to 563 feet). Also planned were levees to protect specific properties, like the California Institution for Women, from any flood damage that might result from an enlarged reservoir. New Prado Dam outlet works were also planned to increase controlled flood water release. Once again, it was assumed that local agencies would have to pay an estimated 25 percent of the flood control costs (Environment Scoping 1987).

No final decision or action was forthcoming, and by 1988 the Orange County Water District, sole owner of most of the water rights in the Prado Basin since 1968, was emphasizing its 1969 court-ordered right to store water in the reservoir up to elevation 514 feet. Up to that point, the CoE had allowed incidental storage up to 494 feet (Nick Richardson, personal communication 1989). The CoE, however, countered that such an increased level of storage would interfere with other land uses, such as recreation and the protection of environmental resources, specifically the habitat of Least Bell's vireo. The CoE instead, approved seasonal water conservation up to the level of 505 feet elevation (Steven Dibble, personal communication 1996).

Plans for raising the dam are still in flux. The present Santa Ana River Mainstem Project calls for a flood control dam at Seven Oaks, currently under construction, at the upper end of the Upper Santa Ana Canyon in the middle of the San Bernardino Mountains. This construction would mean that the Prado Dam would only have to be raised 28.4 feet (from 566 to 594.4 feet above sea level), with the spillway being raised 20 feet as before. Also involved in the project is the on-going modification of the Santa Ana River channel in Orange County (CoE 1988b:iii-iv).

From its inception, the plan to raise Prado Dam has been the subject of local controversies about objectives (flood control and water conservation), allocation of costs among the counties, and the respective benefits to Orange, San Bernardino, and Riverside counties. The project is clearly in need of some modification. It has been determined that the dam has insufficient capacity to control a volume larger than a 70-year flood. This is primarily due to the spillway design, greater than anticipated rainfall, sedimentation which further reduces capacity, and increases in upstream runoff as a result of the urbanization and development of the Chino and Pomona Valley area. In some ways, contemporary concern for water conservation is antithetical to the original design, since it contributes to sedimentation.

Peak-discharge rates have been substantially increased due to higher runoff resulting from urbanization. As the peak discharge rate increases, so does the volume and peaking time. This has raised the design volume of a Probable Maximum Flood from about 230,000 acre-feet to as much as 1,543,000 acre-feet. If all of the flood waters were directed through the existing Prado Flood Control reservoir, this would mean that the embankment could be topped by as much as 4.3 feet of water. This would pose a major threat to an earth filled structure such as Prado Dam, and a major, catastrophic release of water could occur.

Prado Dam has always been the subject of political controversy, particularly between the competing demands of flood control and water conservation needs in the Santa Ana watershed. With the greatly accelerated growth downstream from the dam in recent years, there has been an even greater demand for what is a limited water supply. Because of the tremendous residential and commercial development that has taken communities to the brink of almost all flood control basins and river channels, even the obvious solution of increased dam and reservoir size cannot be implemented without creating its own set of problems. The Prado Dam and reservoir are now much more than a simple flood control device envisioned by the CoE in the late 1930s. It has long been a political weathervane, attracting attention from all sides. In such a climate, its solutions can never be approached from a wholly dispassionate point of view; they too will have to be political.

Project Information Statement

This document has been prepared at the request of the United States Army Corps of Engineers, Los Angeles District, as one of several mitigation measures undertaken in anticipation of modifications which may affect Prado Dam. The facility has been determined to be a cultural resource eligible to the National Register of Historic Places for its historical, engineering, and architectural values. The governing authority is contained in the National Historic Preservation Act; the Archeological and Historic Preservation Act, amending the Reservoir Salvage Act on 1960; and Corps of Engineers regulations ER 1130-2-438 for Historic Preservation and 36 CFR 800, "Protection of Historic Properties."

This report supplements and illustrates the original historical report prepared in 1989 (Swanson and Hatheway). Under the supervision of Roberta S. Greenwood as Principal Investigator, the new photographs and reproductions of historical engineering drawings were prepared to archival standards and indexed by David De Vries. Descriptions of the functioning elements and overall architecture were prepared by Architectural Historian Dana N. Slawson, M. A., and Jeffrey Skiles, M. A., was in charge of production.

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No.	9	March 31, 1939:	Overall to East from East Abutment
No.	10	March 31, 1939:	Axis of Dam Showing Keywall

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No.	14	Sept. 29, 1939:	Intake/Service Bridge Pier Construction
No.	15	Aug. 16, 1939:	Closed Conduit of Outlet Works
No.	16	Aug. 16, 1939:	Lower End of Outlet/Gravity Wall
No	17	Sept. 29, 1939:	Gravity Walls and Stilling Basin
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No.	14	Nov. 29, 1939:	Ogee Section Backfilling
No.	15	Nov. 13, 1939:	Intake Structure Slide Gates
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No.	18	Dec. 18, 1939:	General View along East Abutment
No.	19	Dec. 18, 1939:	Upslope of Dam from East Abutment

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No.	10	Jan. 18, 1940:	Construction of Dam embankment
No.	11	Jan. 18, 1940:	Aerial of Diversion Channel/Control
No.	12	Jan. 29, 1940:	Control Structure and Bridge Pier

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No.	5	June 15, 1940:	Aerial View showing Work in Progress
No.	6	April 12, 1940:	View along Axis toward Outlet
No.	7	June 24, 1940:	Embankment Rock Paving in Progress
No.	8	April 12, 1940:	Completed Outlet Control Structure

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No.	6	Sept. 5, 1940:	Progress along Spillway Bucket
No.	7	Sept. 25, 1940:	Nearly Completed Spillway Bucket
No.	8	Sept. 9, 1940:	Aerial View of Operations

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No.	2	Dec. 20, 1940:	Concrete Pouring on Crib Outlet
No.	3	Nov. 19, 1940:	General View Spillway Progress
No.	4	Dec. 20, 1940:	Concrete Pouring on Spillway Lip
No.	5	Dec. 21, 1940:	Aerial View Dam Embankment/Spillway

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No.	3	Feb. 8, 1941:	Spillway Bucket and Channel
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No.	6	March 5, 1941:	Aerial View with Reservoir Water

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No.	1	May 17, 1941:	Completed Spillway, Wall and Dam

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The following agencies and individuals were particularly helpful.

Orange County Environmental Management Agency
(before 1975, Orange County Flood Control District)
Nick Mastrocola
Joe Natsuhara
Central Files
Maggie Adams
Flood Design
Richard Runge
Library
Janet Hilford
Right-of-Way Engineering (old land files)
Harold Scott
Ron Miller

Orange County General Services Agency
Land Acquisition
John Shaddy

Orange County Water District
Nick Richardson, Assistant Manager & District Engineer

United States Army Corps of Engineers, Los Angeles District
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(Prado Dam As-Built Plans)
Environmental Section
Steven Schwartz
Gloria Lauter
Steven Dibble
Map File Room, Basement
Robert Murai
Prado Dam Caretaker
Dave Riggle
Project Management
Tom Sage
Public Affairs
Anthony Turhollow, Los Angeles District historian
Carol Wolff, Assistant Chief

United States National Archives and Records Administration - Pacific Southwest Region
Suzanne Dewberry, Archivist

APPENDIX

Pertinent Data, Prado Flood Control Basin

Drainage area	Square Miles	2,233*
Reservoir:		
Area at spillway crest	Acres	6,710
Capacity at spillway crest	Acre-feet	222,000
Area at maximum water surface	Acres	8,720
Capacity at maximum water surface	Acre-feet	322,000
Area at top of dam	Acres	11,250
Capacity at top of dam	Acre-feet	420,000
Allowance for silting	Acre-feet	12,000
Regulation:		
Inflow of storm (7 days)	Acre-feet	275,000
Inflow peak	c.f.s.	193,000
Outflow peak	c.f.s.	9,200
Reduction in peak	c.f.s.	183,000
Dam:		
Type		Earth
Top elevation	Feet, msl	566
Height above stream bed	Feet	106
Length at crest	Feet	2,280
Embankment	Cubic yards	3,090,000
Spillway:		
Type		Concrete ogee
Length	Feet	1,000
Crest elevation	Feet, msl	543
Maximum water surface elevation	Feet, msl	556
Surcharge on crest (max. w.s.)	Feet	13
Discharge (max. w.s.)	c.f.s.	179,000
Excavation	Cubic yards	3,100,000
Concrete in spillway	Cubic yards	130,000
Outlets:		
Gates - number		6
Gates - size	Feet	7 x 12
Openings - ungated (bypass) - number		2
Openings - ungated (bypass) - diameter	Feet	5.5
Conduits - type		Square
Conduits - number and size	Feet	2 - 13.5 x 13.5
Conduits - length	Feet	750
Regulated capacity at spillway crest	c.f.s.	9,200
Maximum capacity at spillway crest	c.f.s.	17,000
Gate sill elevation	Feet, msl	460
Gate sill to maximum flood control pool	Feet	73
Concrete in outlets	Cubic yards	35,000
Excavation	Cubic yards	360,000

* Includes San Jacinto River-Lake Elsinore drainage area of 798 square miles (Source: Hunter 1945)

"TEMESCAL TIN DISTRICT,"

("SAN JACINTO ESTATE")

SAN BERNARDINO COUNTY, CALIFORNIA,

U.S.A.

REPORTS

OF

E. N. ROBINSON, M E.

HENRY MATHEY, M.E.

CAPTAIN CHARLES CRAZE, M.E.

GEORGE GRANT FRANCIS, M.E.

1888, 1889,

1890.

"San Jacinto Estate" and "Temescal Tin District,"

CALIFORNIA.

INDEX

TO

[Copy.]

Anderton's Hotel,

162, Fleet Street, E.C.,

London, *March* 31*st*, 1890.

E. N. Robinson, Esq.,

24, Austin Friars, E.C.

Dear Sir,—

Our accidental meeting on Friday last, and the sight of "Temescal Tin Ore" that you showed me, carries me back to the days of '68 and '69, when we took possession of the San Jacinto Rancho and commenced work on the then little known, but now the much talked about, Tin deposits of Temescal, and I am sorry my engagements for Friday made our interview so brief.

I have thought of that property many times in my travels, for everywhere there is more or less talk of tin in one way or the other. I have travelled much since I saw you last, and am lately returned from South Africa, after a residence there of over two years. I have often wondered if you had succeeded in substantiating your claims and proprietorship to that grand Estate, with all its mineral wealth, and am very glad to hear you have.

Many changes have taken place in that part of California since I left the "Old Stone House," over 20 years ago. Riverside, with a population now of 8,000 or 10,000, was then unthought of, and I could have purchased the land then upon which the town is located for $1.50 per acre, which I am told is selling at the present time for from $300 to $3,000 per acre, and in my trips in those days to San Bernardino, 20 miles, and Los Angeles, 55 miles, from the Mine I scarcely met a person. The county then was virtually a great cattle range, with immense herds grazing in all directions. I am told that grazing lands are scarce now, and that Railways surround the Estate, and that the tin property can be reached in a palace car—while—in *our day*, it was on mule back or on foot.

Then Los Angeles claimed less than 10,000 inhabitants, and New San Diego less than 100, and now I am told the former has over 80,000 and the latter 40,000 in population. What a change for so short a period. *Did you* ever speculate on what the opening up of the Tin mines on the San Jacinto Estate in the manner their extent and richness warrants, will add to the population and value of the country surrounding it? I am aware of your decided views regarding the immense future of the San Jacinto Estate at large, and I also know that it was through your exertions, combined with those of our old friend Edward Conway, that the tin deposits were proved to be what they are, and yet I do not think you appreciate its full value as a *tin property*, *independent of its great value* as an agricultural proposition as well as I do.

All that you say, and have said in your Reports, and I think I have seen them all, I fully endorse. I consider Mr. Mathey's, Captain Craze's, and Mr. Francis's Reports conservative, and their conclusions quite within the possibilities of the property. Their examinations were confined to a limited time, while my knowledge and information of the property, and the Cajalco lode in particular, springs from a *daily* contact with same in practical mining work, and from daily tests of the ore and lode in all places for over one year.

From full enquiries made by you regarding my capabilities, before I assisted you in the opening out of the Cajalco lode, you know that I have been engaged in mining from boyhood, and many years of my early life were spent in practical work among the Tin Mines of Cornwall, hence I speak not from hearsay, for close application and hard labour have been my teachers in the school of Tin Mining. Therefore my ideas and opinions springing from experience among the Cornish Tin Mines, may be of service to you, if so I shall be glad to offer you any and all information in my power, not only covering what I know about Temescal, but also what I know about Cornish tin ores, and their comparative values with the ores of the Cajalco lode.

I do not think you ever saw any Cornwall, or other tin ore, precisely similar to that of Temescal. I have tossed many a sample of tin in my day, but never any like the tin stone mined at Temescal. In your statement of assays made by me of the Cajalco lode, during the time I was developing it, you only mention 48. That number is but a small percentage of the tests I personally made in the Cornish way of Cajalco ore. If y u had them all the average per cent. you name is below the facts. A gain I have seen no reference by you to the wire tin that was found in the Cajalco lode, that is to say, ore *containing metallic tin*, and, if I am not mistaken, a specimen of it, handed you by me, is in your cabinet of minerals.

If I return to America and go to California I shall certainly visit "Temescal," and, if possible, climb to the "look out" of flag-staff, that I see by your photographs still stands on the top of Cajalco Hill. I erected it 21 years ago last 4th of July, to celebrate not only *the day*, *but the establishing of the fact* that America could produce *tin*. In my belief there is enough tin territory in sight of the "look out" to supply the demand of the United States, when properly developed. I shall remain in London some days, and while I am here, if you desire it, I will with pleasure meet any of your friends and explain to them my practical knowledge of tin mines in general, and the Temescal tin district in particular.

Though the Cajalco is a great and rich lode, there are many other tin outcrops in the vicinity of it that will yield tin stone at the surface far richer than the croppings of the Cajalco did at the surface when I started the work in 1868. The shaft, ten feet deep, on the "Little Scotty" lode I opened, and it is, in my opinion, the commencement of a mine that, when worked, will be the equal, if not the superior, of the Cajalco. Will you please send me a few copies of the late reports on the property, and if I want any of the ore I shall take the liberty of sending to your office for it.

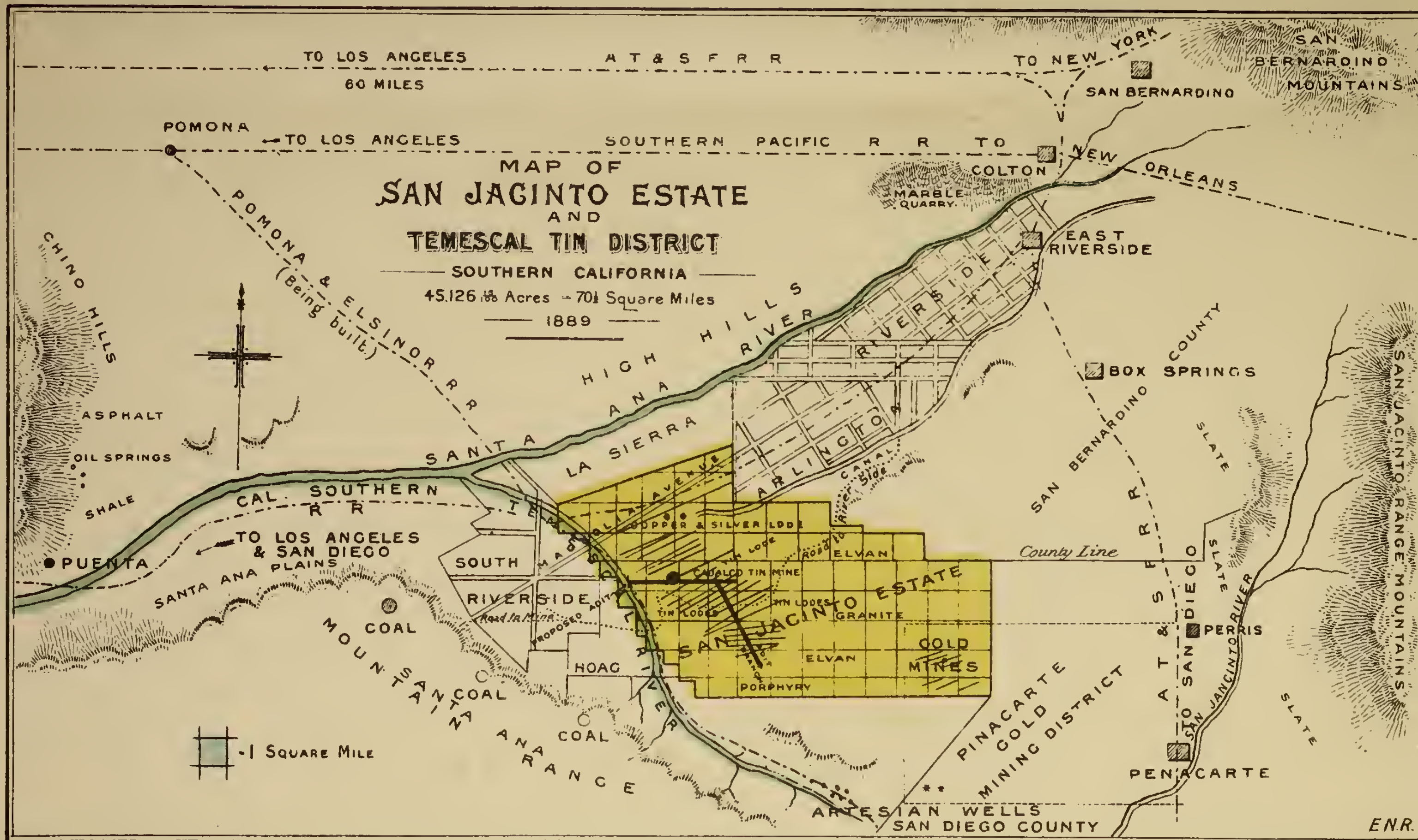
I have carried in my pocket, for over 21 years, a small bar of tin metal (from a larger bar) produced from the *first ledge tin deposit* found in America, and it came out of the Temescal district, and out of the "Cajalco Mine," in the beginning of 1869, *and the ore was mined by myself.*

Yours faithfully,

(Signed) WM. WILLIAMS.

Map A

MAP
SHOWING THE ACCESSABILITY
OF THE
TEMESCAL TIN DISTRICT.
OREGON R.R.
Connecting with the Northern Pacific and Canadian Pacific R.R's
C.P.R.R.
JUNCTION
SACRAMENTO
PORT COSTA
BENECIA
Sacramento River
S.P.R.R.
CENTRAL PACIFIC RAILROAD
LATHROP
CALIFORNIA
SOUTHERN PACIFIC RAIL ROAD
To China
SAN FRANCISCO S.P.R.R.
SAN BERNARDINO COUNTY
To New York
ATLANTIC & PACIFIC R R.
BARSTOW
MOHAVE
OIL WELLS
LOS ANGELES
A.T. & S.F.R.R.
SAN BERNARDINO
S.P.R.R.
COLTON
POMONA
RIVERSIDE
ARLINGTON
PERRIS
ELSINOR
TEMESCAL TIN DISTRICT
PACIFIC OCEAN
Steamer Line San Francisco & San Diego
To New Orleans
SAN DIEGO COUNTY
To China & Japan
W
E
SAN DIEGO
NATIONAL CITY
PROPOSED R.R. TO CITY OF MEXICO.
Boundary
To Mexico, Central & South America
To Lower California & Mexico.
MEXICO
E.N.R.


MAP OF
SAN JACINTO ESTATE
AND
TEMESCAL TIN DISTRICT
SOUTHERN CALIFORNIA
45.126 Acres – 70½ Square Miles
1889
TO LOS ANGELES
60 MILES
A T & S F R R
TO NEW YORK
SAN BERNARDINO
SAN BERNARDINO MOUNTAINS
POMONA
TO LOS ANGELES
SOUTHERN PACIFIC R R TO NEW ORLEANS
COLTON
MARBLE QUARRY
EAST RIVERSIDE
POMONA & ELSINOR R R (Being built)
CHINO HILLS
HIGH HILLS
SANTA ANA RIVER
LA SIERRA
RIVERSIDE
ARLINGTON
BOX SPRINGS
SAN BERNARDINO COUNTY
SLATE
ASPHALT
OIL SPRINGS
SHALE
CAL SOUTHERN R R
TO LOS ANGELES & SAN DIEGO
PUENTA
SANTA ANA PLAINS
SOUTH RIVERSIDE
COAL
HOAG
COPPER & SILVER LODE
ELVAN
TIN LODES
GRANITE
SAN JACINTO ESTATE
GOLD MINES
PORPHYRY
County Line
PERRIS
SAN JACINTO RIVER
SAN JACINTO RANGE MOUNTAINS
SANTA ANA MOUNTAIN RANGE
PINACARTE GOLD MINING DISTRICT
PENACARTE
ARTESIAN WELLS
SAN DIEGO COUNTY
-1 Square Mile
E.N.R.

Map B

GEOLOGY OF

Temescal Tin District, California.

The Temescal Tin District is located in the Temescal range of mountains, San Bernardino County, California, and presents a large surface of granite that is in a remarkable degree similar to the formation in Cornwall surrounding the Dolcoath, East Pool, Carn Brea, South Condurrow, Tincroft, Wheal Grenville, Cook's Kitchen, South Francis, West Francis, and other of the most productive mines in the West of England. It is bounded on the north by the Santa Ana River and valley, on the south by the Temescal River (which separates it from the Santa Ana range of mountains containing the only coal measures being worked yet found in Southern California), and to the west lie the Santa Ana plains, which skirt the northern slope of the latter range, and extend about 12 miles to the "Puenta" and "Chino Hills" (shale), wherein exist extensive deposits of asphalt; and oil springs. To the east flows the San Jacinto River, which skirts the west slope (in slate) of the San Jacinto range of mountains (the San Bernardino range lying to the north and north-east of the Estate, about 20 miles). In coming from the Santa Ana plains (on the west) and crossing the Temescal River, you ascend the foot-hills of the tin district on a porphyritic formation (*geologically* speaking), its average altitude being about 500 feet above the river. The width of this porphyritic belt is about 1 mile, and its strike south-easterly for a distance of about 8 miles, where it intersects the slate and shales of the Santa Ana range. Lying next, and along the north-easterly side of the porphyritic belt, comes an Elvan porphyry of a fine texture, of a grey-white and rosy colour. (This is often encountered in the granite formation in close proximity to the tin lodes). Then comes the *tin granite*, with its strike south-easterly and north-westerly, having a known length of 12 miles, and a width north-east and south-west of about 4 miles. Within this area of granite occur veins or lodes of capel, heavily charged with *tin oxides*, or cassiterite, in a remarkably pure form. There are *over sixty* known tin lodes in this formation, running in a north-easterly and south-westerly direction, and nearly parallel, in the aggregate representing an *estimated length of tin lode* of at least 35 miles, the ore being a brown oxide of tin, free from wolfram, mispickle, and mundic, and the iron present is in the form of an oxide of low per cent. The ore is easy to reduce, and can be concentrated expeditiously into black tin (cassiterite), that will return at least 70 per cent. metal of fine quality.

See Map B.

Geology.

The strike of the granite belt being south-east and north-west, and the lodes north-east and south-west, denotes *true fissure veins*. These lodes have a dip in a north-west direction at an angle of about 65° from the plane of the horizon. The deposit has been tested to a depth of 150 feet on one of the centre lodes, and by several hundred feet of levels and cross-cuts. The lode will average 6 feet in width.—"*R. on Resources of California.*"

See Map C.

SAN JACINTO ESTATE

(*"RANCHO SOBRANTE DE SAN JACINTO"*),

CALIFORNIA.

Report of E. N. Robinson, M.E.,

SAN FRANCISCO, CALIFORNIA.

Gentlemen—

In the following Report I shall refer to Geological conditions only in a limited manner—that subject, in connection with the courses and dips of the various lodes and other detail, being correctly set forth in the accompanying "*Geology of Temescal Tin District, California*," from "*R. on Resources of California.*"

I shall confine my report to a brief history of the property, the *Mineral conditions* of the *Tin District* which lies within the four corners of the "*San Jacinto Estate*," as I have encountered them in a *practical* manner, covering a period of over 20 *years*, and to estimates covering costs of the improvements necessary to develop the district properly.

Area of Estate. The "San Jacinto Estate," with an area of 45,126 acres, or 70½ square miles (see Map "B"), is situate in San Bernardino County, Southern California, 55 miles East of Los Angeles, the largest city in Southern California, and which, within 10 years, has increased its population from 10,000 to 85,000. Location. It is less than 100 miles from San Diego, a city having the finest harbour on the Pacific Coast (outside of San Francisco), the population of which increased from 12,000 in 1866 to 45,000 in 1888. It is made accessible to all markets by the railways which environ it; on the North and East by the Southern Pacific and the Atchison, Topeka and Santa Fé Railways; on the West by the Southern Pacific Railway, and a branch of the Atchison, Topeka and Santa Fé. (See Map "A.")

In addition to said railways, another line, now under process of Railways. construction from Pomona, on the Southern Pacific Railway, to Elsinor on the Atchison, Topeka and Santa Fé Railway, crosses the Western and Southern portion of the property, thus making it one of the most accessible mineral districts in the United States. (See Map "B.")

Area of Tin District. The *Tin district* covers an area of about 23 square miles, being Number of Tin Lodes. more than 11 miles in length (S.E. and N.W.) by two miles in width, encompassing over 60 known parallel tin lodes (as per records of district).

At the time of the ceding of California to the United States by Mexico, the Estate (within which the Tin district lies), was owned by Mexican citizens (it being a grant to them from the Mexican Government, issued in 1846), from whom, in 1867, it was purchased by the present owners (the San Jacinto Tin Company), for the purpose of developing the tin deposits. History of Estate.

The boundaries of the old Mexican Grants, made by the Mexican Government, being roughly defined, this grant, on passing into the hands of citizens of the United States, was surveyed, its boundaries permanently fixed by United States Government Surveyors, and a Patent issued therefor in 1867.

Before this took place, the mineral richness being well known, many mining claims (over 600) had been located on the property, the locators of such erroneously supposing it to be public land; but upon the United States Government surveys defining the boundaries of the Estate to include the *mining claims* thereon located, the miners were ejected, and some time afterwards legal proceedings were commenced by them in support of their claims. History of Estate.

I commenced work on the Cajalco lode, for the present owners in 1868, but suspended all active operations on the beginning of litigation, which continued until March of last year, when, on appeal, the Supreme Court of the United States confirmed and settled for all time the validity of the title in the present owners.

(Herewith, marked "E" and "F," are copies of the decisions of the *U.S. Circuit Court* and the *U.S. Supreme Court*). Title.

The legal costs in connection with the expenditure in the work of exploration and development of this Estate amounts to over £80,000.

By reason of litigation, work has been suspended for over twenty years, and the vast tin and other valuable mineral deposits of the Estate have been lying dormant during that time.

I was appointed as "Mining Engineer" in 1868, to develop the tin *deposits* of this district. Finding that the outcroppings of 39 known tin lodes (assaying from 3 per cent. and upwards in black tin per ton) extended in a marked form over a large area, I selected a central point near "Cajalco Hill" (see Map herewith, marked "D"), and commenced the work of development by sinking on one of the lodes two inclined shafts, 272 feet apart, following down on the dip of the vein, at the same time driving an adit tunnel in on the course of the lode, intersecting such shafts at 45 feet and 100 feet from surface respectively. These explorations extend on the line of this *one lode* for a distance of 432 feet in the adit tunnel and 375 feet along the lode, on the lower level (65 feet below the adit tunnel). A winze connects these two levels at a point about half-way between the two shafts, and numerous cross-cuts were

See Photographs 14, 15, 16, 17, 18.

Development.

made from foot to hanging wall to test and prove the extent, reliability and value of the lode.

(See Plan and Section herewith, marked "C.")

The total work done aggregates over 1,186 feet of shafts, tunnels, drifts, winze and cross-cuts; such work being of sufficient extent to determine the fact that this one lode (of the many within the district), is of great magnitude and of remarkable richness; that it will average at least 6 feet in width, and holds its permanency in every part thereof. The ore is a brown oxide, of very high grade, free from mundic, wolfram, arsenic, &c., which are objectionable combinations in most Tin ores. This ore produces a fine quality of tin, and equal to the best "Cornish refined." I have sampled every part of the lode, as developed, many times, and have worked the ore therefrom in quantity, on a practical scale, with extraordinary results. I sent 12 tons of ore (fair samples from the Mine,) to Joseph Mosheimer, Smelter and Metallurgist, of San Francisco, and had such crushed, concentrated, and reduced to pig tin, which yielded about 20 per cent. of pure metal, in 50 bars, of about 100 pounds' weight each. 1½ tons sent to Taylor and Co., Smelters, of San Francisco, yielded over 30 per cent. of pure metal. One ton of ore, taken from the dump pile, was sent to London in September last, and an analysis thereof by Messrs. Johnson, Matthey and Co., yielded over 16 per cent. of metal (being equal to 24 per cent. of black tin).

Developments

Description of Ores.

Purity.

Assays and Working Tests.

1,700 pounds of ore, taken from different parts of this lode by Capt. Charles Craze, M.E., of Redruth, Cornwall, in May, 1888, was shipped to Cornwall and reduced by W. J. Trythall, of Bissoe, which yielded over 17 per cent. of pig tin.

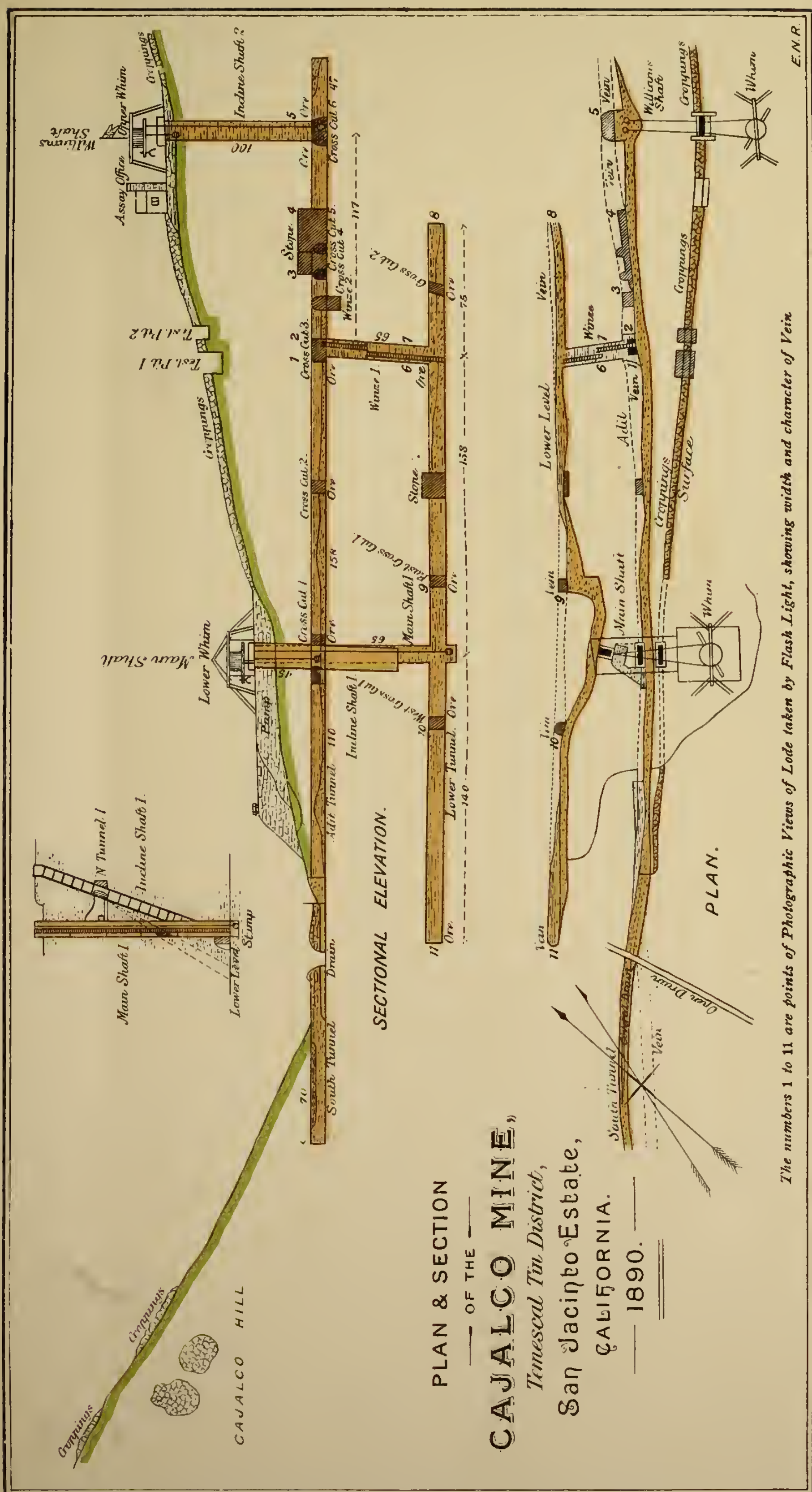
Professor Henry Mathey, of San Francisco, tested 18 large samples, weighing from 6 to 100 pounds, taken from various parts of the Mine, which averaged over 24 per cent. of black tin (the black tin returning 72½ per cent. metal).

During the progress of developments, extending over a period of about 12 months, tests were frequently made, in the practical Cornish way, of samples of ore taken from every part of the Mine by Captain William Williams, selected by me as the Mine Superintendent (who for over twenty years was connected, in responsible positions, with tin mines in Cornwall), and the record kept of these tests shows an average yield of over 20 per cent. of black tin (cassiterite).

Mr. Williams estimated that the ore in sight in present openings of the Cajalco mine would, if reduced, return at least 600 tons of metallic tin.

Notwithstanding the fact that the various tests I have made of the "Cajalco" ores, and the result from same being over 20 per cent. pig

Map C


PLAN & SECTION
— OF THE —
CAJALCO MINE,
Temescal Tin District,
San Jacinto Estate,
CALIFORNIA.
1890.
SECTIONAL ELEVATION.
PLAN.
CAJALCO HILL
Croppings
Main Shaft
Lower Whim
Williams Shaft
Upper Whim
Assay Office
Test Pit 1
Test Pit 2
Incline Shaft 2
Incline Shaft 1
Main Shaft 1
Adit Tunnel
Lower Tunnel
South Tunnel
Drain
Winze 1
Winze 2
Stope
Ore
Cross Cut 1
Cross Cut 2
Cross Cut 3
Lower Level
Adit
Vein
Surface
Whim
Open Drain
N Tunnel 1
Main Shaft 1
Lower Level
Sump
The numbers 1 to 11 are points of Photographic Views of Lode taken by Flash Light, showing width and character of Vein
E.N.R.

tin, in my estimate of what the practical working yield of this one Mine *may be*, I have assumed *only* 15 *per cent. of black tin* in the ores; estimating the latter to return 66·5 *per cent. pig tin* from furnace workings. (The black tin will assay over 70 per cent.) The return of metal from concentrates of the mines of Cornwall for the past 10 years has been from 64·5 to 68·5 per cent.

I have manufactured a quantity of tin plate, using the tin of this district to coat *American iron*, and it proved equal to the best imported English plate.

I have been engaged in mining and smelting for over 30 years, and have twice examined the most important tin mines of Cornwall (under advantageous circumstances), and have never met in any mine of any kind, more indubitable evidence of a reliable and continuous lode, both horizontally and vertically, than is shown in the workings of the "Cajalco Mine" (Temescal Tin District). The present openings expose at least 10,000 gross tons of tin stone in place, ready for stoping, when the necessary machinery is erected for lifting ore to the surface. This, and the other lodes of the District, have remarkable natural facilities for working on a very large and profitable scale. **Ore in Sight.**

I have prospected and tested many lodes within the district, and obtained results equal to, and in many places, much better than obtained from the surface croppings of the "Cajalco" lode.

In my extended experience I have never met with such a vast and concentrated metalliferous deposit as exists in this district, in conjunction with every requirement for economical working.

Note.—Tin is invariably found in crystalline and metamorphic rocks, in several kinds of deposits, the most reliable of which exists in the form of lodes or ledges, and this is particularly the case in Cornwall, and the same conditions exist in this district, but in a more marked degree.

The necessary plant for mining (and reducing to pig tin) 100 tons of ore per day from the "Cajalco Mine" can be erected and put in operation within four months from the time an order shall be given for such; and I am positive (from my long and thorough knowledge of the value of this lode) that *it alone*, through its present openings, is capable of maintaining for a long time an output of 100 tons of ore per day, and twice that amount when the underground workings shall be extended horizontally and vertically, which may be done by an expenditure of 90 days' work. I am also positive that the ore can be reduced to pig tin at a cost of *much less* than 5d. per lb. of metal (the general estimate). **Cost of Tin Metal per lb.**

Estimating that the ore should yield 15 per cent. of black tin (of 66·5 per cent. metal), it would return (at £100 per ton for pig tin) a yearly net profit, for 300 working days, of £250,000, on an output of only 100 tons per day, and *double that amount* if the output should be increased to 200 tons per day. **Profits.**

In my estimate of the cost of producing pig tin I have adopted the price of fuel as it is at the present time; but, with a large consumption, I am satisfied that such cost would be much below my estimate. Several coal mines are now being developed within six miles of this district, and an excellent quality of coal, in limited quantity, is now being mined. (See Map "B.") The output of coal increases as work progresses, and the day is undoubtedly near at hand when these coal deposits will supply the whole of Southern California, thereby ensuring this district cheaper fuel, and reducing my estimate of reduction cost. Lumber and mining timber can be obtained at reasonable prices.

Fuel.

Location of Reduction Works.

The Temescal River, which flows across the western portion of the district, will furnish ample power to reduce all the ore that can be mined within the district. An admirable mill site exists, in conjunction with an extensive reservoir location, on the river within a short distance of the "Cajalco Mine," and within 1,000 feet of a second prominent tin lode. My estimate of cost of plant contemplates the erection of a Dam at the site named for impounding water, and creating a head, for power and water sufficient for extensive and all necessary reduction works.

Water.

Photographs 20, 21.

The amount of water flowing in the Temescal River, at *its lowest* stage, over the proposed Dam site exceeds 400 inches per day (sufficient in itself to *dress* 1,000 tons of crushed ore daily). The building of the proposed Dam on *bed rock* to a height of 75 feet will furnish *power* and water sufficient to *reduce* and *dress* to black tin 1,500 tons of ore daily.

To place this property (the "Cajalco" lode) in condition, fully equipped with all necessary requirements for mining, transporting, reducing, concentrating, smelting, and refining 100 tons of ore per day, will require the following expenditure:—

AT CAJALCO MINE.

Mining Plant.

Tramway.

Engine, Boilers, pumping and hoisting machinery, cages, steel rope, pump connections, water pipe, mining cars, car track, water tanks, &c. -	£4,500
Buildings over plant with ore bins complete, including grading and retaining walls - -	2,000
Air compressors and drills, with fixtures complete -	600
Electric light plant and connections - - -	200
Boarding-house, lodging-house, office, blacksmith and carpenter shops, stable, &c. - - -	1,500
Other necessary buildings - - - - - -	600
Tramway from mine to mill, and telephone line -	1,300
Waggon roads to railway station - - - -	300
Sinking shaft 500 feet deep, 16 by 6 - - -	3,500
Tools of all kinds and furniture - - - -	700
Forward - -	£15,200

Forward - - - £15,200

The above plant will have sufficient capacity to serve the mining and transportation of 200 tons of ore, and more, per day.

REDUCTION WORKS AT RIVER.

Reduction Works.

Stone dam 75 feet high - - -	£15,000	
Pipe to mill, water gates, valves, &c. -	1,000	
		16,000
Mill, with necessary crushing machinery, Turbine or Pelton wheel, concentrators, buddles, dressing floors, frames, and building over same, complete, including grading - - - -		12,000
Smelting furnace and refining plant, complete -		4,000
Tools of all kinds for every department - - -		1,000
Contingent - - - - - - - -		1,800
Total requirements - -		£50,000

Smelting Works.

Costs.

The output of the "Cajalco" Mine could, within six months, be increased to 200 tons per day by extending the underground workings at a small additional expense, requiring an increased milling capacity, not to exceed in cost £15,000.

Note.—The average yield of Temescal tin ores have been about 20 per cent. metallic tin, but to keep within safe limits, I base my estimate of yield at 10 per cent. metal (say 15 per cent. black tin).

I estimate the daily expenditure for mining, milling, and reducing to refined pig tin 100 tons of 15 per cent. (black tin), ore (66·5 per cent. metal) from the "Cajalco" Mine as follows, the result being 10 tons of metallic tin.

MINING EXPENSES.

	dols.	dols.
2 Engineers ...	at 4·50	= 9·00
2 Firemen	,, 2·00	= 4·00
6 Carmen	,, 1·50	= 9·00
2 Blacksmiths ...	,, 3·50	= 7·00
2 Helpers	,, 2·50	= 5·00
1 Teamster	,, 2·00	= 2·00
1 Ostler	,, 1·50	= 1·50
1 Labourer	,, 1·50	= 1·50
1 Watchman ...	,, 2·00	= 2·00
1 Timekeeper ...	,, 2·00	= 2·00
2 Cooks	,, 1·50	= 3·00
21 *On surface.*		$46.00 = £9. 4s., or 1s. 10d. per ton of ore mined.

Forward - - £9. 4s., or 1s. 10d.

Mining Expenses.

		dols.	dols.
2 Foremen ...	...	at 4·00 =	8·00
10 Miners ...	...	,, 2·50 =	25·00
40 ,, ...	...	,, 2·25 =	90·00
32 ,, ...	...	,, 2·00 =	64·00
10 Carmen ...	...	,, 1·50 =	15·00
2 Tool Tenders	...	,, 1·00 =	2·00
96 *Underground.*			$204·00=£40. 16s., or 8s. 2d. per ton of ore mined.

	dols.
Fuel (at mine) ...	30·00
Mining Supplies, Tools, &c. ...	40·00
Feed for Animals ...	5·00
	$75·00 =£15, or 3s. per ton of ore mined.

Superintendence, office expenses and contingent ... $25·00 = £5, or 1s. per ton.

Total cost of mining ... ... £70, or 14s. per ton of ore mined.

Transporting.

Transporting 100 tons of ore to mill ... ... $25·00 = £5, or 1s. per ton.

Total cost of mining and transporting 100 tons of ore } £75, or 15s. per ton of ore mined.

MILLING EXPENSES.

Milling.

		dols.	dols.
2 Foremen ...	...	at 4·00 =	8·00
4 Mill men ...	...	,, 2·50 =	10·00
4 Rock breakers	...	,, 2·00 =	8·00
8 Concentrators	...	,, 2·00 =	16·00
8 Assistants	...	,, 1·50 =	12·00
1 Gate tender	...	,, 2·00 =	2·00
1 Dam keeper	...	,, 2·00 =	2·00
1 Machinist ...	...	,, 4·00 =	4·00
1 Blacksmith	...	,, 4·00 =	3·00
2 Labourers ...	...	,, 1·50 =	3·00
2 Cooks ...	...	,, 1·50 =	3·00
1 Watchman	...	,, 2·00 =	2·00
1 Timekeeper	...	,, 2·00 =	2·00
36 *in reduction works.*			$75·00 = £15, or 3s. per ton of ore mined.

Total cost—mining, transporting, and milling ... ... } £90, or 18s. per ton of ore mined.

SMELTING AND REFINING.

Forward ... ... £90 or 18s.

			dols.	dols.
2	Foremen ...	...	at 4·50 =	9·00
3	Smelters ...	...	,, 3·50 =	10·50
16	Helpers ...	...	,, 2·50 =	40·00
6	Coal Passers	...	,, 1·75 =	10·50
1	Mason ...	...	,, 3·50 =	3·50
1	Weigher ...	...	,, 2·00 =	2·00
29	*in Smelting and Refining Works*			75·50
	Fuel	...		200·00
	Tools and Contingents	...		24·00
				$299·50 = £60 or 12s. per ton of ore mined.

Smelting and Refining.

Total cost for mining, transporting, milling, smelting and refining ... ... £150 or 30s. per ton of ore mined.

(The estimated cost for smelting and refining the black tin is equal to £4 per ton for reducing it to commercial tin.)

SUMMARY.

Cost of mining per ton of ore	14s.	or £70	per day.
,, transportation per ton of ore mined...	1s.	,, £5	,,
,, milling per ton of ore mined ...	3s.	,, £15	,,
,, smelting and refining per ton of ore mined	12s.	,, £60	,,
	£1 10 0	£150 0 0	

Total Costs of Reduction.

Total expenses per day for mining and reducing 100 tons of ore, containing 15 per cent. black tin (the black tin containing 66·5 per cent. metal) to 10 tons of pig tin } **£150**

Equal to £15 per ton of pig tin.

Cost of Metallic Tin per ton.

Under same conditions pig tin could be produced from $7\frac{1}{2}$ per cent black tin, for not to exceed £25 per ton of metal.

With an output of 200 *tons of ore per day, the cost per ton will be reduced somewhat.*

The location of this district is all that can be desired; it has a market in its immediate vicinity for a large output of tin, and is made accessible to all American markets by the railways surrounding it. The average cost per ton for delivering the tin product of this district to all the *principal markets* of the United States would not exceed £1 15s.; to China and Japan, £2 10s; and to Mexico and Central and South America, £2 5s.—and probably less. The climate is exceptionally healthy and delightful, permitting out-door labour every day of the year.

Climate.

In my opinion this district can maintain for any length of time an output of at least 15 per cent. black tin, and the product of pig tin may be measured by the capacity of the Mining Plant and the Reduction works that may be provided.

Recommendations.

Main Adit.

A main adit should be started at once from the Temescal River (its objective point being "Cajalco Hill"), which in its length of 7,500 feet will intersect the 10 known tin lodes lying between the river and the Cajalco lode (see Map "D"), *which would enable the output to be enormously increased at reduced cost for mining and transportation.* This adit will drain all the intersecting lodes, and give backs of at least 400 feet above adit level. (A proper sized adit, 7,500 feet long, would cost about £2 per lineal foot.) Water power for air compressors to work machine-drills in running the main adit is obtainable at the Temescal River, near the proposed mouth of adit. *The output can again be largely increased* by branch "A" from the main adit intersecting 28 of the other known lodes lying beyond the "Cajalco" Mine. (*See Map D.*)

Consumption of Tin.

The demand for tin in America has been, and still is, steadily increasing; all now used in the United States is imported, and more than three-eighths of the total pig tin product of the world, and more than two-thirds of the tin plate manufactured in Great Britain is consumed there, the latter paying a duty of one cent per pound. The value of the tin products imported exceeds £4,000,000. It is estimated that California alone consumes 15,000 tons of tin plate for local and packing purposes, besides a large amount of pig tin, and the estimated requirements of the Pacific Coast for the *current year is over* 30,000 *tons of plate* and 3,000 tons of pig tin.

In conclusion, I contend that the "Temescal Tin District" can be made the most valuable mineral property in the United States, and such has been my opinion since I first became connected with its development, over twenty years ago. I predicate my opinion as to the *great value* of *this* property upon the following facts:—

1*st.*—The ores are brown oxide, known as a most desirable character of tin ore, and the strata in which the tin lodes exist are precisely similar to those of the richest and most productive mines of Cornwall.

2*nd.*—The tin is found in strong and well-defined veins of unusually great width, averaging upwards of 6 feet.

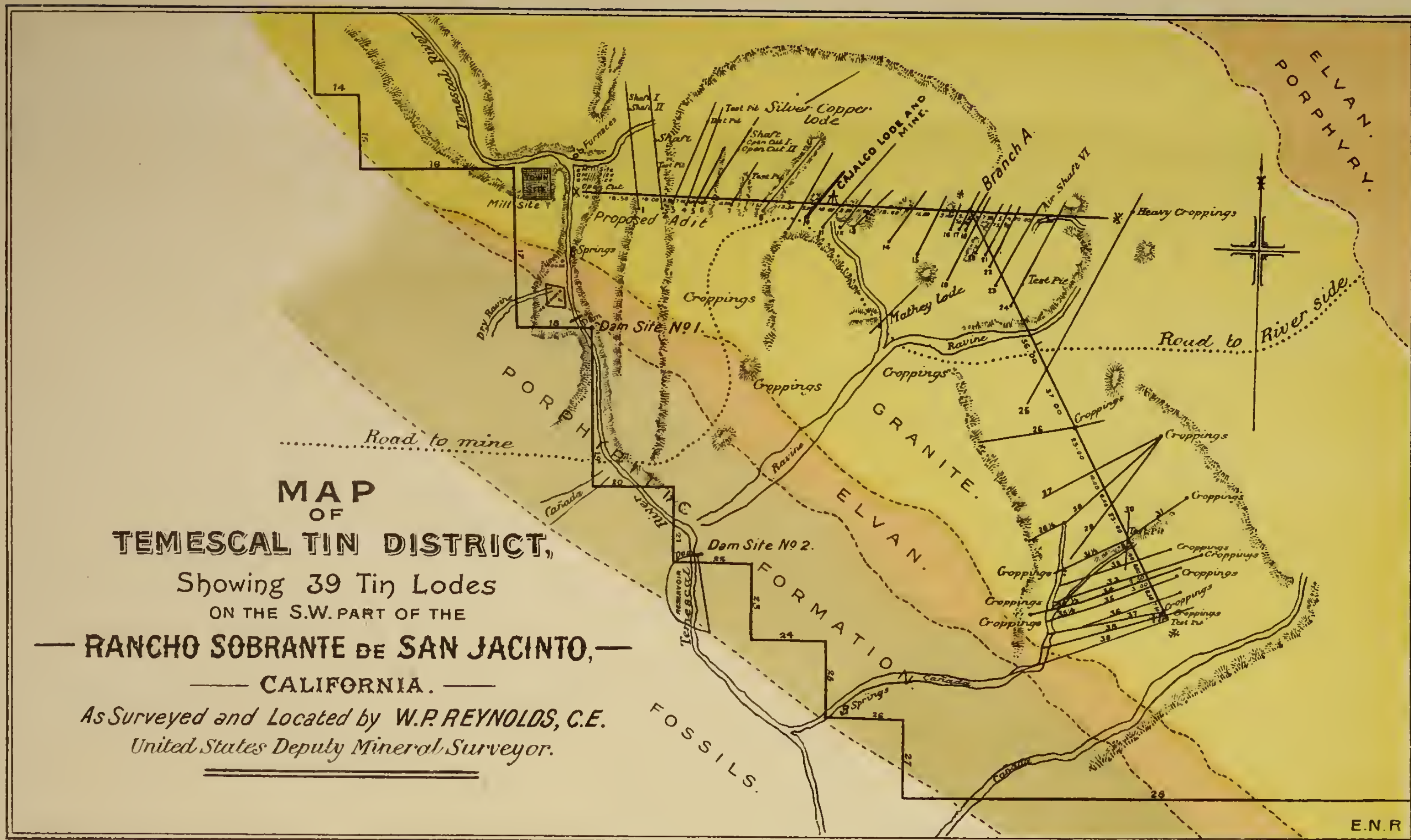
Conclusions.

3*rd.*—The ore is of extraordinary richness, yielding an average of about 20 per cent. metallic (pig) tin per ton of ore.

4*th.*—The ores are easily and cheaply reduced owing to their exceptional purity, being entirely free from wolfram, mundic, and other objectionable features found in most tin ores.

5*th.*—The lodes are of easy and cheap access for working, their average altitude being 500 feet above the Temescal River, and can be worked by a main adit level, which will drain and open out all the numerous lodes, giving backs to each of over 400 feet above water level.

6*th.*—The property has been visited and critically examined, and


MAP
OF
TEMESCAL TIN DISTRICT,
Showing 39 Tin Lodes
ON THE S.W. PART OF THE
RANCHO SOBRANTE DE SAN JACINTO,
CALIFORNIA.
As Surveyed and Located by W.P. REYNOLDS, C.E.
United States Deputy Mineral Surveyor.
ELVAN. PORPHYRY.
GRANITE.
ELVAN.
PORPHYRITIC FORMATION
FOSSILS.
Temescal River
Silver Copper lode
CAJALCO LODE AND MINE.
Branch A.
Heavy Croppings
Proposed Adit
Mill Site
Springs
Croppings
Mathey Lode
Dam Site No 1.
Dam Site No 2.
Road to River side.
Road to mine
Ravine
Dry Ravine
Cañada
Test Pit
E.N.R

Map D

the ores tested many times by reliable and disinterested experts in tin mining and tin ores, and the claims and statements I have set forth as to the extent and magnitude of the lodes, the richness of the ores, and purity of the resulting metal, has never been disputed.

7th.—The richest tin mines of Cornwall pay large profits on ore that returns practically an average of less than 2½ per cent. metal, at a cost of production exceeding £45 per ton of black tin.

8th.—The *Temescal tin ore* being of much higher per cent. in metal, and entirely free of base metal, can be reduced at less cost *per ton of metal* produced, than the Cornwall ores, *as the cost of producing pig tin is reduced in proportion to the increase in the richness and purity of the ore.* Cornwall Ores.

I believe the day is not far distant when the population within this district will equal that surrounding the mines of Cornwall, which now give direct employment to over 12,000 people, and supporting as many more, *and that the output of those mines is no more than this district can be made to yield within the next five years.* Conclusion.

I have always maintained, and still believe, that the Temescal tin district will soon be to the United States what Cornwall has been, and is, to Great Britain.

Respectfully,

August, 1889. (*Signed*) E. N. ROBINSON, M.E.

P.S.—In addition to the tin deposits, this Estate contains extensive and valuable deposits of gold, silver, and copper. About one mile from the Temescal River and 3,000 feet north-westerly of the "Cajalco" Mine, there is an important outcrop of a silver-copper lode (see Map "D"), showing a formation at least eight feet wide, upon which I had several open cuts created. Samples taken at different points and by different parties, and assayed by a number of assayers, returned an average of 165 ozs. silver, £1 10s. gold, and 15 per cent copper. Photographs 22, 23, 24. Copper and Silver.

The following was the average of temperature at "Cajalco Mine" for 1888:— Temperature.

	6 a.m.	Noon.	6 p.m.
1888—January	43 degrees.	62 degrees	52 degrees
February	44 "	63 "	53 "
March	45 "	64 "	52 "
April	51 "	73 "	61 "
May	55 "	72 "	60 "
June	61 "	82 "	70 "
July	65 "	91 "	70 "
August	61 "	90 "	78 "
September	61 "	86 "	71 "
October	56 "	74 "	66 "
November	47 "	63 "	57 "
December	41 "	60 "	49 "

See Exhibit of Assays on next page.

The yield of metallic tin from the ores of "Temescal Tin district" has averaged over [illegible] per cent., as shown by following table.—

By whom Worked.	Assays.	Pounds Black Tin to 1 ton ore.	Per cent. of Black Tin in ore.	Per cent. of Metal in ore.	Fineness of Black Tin.
Captain Charles Craze, M. E., Cornish Tin Expert	1	[illegible]1	[illegible]	2[illegible]	76
" " " "	1	627	28	21 [illegible]	75½
" " " "	1	806	[illegible]6	26 [illegible]	[illegible]½
" " " "	[illegible]	492	22	16 [illegible]	76
" " " "	1	806	36	27 [illegible]	76¼
" " " "	1st Level	1,612	72	50 [illegible]	70
" " " "	Bottom	806	36	25 [illegible]	[illegible]
" " " "	"	448	20	14	[illegible]
" " " "	Winze	314	14	9 [illegible]	[illegible]
" " " "	"	651	[illegible]	1[illegible]	70
		7,612	330	230 [illegible]	
" " " "	Croppings	[illegible]1	13	9 [illegible]	[illegible]
* " " " "	"	67	3	2 [illegible]	70
		35[illegible]	16	11 [illegible]	
*Professor Genth, Philadelphia	Sample	1,747	[illegible]	59 [illegible]	76 [illegible]
Henry Mather, M.E. and Metallurgist, San Francisco	1	627	[illegible]	20 [illegible]	72[illegible]
" " " "	1	515	23	16 [illegible]	72[illegible]
" " " "	1	179	8	5 [illegible]	72[illegible]
" " " "	1	582	26	1[illegible]	72[illegible]
From 18 Assays of Samples, Weighing from 6 to 100 pounds	1	515	23	16 [illegible]	72[illegible]
" " " "	1	201	9	6 [illegible]	72[illegible]
" " " "	1	179	8	5 [illegible]	72[illegible]
" " " "	1	[illegible]	40	29	72[illegible]
" " " "	1	[illegible]51	3[illegible]	27 [illegible]	72[illegible]
" " " "	1	1,187	53	38 [illegible]	72[illegible]
" " " "	1	1,187	53	38 [illegible]	72[illegible]
" " " "	1	560	25	1[illegible]	72[illegible]
" " " "	1	313	14	1[illegible]	72[illegible]
" " " "	1	201	9	6 [illegible]	72[illegible]
" " " "	1	604	27	19 [illegible]	71½
" " " "	1	492	22	15 [illegible]	71½
" " " "	1	[illegible]1	9	6 [illegible]	72
" " " "	1[illegible] lbs.	425	19	13 [illegible]	71½
		9,715	434	314 [illegible]	
Capt. Wm. Williams, Cornish Tin Expert	4	463	20 [illegible]	14 [illegible]	70
" " "	3	180	8	5 [illegible]	[illegible]
" " " Main Shaft	4	[illegible]	26 [illegible]	1[illegible]	70
" " " Bottom Level	5	661	29 [illegible]	[illegible]	[illegible]
" " "	6	395	17 [illegible]	1[illegible]	70
" " "	5	4[illegible]	1[illegible]	13 [illegible]	[illegible]
" " "	3	567	25 [illegible]	17 [illegible]	[illegible]
" " "	4	366	16 $\frac{5}{16}$	11 [illegible]	[illegible]
	34	3,652	161 $\frac{5}{16}$	114 [illegible]	
Geo. Grant Francis, M. E.	1	1,008	45	[illegible]1 [illegible]	[illegible]
Benedict Kitto, Assayer and Metallurgist, London	25 lbs.	860	38 [illegible]	30 [illegible]	7[illegible]
" " " "	55 "	492	22	15 [illegible]	[illegible]
" " " "	60 "	[illegible]	4[illegible]	27 [illegible]	70
	140 lbs.	2,348	100 [illegible]	73 [illegible]	
Phillipps "South Crofty Mine" Cornwall	1	919	41 [illegible]	[illegible]	[illegible]
Tryhall Beare, Cornwall, Smelter	1,7[illegible] lbs.	58[illegible]	26	17 [illegible]	[illegible]
Johnson, Matthey & Co., Metallurgists, London	1,906 lbs.	537	24	16 [illegible]	[illegible]
Taylor & Co., Metallurgists, San Francisco	2,[illegible] lbs.	963	43	[illegible]	70
" " "	1,000 "	448	20	14	[illegible]
	[illegible] lbs.	1,411	63	44 [illegible]	
Mosheimer, Smelter, San Francisco	12 tons	[illegible]	[illegible]	1[illegible]	[illegible]
Average		653	25 [illegible]	20 [illegible]	70 [illegible]

NOTE.—In addition to the above, many Assays and tests have been made of the Temescal ores by myself and Geological Engineers of the United States and other countries, which, if added to the above aggregates, would raise the average per cent. of Temescal Tin Ores to above 21 per cent. metallic tin. *The remarkable freedom of the ores from base metal has never been disputed.*

L. N. ROBINSON, M. E.

* Not included in averages.

TEMESCAL TIN DISTRICT, CALIFORNIA.

REPORT OF HENRY MATHEY, M.E.,

SAN FRANCISCO, CALIFORNIA.

INTRODUCTION.

The Mexican Grant, "Rancho Sobrante de San Jacinto," covering an area of about 45,000 acres, is situated in the county of San Bernardino, in Southern California, at a distance of some 50 miles East from the city of Los Angeles. The towns of Colton, and San Bernardino, the county seat, are located 12 miles North East, and the well-known colony of Riverside (which is a wonder to all travellers who visit this land of oranges and honey) adjoins this property on the North, of which 3,700 acres was purchased from the owners of this property about 12 years ago. This rancho is to-day surrounded by railroads, and soon a new line crossing its North-West Section will connect Pomona with Elsinore, naturally reducing the distance to Los Angeles by rail.

Area of Estate.

Location.

Railways.

Mines of gold, silver, nickel, cobalt, **tin**, copper, and iron, are known to exist on this grant. In 1868 work was started on one of the most important outcroppings of the "Tin district." Considerable work was done at that time, and the richness of the "Cajalco" load proven beyond any possible doubt. The property was then invaded by prospectors, and monuments and notices of location placed on several hundred promising outcroppings.

History.

The *bonâ fide* owners of this vast tract of land (under a United States Patent issued in 1867) suspended operations in 1870 to await a judicial decision covering the matter in dispute. After a long, tedious and costly litigation, the Supreme Court of the United States has lately rendered the final decision, and sustains the validity of the Patent issued in 1867. The fact of this litigation has prevented the development of this property up to the present time, while in the last seven or eight years the surrounding country has developed into a perfect wonder in agricultural products and mineral wealth.

GEOLOGY.

The West and South-West boundary of this property is located near the Temescal Creek, which at several points and for long distances flows inside of said boundary.

Coming from the Valley West, and after crossing the Creek, you ascend a chain of mountains of a porphyritic formation, and whose average altitude is about 700 feet above the Creek. As well as I can

Geology.

judge, the width of this formation will be about $1\frac{1}{4}$ miles. The porphyry is very hard and generally of a dark color. Following a North-East direction for about $2\frac{1}{2}$ miles from the Creek, you reach the tin district, which is located in a secondary granite formation. Two hundred or three hundred feet before entering the district, well defined and wide dykes, of a different kind of porphyry, are encountered. Instead of being of a dark color and coarse grain, they are rosy, grey white, and their texture is very fine. I will call this rock a porphyritic granite, and it is also often encountered in the granitic formation and in close proximity with the tin veins.

See Map D.

Capt. Craze, in his valuable report on the Tin mines of this property, mentions that it is a similar rock to what is found in connection with the granite of the tin district of Cornwall (England), and that the Cornish miners have given the name of "*Elvan*" to this fine grain porphyry. He also pronounces the secondary granite the *fac simile* of Cornwall secondary granite, and arrives at the conclusion that the conditions of formation of the two districts, although located 7,000 miles apart, are in every way identical.

Geology.

As soon as you have crossed these dykes of fine grained porphyry, you are in the granite formation, and the tin veins make their appearance. In my opinion, these dykes of porphyritic rock and secondary granite are the condition *sine quâ non* for tin veins.

NOTE.—See publication "On Tin Mining," by Mr. A. G. Charleton. "The relationship between tin ores and rock of granitic character seems to be universal, and the most productive lodes are generally those situated near the junction of granite, syenite, or rock of that class."

On the East portion of the property where *gold deposits* are found, the formation is also granitic, but the granite is altogether of a different nature and appearance, and older than the one of the tin district. These four kinds of rock above mentioned, are the only ones which I have met with during my examination of the property.

TIN DISTRICT.

All the veins and ledges of the tin district run in a N.E. and S.W. direction. I will now describe the most important of these veins (outside of the Cajalco Mine), judging their importance by the surface indications as to the regularity of their courses, the distance they crop out, their size, and the richness of their floats and croppings.

Other Tin Veins.

At 700 feet in a N.W. direction from the "Cajalco" main shaft is found a well-defined tin vein. At a distance of 75 feet S.E. a vein is encountered with a regular and strong line of tin croppings. The next vein is the "Cajalco" the one which has been worked and extensively developed by the owners of this property, and which I will specially describe farther on.

Starting from the "Cajalco," and continuing in the same S.E. direction, at 325 feet we meet another tin vein. The surface indications do not show it to be quite so strong a vein as the Cajalco; however, it crops out for a longer distance, and its floats are the richest encountered in the district. I have tested some samples which contain as much as 17 *per cent. of black tin.*

Three more promising ledges are met with before reaching the one known as the "Little Scotty," which is located 600 feet S.E. from the "Cajalco." An incline shaft 15 feet deep has been sunk on this vein, showing it to be a very valuable deposit, containing excellent ore, some samples showing as high as 20 per cent. of black tin.

At 50 feet N.W. from the "Little Scotty" incline is a very large copper-stained outcropping, carrying tin. It may be a branch of the Little Scotty vein, but I think that future working will prove it to be a separate deposit.

About 600 feet from the "Little Scotty," to the S.E., a great quantity of floats and a very strong and straight line of croppings can be seen from the road leading to Riverside, and during my examination I thought it advisable to do some work on this location, and a shaft was sunk 10 feet deep. This vein is the only one of the district, which for a long distance carries copper near the surface. I have assayed several samples, and have found as much as 9 per cent. of copper in some of them.

Other Tin Veins.

Photograph 23.

The tin oxide from this deposit is also of a different colour. Instead of red brown it varies from a rosy grey to a light grey, and this I think is to be attributed to a smaller proportion of iron associated with the oxide of tin.

Description of Ores.

From the "Little Scotty" to the copper tin vein no conspicuous croppings exist, but the ground is covered with floats, and as the land is nearly level, and covered for several feet deep with rich soil, my opinion is that future deep working will show that veins of tin exist between the two last described locations.

"CAJALCO MINE."

The average course of the "Cajalco" vein is magnetic, N. 30 E., and its inclination is 74 degrees towards the North-West. It can be traced for a long distance, and on Cajalco Hill the croppings are of an immense size, as they stand 20 and 25 feet, high and their width is fully 30 feet. At said point, and on both sides, other very large tin vein croppings can be seen for a distance of 300 feet, forming like a continuous line of mammoth croppings running parallel with the "Cajalco."

As it is not probable that a vein whose average width, as shown by all the underground working, is about six feet, could have developed

Developments

to such a tremendous lode in so short a distance, I would rather come to the conclusion that there are several blind ledges, or veins, running in close proximity to the "Cajalco," and that the erosion has exposed their croppings on "Cajalco Hill," where they have also attained their maximum width. I also believe that a system of branches and scarifications, connecting one vein to another (as indicated by the underground working of the "Cajalco") exists, and I am confident that this assertion will be clearly proven by future underground workings of the Mine.

Photograph 17.

The "Cajalco" vein crosses a ravine 140 feet lower than the summit of "Cajalco Hill," and from the ravine two tunnels have been driven. Little work has been done in the one running in the S.W. direction, as it has been driven only 70 feet. Its face is in vein matter, composed of quartz, chlorite, clay seams, oxide and sulphurets of iron. The face of this tunnel will have to be extended 130 feet more before it will enter the ground under the monumental croppings, where I have every reason to believe will be found the largest body of ore of the tin district.

Photograph 15, 18.

The North-East adit tunnel is to-day 432 feet long. At its entrance a vein 16 inches wide can be seen, and at a short distance in it leaves the vein on the North side to follow its foot-wall.

Cajalco Mine.

At 110 feet a well-timbered three-compartment incline shaft, in a fair state of preservation, is intersected at a depth of 45 feet from the surface. A short cross-cut on one side of said incline to the North connects this tunnel with a perpendicular shaft sunk to the second level of the mine. It is on the same line, across the vein, and both shafts connect at about 25 feet above the lower level.

See Map C.

At 158 feet North-East from the incline in adit tunnel a winze 70 feet deep connects the adit tunnel with the second level, and at 117 feet farther, and in the same direction, the Williams' Shaft, 99 feet from the surface, is encountered. The tunnel has been extended 47 feet farther, leaving the lode on its North side.

Developments

From the incline shaft to the foot of the Williams shaft, where a large chamber has been excavated, five cross-cuts have been driven, showing the vein to be of an average width of 6 feet, and a rich chimney of tin ore, extending for about 200 feet in length, has been exposed in place.

At the foot of the Williams' shaft there is a large body of rich ore exposed, and no one can tell now how much farther North-East this body of ore will extend.

Photograph 5

Along the paying chimney the vein is at its greatest width. At the foot of the Williams' Shaft it is fully eight feet wide.

The winze was sunk on the ore body nearly all the way down. At some 8 or 10 feet before reaching the lower level, the stratification of the ore vein is nearly perpendicular and leaves the winze, which still continues to the lower level, at an angle of inclination of about 60 degrees.

The second level extends 140 feet South-West from the perpendicular shaft, and at 158 feet North-East it connects with the winze above described, and from this point it has been extended 75 feet more in the same direction. This end of second level having left the rich ore body on its South side, cannot compare with the tunnel above. However, it has followed some feeders of the main ore body, which contain tin ore. Without doubt the main body of ore, for reason given, is still untouched, and remains on the South side of this level. The ore vein, on the South-West end of this level for a long distance lays on North side of same, which will be penetrated by the continuance of the main incline shaft, which cuts the perpendicular shaft 25 feet above second level. Cajalco Mine.

By the way, the Mine has been opened (exposing the paying chimney only in places) the exact quantity of ore in sight cannot be stated. I will say, however, and without hesitation, that for the amount of work done it is very large, and that the "Cajalco" Mine will be in the near future a great tin ore producer.

The veins above described, and including the "Cajalco," form what I will call the North-West group of veins of the district. They run parallel, and have nearly the same inclination towards the North-West, and the distance between the first one to the copper tin vein is about 1,300 feet. Their courses are regular, and their strong croppings can be followed for a long distance. Several of them show rich tin ore from the grass roots, and as they are in the same formation as the "Cajalco," there is no doubt that their opening will meet with corresponding results. Other Veins.

OTHER VEINS,

South-east from the Copper Tin Vein.

From the copper tin vein the tin district extends for about $1\frac{1}{2}$ miles south-east. Within this distance (and without mentioning the small outcroppings) I have examined seventeen regular and strong veins, all of them parallel to the "Cajalco," or nearly so. In this last group of veins are the two best defined ones of the district, and they show a very perfect line of continuous croppings. I have followed one of them for over one mile. They are at about 150 feet apart, and maintain the same distance for thousands of feet, and in my opinion will prove valuable Mines when worked.

TESTS OF TIN ORE OF THE "CAJALCO" MINE.

I have tested 18 samples of ore from the different workings of the "Cajalco Mine," and found them to contain

NO.			BLACK TIN.
1	...	...	28 per cent.
2	...	...	23 ,,
3	...	...	8 ,,
4	...	...	26 ,,
5	...	...	23 ,,
6	...	...	9 ,,
7	...	...	8 ,,
8	...	...	40 ,,
9	...	...	38 ,,
10	...	..	53 ,,
11	...	...	53 ,,
12	...	...	25 ,,
13	...	...	14 ,,
14	...	...	9 ,,
15	...	...	27 ,,
16	...	...	22 ,,
17	...	...	9 ,,
18	...	...	19 ,,

They were all large samples, several of them ranging from 6 lbs. to 100 lbs. Lot 18 was a 100 lb. sample. All these different lots were smelted, and yielded from 69 to 76 per cent. of the best refined tin.

Purity of Ore.

I will here state that the ore from this district does not contain any wolfram, mundic, or antimony, but only a certain percentage of iron, and that the treatment of the concentrates will be simple, easy and inexpensive.

MACHINERY TO BE ERECTED AND WORK TO BE DONE.

I will advise the erecting at once, at the "Cajalco Mine," of Steam Pumping and Hoisting Machinery of sufficient power to sink the incline shaft 500 feet deeper, and also Air Compressors. I have

Recommendations.

already mentioned the conditions of this shaft, which at a very small cost could be placed in good order and, if required, sunk to the lower level at small expense.

A good track will have to be laid in the lower level, which must be extended 150 feet both ways, and when this distance is reached, two cross-cuts should be run at right angles with the course of the vein, to cut the parallel ones, and any blind ledges which, as indicated by the underground working, may be encountered.

The sinking of the Williams' Shaft to the second level should be considered, as it will go through the richest body of ore of the mine, and will also ventilate the Mine.

I will also recommend the sinking of prospecting incline shafts on the most promising veins. Recommendations.

Before this work can be completed the quantity of ore in sight will be *largely increased.*

LOCATION OF THE CONCENTRATION WORKS.

It can now be safely stated that the "Cajalco Mine," at present depth, will supply daily 30,000 gallons of water. It is a sufficient amount to raise all the steam which will be required for hoisting, pumping, and air compressors for drills. It is quite probable that this quantity will increase with deeper working, and sufficient found for the dressing of, say, 100 tons of tin ore per day at the mine if found advisable to do so. If so, the concentration works ought to be erected at the mine, thereby saving the expense of transportation and rehandling. Reduction Works.

The main-reduction works will have to be erected on the Temescal Creek (sooner or later), west of Mine, or north of same on line of the Californian Central railway road. The distance from the mine to either of these points is about $2\frac{1}{2}$ miles by road. Location of Reduction Works.

CONCLUSION.

I will end my report on the tin district in saying that it is the first time in my professional career (which has been solely devoted to mines and metallurgy) that I have encountered so many promising veins in any mining district. Pig tin can be produced here at a very remunerative price, and with no possible competition. My conclusion is that in the near future the opening and the exploitations of the tin veins of this Grant will create one of the best paying mining industries of the United States. Conclusions.

COPPER SILVER VEIN.

At about half-a-mile in a northerly direction from the Cajalco there is a large blow-out, and an open cut has shown stratifications which seem to indicate that it is the outcroppings of a large lode. Some of the ore is very rich in silver. It is located in a porphyritic formation, and the analysis and assays show the ore to contain other metals besides silver and gold. Photograph 24. Copper and Silver.

COPPER ASSAYS. (CROPPINGS.)

(From silver-copper lode. See Map "D.")

Sample No.	1	7 per cent.
,, ,,	2	$7\frac{1}{2}$,,
,, ,,	3	18 ,,
,, ,,	4	$12\frac{1}{2}$,,
,, ,,	5	9 ,,
,, ,,	6	$12\frac{1}{4}$,,
,, ,,	7	11 ,,

SILVER ASSAYS.

(From silver-copper lode. See Map "D.")

Sample No.	1	96·64 dols. per ton of 2,000 lbs.
,, ,,	2	5·28 ,, ,, ,,
,, ,,	3	90·60 ,, ,, ,,
,, ,,	4	332·50 ,, ,, ,,
,, ,,	5	169·87 ,, ,, ,,
,, ,,	6	30·20 ,, ,, ,,
,, ,,	7	67·95 ,, ,, ,,
,, ,,	8	22·65 ,, ,, ,,
,, ,,	9	143·45 ,, ,, ,,
, ,,	10	207·62 ,, ,, ,,
,, ,,	11	52·85 ,, ,, ,,
,, ,,	12	2·26 ,, ,, ,,
,, ,,	13	67·95 ,, ,, ,,
,, ,,	14	14·00 ,, ,, ,,
,, ,,	15	7·50 ,, ,, ,,

Samples 4, 5, 6, 7, 8 and 9 were assayed for gold, and were found to contain an average of 6·02 dols. per ton of ore.

There is not enough work done on this lode to form an extended opinion as to its future value. It looks very encouraging.

GOLD MINES.

Photograph 22.

I have visited the gold district, which, under the name of the "Gabilan District," created eight years ago considerable excitement. It is located in a granitic formation on the south-eastern portion of the rancho, and is about seven miles from the Cajalco Mine. The granite and formation resembles in a marked degree that which surrounds Nevada City. The surface indications as regards croppings are not conspicuous. The quartz has, however, all the appearances of the best auriferous quartz, not silex-like and crystalline, but opaque and milky, with galena crystals and sulphurets of iron.

Considerable work has been done on one of the veins, as can be ascertained by the size of the waste dumps, but the workings having caved in, I could not make a thorough examination. Photograph 22.

I am indebted to Mr. Abraham Hoag for an explanation of underground workings, and results from same.

The greatest amount of work has been done on a flat vein of about 25 degrees inclination by Mr. Hoag. He had a contract from the owners, with privilege to purchase, but was forced to suspend work on account of litigation. He says:— Gold Mine.

"The incline shaft was sunk to the depth of 400 feet; that he milled quartz which for quite a time yielded 50 dols. per ton.

At my last visit to the gold district I found a prospect pit lately dug. It is located near the old shaft, and follows a feeder of the main vein. The prospector had extracted a few sacks of ore which I sampled and tested, and found it to be *very rich gold quartz.*

The gold district is large, and I have ascertained that every Winter Mexicans wash gold from the ravines below the croppings. It is quite probable that when the veins are worked systematically, they will yield a handsome profit.

WATER AND LAND.

The Temescal Creek is a large stream of water running along the western portion of the rancho. Everyone who is familiar with it, and also with the sandy gravel formation of its bed, are of the opinion that if a substantial dam is built at a certain well-selected point on the creek, a fine artificial lake would be created, and a very large and permanent supply of water would be secured, sufficient for extensive water power and irrigation purposes. Photograph 20.

Several estimates have been made as to the cost of this dam, and also as to the quantity of water to be relied on at its completion. According to my opinion the dam proper will cost about 70,000 dols., and to this figure will have to be added the expense of ditches and pipes to carry the water to the mill plant, or the land to be irrigated.

I have visited the stream of water often, and at the dryest season, and at its lowest stage I place the quantity of running water at 400 inches. When the dam is built, and when the water now percolating through the gravel and running on the bed rock is stopped, the quantity will, I think, increase to 800 or 1,000 inches (12,000,000 to 15,000,000 gallons) daily.

Water is selling in this vicinity for 1.000 dols. and upward per inch (one inch is sufficient to irrigate 10 acres of land), and lately some sales have been made at 1.500 dols.: and, taking the lowest figure, it is a safe estimate to say that the water of the Temescal Creek belonging to this property, when dammed, will be worth at least 800.000 dols. (£160,000).

As this property has not been surveyed for many years, and as there is no large map of the Grant, it is an impossibility to furnish exact figures as to the extent and size of the different tracts of land. I will, however, endeavour to give an opinion based on my personal knowledge of the property, and also on reliable information which I have gathered during my ten months' stay here.

The South Riverside Land and Water Company are now selling unimproved colony land at 250 dols. to 300 dols. an acre, and there is on this rancho, near the city limit of said town and along the Temescal Creek, a large tract of similar land which will sell for corresponding prices.

Water and Land. The valley lands cover about from 15,000 to 20,000 acres of this property, and they will bring now from 25 dols. to 50 dols. per acre. In a few years they will sell readily from 50 dols. to 100 dols. an acre. The water is close to the surface, and I have visited several wells which furnish an abundant supply, and they are only from eight to ten feet deep. (Photographs 13, 19.)

Since my arrival here, in the middle of March, the wind has blown every day from 9 a.m. to 7 p.m., and has kept blowing regularly till some time in November, and I am fully satisfied that sufficient water can be secured by surface wells and windmills to render this valley land very desirable. (Climate.)

It is quite probable that the sinking of artesian wells will meet with success, and that a large supply of flowing water would be secured at several well-selected points on this vast tract of land. If so, the land near these wells will be worth much more than the figure I have placed upon it. (Photographs 25, 26.)

If the tin mines are worked on a large scale, a large population will locate on this part of the rancho, and the land will find purchasers at once.

Riverside is improving very fast, and if the population keeps on increasing as it has done in late years, the part of this property located within the City limits will surely increase in value over my estimates.

The balance of the rancho is composed of rolling hills, and of more mineral than agricultural land; and as, during six months of the year, there is splendid feed on it, it could be disposed of and sold at grazing land, reserving the right to the mineral. (Photograph 14.)

I will advise the purchasers to have a new and accurate survey of this property made at once. Then only the true size and extent of the different tracts of land, and also the correct and exact value of the land, could be stated. Recommendations.

PORPHYRY QUARRY AND FIRE-CLAY.

There is a porphyry quarry three miles from here (on the Estate). After the rock is broken by rock breakers, it is shipped by rail to the adjacent towns, where it is used to macadamize roads and streets.

Deposits of good fire-clay exist also on this property.

POTTERY WORKS.

A very large pottery works is now in operation at South Riverside. They manufacture all sorts of pipe, tiles, *and excellent fire bricks, which can stand any high degree of heat.*

FUEL.

Coal can be obtained for about 5 dollars per ton delivered at Mine. Petroleum can be obtained for a reasonable price. Wood will cost about 5 dollars per cord. The petroleum fields are near at hand. It is largely used here for steam purposes, and it can also be delivered at the tin mine at a reasonable price.

CLIMATE AND TEMPERATURE.

The climate of the rancho is unsurpassed, and the following figures show the average temperature during my stay at the Mine. Climate.

			6 a.m.	Noon.	6 p.m.
1888,	March	(11 days)	45 deg.	64 deg.	52 deg.
,,	April	(30 ,,)	51 ,,	73 ,,	61 ,,
,,	May	(31 ,,)	55 ,,	72 ,,	60 ,,
,,	June	(30 ,,)	61 ,,	82 ,,	70 ,,
,,	July	(31 ,,)	65 ,,	91 ,,	70 ,,
,,	August	(31 ,,)	61 ,,	90 ,,	78 ,,
,,	Sept.	(30 ,,)	61 ,,	86 ,,	71 ,,
,,	Oct.	(31 ,,)	56 ,,	74 ,,	66 ,,
,,	Nov.	(30 ,,)	47 ,,	63 ,,	57 ,,
,,	Dec.	(31 ,,)	41 ,,	60 ,,	49 ,,

Hoping that I have covered every point of interest,

I remain, Dear Sir,
With much respect,
Very truly yours,

(*Signed*) HENRY MATHEY, M.E.

Tin Mine, November 4th, 1889.

REPORT OF CAPTAIN CHARLES CRAZE.

CAJALCO TIN MINE OF CALIFORNIA, U.S.A.

GENTLEMEN—

Having, in pursuance of your request, proceeded to California to inspect the Cajalco Tin Mine, and having spent several weeks in thoroughly examining the same, I am now enabled to hand you the following report thereon:—

The mine is situated on the "San Jacinto rancho" (estate), in the county of San Bernardino, California, N.A.

Location.

Area of Tin District.

The mine belt or territory is very extensive, being in all about 15 square miles, and fully 3 miles on the line of the lodes, the out-croppings of many of which are distinctly observable for a great distance at the surface.

The principal workings of the mine up to the present time have been confined to one lode, upon which an adit tunnel (or level) has been driven into the hill 70 fathoms, and at the farthest end of which a shaft has been brought down to it, and providing good ventilation.

Developments

This lode has a bearing of about 45° north of east or south of west, with an underlay of 3 feet in a fathom north-west. The adit level has been driven principally under the lode or on its foot-wall part, but several cross-cuts have been put through the lode in different places.

Its width is found to vary from three to seven feet, with generally well defined walls, and is composed of quartz, chlorate, a little oxide of iron and tin, and will produce from 5 cwt. to 1 ton of tin per fathom for upwards of 30 fathoms in length, with the longest and most productive point at the east end of the tunnel, where the hill is still rising considerably, and I have every confidence that the lode will still improve and produce a great quantity of tin in this direction.

The main shaft has been sunk 11 fathoms below the adit tunnel, at which depth a level has been extended west of shaft 24 fathoms. This drivage has been in a large lode, which in places contain some good tin stuff. The lode in the present end of this level is from 4 to 5 feet wide (letting out a quantity of water), carrying a little tin, and looks very promising for the depth, being at this point only about 10 fathoms below the surface.

The lower level has been driven east of shaft 42 fathoms. This drivage has passed through three or four good pipes of tin, on one of which a winze has been sunk from the adit tunnel 11 fathoms, and for the whole distance a good paying lode is standing entire in the ends of the winze.

There is a lode from 4 to 5 feet wide 3 fathoms behind the eastern end, which contains some good tin stuff.

In the present end the lode is pinched, but I think it will open out larger, and will again become productive as the drivage is continued in this direction.

I have broken and assayed the produce of the lode from various places, and found it to contain black tin (tin ore) from 5 per cent. up to 72 per cent., which may be considered very rich ore indeed; and the samples of black tin I have smelted gave a result of fully 76 per cent. of refined tin metal. Assays.

The strata in which the tin lodes exist here (and which extends for several square miles) is a highly-congenial secondary granite, precisely similar in character to that in which the largest and most profitable tin mines in Cornwall have been met with, while intersections of "Elvan" rock, cross-courses, &c., are found completing the geological conditions of the tin district. Geology.

I have prospected the out-croppings of many other parallel lodes (some twelve or more) which apparently are of the same character, bearing, &c., as the one which has been worked on up to the present time. These vary in size at surface from 3 up to 10 or 12 feet wide, and from several of them I have broken samples of stuff which have produced from 2 per cent. up to 6 per cent., and as high as 11 per cent. of black tin. Other Veins.

The geological conditions surrounding these lodes are the same as those in connection with the good lode now being wrought, and there is every reason to expect that the development of many of them would be attended with large returns of tin and good profits.

To the north-west of the present workings, about a mile, there is the outcrop of a very large lode, and on this a pit has been sunk a few feet, which has shown it to contain oxide of iron, and a considerable quantity of green carbonate, the latter producing about 15 per cent. of copper. Silver and Copper.

This lode presents a very fine appearance, and further development of it may show it to be of great importance and value.

On the same property, about 3 miles to the north-west of the tin mine, there is an important porphyry quarry, where good stone can be obtained for building purposes, road metalling, &c., which in itself will, in the near future, be a profitable business, as new towns are being created in all the surrounding districts. Fire-clay also exists in abundance on this portion of the property. Porphyry Quarry.

There is also some 3,000 or 4,000 acres of valuable land between the mountains and along the valley to the north-western extent of the property, which could be turned into sources of revenue to the owners. Cattle and sheep could be raised on the mountain and the table lands Lands.

between the same, while 1,300 or 1,400 acres in the valley would grow the orange, lemon, grape, &c., in abundance, and to a great profit, as is now being done by the inhabitants in the neighbourhood.

Climate.

The general facilities for working the mines are good, roads fair, climate all that can be wished, while a railroad is now being laid on the north-west range of the property, and will be opened for traffic in three or four months from now, with a station within $2\frac{1}{2}$ miles from the present workings, and which must lessen the transportation cost of material, fuel, &c., to, and the produce from, the mines.

Water.

There is a large stream of water passing through the western portions of the property about $2\frac{1}{2}$ miles from the present working, which, if required, can be utilised for dressing works and other purposes.

Location of Reduction Works.

For the immediate future working of the mine, I would advise the erection of a good and substantial horizontal pumping engine of sufficient power to put the present shaft down to a 50 or 60 fathom level, from which, at different stages, levels should be run or extended both east and west on the lode now being wrought. By sinking and driving in this way, not only will the lode be developed, but it will soon be seen if there is water enough in the mine for stamping and dressing purposes on the spot, or whether it will be best to go down to the creek or stream, $2\frac{1}{2}$ miles away, to erect the necessary stamping and dressing machinery.

Recommendations.

A winding engine should be put up at the same time, and there is plenty of stone on the spot for building purposes, foundations, loadings, &c., &c.

Trial shafts (or pits) should at the same time be sunk on the many other promising lodes to the south and north of the one now being worked, when I have no doubt further important discoveries of tin will be made.

Conclusions.

The mine having been opened out to a very limited extent, it is impossible to make any definite calculations as to what the output of tin may be in the near future, but this I may say, that the Cajalco lode is a good one so far as opened up, and gives promise of continuing good both in length and depth, while I have never seen in any mining district so many large and promising lodes cropping out at the surface as there are on this property, and these, together with the very congenial granite surrounding them, leads me to the belief that there is an immense quantity of tin in these hills, which, with proper treatment, can be worked long in the future with great success.

(*Signed*) CHARLES CRAZE.

June, 1888.

REPORT OF GEO. GRANT FRANCIS, M.E.

To the Chairman and Directors,

Temescal Tin District, Limited,

London.

Gentlemen,

Having received your cable instructions to proceed to California for the purpose of inspecting and reporting on the above property, I reached San Francisco last month, and accompanied by Mr. E. N. Robinson, M.E., of that city, visited the mines in the early part of the present month.

The property had already been reported on by several mining experts and engineers, and, as I understood it your wishes were, that my report should be confined to determining the correctness of the representations already made rather than going exhaustively over the same ground so fully set forth in the reports of Captain Charles Craze, made in the month of June of last year, and of Mr. Henry Mathey, M.E., of quite recent date. Further valuable information is contained in the statements and report submitted by Mr. E. N. Robinson, M.E., and extracts from the correspondence of Mr. William Williams, who was underground superintendent during the opening of the mine, about twenty years ago, since which time the property has not been worked, in consequence of costly and lengthened litigation as to title and ownership, which has I understand, been now finally settled in favour of the present owners, by a decision of the Supreme Court of the United States; but as to the validity and security of the title, no doubt, you will be fully advised by your solicitor.

All of the above reports, with plans and sections of the underground workings, are submitted herewith, and I may say that, having read them carefully, I consider they fairly and conservatively represent the facts. The most important of these reports are those of Captain Craze and Mr. Mathey. In these two reports will be found a minute description of the different veins and outcroppings, the geographical and geological positions of the district, and the accompanying maps, plans, and sections of the Mines and district, with photographs taken during my visit, will so clearly and correctly set forth the position of affairs that it is only necessary for me to refer you to them for detailed information on these points.

I understand it is proposed to take out of the whole of Rancho Sobrante de San Jacinto, which comprises 45,126 acres, about 14,000 acres supposed to cover all the tin lodes. Area of Estate and Tin District.

In my judgment, the tin lodes extend beyond the limits of the 14,000 acres, and it will be most desirable for the Company to embrace in its ownership the minerals and mining rights of the entire estate, so as to control all the tin lodes, and also the gold district in the South-Eastern corner, and the copper-silver lode in the North-Western portion of the estate, as well as all other minerals, including coal (should it be found) underlying the whole of the 45,126 acres, giving back to the vendors, in consideration, the surface rights over the 14,000 acres, but retaining the freehold of such portions of the estate (not exceeding 2,000 acres in all) as you may require for the proper carrying on of the extensive mining operations that must follow the mineral development of the estate. You should also own all rights of way, and water privileges, dumping facilities, &c., undertaking on your part to supply to the owners of the surface such surplus water as you may have to spare at an agreed price. You should also have the right of working for stream tin, if such on trial, should prove to exist, in the sands of the Temescal or other Creeks.

Recommendations.

The present owners commenced the development of the tin district at the Cajalco Mine (which was opened out to its present condition previous to the commencement of the litigation) under the superintendence of Mr. W. Williams, a practical Cornish miner. The mine was unwatered for my inspection, and I found on examination the lode and workings in the condition fully described in the above-mentioned reports.

From the way the mine has been opened, it is difficult to make an accurate estimate of the ore in sight, as the lode has been left standing in the hanging wall and cross-cut into in several places. I had many blasts put in and the ore tested. I also took a picked sample from the small piles of ore at surface, which was crushed and concentrated, and this gave 45 per cent. of tin oxide, such ore is by no means rare in the lode. I do not consider Mr. Williams' estimate of 600 tons, as the quantity of metallic tin in sight too high, which may be roughly represented as 12,000 tons of dressable ore ready for stoping, averaging, say, 5 per cent. of tin.

Assay.

"Ore in Sight."

It is demonstrated by the reports already made, and from the facts as I found them in the underground workings, that the present development of the Cajalco Mine will justify the erection of a mill to treat 40 tons a day, which would put through 12,000 tons of ore in 300 days, in my judgment, sufficient to yield profits to pay within a short time after its organization a fair dividend on any reasonable capitalisation of a Company.

I have little doubt that within a short time the Cajalco portion of the property could be further opened to produce 100 tons of tin ore per diem. Taking only 5 per cent. of metallic tin as the average of the ore, equal to about 7½ per cent. oxide tin, as a conservative estimate (it would not surprise me if the average even reached 10 per cent. of tin oxide), £25 a ton, with the advantages the property possesses for opening out and subsequent working, should be ample to cover all cost of production, administration, and dead work, to produce a ton of metallic tin. Tin being worth £95 a ton, there would be a profit of £70 a ton, or £350 per day, and taking 300 working days for the year, you would have an annual profit of £105,000, and this on a production of only 1,500 tons of tin. When the long adit level, as set forth in the reports and plans submitted, is completed and connected with the Cajalco shaft, probably two or three times the above quantity would not overtax the property.

Cost of Tin Metal.

Estimated Profits.

The Cajalco lode has probably been opened first in consequence of its great outcrop, and from the fact that tin was obtainable from the matrix in the "float." I consider, however, that other lodes, some of which have and some have not, tin oxide in the matrix on the surface, when opened out will be quite equal to, if not superior, to the Cajalco; at any rate the number of lodes and the distinctness of their outcropping is unprecedented, as is also the percentage and purity of the tin stone the lodes carry.

Other Tin Veins.

Purity.

The amount of working capital necessary for the erection of a 40-ton concentrating mill, and for carrying on the mining operations confined to the development of the Cajalco lode proper, will not be more than £10,000.

Estimated Cost of Mill.

For the larger development of the property, I consider it necessary that a mill dam be made near a point on the Temescal Creek adjoining the North-Eastern boundary of the Hoag estate, marked on the map herewith "Mill-dam No. 2." This dam would require to be 30 feet high. It is estimated that the minimum supply of water would be 500 miners' inches, and the maximum 1000 inches; the former would fill a pipe 24 inches in diameter without pressure. Now as the permanent mill-site would be $2\frac{1}{4}$ miles from the dam, with a net fall of say 100 feet, a Pelton water wheel would supply a mill with ample power, and the cost of iron pipes to convey the water to the mill would be about £5,000 put in place.

Photograph 19.

Water.

Location of Reduction Works.

The main adit level, already alluded to, should be started from a point on the Temescal creek near the mill-site. It would require a drivage of about 7,500 feet to intersect the main shaft sunk on the present Cajalco lode, with a grade of about 20 feet in the mile; a further allowance of 30 feet above the water of the creek at the mouth of the adit for dumping room would give over 400 feet of backs on the lodes.

At the present workings of the Cajalco mine this adit would, in all probability, cut many of the lodes in depth long before it reached the

Recommendations.

main shaft, and if proved to be ore-producing, it could then with accuracy be determined as to the size and capacity of the permanent mill to erect. Simultaneously the main Cajalco shaft should be sunk to meet the adit, and as the adit should be driven with air compressor drills, the power being derived from the dam, ventilation would be secured for the drift until it intersected the shaft, when natural ventilation would be secured.

Main Adit.

The cost of driving the adit 7,500 feet, at eight dollars a foot (the price in hard ground) would be about £12,000. It would take, from one year to a year-and-a-half to accomplish, provided one or two intermediate shafts were sunk, so as to increase the drifting capacity; but the advantages to the property in the end would be enormous, and the outlay would be fully returned in the subsequent cheapness of mining and carrying the ore to the mill, to say nothing of the water it would be likely to produce, which would become a valuable permanent asset for irrigation purposes.

Silver and Copper.

Photograph 24.

The Copper-Silver Mine is about half-a-mile North from the Cajalco Mine. Very little work has been done, but an open cut exposes an apparently strong lode, carrying copper oxides and arsenical pyrites. Mr. Mathey in his report gives the results of several assays he had made, which go to show that the copper contents range from 7 per cent. up to 19 per cent.; and the silver, which is in the form of a chloride, from a few dollars up to 332 dollars 50 cents per ton of 2,000 lbs., with small quantities of gold. This vein should be opened upon, and I consider it likely that it may become a valuable contributor to the profits of the concern.

Gold Mine.

The Gabilan Gold Mine is situated a few miles to the South-East of the Cajalco Mine. I visited the location, but as the old workings have all fallen in I was unable to go underground. I was accompanied by Mr. Hoag, who worked the mine some years ago.

Photograph 22.

The lode has a course slightly West of North, and for the first 200 feet from surface a dip of 30 degrees to the North. The ground for the next 200 feet was very broken and nearly flat, after which the lode seemed to take its regular dip at an angle of about 70 degrees, but only five to six feet have been sunk on it below the broken ground. The lode is quartz in granite, and runs from two to four feet in width, of which an average of about two feet was pay streak, yielding 50 dols. a ton in gold in a small five-stamp mill. A plan and section herewith will more clearly set this forth. It is said that 250,000 dols. have been taken out of the mine from stopes 350 feet North and South from shaft down to about 400 feet in depth. The ore used to mill about 50 dols. (say $2\frac{1}{2}$ ozs.) in gold per ton of 2,000 lbs., but it all had to be hauled in carts to water about 9 miles off. If a shaft were sunk 150 feet to cut the lode below the broken ground and intersect the vein, the Mine could be opened anew. One of the difficulties here is want of water, but it is quite likely that the Mine would produce sufficient water for a small ten-stamp mill. The cost of sinking the shaft 150 feet, erecting hoisting and pumping machinery, &c., would be about £3,500.

The lode contained, besides free gold, sulphurets of iron, copper, and a little lead in small crystals. These sulphurets, when concentrated by panning, assayed 200 dols. to 500 dols. a ton, and some assayed as high as 7,000 dols. a ton. The foregoing information I obtained from Mr. Hoag.

To work the whole estate vigorously, a working capital of about £50,000 will be necessary, and this would be ample to do all the work I have indicated, besides opening up some of the very many other tin lodes known to exist on the property outside the Cajalco lode. Estimated Costs.

The oxide of tin is disseminated through the gangue in fine crystals of cassiterite, in the form of a brown oxide of tin. It dresses easily, and to a high percentage, but it will require fine crushing; to obtain scientific information as to its dressing properties, I have had shipped to the celebrated Humboldt Works, in Germany, three tons of the ore, from the results of the dressing of which we shall obtain a full report. It appears to me that some high-speed crusher and the Linckenbach buddle table will probably suit best. Description of Ores.

The climate is everything which could be desired. Professor Agassiz in writing from San Diego in 1872, said: "You have a capital in your climate; it will be worth millions to you. This is one of the favoured spots on earth, and people will come to you from all quarters to live under your genial and healthy atmosphere." Climate.

Wages and labour are fairly cheap for the United States and good miners plentiful. Coal is reasonable in price and has lately been found on the immediate confines of the estate, which will when worked make your fuel still cheaper. Fuel.

Ample water for dressing purposes and power is available and well-placed, and any surplus water will be a means of revenue to the Company. Water.

The property has often been reported upon by several mining engineers and experts, all of whom, without exception, agree generally as to the great extent and value of the property.

To conclude, it is clear from all the evidence adduced that the property is a very valuable one, and aside from the gold, silver, copper and other mineral deposits, there is no doubt in my mind as to the

Conclusions. great extent and richness of the tin deposits. The great area of the lodes, their extraordinary richness, ease of treatment and purity of resulting tin, are unprecedented. The property is in a most favored position for the earning of immediately reasonable, and subsequently, large dividends; and it only remains for it to have the proper expenditure of capital and labor to make it probably one of the greatest mining properties in California, if not in the United States.

I have the honour to remain,

Gentlemen,

Yours faithfully,

(*Signed*) GEO. GRANT FRANCIS, M.E.

London, November 18*th*, 1889.

REPORT OF E. N. ROBINSON, M.E.,

Relating to the proposed establishing of Tin Plate Works in the United States of America.

LONDON, *March* 18, 1890.

TO THE CHAIRMAN AND DIRECTORS,

TEMESCAL TIN DISTRICT, LIMITED.

GENTLEMEN,

You ask for information regarding tin plate, and the possibility of its being profitably manufactured in the United States.

In my opinion this will be accomplished in the near future, and the introduction of that important industry at any suitable location in America must result in immense profit to the capital invested.

Great as has been the expansion of tin and terne plate production in England the last few years, the *increased requirements* of the United States for tin plates (especially on the Pacific coat) absorbed it.

The fruit, vegetable, oil, fish, chemical and other canning enterprises of that rapidly growing country, in addition to the roofing tin, required last year (1889), over 430,000 tons of tin and terne plate, upon which a duty amounting to over £1,100,000 was collected by the United States Government, and, as yet, the price of tin plate in New York (24s. per box) does not indicate that the country at large is glutted, though the market in New York may be "dull" (as it usually is before and after the canning season), tin plate at the same time selling at Liverpool for 16s. to 17s. per box f.o.b.

The duty imposed upon tin plate in America is about 4s. 6d. per box; this with *freight added*, would indicate a profit to the merchant or dealer of about 2s. per box, giving a large aggregate profit on a consumption of over 5,000,000 boxes per year.

The price of tin plates at Liverpool f.o.b., taking one year with another, will average 14s. per box, to which must be added freight (say 1s.), and duty, 4s. 6d. per box on entering the United States, or a total of 19s. 6d. average cost per box laid down in New York.

Strong efforts are now being made in the United States to have the duty on tin raised to 9s. per box, and there are many reasons advanced for the proposed increased tariff.

Over 95 per cent. of the tin and terne plate sent to America is *iron*. In 1888 and 1889 (combined) about *800,000 tons* of *iron ana steel* plates passed through the custom-houses of that country, *coated* with less than 35,000 tons of tin. These facts have attracted the attention and aroused the great iron and steel producers of America, and they are now using their combined efforts to protect the *iron interests*, hence the new Tariff Bill introduced by the Ways and Means Committee in Congress lately, wherein *it is recommended* that the duty on *tin plate* shall be raised to *double* what it has been for years.

This being done, and the necessary plate mills erected in America, it would give employment to the labour that would be necessary for mining hundreds of thousands of tons of *iron ore* (estimated at over 1,000,000 tons per year), and to the labour that would be necessary to reduce the iron ore to pig iron, and to the labour that would be necessary to reduce the pig iron to sheet iron or steel, and then to the labour that would be required to manufacture the enormous amount of tin plate consumed in the United States.

The tin plate plants alone would require over 20,000 people to conduct the business. Add to this the fuel, the acids, the lumber for boxes, the nails for same, and other incidentals, with the requisite labour, &c., growing out of such an immense industry, and it is manifest what the increase of 4s. 6d. per box on tin plate means for the labouring classes of the United States. £5,000,000, at least, would be distributed at home in place of its being sent abroad, and reducing the duty income of the United States only about £1,200,000; and if the price of tin plate was raised to 29s. per box, the extra cost added to *the packages*, containing the goods canned, and to domestic utensils used, would be less per pound of same than the smallest coin known in that country. To illustrate :—*The extra cost of a labourer's or miner's dinner pail would be two farthings, and a dinner pail made of good tin plate would last its owner several years.*

That the iron industries of America will be protected in the manner now suggested is beyond doubt. That tin plate can be produced in the United States without going abroad for an ounce of the raw material used in its manufacture seems more apparent every year. I have taken pains to familiarise myself with what is being done in this country in the manufacture of tin plate, where tin, iron, coal, and labour are cheap. In America (where labour especially is higher) coal can be, and is, sold f.o.b. cars at Trinidad, Colorado (see Map hereunto attached), for 5s. per ton, and A 1 coke for 9s. per ton, and Gray Forge iron can be obtained for less than £4 per ton; the very best of *pig tin* can be laid down at the same place for less than £50 per ton.

With these figures and the information I have at hand, I am of the opinion that a *tin-plate mill* can be placed in operation within six months, at many places in the United States between the Atlantic and the Pacific Oceans, and on the direct lines of overland railways having branches and connections with all parts of the United States, British Columbia and Canada, at an outlay not to exceed £20,000, which will produce over 1,000 boxes of tin plate per week (say 10 tons per day), equal in manufacture and superior in quality (coating of tin) to the average tin plate imported at the present time. In fact I have manufactured, on a limited scale, tin plates, in California, of American iron coated with American tin, which was pronounced by expert tin workers equal to the *best* imported.

In my estimate for establishing tin plate works in the United States, I have selected a central point from which every principal tin market of America can be reached for not to exceed an average of £2 per ton, or say 2s. *per box freight* (see Map).

I should advocate the rolling of iron or steel plates, which would necessitate a plant similar to the sheet-iron rolling mills that are plentiful in the United States, from the Atlantic to the Pacific, and from the Gulf of Mexico to the Great Lakes, Gray Forge, or any other suitable iron to be used; the cost of former will not exceed £4 per ton, coal 8s. per ton, sulphuric acid 1d. per pound, and palm oil or tallow, as cheap as in England.

The puddling and rolling furnaces, the same kind as used in the ordinary sheet mills. The sheet furnaces and the rolls for the sheets being smaller, the sheets are pickled in acid (sulphuric or muriatic), they are then cold rolled through chilled rolls, annealed, again passed through acid, and then coated with tin or terne as required. This process, or any other improved method, could be adopted to cheapen production, if such is available.

Tin plates can be produced in the United States at the present time, at the following cost, paying the wages of that country to the puddlers, rollers, &c.

Best coke, 14 by 10 and 14 by 20, for 17s. per box.

Best charcoal, 14 by 10 and 14 by 20, for 18s. box.

225 sheets in a box; average weight, including box, 120 pounds.

(Of course the plant would be arranged for producing all sizes required by the trade from I C to D XXXX.)

The above cost is made from prices paid to the forge department of £1 per ton for puddling, &c., and 50 per cent. advance on English wages for all skilled labour which may be imported for *tin works*, such as tin sheet rollers, tin-men and wash-men. At these rates they will earn from 12s. to 15s. per day. Other required labour car be obtained for from 6s. to 8s. per day, making up the following estimate of costs:—

Cost of iron or steel sheets	£13 9 0	per ton of plate.
Cost of pig tin for coating same, 5 per cent. plate	2 0 0	" "
Cost of labour in tin works:—		
1 at £1 0 0 = £1 0 0		
2 at 0 16 0 = 1 12 0		
6 at 0 12 0 = 3 12 0		
8 at 0 10 0 = 4 0 0	1 10 0	" "
12 at 0 8 0 = 4 16 0		
For 10 tons ... £15 0 0		
Acids, Tallow, &c.	0 8 0	" "
Boxes, nails, boxing and sundries ...	0 12 0	" "
	£17 10 0	

or 17s. 6d. per box (110 lbs.) f.o.b.

The following is an estimate of cost and requirements of machinery, &c., for an initiatory tin-plate mill in the United States, having the capacity for making about 10 tons of tin plate per day (from pig iron) equal to about 1,000 boxes per week.

FORGE DEPARTMENT.

Buildings 120 by 75 feet wide (corrugated iron).
6 puddling furnaces.
2 rolling furnaces.
1 steam hammer.
Flooring plates for forge.
Ore crusher.
Housings, pins and boxes for bar rolls.
1 pair bar rolls.
Spindler and pinions for bar rolls.
Standard for pinions.
Bed-plate for bar rolls.
Brasses for same.
Shears for cutting bars, and bed plate for same.
Crab wheels and coupling boxes.
75-h.p. engine for driving machinery in this department.

SHEET MILL DEPARTMENT.

Building 100 by 70 (corrugated iron).
Bed-plate for mills.
8 Housings for rolling mills.

8 chilled rolls, 21 inches by 23 inches, for sheet mills.
Brasses and coupling boxes.
2 mill furnaces, doors, studs, &c., for same.
Carriage and slow motion for turning rolls.
Leading spindles and slow motion.
Lathe for turning rolls.
6 chilled rolls for cold rolling sheets.
6 housings for same.
Bed-plate for cold rolls.
Brasses and coupling boxes for cold rolls.
Annealing furnace, for annealing sheets, doors, uprights, sides, &c.
Annealing pots and stands.
200-h.p. engine for 2 rolling mills and cold rolls.

TIN HOUSE OR COATING DEPARTMENT.

Building 100 by 50 (corrugated iron).
Cast iron pots for tinning plates.
Small cast steel rolls 3 inch. diameter.
Lathe for turning rolls.
The most improved pickling and swilling (washing) machine.
20 h.-p. engine for tin house rolls.
Hazelton boilers sufficient for the entire plant.
Boxing house and carpenter's shop, and sawing machinery.
Scales, &c.
Brick stack connecting with every department.
Office, blacksmith's forge, cars, car tracks, &c., &c.

Total cost of plant including

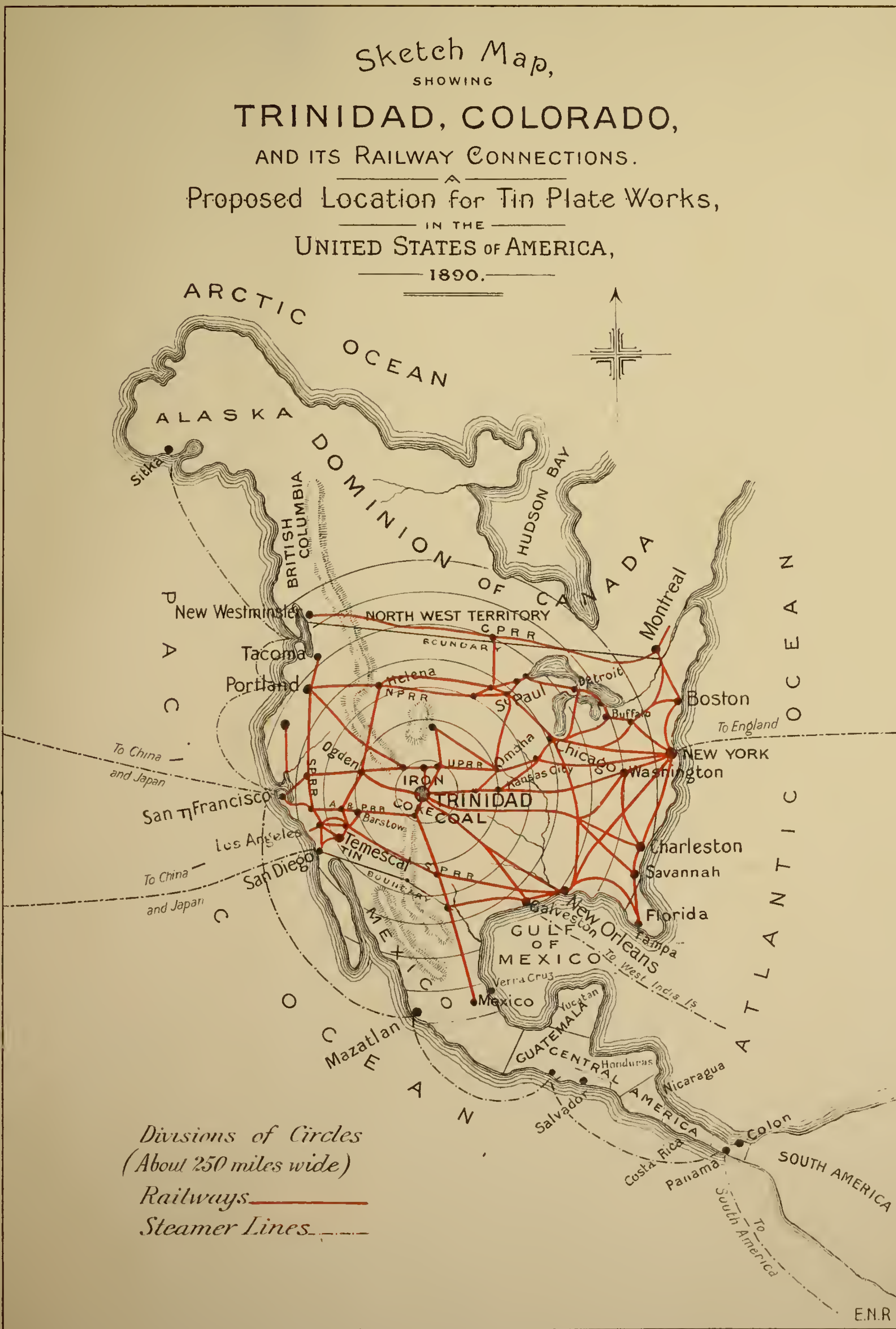
Grading, retaining walls, buildings, stock, &c. ...	£17,000
Supplies of all kinds	2,000
Incidental expenses	1,000
	£20,000

Any tin machinery manufacturer in Wales or elsewhere can furnish you an estimate of cost of machinery from the above memorandum.

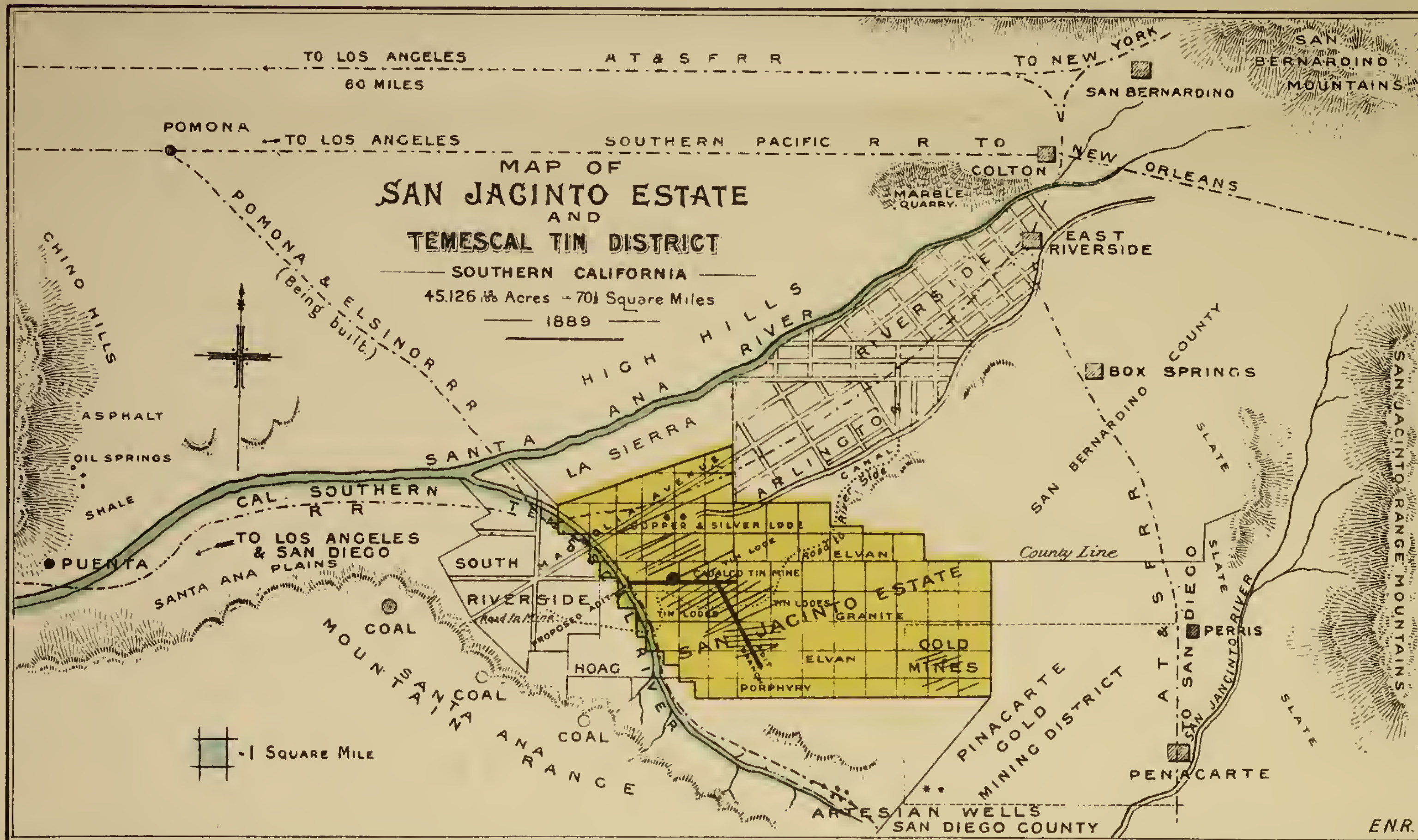
Such a plant and industry located in the United States will pay at least 35 per cent. per annum on the estimated capital required to promote it, and only *supply one per cent.* of the demand or consumption in the United States at the present time.

Respectfully submitted,

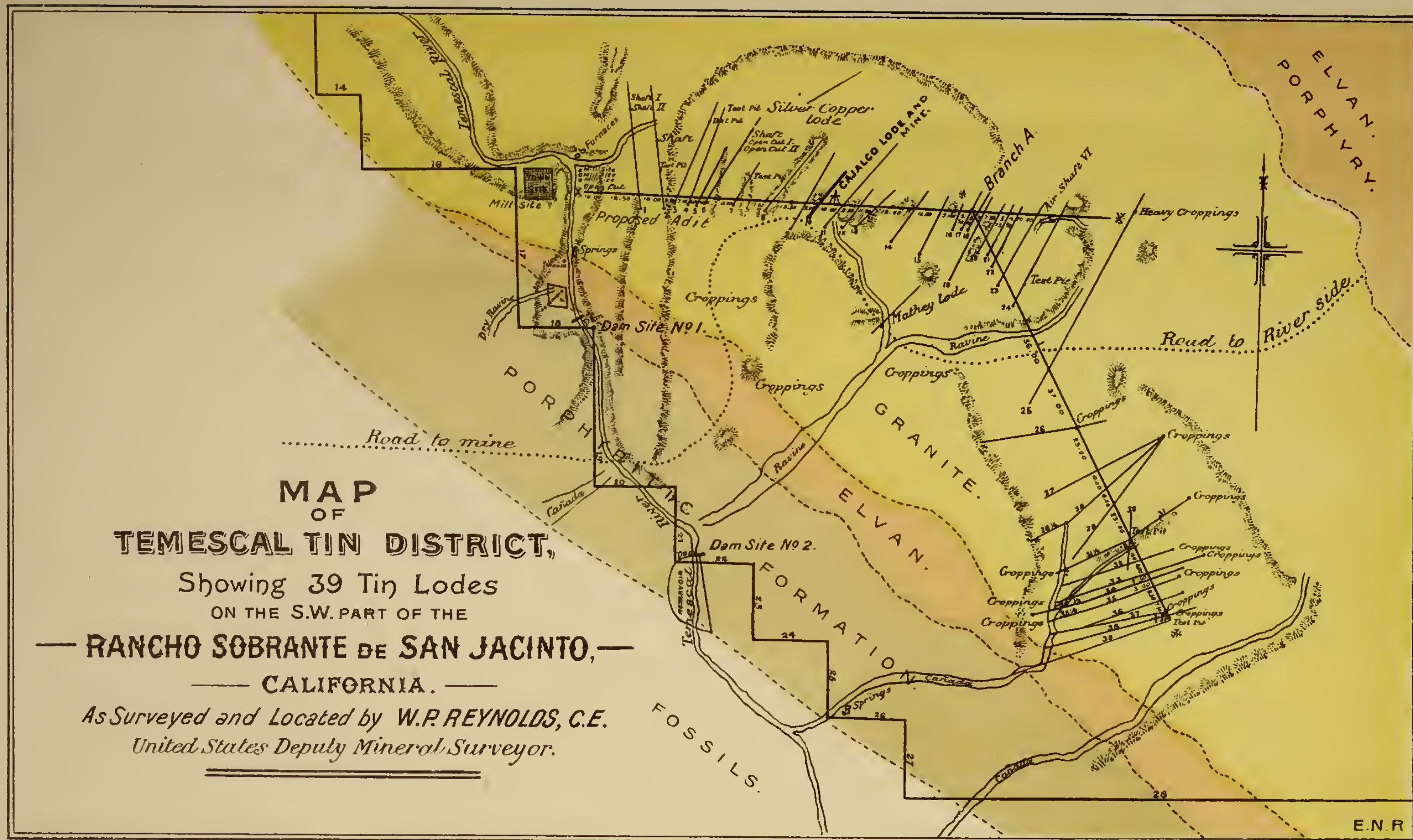
(Signed) E. N. ROBINSON, M.E.



Sketch Map,
SHOWING
TRINIDAD, COLORADO,
AND ITS RAILWAY CONNECTIONS.
Proposed Location for Tin Plate Works,
IN THE
UNITED STATES OF AMERICA,
1890.
ARCTIC OCEAN
ALASKA
Sitka
DOMINION OF CANADA
BRITISH COLUMBIA
HUDSON BAY
NORTH WEST TERRITORY
C P R R
BOUNDARY
New Westminster
Tacoma
Portland
Helena
N P R R
St Paul
Detroit
Buffalo
Montreal
Boston
To England
NEW YORK
Washington
Chicago
Omaha
Kansas City
U P R R
Ogden
IRON
TRINIDAD
COKE
COAL
San Francisco
Los Angeles
San Diego
Barstow
Temescal
TIN
S P R R
BOUNDARY
Charleston
Savannah
Florida
Tampa
New Orleans
Galveston
GULF OF MEXICO
To West India Is.
Verra Cruz
Mexico
MEXICO
Mazatlan
Yucatan
GUATEMALA
Honduras
CENTRAL AMERICA
Salvador
Nicaragua
Costa Rica
Panama
Colon
SOUTH AMERICA
To South America
To China and Japan
To China and Japan
PACIFIC OCEAN
ATLANTIC OCEAN
Divisions of Circles (About 250 miles wide)
Railways
Steamer Lines
E.N.R


MAP OF
SAN JACINTO ESTATE
AND
TEMESCAL TIN DISTRICT
SOUTHERN CALIFORNIA
45.126 Acres – 70 Square Miles
1889
TO LOS ANGELES
60 MILES
A T & S F R R
TO NEW YORK
SAN BERNARDINO
SAN BERNARDINO MOUNTAINS
POMONA
TO LOS ANGELES
SOUTHERN PACIFIC R R TO NEW ORLEANS
COLTON
MARBLE QUARRY
EAST RIVERSIDE
POMONA & ELSINOR R R
(Being built)
CHINO HILLS
HIGH HILLS
SANTA ANA RIVER
LA SIERRA
RIVERSIDE
ARLINGTON
BOX SPRINGS
SAN BERNARDINO COUNTY
SLATE
ASPHALT
OIL SPRINGS
SHALE
CAL SOUTHERN R R
TO LOS ANGELES & SAN DIEGO
PUENTA
SANTA ANA PLAINS
SOUTH
RIVERSIDE
COPPER & SILVER LODE
ELVAN
CAJALCO TIN MINE
TIN LODES
SAN JACINTO ESTATE
GRANITE
GOLD MINES
PORPHYRY
County Line
PERRIS
COAL
SANTA ANA MOUNTAIN RANGE
HOAG
PINACARTE GOLD MINING DISTRICT
A T & S F R R TO SAN DIEGO
SAN JACINTO RIVER
SAN JACINTO RANGE MOUNTAINS
PENACARTE
ARTESIAN WELLS
SAN DIEGO COUNTY
–1 SQUARE MILE
ENR.

Map B


MAP
OF
TEMESCAL TIN DISTRICT,
Showing 39 Tin Lodes
ON THE S.W. PART OF THE
— RANCHO SOBRANTE DE SAN JACINTO, —
— CALIFORNIA. —
As Surveyed and Located by W.P. REYNOLDS, C.E.
United States Deputy Mineral Surveyor.
ELVAN. PORPHYRY.
PORPHYRITIC FORMATION
FOSSILS.
GRANITE.
ELVAN.
Temescal River
Silver Copper lode
CAJALCO LODE AND MINE.
Branch A.
Heavy Croppings
Proposed Adit
Mill Site
Springs
Croppings
Mathey Lode
Dam Site No 1.
Dam Site No 2.
Road to River side.
Road to mine
Ravine
Dry Ravine
Cañada
Test Pit
E.N.R

Map D

May, 1922

PACIFIC MINING NEWS

Supplement to

ENGINEERING & MINING JOURNAL-PRESS

UNITED VERDE, ARIZONA — MINE IN FOREGROUND, SLAG DUMP IN BACKGROUND

A NOTED mine in one of the great copper districts of a state pre-eminent as a copper producer — The ores in the mine are of sufficient grade to be smelted directly in blast furnaces and reverberatories — The copper matte is converted and the blister copper shipped to refineries — Both the mining and smelting plants are modern and efficient — A model town for employes is maintained at Clarkdale

A Supplementary Service to the Pacific Coast Readers of Engineering and Mining Journal-Press

McGraw-Hill Co., of California San Francisco, California

Letters to the Editor

Californian Clays Require Special Treatment to Meet Metallurgical Demands

For 16 months I have been conducting a survey of the state of California, having for its object the location, inspection and classification of clay deposits, with especial reference to clays having technical and superior metallurgical value. At the conclusion of this survey it was considered that refractory clays of Carboniferous age are poorly represented, and that the majority of deposits in the state belong to the Eocene Tertiary, with a marked development of clay beds of technical value in the Ione formation. Plastic clays of the ball-clay type are scarce, and the same may be said of flint clays.

The best metallurgical clay in the state was discovered in Amador county and near Carbondale; it is the nearest approach to the German Klingenburg pot clay that has been uncovered in the United States. Some of these clays vitrify below Cone 3, and have an initial deformation point in excess of Cone 33. In the same vicinity are deposits of clay of the Gross-Almerode type, also of high fusion point and great strength, both in the raw and in the burned state. They are for the most part white, but occasionally are found of a chocolate-brown color, of extreme plasticity and suitable for pencil clays.

In the northern part of the state and along the Sacramento Valley, typical Tertiary clays are exposed that are suitable for the general run of semi-dense burning ware. As a general rule, strictly Tertiary clays are found to be of less value for refractory ware than either the Cretaceous clays or Pennsylvanian clays. This holds true for the Californian clays as well as for the clays that are found in the East and in the South.

No exceptionally refractory clays are mined in the southern part of the state, although considerable quantities of "moderate-virtue" clays are mined in the Temescal Valley near Los Angeles and used locally. These have been developed along a major fault line; they lie in a depressional area. Owing to much major, minor and cross faulting of the region the continuity and uniformity of any particular clay bed or stratum is much disturbed and is a hindrance to the mining of clay of uniform chemical composition. Although clay from this valley will continue to be in demand owing to the nearness to Los Angeles and for lack of superior materials close by, I fail to find in the region clays possessing extraordinary metallurgical value.

In Section 26, Township 4 South, Range 6 West of Riverside county I discovered the only known deposit of bauxite in the state. This is of the oolitic and lateritic variety and similar to the bauxite ores of Dutch and British Guiana. The deposit is undeveloped. The quantity is limited to perhaps a few thousand tons principally of bauxitic material. The clay has a superior fusion point and the deposit is six miles from the nearest railroad spur.

After having studied the principal geological formations of the state wherein clay may be developed and after having examined many desert types of kaolin I conclude that future requirements of industry will necessitate the beneficiation of clays now used in the raw state before they can meet the increasingly strict technical requirements of metallurgical practice.

L. M. RICHARD.

Venice, Cal., Mar. 16, 1922.

Defining "Engineering" Without Inviting Comment on Altruistic Motives

Much discussion has centered recently in the technical press anent the proper definitions of "engineer" and "engineering." This indicates that various suggestions made from time to time have failed to meet general approval. The most dogmatic of these originated from the Institute of Civil Engineers, which defines the engineer as one whose characteristic was, "Directing the great sources of nature for the use and convenience of man." The idea of altruism is expanded in the definition adopted by the United Engineering Societies and found in the library at New York, which states that engineering is "the art of organizing and directing man, and controlling the forces of nature for the benefit of the human race." Wide publicity was given in 1918 to yet another version of the same idea, by which it was maintained that "an engineer is one who scientifically directs man-power, and, by scientific design, utilizes the forces and materials of nature for the benefit of mankind."

The drawback to such high-flown interpretations is that they are each the work of one mind, or, at most, of a few minds. In spite of this they are usually hewn in stone, cast in bronze, or recorded in some other imperishable manner. The original definition of the civil engineers having met with the silence that is too often taken as indicative of approval, and the main idea of altruism and nobility of aim having been elaborated by others, it is not unreasonable that a civil engineer should be among the first to discountenance further discussion. It is strange, however, that his contention should have received so much support from academic quarters.

The age of oligarchic domination by means of individual ideas is past; the opinions of all are welcome and needed. In Berkeley we are forever reminded that the purpose of a school of agriculture is "To rescue for human society the native values of rural life." Every morning I expect to read in the local paper the inquiry of some perplexed visitor who has attempted to analyze the inscription that faces the city; he will probably sign himself "G. Helpus," or words to that effect.

The majority of suggestions are one-man ideas. They become valuable when discussed and, possibly, amended by others. The story of Fido may be recalled: He was a pampered pet with an abnormal appetite. One morning he saw what he thought was his usual dish of white breakfast food and cream; and, without further thought, gulped it down in a few mouthfuls. Alas! it was liquid plaster of paris. Whereupon Fido "passed out," creeping away to die under the shade of some bushes. Several months later, when all that was mortal of him had disappeared, his mistress found the plaster cast of his internal anatomy. This was cherished as the sole link with the past; it was placed in a glass case with this inscription thereon: "Fido—An Inside View; Taken by Himself."

Few of us there are who are not guilty of "inside views." Some years ago I had the temerity to propose that an engineer is, essentially, "a technician who applies creative effort to the solution of a problem or to the operation of an enterprise." I also stated that "much engineering effort is beneficial to mankind, but it would be invidious to emphasize this fact in the formulation of the definition of an engineer." These ideas are so opposed to all definitions that have received wide prominence and publicity that I await a repetition of the phenomenon that recently disturbed the town of Chico. In any case, I am unwilling to agree that engineers should admit the impossibility of defining their own calling.

A. W. ALLEN.

San Francisco, March 31, 1922.